MESO LEVEL SITUATIONAL ANALYSIS OF NUTRITIONAL STATUS OF CHILDREN AND PREVALENCE OF ANAEMIA AMONG CHILDREN, ADOLESCENT GIRLS AND PREGNANT WOMEN IN SELECTED DISTRICTS OF INDIA.

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B.Voc. Home Economics with Education

(Foods and Nutrition).

MASTER OF SCIENCE IN HOME SCIENCE

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CHAIRPERSON: Dr. K. MANORAMA

DEPARTMENT OF FOODS AND NUTRITION
POST GRADUATE AND RESEARCH CENTRE
PROFESSOR JAYASHANKAR TELANGANA STATE
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DECLARATION

I, **ACHIRO ENID**, hereby declare that the thesis entitled **"MESO LEVEL SITUATIONAL ANALYSIS OF NUTRITIONAL STATUS OF CHILDREN AND PREVALENCE OF ANAEMIA AMONG CHILDREN, ADOLESCENT GIRLS AND PREGNANT WOMEN IN SELECTED DISTRICTS OF INDIA."** Submitted to **Professor Jayashankar Telangana State Agricultural University** for the degree of **Master of Science in Home Science** is the result of original research work done by me. I also declare that no material contained in the thesis has been published earlier in any manner.

Place: **(ACHIRO ENID)**

Date: **I.D.NO. HHM-2012-019**

CERTIFICATE

This is to certify that the thesis entitled "**MESO LEVEL SITUATIONAL ANALYSIS OF NUTRITIONAL STATUS OF CHILDREN AND PREVALENCE OF ANAEMIA AMONG CHILDREN, ADOLESCENT GIRLS AND PREGNANT WOMEN IN SELECTED DISTRICTS OF INDIA"** submitted in partial fulfillment of the requirements for the degree of 'Master of Science in Home Science' of the Professor Jayashankar Telangana State Agricultural University, Hyderabad is a record of the bonafide original research work carried out by Ms ACHIRO ENID under our guidance and supervision.

No part of the thesis has been submitted by the student for any other degree or diploma. The published part and all assistance received during the course of the investigations have been duly acknowledged by the author of the thesis.

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Date: **(Dr. K. MANORAMA)**

Chairman of the advisory committee

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(ACHIRO ENID)

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LIST OF SYMBOLS AND ABBREVIATIONS

et al	And other workers
etc	And so on
BMI	Body Mass Index
X^2	Chisquare value
CED	Chronic Energy Deficiency
$^{\circ}C$	Degree Celsius
DF	Degrees of freedom
DHS	Demographic Health Survey.
DK	Donot Know
e.g	For example
FAO	Food and Agriculture Organization
Gov't facility	Government Facility
G	Gram
g/l	Gram per litre.
>	Greater than
Hb	Haemoglobin
ICMR	Indian Council of Medical Research
IIPS	International Institute of Population Studies
Kg	Kilogram
<	Less than
L	Litre
MoHFW	Ministry of Health and Family Welfare
Min	Minute(s)
NFHS	National Family Health Survey
NA	Not Available
NC	Not Computed
NS	Not significant
OBC	Other backward classes
OW/OB	Overweight/ Obesity

PAHO	Pan American Health Organization
%	Percent
RR	Relative Risk
Sec	Second(s)
SES	Socio-economic status
SEARO	South East Asian Regional Office.
SD	Standard deviation
i.e	That is
UNICEF	United Nations Children's Fund
UNSCN	United Nations Children's Fund
Vs	Versus
Wt	Weight
WHO	World Health Organization

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ABSTRACT

Malnutrition remains a complex scenario claiming a lot of lives and creating loss of time to disability among the vulnerable populations which are children below five years, adolescent girls, women and pregnant women. Poor nutritional status and high prevalence of anaemia in the Indian population is among the highest globally despite government efforts to avert the nutritional situation in the country.

The primary aim of this comparative and correlation study is to analyse the nutritional status of children and women and the prevalence of anaemia among children, adolescent girls and pregnant women in selected districts and states of India so as to understand the differences and predictors in each location and changes over time. Analysis was carried out using SAS and SPSS on secondary data of NFHS-2 and NFHS-3 in Prakasam, Mahbubnagar, Akola, Solapur, Bijapur, Tumkur districts and Andhra Pradesh, Maharashtra, Karnataka states respectively and results presented on the basis of bivariate analysis using chisquare for correlation and ordinal logistic regression for predictors of malnutrition and results showed variations across districts and states.

Prevalence of underweight in children below five years was 58.8 percent in (Prakasam), 81 percent (Mahbubnagar), 83.7 percent (Akola), 79.2 percent (Solapur), 73.1 percent (Bijapur) and 79 percent (Tumkur) districts during NFHS-2 survey. Regression results revealed that the common predictors of underweight at district level were age of the child, child anaemia and occupation of the mother. At state level however, prevalence varied in trends between the two surveys with (74.9 % vs 74.1 %) for Andhra Pradesh, (75.5 % vs 79.7 %) for Maharashtra and (70.9 % vs 76.0 %) for Karnataka states. The common predictors were residence, age of the child, ethnicity (caste), education and occupation of mother, child immunization and toilet facility.

Prevalence of malnutrition among women (15-49 years) ranged between 46.7 percent and 56.1 percent for NFHS-2 and NFHS-3 respectively. However, CED ranged between (31.3 % to 50.5 %) while OW/OB ranged between (10.2 % to 23.2 %). Results also show that between the two surveys, CED decreased slightly while OW/OB increased giving rise to a dual burden of malnutrition in women especially Andhra Pradesh state.

Comparison of NSSO data and NFHS data in the studied population (women and children) revealed that SES of the woman affects her dietary consumption of food nutrients with higher percentage of inadequate consumption of calories and proteins being among low SES and consumption improving with improvement of SES. This explains the higher prevalence of CED among low SES. Consumption of fat was almost adequate in all SES but remains highest among high SES which explains the higher prevalence of OW/OB. Also in all studied areas, no significant differences were found between males and females.

Prevalence of child anaemia was (62.3 %, 52.0 %, 55.5 %, 69.0 %, 69.3 %, and 63.0 %) for Prakasam, Mahbubnagar, Akola, Solapur, Bijapur and Tumkur districts respectively. Regression analysis found stunting, wasting, age of child, mothers' education and occupation as predictor variables for child anaemia in Prakasam, Mahbubnagar and Tumkur districts only as none of the variables predicted anaemia prevalence in the remaining districts. However, trend analysis between the surveys at state level revealed a prevalence of (67.3 % vs 66.0 %, 74.6 % vs 62.3 % and 66.4 % vs 68.7 %) for Andhra Pradesh, Maharshatra and Karnataka states during NFHS-2 and NFHS-3 respectively. The prominent predictors were age, caste, poor nutritional status of the child and poor education of the mother.

Prevalence of anaemia among adolescent girls (15-19 years) was (69.1 %, 60.2 %, 43.7 %, 51.1 %, and 51.7 %) for Prakasam, Mahbubnagar, Solapur, Tumkur and Bijapur districts respectively during NFHS-2. Regression results found age, caste, wealth and occupation as predictors of anaemia at district level except for Akola which was not included in the analysis. However, at state level, anaemia increased in Andhra Pradesh and Maharashtra state with a prevalence of (59.4 % vs 69.4 % and 54.9 % vs 55.2 %) for NFHS-2 and NFHS-3 respectively while anaemia decreased in Karnataka adolescent girls of the same age (54.8 % vs 48.9 %) over the years. Predictors identified were age, BMI, caste, education, wealth and occupation.

Among the pregnant women, trend analysis of anaemia prevalence revealed an increase in anaemia prevalence over the years between the two surveys. The prevalence of anaemia was (38.8 % vs 61.0 %, 50.2 % vs 60.9 % and 47.3 % vs 60.6 %) for Andhra Pradesh, Maharashtra and Karnataka states between NFHS-2 and NFHS-3 respectively. Across the years, socio-economic factors (caste, education of woman and partner, occupation and BMI were identified as predictors for anaemia.

Due to the persistently poor nutritional status of all the vulnerable population and variations in districts and states, nutritional programmes should be tailored and designed to suite the targeted groups at district level in order to capture variations in causes/ predictors so as to effectively tackle the problem of malnutrition with quick and evident positive results rather than at national level which will not cater for variations in this vast population in the country. Also, at national level, nutrition and sanitation education should be incorporated into the school curriculum as a compulsory subject at an early stage so as to equip all individuals with the necessary knowledge to care for themselves better irrespective of the level of education they might attain. Lastly, intervention programmes should aim at improving SES of families.

Chapter 1

INTRODUCTION

Health is a fundamental human right which is central to the concept of quality of life and to achieve this, proper nutrition is vital (Sundar, 2007) which is normally sabotaged by hunger, poverty and other environmental factors like sanitation, hygiene and absence of clean water especially in developing countries among the less privileged sectors of the population. Nutritional status of a population is a prominent reflection of a nation's economic development and public welfare policies.

Nutritional status is defined as the evident state of nutrition of an individual. A person is said to have a good nutritional status if s/he shows no evidence of malnutrition whether frank or latent. Nutrition includes the uptake of food, liberation of energy, elimination of wastes and the biochemical synthesis that are essential for maintenance of normal growth and development (Laditan, 1983). The nutritional status of any person is his/her health as dictated by the quality of nutrients consumed and the body's ability to utilize them for its metabolic needs.

Nutritional status is assessed using anthropometric measurements in a population, supported by other methods like diet surveys. For adults, BMI is used (Table3.4) and among children under 5 years of age, indicators like stunting, wasting, underweight and overweight are used and calculated based on weight and height measurements of each individual. The WHO Z-score is used to categorise the severity of these indicators in children with under nutrition being z-score (-2) and over-nutrition z-score (+2) (WHO, 2006). Apart from the use of anthropometric measurements, the nutritional status of children and women in any population is also reflected by the haemoglobin level, which indicates the presence or absence of iron-deficiency anaemia (Table. 3.3.) (UNICEF, 2005)

Being nutritionally vulnerable, nutritional status of under-five children, women of reproductive age (15-49 years), adolescent girls (10-19 years) and pregnant women is generally accepted as an indicator of the nutritional status of any particular community (Davidson *et al*., 1975). This is due to the fact that children are susceptible to malnutrition and infection (Akinlosotu and Hussain, 1985; Uppal *et al*., 2005) who then grow up into malnourished adolescents and finally adults with low physical and mental abilities, affecting their usefulness in contributing to the economic growth of the country in which they live. These conditions are passed on to their unborn children during pregnancy and through poor child feeding practices after birth of the child, thus prolonging the vicious cycle of poverty and malnutrition.

Early childhood starts from in-utero to new birth and then through postnatal life. In intrauterine life, the nutritional status of the unborn foetus depends largely on the adequacy of the dietary intake of the mother and this determines the outcome of birth of the new born. Postnatal life is a continuum in human development. Normal growth and development depend largely upon the nutritional status of the new born which in turn, relates directly to the nutrition of the mother and inherited characteristics coupled with the dietary intake of the infant (Krauss and Mahan, 1982). Thus, poor nutrition in the first 1000 days of a child's life can also lead to stunted growth which is irreversible and associated with impaired cognitive ability and reduced school and work performance (UNICEF, 1998) and for that, early childhood nutritional status is of paramount importance for a child's later physical, mental and social development because any form of malnutrition hinders proper growth. Kothari *et al*. (2014) reported that in children below five, malnutrition in the form of anaemia was highest in children whose mothers were too thin (BMI $<18.5 kg/m^2$) with 72.9 percent being anaemic and 3.2 percent severely anaemic as compared to mothers with a normal BMI or overweight.

Malnutrition in its several forms of under nutrition, namely wasting, stunting and underweight has been coined as the "silent emergency" by the United Nations Children's Fund (UNICEF). It has been associated with endangering women and children across the world (UNICEF, 1998).

According to the most recent report on millennium development goals, 162 million young children globally are still suffering from chronic under nutrition (united Nations Millennium Development Report, 2014). Nearly half of all deaths in children under 5 are attributable to under-nutrition which translates into the unnecessary loss of about 3 million young lives a year. Undernutrition puts children at greater risk of dying from common infections, increases the frequency and severity of such infections, and contributes to delayed recovery. In addition, the interaction between under-nutrition and infection can create a potentially lethal cycle of worsening illness and deteriorating nutritional status (UNICEF, 1998). The situation of children and women remains critical the world over despite the improvements in under-nutrition.

Globally, prevalence of stunting, which is low height for age in children, was estimated by UNICEF, WHO and World Bank (2014). The report stated that 161 million children under five years of age were stunted with half of them living in Asia and one third in Africa in 2013. However, it was noted that stunting had reduced from 33 percent to 25 percent between 2000 and 2013 which is a positive direction toward millennium development goal-1. In India however, studies have reported higher prevalence of stunting among children 5 years and below to be 30.3 percent (Rao *et al*., 2005), 48 percent (Arnold *et al.,* 2009), 43.1 percent (Anwar *et al*., 2013) and 40.6 percent (Shahjada, 2014).

In 2013, globally 51 million children under 5 were wasted and 17 million were severely wasted which translates into a prevalence of almost 8 per cent and less than 3 per cent respectively. Of the wasted children under five years, approximately two thirds live in Asia and almost one third in Africa with similar proportions for severely wasted children. The South Asia's wasting prevalence indicates a 'critical' public health problem (UNICEF-WHO and World Bank, 2014). Studies in India have reported wasting prevalence at 17 percent wasting and 3 percent severe wasting (Vinod *et al*., 1999), 20 percent (Arnold *et al*., 2009), 31.5 percent (Anwar *et al*., 2013) and 38 percent (Shahjada *et al.*,2014).

Worldwide, 99 million children under age 5 were underweight in 2013. Underweight prevalence continues to decline but at a slow pace. Between 1990 and 2013, it decreased from 25 percent to 15 percent of the under-five population worldwide (UNICEF,WHO and World Bank, 2014). In India however, studies have reported a prevalence of 54 percent and 22 percent underweight and severely underweight in NFHS-1 respectively (Vinod *et al*., 1999), 43 percent in NFHS-3 (Arnold *et al*., 2009), 35.2 percent (Anwar *et al*., 2013) and 38.6 percent (Shahjada *et al*., 2014).

The most recent report on global hunger index (GHI) shows a tremendous improvement of the situation in India with a decline in GHI Score by 26% between 2005 and 2014, ranking India as 120th among 128th countries with data on underweight in children from 2009 to 2013. However based on the scale of GHI, the GHI Score of 17.8 still indicates a serious problem in India (Klaus *et al.,* 2014).

UNICEF (2014) reported that in 2013, 42 million children under the age of 5 worldwide were overweight as compared to 32 million in 2000, and suggested a continual rise. The prevalence of overweight among this sector of children increased from 1 percent to 19 percent in southern Africa but in 2013, Asia had the highest percent of children who were overweight (8.8 %) compared to other regions.

Just like under nutrition, micronutrient deficiency is a violation of a child's right to a standard of living adequate for their physical and mental development (Olive, 2013). This problem is normally aggravated by hunger and poverty among the populations coupled with ignorance on proper nutritional habits. Anaemia is one of the micronutrient deficiency disorders which are a serious public health problem among all vulnerable populations. It has been estimated that nearly 47 percent of preschool children worldwide are afflicted with anaemia, with the highest prevalence in Africa (67 %) and South Asia (65.5%) (UNICEF, 2008).

Ramesh and Lopamudra (2010) reported a very high prevalence among all vulnerable populations with more than 95 percent of the children less than five years of age, adolescent girls and pregnant women suffering from anaemia in India. The prevalence was highest among adolescent girls (98 %), followed by children (97 %) and pregnant women (96 %) based on analysis of DHS data for 2002-2004.

This is caused by the cultural practices in which the predominantly vegetarian diet of Indians is high in phytates that bind iron, making most of the iron from the food unavailable for absorption and utilisation by the body, resulting in high prevalence. Further, cultural practices disadvantage women in many ways and add to their poor nutritional status. It is customary in many households across the country that the women should eat last and eat the leftovers after the men folk have had their food (Dube, 1998). Physiological conditions like menstruation, recurrent pregnancies due to child birth with minimal time for the body to recuperate, are all critical to anaemia prevalence.

The nutritional status of women in India is still critical. According to NFHS-3, 33 per cent of the women (15-49 years) are too thin and 15 percent are obese/ overweight. Comparison in nutritional trends show a decrease in women who are too thin from (36 % to 33 %) and increase in women who are overweight/obese from (11 % to 15 %) between NFHS-2 and NFHS-3 surveys (Arnold *et al*., 2009). In Indian women with a height below 145cm which is considered the minimum height for a woman of reproductive age by WHO, the nutritional status is considerably poor with (35.6 %) being too thin ($<18.5 kg/m^2$), (9.7 %) were overweight and (3.2 %) obese (Kothari *et al*., 2014).

Severity of anaemia in women of reproductive age was also reported to have increased between NFHS-2 (52 %) and NFHS-3(56 %). Anaemia increased at all levels but severe anaemia remained at 2 percent (Arnold *et al*., 2009).

The situation of women in India is worsened by several factors. Foremost among them is the discrimination against them which starts from birth or even before they are born due to male child preference. A woman is looked at as an economic burden due to the high dowry costs that surround marriage. Their low education status, lowered occupation opportunities as there is discrimination in work, as well and lack of autonomy, hinders the empowerment of women. This aggravates the problem of malnutrition and the cycle continues throughout life. Chaparro *et al*. (2014) reported that 43 percent and 99 percent of women and men 15–49 years reported being employed respectively. However 24 percent of women reported not being paid for their work compared to only 5 percent of men. Of those women who are paid, only 24 percent reported being able to decide on their own how to use their income and 74 percent reported being paid less than their husbands for the same work.

However, economic prosperity alone cannot be a sufficient condition for good nutritional status of a population, the state of Maharashtra in western India being a prime example in this regard. Maharashtra has one of the highest per capita incomes among states in the country but is marked by poor nutritional profile of its people. More than half the households in both the rural and urban areas of the state receive less than the prescribed adequate amount of calorific intake and the situation has worsened in the rural areas of the state in the past twenty years (Duggal, 2002). A study of three backward districts of Maharashtra shows that in the project areas of the ICDS (the Integrated Child Development Services-the state run programme designed to ameliorate the nutritional status of children and pregnant and nursing women with the help of supplementary nutrition), the girl beneficiaries consistently showed poorer weight for age results, compared to the boy beneficiaries another indication of discrimination on the plate (Mishra *et al*., 2004).

The present study was therefore undertaken with a rationale of measuring percentage of underweight in children below five years and women, and also assess anaemia prevalence in children below five years, adolescent girls and pregnant women across three points in time so as to get a deeper understanding of the role socio-economic status plays in determining the reason for persistently poor nutritional status of these vulnerable groups across the years.

To achieve these goals, the study was designed with the following set objectives:

1.To analyse meso-level data already collected at district and state level with special reference to changes in nutritional status of women and children,

2. To establish linkages of the above with changes in technological (cropping pattern changes), institutional, socio-economic and policy environment.

3. To compile and analyze the meso-level data on prevalence of anaemia among children, adolescent girls and pregnant women in selected districts and states of India.

Hypothesis.

H_1: Social economic status of any individual affects their nutritional status directly.

H_2: Nutritional status of children is greatly dependent on the mother’s nutritional status and status in society.

Chapter II

REVIEW OF LITERATURE

Review of literature is very important part of a research study that aims to develop the scope of the research. Aside from technical chapters like methodology and analysis, the review of literature provides as the reference comparison of the importance of research study. A good literature review is characterized by: “a logical flow of ideas, current and relevant references with consistent, appropriate referencing style, proper use of terminology, and an unbiased and comprehensive view of the previous research on the topic”. The purpose of this chapter is to relate the results to already published work.

This literature is presented under the following headings:

2.1. Nutritional status of children under five years of age.

2.1.1. Indicators.

2.1.2. Forms of malnutrition

2.1.3. Types of malnutrition occurring in children.

2.1.4. Factors affecting nutritional status of children

2.2. Nutritional status of women 15-49 years.

2.2.1. Indicators

2.2.2. Malnutrition in women.

2.2.3. Prevalence of malnutrition in women.

2.2.4. Factors affecting nutritional status of women

2.3. Anaemia

2.3.1. Types of anaemia

2.3.2. Stages of Anaemia

2.3.3. Effects

2.3.4. Symptoms of anaemia

2.1 .Nutritional status of children

Malnutrition is high in India especially with micronutrient deficiency prevailing consistently over the decades. Among the vulnerable groups are children, adolescents and women with the major deficient nutrients being iron, vitamin A, iodine and zinc (Singh, 2007**)**. A deficiency of these nutrients remains a major public health problem throughout the developing world and is an underlying factor in over 50 per cent of the child deaths under 5 years occuring due to preventable causes (Rice *et al*., 2000., Black *et al*., 2003., Pelletier and Frongillo, 2003 and Caulfield *et al*., 2004).

Approximately 9 per cent of sub-Saharan African and 16 per cent South Asian children suffer from moderate acute malnutrition and approximately 2 per cent of children living in developing countries suffer from severe acute malnutrition (UNICEF and WHO, 2012).This is equivalent to approximately 60 million children suffering from moderate malnutrition and 13 million suffering from severe acute malnutrition at any one time. In India approximately 20 per cent of children under five years, are severely wasted (IIPS and Macro, 2007).Estimates from a most recent nationally representative survey indicate that 6.4 per cent of children below 60 months of age have weight-for-height below third standard deviation. Presently, with an Indian population of approximately 1.2 billion, there are about 132 million children under five years (12 % of population), of which 6.4 percent, or roughly 8 million are assumed to be suffering from severe acute malnutrition.

Children are the most important assets of our country. Childhood and maternal under-nutrition is currently the single leading cause of the global burden of under-nutrition. One in every three malnourished children of the world lives in India (UNICEF, 2013). India also contributes to the highest number of deaths among under-fives in South East Asia region and one-fifth of under five deaths worldwide (UNICEF, 2008). Atleast 50 percent of Indian infant deaths are related to malnutrition often associated with infectious diseases, some of which being mostly vaccine preventable diseases (VPDs). It has been estimated that approximately one out of every three Under-five children are chronically malnourished and thereby subjected to a pattern of ill health and poor development in early life (UNICEF, 1998), with malnutrition being associated with more than half of all deaths of children worldwide (Sobo and Oguntona, 2006).

Nutritional problems like Protein Energy Malnutrition (PEM), Anaemia, and Vitamin-A deficiency continue to be major problems in Indian children. These nutritional deficiencies adversely affect the health and development of children and contribute to high level of morbidity and mortality in the developing countries like India (Gosh and Shah, 2004).

Despite the many national programmes in India like Reproductive and Child Health (RCH) programme, Integrated Management of Neonatal & Childhood Illnesses (IMNCI), Integrated Child Development services (ICDS) scheme, Midday Meal programme and many such programmes, which aim to reduce malnutrition in this sector of the population, 47 percent of children under-five years in India are malnourished (IIPS and Macro, 2007).

2.1.1. Indicators

The indicators of nutritional status used in most cases are weight –for-age, height-for-age and weight–for-height, MUAC (Mid Upper Arm Circumference) and Head circumference (HC) in children. Several standards have been adopted but the most frequently used and adopted one is WHO growth standards which were released on April 27, 2006. These standards were adopted by UNICEF, FAO and other agencies involved in research of child malnutrition (United Nations System Standing Committee on Nutrition). These parameters are used to calculate and categorise stunting, wasting and underweight among infants and children as a means of assessing growth of a child. Assessment of growth thus not only serves as a means for evaluating the health and nutritional status of children but also provides an indirect assessment of the quality of life of an entire population.

Height –for-age measures linear growth retardation, primarily reflecting chronic (long-term) malnutrition which could be due to prolonged food deprivation and/ or illness which is referred to as stunting (low height-for- age). Weight-for-height measures body mass in relation to height, primarily reflecting acute (short term) under-nutrition (malnutrition) which is a result of more recent food deprivation and /or illness. It is referred to as wasting (low weight-for-height). Weight-for-age is used as a composite measure to reflect both acute and chronic under-nutrition, although it cannot distinguish between them. It is referred to as Under-weight (low weight-for-age).

The three indices are expressed in terms of standard deviations from the median for an international reference population specified by the WHO. The current WHO recommendation is to use the Z-Score or Standard Deviation (SD) measures to grade under nutrition. Children who are less than 2 SD below the reference median (i.e. a Z-Score of less than 2) are considered to be undernourished i.e. to be stunted, wasted or underweight. Children with measurements below 3 SD (a Z-Score of less than 3) are considered to be severely undernourished. Although widely recommended, the Z Scores have not been widely in use in India, especially in community based studies (Seetharaman *et al.,* 2007).

2.1.2. Forms of malnutrition

Several reports have documented data on the several forms of malnutrition which children below five are predisposed to due to several contributing factors. A double burden of malnutrition has been defined as the emerging growth of both under-nutrition and over-nutrition co-existing in children and their mothers in both developing countries as well as developed countries. This clearly stratifies the problem of poor nutrition due to availability of poor quality food (not balanced in all nutrients) i.e excess of carbohydrates among the rural and urban poor and consumption of fatty foods among the urban rich all of which lead to obesity and other non-communicable diseases like high blood pressure, diabetes, cardiovascular diseases, which are on the rise in this century and claiming more lives than attention given towards their control.

Considerable investments have been made on under-nutrition of children neglecting another deadly sector of nutrition, which is over nutrition, both in terms of money and research, thereby resulting in paucity of information on over-nutrition in children below five. However, the most recent estimates reported in 2013 by UNICEF show that overweight in children is on the rise and likely to continue. It can therefore be predicted that more children are likely to die of NCD's in the future or suffer from them at an early age. Listed below are some examples of the different forms of malnutrition that have been documented to occur in children.

Under-nutrition: Insufficient food intake over an extended period of time. For example, PEM in the form of kwashiorkor and marasmus or both, vitamin A deficiency and anaemia.

Over-nutrition: Excessive intake of food over a period of time. For-example, over-weight and obesity.

Imbalance: Disproportion among essential nutrients with or without absolute deficiency of any nutrient.

Specific deficiency: Relative or absolute lack of an individual nutrient. This can be a genetic defect or due to presence of particular diseases which hinder digestion of some food and absorption of some nutrients.

2.1.3. Types of malnutrition occurring in children.

Children are a vulnerable sector of the population facing a double burden of malnutrition in which they suffer both under-nutrition and over-nutrition. These two states have resulted in compromised nutritional status of children to the extent of causing increased levels of morbidity and mortality. However, documented facts place under nutrition (PEM, VAD and IDA) as the most prevalent type of malnutrition with over-nutrition in the form of overweight and obesity as a new emerging problem with lesser number of reports available in literature (UNICEF-WHO and World Bank, 2014).

Prior to 2006, the nutritional status of preschool children was most often assessed in relation to an international growth reference population established by the U.S National Centre for Health Statistics (NCHS, 1997) which was endorsed by WHO. However the 2006 WHO Growth standards were also adopted by the government of India and when the two are compared for malnutrition among children under five years in India based on data from NFHS-3, the new WHO growth standards estimate that a higher proportion of children are stunted (48 %), wasted (20 %) and a lower proportion are underweight (43 %) while the old NCHS standards estimate that a lower proportion of children are stunted (42 %),wasted (17 %) and a higher proportion are underweight (48 %). However both standards report remarkably high levels of malnutrition (Arnold *et al.,* 2009).

2.1.3.1. Prevalence of under-nutrition in children.

This section covers reports from earlier studies to the most recent studies that show the extent and direction of malnutrition over the years in children below five years, both within and outside India which will explain the significance of the study. Documented literature indicates a high prevalence of malnutrition among children in the form of stunting, wasting and underweight in India and elsewhere over the years. There are also other forms of malnutrition which are prevalent besides the above mentioned ones like micro-nutrient deficiencies, especially vitamin A, IDD (Iodine deficiency disorder), IDA (Iron deficiency Anaemia).

2.1.3.1.1. Out-side India.

Several studies in Ethiopia have indicated a higher prevalence of chronic under-nutrition as represented by stunting and underweight, as compared to acute under-nutrition reported by wasting prevalence. A cross sectional study conducted in Aynalem village in Tigray region, Ethiopia indicated the overall prevalence of stunting, underweight and wasting as 45 percent, 43.1 percent and 7.1 percent respectively (Taffesse and Goitom ,1997). Another cross sectional survey conducted in rural communities of Tigray region also revealed that the levels of stunting, under weight and wasting were 42.7 percent 38.3 percent and 13.4 percent respectively (Mulugeta *et al.*, 2005).

A community based cross-sectional survey conducted in West Gojam zone revealed that 49.2 percent children were under-weight, 43.2 percent of the children under age five were suffering from chronic malnutrition (stunting) and 14.8 percent acutely malnourished (wasted) (Teshome *et al*., 2006). According to research conducted in Gimbi district Oromia region, 32.4 percent were stunted, 23.5 percent underweight and 15.9 percent of the children were wasted. Prevalence of severe stunting, severe underweight and severe wasting were 15.7 percent, 8.0 percent and 5.7 percent respectively (Kebede, 2007).

Amonsu *et al*. (2011) in Nigeria in a cross-sectional descriptive study among 304 males and 296 female children aged 6 – 59 months indicated that malnutrition was prevalent inform of underweight (82.13 %), stunting (33.52 %) and wasting (85.15 %) among the children.

A study in rural kebeles of Haramaya district reported the prevalence of stunting, underweight and wasting as 42.2 percent, 36.6 percent and 14.1 percent respectively. In addition, the proportion of the prevalence of malnutrition by its level of severity indicated that 19.9 percent were severely stunted, 16.6 percent were severely underweight and 3.9 percent were severely wasted (Zewdu, 2012).

Mengistu *et al.* (2013) in a study in Ethiopia revealed that 47.6 percent, 30.9 percent and 16.7 percent of children were stunted, underweight and wasted, respectively.

2.1.3.1.2. Indian Scenario.

Malnutrition in India still remains high among children under five with the highest mortality globally. This has been confirmed by several studies conducted in India despite numerous programmes in operation to try and curb this problem. It is because of the magnitude of this problem that India is still placed among the developing countries despite its fast economic growth.

In a study conducted in a rural area in Faridabad district, malnutrition was detected in 27.2 percent of the children by using mid-arm circumference. The sensitivity and specificity was found to be 34.1 percent and 80.8 percent and the authors concluded that this criterion detected moderately severe cases of malnutrition (Sood and Kapril, 1984).

A cross sectional study conducted in the urban slums of Jamnagar, India reported the prevalence of malnutrition at 54 percent of which half of them belonged to grade-I and grade-II. Grade-I (26.22 %), followed by grade-II (21.33 %) and grade-III (6.45 %). It was also observed that prevalence of malnutrition was higher in female children compared to male children. This difference was found statistically significant (Dwivedi *et al.*, 1992). In studies conducted in urban slums of Delhi and Jabalpur which aimed at evaluating the prevalence of underweight, stunting and severe underweight, it was observed that the prevalence of stunting was more than that of wasting and severe wasting (Saxena *et al.*, 1997 and Bloss *et al.*, 2004).

Bhalani and Kotecha (2002) reported the prevalence of malnutrition to be 41.00 percent in grade I, grade II (20.00 %) and grade III (0.200 %) in their study.

In another study involving Integrated Child Development Services (ICDS) in Indian Anganwadis, the prevalence of malnutrition according to Indian Academy of Paediatrics (IAP) classification of underweight, stunting and wasting, was 40.5 percent, 20.1 percent and 2.3 percent respectively. Severe degree (below -3 SD) of underweight, stunting and wasting was prevalent in 27.8 percent, 30.3 percent and 6.5 percent respectively (Rao *et al.*, 2005). According to this study, severe malnutrition was prevalent in Anganwandi children, which could possibly mean that the ICDS services needed close monitoring and improvement to meet their target goals.

Damon *et al.* (2013) evaluated risk factors associated with under nutrition and reported a prevalence of 54 percent malnutrition in children out of which half of them belonged to grade I (26.22 %), grade II (21.33 %) and grade III (6.45 %) malnutrition.

A significantly higher prevalence of malnutrition was also reported in female children compared to male children.

Anwar *et al.* (2013) examined 483 children aged 0-36 months in Varanasi, India and reported a prevalence of stunting, underweight and wasting of 43.1 percent, 35.2 percent and 31.5 percent respectively. The composite index of anthropometric failure (CIAF) showed that 2.5 percent of the children were suffering from anthropometric failure and 42.9 percent of the children were suffering from malnutrition according to MUAC criteria (<13.5cm). The study also indicated a high prevalence of malnutrition in children ≥1 year which is line with another study by Joseph *et al*. (2002). In Madhya Pradesh, prevalence of underweight, wasting and stunting as 46.8 percent, 38.6 percent and 40.6 percent respectively (Shahjada *et al.,* 2014*).*

It is evident from the above studies, that chronic malnutrition is more prevalent than acute malnutrition which is seen as wasting. However, a study conducted in Nigeria showed a very high prevalence of wasting (acute) and underweight (chronic) under-nutrition. This could be due to regional differences in terms of geographical location and also cultural differences as one study is from western Africa while the others are from eastern Africa and the rest were from India.

2.1.4. Factors affecting the nutritional status of children under-five.

There are several factors which contribute to malnutrition in children and they are given below in different categories such as health status of the child and mother, nutritional factors, socio-economic factors, literacy, sanitation, mental health of care takers and environmental factors/ natural disasters.

The causes of malnutrition are numerous and multifaceted. These causes intertwine with each other and are hierarchically related. The most immediate determinants are poor diet and disease which are themselves caused by a set of underlying factors; household food insecurity, maternal/ child caring practices and access to health services and healthy environment. These underlying factors themselves are influenced by the basic socio-economic and political environment.

2.1.4.1. Personal factors of the child

2.1.4.1.1. Age

The age of the child is crucial to his/her survival. At a tender age, the risk of mortality is high as the child is just getting acquitted to the new surroundings. A few days after birth, the child faces several risks due to low immunity as compared to children who have lived for a few years and built their immunity by acquisition (acquired immunity) or through immunization. Stunting, wasting and underweight are most common in the first two years of a child's life but also prevalent throughout in children below five years, though the extent varies with age of the child. More frequent infections like cold, cough, diarrhoea episodes, measles and pneumonia, which drain on the body's nutrient reserves leading to ill health and malnutrition in the form of PEM, anaemia and VAD, are also age dependent.

Because children are breastfed at their tender age, some studies found that malnutrition was more common as the child grows up i.e. when weaning (complementary feeding) is introduced after 11 months of age. Vinod and Retherford (2000) in analysis of NFHS-1 data, found that infants less than six months old were less likely to be malnourished than older children, which they attributed to breast feeding. This supports the documented fact that breast milk is the best food for children as it contains all nutrients in their balanced form, enough to support the proper growth of a child. However, proper feeding of the mother is necessary to sustain the quality of nutrients in the milk, especially the micronutrients like vitamins (WHO, 2014).

Results from Mengistu *et al.* (2013) indicated that malnutrition is associated with the age of the child. Children in the age group 13-24 months were reported to be 7 times more likely to be stunted than children aged 6-11 months (AOR = 7.15; 95 %; CI = 2.33, 21.90). The highest prevalence of underweight was reported in children aged 48-59 months with prevalence of 8 percent. The lowest prevalence of underweight was seen in children aged 6-11 months with prevalence of 1.7 percent, while the highest prevalence of wasting was seen in children aged 48-59 months at Hidabu Abote district, Ethiopia with 5 percent prevalence. The lowest prevalence of wasting was seen in children aged 6-11 months. Several studies have reported similar findings where malnutrition is reported to increase with age of the children under five, especially stunting and wasting (Mulegeta *et al.*, 2005.,Teshome *et al.*,2006., Asres and Eidelman, 2011). According to a study conducted in Kenya, stunting was maximum in 12-24 months age group children and was statistically significant (Bloss, 2004)).

A study in Varanasi, India by Anwar *et al.* (2013) in which malnutrition among rural Indian children was assessed using web indices revealed stunting as being significant among children ≥ 1year of age, while wasting was significantly more among infantile age group. Additionally, the Composite Index of Anthropometric Failure (CIAF) showed a higher prevalence of under nutrition (62.5 %) of children (58.3 %) in infants and (68.3 added space %) ≥ 1 year age group. It is at this stage (≥ 1 year) that complementary feeding is introduced and if it does not contain nutrients in a balanced formed to support the spurt growth of child, then their bodies fall deficient and it interferes with growth. Similar results were reported in a study conducted in Coimbatore slums among under-fives where the prevalence of wasting was seen among 0-11, 12-23, 24-35, 36-47 and 48-59 months age group as 32.1 percent, 23.8 percent, 31.8 percent, 36.1 percent and 20.7 percent respectively (Joseph *et al.,* 2002).

From the above studies, it is clear that the form of malnutrition is age dependent with chronic under-nutrition increasing as the child grows whereas acute malnutrition was common in the younger children especially due to recurrent infections and improper feeding practices.

2.1.4.1.2. Gender.

Both female and male children are affected by malnutrition globally with high values of malnutrition still being reported in developing countries beyond 40 percent as per WHO standards making malnutrition in children under-five a public health problem. However in countries like India, the female children are reported with higher prevalence in malnutrition than the male children. This could be an impact of societal and cultural values or beliefs in which male children are given more importance than the girl child. Due to this, less care is accorded to the female children making them vulnerable throughout their entire lives as some effects of malnutrition are long lived and cannot be corrected.ie cognitive impairment due to IDA, poor body organ development (brain) due to PEM among others.

To support the above theory, Gul and Kuramat (2012) reported that 20 percent of the boys had ‘mild’ and 80 percent had ‘moderate’ malnutrition while 28.3 percent girls had ‘mild’ and 71.7 percent had ‘moderate’ malnutrition. Damon *et al*. (2013), Ray *et al*. (1996) and Dwivedi *et al.* (1992) also reported a similar observation between girls and boys of that age group with malnutrition being higher among female children than the boys. In countries like India, this could be influenced by the cultural beliefs in which the male child is considered more valuable than the girl child, placing the females at a vulnerable site for their entire life.

However when NFHS data of 1992-1993 was analysed across Indian states, the proportion of wasting was higher for boys (19 %) as compared to girls (16 %) but stunting (52 %) and underweight (54 %) was reported equal for both genders (Vinod and Retherford, 2000). This was a surprising finding given the widespread evidence of discrimination against girls in India.

Some studies however find the difference between boys and girls with respect to malnutrition as statistically insignificant as both categories are affected almost equally or very minimally different between genders (NNMB, 2006 and Santosh *et al.* (2013).

2.1.4.1.3. Birth weight/size.

The nutritional status of children is known to be influenced by several factors, of them birth weight is an important component. As defined by the World Health Organization, birth weight is the first weight of the newborn obtained within the first hour of life and a birth weight less than 2.5 kg, is defined as low birth weight which is a universally accepted classification (WHO, 2008). A baby's weight at birth is a strong indicator of maternal and newborn health and nutrition. Being undernourished in the womb increases the risk of death in the early months and years of a child's life. Those who survive tend to have impaired immune function and increased risk of disease; they are likely to remain undernourished, with reduced muscle strength, cognitive abilities and IQ throughout their lives. As adults, they suffer a higher incidence of diabetes and heart disease (UNICEF, 2014), thus, the body size at birth is very vital in child survival.

In 2013, nearly 22 million newborns—an estimated 16 per cent of all babies born globally that year—had low birth weight. The ideal birth weight is between 2.5 kg -3.0 kg body weight. Such a child is capable of survival with reduced risk of mortality, keeping other factors constant, like environment (weather). However a birth weight of <2.5kg is risk factor for child mortality. Such children have higher risks of morbidity and hence reduced chances of survival.

The relationship between birth weight and nutritional status of children at the end of their first year of life was investigated by Motta *et al*. (2005), who reported the significant influence of low birth weight on the incidence of underweight among children compared to those who had birth weight above 2.5 g. More studies conducted later confirmed the importance of birth weight as a determinant of a child's nutritional status (Hein and Kam, 2008; Sarni *et al*., 2009).

Ujwala and Dhruv (2012) evaluated morbidity in children in an urban slum and found that 24.1 percent of the children had a low birth weight (BW <2.5kg). Of those children, 69 (81 %) had morbidity which was significantly higher in these children ($p<0.05$). A malnourished child is likely to grow into a malnourished adult for both types of malnutrition.

2.1.4.2. Health status of the child.

2.1.4.2.1. Infections and diseases.

Infections are a serious problem in children which lead to increased morbidity. They are defined as short term illness which interferes with food consumption as they are known to lower appetite for example ARI (cough, pneumonia, flu). Some interfere with absorption of food like diarrhoea and cholera leading to loss of valuable nutrients that the body needs to reach its full potential in development and growth. Other common infections lead to excessive utilisation of the available nutrients due to high fevers, for example measles, typhoid, malaria and ARI, leading to loss of lean body mass and resulting in muscle wasting if the condition is not attended to. Several studies have reported the impact of infections on nutritional status of children globally, making it a serious problem which needs to be addressed critically because low response has resulted in deaths of children, which is very common in Asia and sub-Saharan Africa, but the worst effect is their association with malnutrition.

A comparative study on children's nutritional status (Sommerfelt *et al*., 1994) indicated that stunting was highest among children with recent diarrhoea. Another cross sectional study in an urban slum area of Visakhapatnam investigated the burden of illness and morbidity among 353 pre-school children under five years, and reported a prevalence of communicable diseases at 82 percent out of the 146, with 41.1 percent children diagnosed with morbid conditions and 18 percent prevalence of non-communicable diseases like anaemia and PEM. Basing on the classification of malnutrition, weight for age was represented in 78 (22.1 %) who belonged to grade I, 47 (13.3 %) to grade II, 20 (5.7 %) grade III and 12 (3.4 %) grade IV. Morbidity was also reported more prevalent in male children (59.6 % of the 146) as compared to (40.1 %) in females and the difference was found to be statistically significant ($p<0.05$). This clearly shows that in urban slums where there is overcrowding, morbidity increases in children of both gender and increases the risk of malnutrition also irrespective of gender (Ujwala and Dhruv, 2012). Santosh *et al.* (2013) also reported higher prevalence of underweight among children with ARI and history of diarrhoea.

So according to these studies which are a representative of many, a strong relationship between presence of infections and malnutrition in children less than five years of age has been established. It is on this basis that close attention to child infections be given with timely medical help to prevent the adverse side effects of malnutrition that can arise due to these infections.

2.1.4.2.2 Childhood immunization and nutritional status

Immunization against the six vaccine preventable diseases namely poliomyelitis, diphtheria, pertusis (whooping cough), tetanus, tuberculosis and measles has been recognized as one of the most cost effective intervention strategies to reduce childhood morbidity and mortality (UNICEF, 2008). Previous studies have confirmed the importance of childhood immunization for optimal nutritional status (Chowdhury *et al.*, 2006 and Semba *et al.*, 2007). In a Bangladesh based study of children aged 12-23 months, nearly 51.0 percent of children without measles immunization, i.e. incomplete immunization were stunted, while underweight and wasting were prevalent among 76.0 percent and 48.0 percent children respectively (Chowdhury *et al.*, 2006). The same study also noted higher frequencies of morbidity and hospitalization in unimmunized children.

Another study in Indonesia reported higher prevalence of severe underweight, stunting and anaemia in non-immunized children compared to completely immunized children with non-immunized children being 9 times more likely to suffer from frequent diarrheal episodes compared to their immunized counterparts (Semba *et al*, 2007). These studies imply that children who miss being completely immunized are at a higher risk of poor nutritional status from repeated morbidities due to lack of immunity against the vaccine preventable diseases.

2.1.4.3. Maternal factors.

2.1.4.3.1. Birth interval.

This refers to the spacing a mother puts in between subsequent pregnancies. Every pregnancy is by far documented to inflict nutritional drain on the mother in which the mother suffers deficiencies as the nutrients are used by the unborn baby during pregnancy for its complete growth and by the baby when born to support its survival through breast milk. These two processes demand heavy supply of nutrients which can only be achieved if the mother is feeding on very nutritious food.

Encouraging women to space births through family planning services and educational awareness could contribute to reducing childhood under-nutrition, improve maternal health and provide healthy childhood development.

A short previous birth interval could be risky if the mother's nutrient reserves become depleted which could increase the risk of intrauterine growth retardation and adversely affect infant nutrient stores at birth and nutrient delivery via breast milk (WHO, 2002 and IIPS and Macro, 2007). A short subsequent birth interval can also place the child at risk for several reasons. A new pregnancy often prompts weaning of the current child or at least a reduction in the volume of breast milk consumed and reduced breast milk intake can be hazardous both nutritionally and in terms of resistance to infection (Yimer, 2000., Kathryn *et al.*, 2004., Israt *et al.*, 2006, IIPS and Macro, 2007).

The relationship between subsequent birth interval and duration of breastfeeding is bi-directional, however cessation of breastfeeding (or introduction of other infant foods) can prompt the return to fertility which, in the absence of contraception, will cause repeated pregnancies and a shorter birth interval, if birth control is not exercised. Children who are younger when a new pregnancy occurs (i.e., when there is a short birth interval), are likely to be more vulnerable to reduced care-giving than children who are older (Mazumder *et al.*, 2000).

Use of birth control methods is one way that helps in achieving birth spacing of children, thus enabling the child to have full care before the next one comes in. Exclusive breast feeding is another form that helps in spacing children as cessations makes a woman return to full fertility potential.

Results of one study revealed that children whose mothers did not use family planning were found to be 2.54 times more likely to be stunted as compared to children whose mothers used family planning (Mengistu *et al*., 2013).

A study in Bangladesh by Mazumder *et al*. (2000) observed that the proportion of children who were under 60 percent weight-for-age decreased with the increase in the length of the subsequent birth interval and the proportion of malnourished children increased with the number of older surviving children. Children were at higher risk of malnutrition when subsequent siblings were born within 24 months. Similarly, Yimer *et al.*, (2000) in Ethiopia observed that chronic malnutrition is significantly linked with shorter birth interval. The proportion of stunted children among those children with short preceding birth interval less than 24 months was 47.7 percent while it was 45.2

percent and 32.5 percent for children with a birth interval of 24-48 months and above 48 months respectively. Other studies have also reported similar finding of malnutrition being prevalent in a birth interval of less than 24 months between pregnancies (Kathryn *et al*., 2004. lsrat and Khan, 2006 in Bangladesh and Shahjada *et al.*, 2014 in Madhya Pradesh).

A short birth interval is also associated with increased child mortality but high socio economic status and access to health care mitigates the high risk of mortality. Gondares (IUSSP-2009) revealed that mortality rates of under five children showed a generally declining trend as the length of the preceding birth interval increased in a study conducted in Mozambique where DHS data at different points in time was analyzed. Kozuki and Walker (2013) reported an 82 percent increased odd of neonatal mortality and 66 percent odds of under five mortality compared to those born after 24-60 months interval and a 20 percent decreased odds of mortality in birth-interval of 72 months using DHS survey data 29-Africa,8-Asia,5 America,7 North Africa/Central Asia/Europe.

Hence from the above studies, it is clear that short birth interval increases the risk of poor nutritional status which can result in increased risk of under –five mortality, low nutritional status and shortest birth interval was found to be strongly associated with poor nutritional status of children less than five years of age, with a birth interval of < 24 months.

2.1.4.3.2. Health status of the mother.

World Health Organization: (WHO, UNICEF, UNFPA and the World Bank, 2005) defined mother's health as the health of women during pregnancy, childbirth and the postpartum period. It is categorised into maternal nutritional status, age at first pregnancy, antenatal care during pregnancy and mental health.

2.1.4.3.2.1 Maternal nutritional status.

This has been documented to have a direct effect on the nutritional and health status of the child. This is because as the foetus grows in the mother's womb, it gets a supply of its nutrients directly from the mother and uses them for its development. Mothers with a poor nutritional status give birth to underweight babies and those deficient in some nutrients predispose their babies to nutritional disorders like cretinism (deficiency of iodine in a mother), low mental development (deficiency in iron/ anaemic mother) and also an anaemic baby being born to an anaemic mother.

The mother's nutrition and health status are important determinants of stunting. An undernourished mother is more likely to give birth to a stunted child, perpetuating a vicious cycle of under nutrition and poverty. A stunted child enters adulthood with a greater propensity for developing obesity and chronic diseases. This would create new economic and social challenges, especially among Vulnerable groups (UNICEF, 2013).

2.1.4.3.2.2. Mental health.

This is defined as a healthy state of mind. WHO (2004) declares that health is ″A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity ″. This has a very important influence on the care practices of the child. Stress causes a lot of destruction as the mother will always be preoccupied in her mind and will at times hardly notice when the child is hungry or has little time and patience for the child to eat all the food.

Stress comes from external pressure, one of which is breast feeding where the mother can spend sleepless nights or has interrupted sleep, holding a job, which might require her to put in extra working hours at the expense of baby care, poverty, where there is little or no food to replenish her body nutrients and domestic violence from abusive family members. In a study conducted to determine whether current and postpartum maternal depression and low intelligence are risk factors for malnutrition in children, Anoop *et al.* (2004) reported that major depression, current depression and low maternal intelligence were associated with infant malnutrition. The study indicated interactions between current maternal depression and low maternal intelligence as statistically significant. Level of maternal intelligence was negatively associated with nutritional status of the child, where by the lower the intelligence levels of the mother, the greater the risk of malnutrition in the child, with a greater effect of malnutrition in mothers with IQ<70 as compared to those with IQ> 111. They also added that low intelligence levels may cause poor prenatal maternal nutrition and consequently low birth weight of the child; therefore, even though nutrition education is imparted to the mothers, with simple instructions, they would still require supervision from health workers.

Another study in which domestic violence and chronic malnutrition among women and children were examined, reported that domestic violence is a psychological factor which increases psychological stress to Indian women (Kumar *et al*.,2005 and Vizcarra *et al*., 2004) and witnessing domestic violence increases psychological stress among children (Kirtzmann *et al*., 2003) which in turn increases oxidative stress (Epel *et al.*, 2004., Hapuarachchi *et al*., 2003., Irie *et al*.,2001 and Sivonova *et al.*,2004) and metabolic levels (Seematter *et al.*,2000), risk factors of anaemia and underweight through withholding food by abusive family members (Raj *et al.*,2006). Results of the study reported 19 percent of the women suffered domestic violence and 19.8 percent of the children had mothers who reported domestic violence. These women suffered malnutrition with nearly half having anaemia (1.4 %) and a third being underweight (5.6 %). 70 percent of their children were reported with anaemia with 48 percent having severe anaemia. Over half of the children were stunted with 33.6 percent severely stunted, 42.7 percent wasted with 17.3 percent severely wasted, 16.2 percent underweight for age with 5 percent severe underweight and 11.9 percent with low BMI with 4 percent having severely low BMI (Ackerson and Subramanian, 2008).

2.1.4.4. Nutritional factors.

This section examines documented literature on factors related to child feeding. It includes breast feeding and weaning, as diet is by far one of the most reliable determinants of nutritional status in children. It is assessed on the basis of commencement of breast feeding, frequency of breastfeeding, initiation of complementary foods (CFs), quality of CFs, age of weaning, type and quantity of food consumed.

2.1.4.4.1. Breast feeding.

Breastfeeding is the natural way to feed infants and young children. Exclusive breastfeeding for the first six months of life ensures optimal growth, development and health (Davis *et al.*, 2003). Breast milk alone is an ideal start to an infant's life. Exclusively breastfed infants who are fed on demand will remain healthy. Inappropriate breastfeeding, especially lack of exclusive breastfeeding during the first half-year of life are important risk factors for infant and childhood morbidity and mortality (Bryce *et al*., 2005). Virtually all children benefit from breastfeeding, regardless of where they live.

Breast milk has all the nutrients that infants need to stay healthy and grow optimally. It protects them from diarrhoea and acute respiratory infections which are the two leading causes of infant death. The process by which breast milk does this is by stimulating the immune system which then responds to vaccinations intended to prevent the occurrence of the health problems mentioned above. It also contains hundreds of health-enhancing antibodies and enzymes and requires no mixing, sterilization or equipment and it is always in the right temperature for the child (UNICEF, 1998) thus the child feeds immediately when demand arises without wasting time in preparation. Breast milk is also an important source of energy and nutrients in children aged 6 to 23 months. It can provide half or more of a child's energy needs between the ages of 6 and 12 months and one third of energy needs between 12 and 24 months. It is also a critical source of energy and nutrients during illness and reduces mortality among children who are malnourished (WHO, 2014).

Exclusive breastfeeding for 6 months has many benefits for the infant and mother. Chief among these is protection against gastrointestinal infections which is observed not only in developing but also industrialized countries. Early initiation of breastfeeding, within one hour of birth, protects the newborn from acquiring infections and reduces newborn mortality. The risk of mortality due to diarrhoea and other infections can increase in infants who are either partially breastfed or not breastfed at all (WHO, 2014). Exclusive breastfeeding during the first 6 months of life also helps to avoid or reduce exposure to contaminants and displacement of breastfeeding by water or other foods (Gupta *et al*., 2007). The use of a feeding bottle is considered an unhealthy and inappropriate practice as far as child feeding is concerned. However, it is documented that the use of a feeding bottle is still practiced in many countries.

WHO estimates that globally, less than 40 percent of infants under-six months of age are exclusively breastfed. It adds that approximately 800,000 children's lives would be saved every year if every child was breastfed within an hour of birth, given only breast milk for their first six months of life and continued breastfeeding up to the age of two years (WHO, 2014).

Breastfeeding also affects the mother in various ways. The physiological suppression of fertility as a result of intensive breastfeeding influences the length of the interval between pregnancies hence lowering the risk of poor nutritional status of the child as there will be enough care offered which is different when the mother is pregnant. It does this through hormonal effect which often induces a lack of menstruation. This is a natural (though not very-reliable) method of birth control known as the Lactation Amenorrhoea Method. Due to an increased birth –interval, the mother's body has an opportunity to recuperate and get back a nutritional balance especially iron which is the most depreciated nutrient during pregnancy, childbirth and postpartum period (lactation). Breastfeeding also reduces the risk of ovarian and breast cancer therefore mothers and families need to be supported for their children to be optimally breastfed.

The age of initiation of breast feeding, duration of breast feeding has a great impact on the nutritional status of the child. WHO recommends immediate initiation of breastfeeding in the first half an hour of life to enable the child ingest colostrums from breast milk which play a big role in building the immunity of the child as they get exposed to the new environment.

2.1.4.4.2. Diet.

This basically centres on complementary feeding and weaning of the child. If done at the right time and with good quality foods to contain balanced nutrients, it should not affect the child at all. Complementary feeding should be gradual with introduction of the most easily digested food to enable the child make the most of the new diet without any morbid conditions following and hygiene too must be maintained.

Around the age of 6 months, an infant's need for energy and nutrients starts to exceed what is provided by breast milk and complementary foods are necessary to meet those needs. An infant of this age is also developmentally ready for other foods. The WHO Guiding principles for appropriate complementary feeding are: continue frequent, on-demand breastfeeding until two years of age or beyond, practise responsive feeding (e.g. feed infants directly and assist older children, feed slowly and patiently, encourage them to eat but do not force them, talk to the child and maintain eye contact), practise good hygiene and proper food handling, start with small amounts of food and increase gradually increase food consistency and variety, increase the number of times that the child is fed, that is, 2-3 meals per day for infants 6-8 months of age and 3-4 meals per day for infants 9-23 months of age, with 1-2 additional snacks as required, use fortified complementary foods or vitamin-mineral supplements as needed and during illness, increase fluid intake including more breastfeeding and offer soft, favourite foods (WHO, 2014).

A study conducted on children under five reported the nutrient intake per day in relation to calorie and protein, 18 (6.21 %) and 164 (56.55 %) children consumed > 90 percent of Recommended Dietary Allowance (RDA) respectively with a higher protein intake noted compared to calories. According to WHO, the prevalence rate of underweight, stunting and wasting was 77 (26.55 %), 91 (31.38 %) and 22 (7.59 %,) respectively. This study clearly noted that if the diet is below RDA for nutrients, malnutrition will manifest, hence a balanced diet is very critical in order to avoid any form of malnutrition (Mathad *et al.*, 2011).

2.1.4.5. Socio-economic factors

This section covers literature on socio-economic factors number of children in the family, family income, occupation of care takers and literacy levels of the child's parents. Considerable amount of data has been documented on this subject with socio-economic status being one of the leading factors in determining the nutritional status of children.

2.1.4.5.1. Family factors

2.1.4.5.1.1 Number of children in the family.

Number of children under–five in a household has been documented to be associated with malnutrition. This is because, at this age and stage in life, the children require utmost attention and care to achieve their full growth potential. This requires a lot of time investment to observe the child in terms of their feeding, behaviour, growth pattern etc. If there is more than one child below five years in a household, the attention is reduced and early symptoms of malnutrition are not easily recognised until late when the negative side effects manifest.

The prevalence of underweight was found to increase as the number of siblings increase. Paramita *et al.* (2010) conducted a study in an urban slum of Ludhiana and reported that the prevalence of underweight increases significantly compared to those with more siblings. Those with no sibling had the lowest proportion of underweight children (12.8 %) and higher in those with 1-2 siblings (30.6 %) and highest (51.7 %) in those with more than three siblings.

Analysis of contributing factors associated with malnutrition by Mengistu *et al.* (2013) showed that children who come from those families that had three under five children in House Holds (HH) were about 4.5 times more likely to be underweight as compared to those children coming from families had one child under five years of age (AOR=4.52; 95 % CI=1,01, 20.23).

2.1.4.5.1.2. Family income.

This section includes all sources of income from both the father and mother that is available for family use in terms of purchase of quality and quantity of food, access to medical care in time, access to basic needs like clothing, proper shelter and playing material, which is necessary for the cognitive development of the child.

Family/household income was significantly associated with nutritional status of the under five children. Children belonging to the low-income group were at a higher risk of being wasted, underweight and stunted, than children of better income families. Although the economic differentials seem to be silent, it appears to be an important predictor of childhood nutritional status in rural society. Low income levels in developing nation's limit the kind and the amount of food available for consumption. Low income also increases the likelihood of infection through such mechanisms as inadequate personal and environmental hygiene (Edris, 2006).

Findings of a study in Ethiopia revealed that family monthly income had a strongly negative association with stunting in children. Families whose monthly income was 750-1000 birr were less likely to be affected by stunting as compared to children from those families with a monthly income less than 750birr (Mengistu, 2013). Similar findings were reported in a study conducted in rural community in rural kebeles of Haramaya district (Zewdu, 2012). As the family income increased, the level of chronic malnutrition among children aged 6-59 months also decreased as in other studies in developing countries (Sapkota and Gurung, 2009, Ola *et al.*, 2011, Zewdu, 2012).

2.1.4.5.3. Occupation of care takers.

Traditionally, a woman's place has been her home and a generation ago, her employment was looked down upon by society. However, this situation has changed and they now seek employment outside their homes because of their gross economic necessity to have an independent income, to make use of their education and to pursue a career (Basu, 1991). The inevitable changes like a woman entering the work field have an effect on the child care and development. Mothers offer more care to their children than alternative care takers.

Women's participation in economic activity is a mixed blessing. It increases the family income and it may give the woman some economic independence and status in the society. However, it increases her work load and cuts into the time she spends with her children. Also, in the workplace, biological qualities like motherhood, reproduction, lactation and child rearing are often turned into biological handicaps (Sivakami, 1997). Some studies report positive effects of working mothers on nutritional status of children while others report negative effects. Although women's employment enhances the household's accessibility to income, it may also have negative effects on the nutritional status of children, as it reduces a mother's time for childcare. Some studies have revealed that mothers of the most malnourished children work outside their home (Popkin, 1980 and Abbi *et al*., 1991).

A cross-sectional descriptive study conducted in the randomly selected slums in Guntur District in Andhra Pradesh between January- April, 2011 with an aim to study the nutritional status of children of employed and unemployed women, reported that children of the unemployed mothers weighed significantly higher than the children of employed mothers and stood significantly taller than those of employed mothers (For 2+ years children, $z=6.18$; $p<0.05$, for the 3+ years children, $z=6.9$; $p<0.05$ and for the 4+ years children, $z=8.8$; $p<0.05$). This was attributed to the fact that among the unemployed mothers, majority (61.7 % and 26.3 %) spent two hours and three hours a day with their children respectively against only 10.3 percent employed mothers who spent one hour with their children. However among the employed mothers, majority (83.3 %) spent only one hour with their children with significantly less of them spending more than one hour with their children as compared to the unemployed mothers. The study also added that 42.9 percent of the unemployed mothers and 37.6 percent of employed mothers exclusively breastfed their children for five months (Yeleswarapu and Nallapu, 2012). Two earlier studies reported similar findings where children of unemployed mothers weighed higher and stood taller than children from employed mothers (Tucker and Sanjur, 1988 and Toyama *et al.*, 2001). Another study argued that there is no association between maternal employment and children's nutritional status (Leslie, 1988).

2.1.4.5.4. Literacy levels.

Literacy refers to the education levels of the parents of the children in addition to their knowledge of nutrition, and the education level of the child care taker in turn determines their nutritional status. A person is considered literate if she /he is able to read and write with understanding in any language. One who can merely read but cannot write is not considered as literate. However to qualify as a literate, it is not necessary that a person should have received any formal education. According to the census of 2001, the literacy rate was reported to be 70.32 percent among males and only 50.43 percent among females in Andhra Pradesh state of India (National Rural Health Mission- District Health Action Plan, 2012-2013). A similar trend is observed in other states of India as well as in African countries. This is clearly indicates that higher literacy rates among men than women has a very significant effect on the nutritional status of women as reported by several studies, which also leads to an improved nutrition status of children with increase in education of the mother. This is because the education or knowledge empowers a woman and also enables them to accept information and follow instructions with respect to healthy feeding with minimal supervision. Child care as a responsibility falls mostly on women and is perceived by most cultures as among the most gender-attached responsibilities.

2.1.4.5.4.1. Education of the mother.

Vinod and Retherford (2000) in the analysis using NFHS data indicated that mother's education has a significant association with children's nutritional status. Results revealed that children whose mothers have some education but have not completed middle school are much less likely to be stunted, wasted or underweight than are children whose mothers are illiterate. Stunting was reported at (56 %, 49 % and 41 %), underweight was (57 %, 53 % and 43 %) and wasting was (18 %,17 % and 14 %) among illiterate mothers, those mothers with some education but less than middle school and those mothers who completed middle school or higher education respectively. The level of under-nutrition prevalence in children decreased with increase in mothers' education across all indices used to measure malnutrition.

Arnold *et al*. (2009) found the percentage of children who were underweight is almost three times as high for children whose mothers had no education than for children whose mothers have completed at least 12 years of education and the situation is worse for stunting. Findings from another study showed that malnutrition in children decreased with increase in the literacy levels of the mother however, no significant association was found between mothers' literacy levels and child nutritional status (Mathad *et al*. 2011).

2.1.4.6. Residency.

This refers to the area in which the child lives. In general context, the location of the care-takers house which could be the parents of the child or any relative they live with.

Data available in literature shows that malnutrition is highest in rural areas as well as in slum areas of big cities. Analysis of NFH-3 data revealed half of the children in rural areas are stunted (51 percent), almost half are underweight(46 percent) and one out of every five is wasted. In urban areas, nutritional deficiencies were reported to be lower than in rural areas. However, malnutrition was still wide spread with a prevalence of 40 percent, 17 percent and 33 percent for stunting, wasting and underweight among children under five years respectively. The study also indicated the differences between the two areas in-terms of malnutrition with children in rural areas being 40 percent more likely to be underweight and 28 percent wasted than children in urban areas (Arnold *et al*, 2009).

2.1.4.7. Sanitation

2.1.4.7.1. Source of water for households cleaning, cooking and drinking.

Water for household use is very vital to the health of the children. If utmost hygiene is not maintained, it increases the risk of infections. Thus water for cleaning, cooking and drinking ought to be clean as children drink any water they access while thirsty irrespective of how clean or dirty it is and they also eat any food whether on the floor or plate. Hence, the household area which children have access to should be clean, especially the crawling babies (8 months -12 months) who have their hands contaminated in the process, failing which, consequences on health and nutritional status might be detrimental.

Analysis of NFHS-3 data revealed that children from households whose drinking water is from non-improved water sources were more likely to be underweight and wasted than children with access to an improved water source. However the level of stunting did not vary with the source of water which could be due to the fact that stunting is an indicator of the long-term effects of malnutrition and does not vary according to recent dietary intake or diarrhoeal disease (Arnold *et al.*, 2009).

A 160 day follow-up study in which children were divided into two groups with one group, 90 children (51.1 %) receiving bottled water and 86(48.9 %) continuing with municipal water reported 3932 episodes of illness with 60.2 % significantly higher respiratory burden morbidity in municipal drinking water group with diarrhoeal diseases reported and vomiting. The same study stated that quality of water available for domestic use can be a better predictor of diarrhoeal diseases (Sakar *et al.*, 2013). The amount of water available for home use predicts a lot on the hygiene maintained in and around the home. The more amount of water available for home use, the better the hygiene in the home. This is affected by the distance covered for fetching water. Families with piped water flowing through the family taps have better hygiene because they have easy access to water. Such homes will mop the floor of the house regularly and as such fewer infections occur in children as their play ground is also well maintained.

2.1.4.7.2. Toilet facilities

Toilet facilities with a very good drainage system are very vital for proper disposal of human waste. In cases of poor toilet drainage or absence of a good toilet/ pit latrine system, water sources can be contaminated which leads to an increased risk of infections like diarrhoea, dysentery (blood in stool), cholera and typhoid. All these put a great demand on the child's body increasing loss of viable nutrients.

Poor households were more likely not to have any toilet facility or to use unimproved facilities like defecating in open space. On the other hand, using improved toilet facilities was found to reduce the risk of contracting diarrhoeal diseases. NFHS-3 results revealed that more than one half (55 %) do not have any toilet facilities with the house hold members practicing open defecation. 15 percent of the households use non-improved toilet facilities with only 3 out 10 households using improved toilet facilities that are not shared with other households (Arnold *et al.,* 2009). It was also noted that children from households which use improved toilet facilities are much less likely than other children to be stunted, wasted and underweight.

2.2. Nutritional status of women

2.2.1. Indicators.

For women, BMI is the commonest indicator used (Table.3.2) for assessing the nutritional status. WHR (waist-hip ratio) and skin fold thickness are other ways to measure the nutritional status of a woman other than weight and height. Anaemia prevalence among women is also used to assess their nutritional status, as women undergo multiple pregnancies which are critical in depleting the iron stores in their body, the constant menstrual cycle throughout their lives from adolescence and the discrimination against the girl child and women in families, giving them very little to eat.

2.2.2. Prevalence of malnutrition in women

Several studies have documented the unpleasant situation of women the world over. In Indian society, where the discrimination against female gender is evident, the poor health and nutritional status of women speak for its consequences especially in the rural population

A study on 100 non-pregnant, non- lactating women between the ages 18-49 in the village 'Badshahpur' near the vicinity of Gurgaon, Haryana reported a prevalence of underweight at (25 %), overweight/ obesity at (16 %). 37 percent were found to have a WHR (waist-hip-ratio) of 0.81-0.85 and 8 percent had WHR >0.85 against the normal WHR of <0.80. These results indicate an increased risk for women due to excess fat in the abdominal region (Mittal, 2013).

A cross sectional study conducted in India on married women who attended an urban health training centre for six months reported that out of the 224 women studied, 11.9 percent were overweight, 9.9 percent were obese and 20.1 percent were underweight with only 58.2 percent having a normal BMI, which clearly indicated high levels of malnutrition among the women studied (Basagoudar and Chandrashekhar, 2013).

Korthari *et al*. (2014) reported that among Indian women with a height below 145 cm, 35.6 percent were too thin (<18.5kg/m^2), 9.7 percent were overweight and 3.2 percent obese.

Another study on anaemia among non-pregnant women in rural Bangladesh (Ziauddin *et al*. 2000) found that anaemia was highly prevalent (73 %). Most of the women had mild (52 %) or moderate (20 %) anaemia, but a few of them suffered from severe anaemia (1 %). Ascaris was common (39 %) while hookworm was not (1 %). Anaemia prevalence had no statistically significant association with age, parity or Ascaris infestation. Women with less than 1 year of schooling, who were landless or who reported having an economic deficit in the household, had significantly higher prevalence of anaemia. There was a significantly increasing trend in anaemia prevalence with decreasing socioeconomic situation. However anaemia was common in all social strata.

2.2.3. Factors affecting the nutritional status of women.

Some evidence in developing countries indicated that malnourished individuals, especially women with a body mass index (BMI) below 18.5, show a progressive increase in mortality rates as well as increased risk of illness (Rotimi, 1999). For social and biological reasons, women of the reproductive age are amongst the most vulnerable to malnutrition. Increased perinatal and neonatal mortality, a higher risk of low birth weight babies, stillbirths, and miscarriage are some of the consequences of malnutrition in women (Krasovec and Anderson, 1991). Some of the socio-economic and demographic factors explaining women's nutrition according to studies done in different places are reviewed below.

2.2.3.1. Diet.

Diet and nutrition are important factors in the promotion and maintenance of good health throughout and contributes highly to the nutritional status as "we are what we eat"

Results from the study by Mittal (2013) revealed that 90 percent of the rural women were not consuming even 50 percent of the total energy requirements, 9 percent were consuming marginally adequate i.e. 50-90 percent of total energy requirements, and only 1 percent were consuming adequate amount of energy i.e. >90 percent of RDA. It also stated that 86 percent of the women were consuming <66 percent of total protein requirements, 94 percent were consuming <66 percent of niacin and folate requirements and none of the women were consuming B-complex vitamins in adequate amounts. It was also found that 99 percent and 97 percent of females were consuming inadequate amounts of iron and vitamin A respectively. Only the consumption of fat was adequate in most of the cases, which explains the increased prevalence of obesity and high WHR.

Basagoudar and Chandrashekhar (2013) indicated overweight and obesity as significantly higher among non-vegetarians as compared to vegetarians and also among women who have the habit of eating junk foods or snacks in between the meals regularly (more than thrice a week) compared to the women who never eat or eat occasionally.

2.2.3.2. Age of women

Women's age and parity are important factors that affect maternal depletion, especially in high fertility countries (Zerihun, 1997, as cited in Winkvisit, 1992). DHS surveys conducted in Burkina Faso, Ghana, Malawi, Namibia, Niger, Senegal, and Zambia show a greater proportion of mothers age 15-19 and 40-49 that exhibit chronic energy deficiencies (CED). Local studies in Ethiopia also showed that women in the youngest age group (15-19) and women in the oldest age group surveyed (45-49) are the most affected by under nutrition (Teller and Yimar, 2000).

In India however, malnutrition in form of iron deficiency anaemia was highest in women between 20-24 years (56 %) but severe anaemia was highest in the age group 40-44 (2.0 %) using NFHS-3 data. Similar trend in severe anaemia was observed in Mozambique (1.9 %) using 2011 DHS data (Korthari *et al*., 2014).

2.2.3.3. Place of residence

In India, the majority of the population resides in the rural part of the country (72 %) according to NFHS-3. Just like many cross sectional studies, rural residency is attached with less access to good facilities like health care, there is less autonomy for women and majority of the women are not working, leaving them with almost no access to resources coupled with their low education.

Korthari *et al*. (2014) reported higher prevalence's of anaemia among the rural Indian women (57.4 % and 1.9 %) compared to the urban Indian women (50.9 % and 1.5 %) for total anaemia and severe anaemia in 2005/06 survey.

A comparative study on maternal nutritional status in 16 of the 18 DHS conducted Countries (Loaiza, 1997) and a study in the SNNPR of Ethiopia (Teller and Yimar, 2000) showed that rural women are more likely to suffer from chronic energy deficiency than women in urban areas. These higher rates of rural malnutrition were also reported by local studies in Ethiopia (Sommerfelt *et al*., 1994; Yimer, 2000).

2.2.3.4. Mental health and stress levels

The balance in mental health of women is mostly disturbed due to environmental factors like family care, jobs and biological factors like menstruation and pregnancy. These cause intense levels of stress on the woman and some might require psychological counselling or proper treatment.

Stress has been considered to have grave effects on nutritional status. Higher stress is associated with less healthy eating behaviour, higher body weight and thus poor nutritional status (Moore and Cunningham, 2012).

In a study done on four purposively selected areas of Uttarakhand and 125 dual career women, the detrimental effects of stress on various psycho-physiological dimensions, like, blood pressure, pulse pressure, heart rate, respiration rate, temperature fluctuations, aptitude test and letter cancellation test were found to be more in women working in banks or in Life Insurance Corporation (Kwatra *et al*, 2012).

Kukreti and Bisht (2013) conducted a study in Uttarakhand in northern India on the nutritional status of women and men under stress in order to assess the differential effect of gender. Results of the study reported that 66.6 percent of the females and 85.4 percent of the males reported moderate stress (31-79) with males being more stressed than females though there was no significant difference observed. In the same study, a significant difference was observed between BMI of males (24.1kg/m²) and that of females (21.5kg/m²) among those suffering from moderately low stress (p=0.003). The group suffering from moderately high stress levels showed a BMI of 22.3 kg/m² for females and 24.1 kg/m² for males. Females were observed to have a lower intake of nutrients like energy, protein, zinc and iron than males when compared with the RDA. The authors further noted that according to the perceived stress levels, female subjects had a decrease in nutrient intake with an increase in stress while male subjects showed an increase in nutrient intake with increase in stress level.

2.2.3.5. Socio-economic factors

Socio-economic class partly determines how much of the earnings are available for expenditure on food consumption. Those who belong to lower socio-economic class have less available resources for food and proper health care.

2.2.3.5.1. Level of education.

Level of education determines the knowledge level of a woman. In general, nutritional status is reported to improve with literacy/ education. This is true for underweight as reported by several studies. Education may enable women to make independent decisions, to be accepted by other household members and to have greater access to household resources that are important to nutritional status (ACC/SCN, 1990).

A comparative study on maternal malnutrition in ten sub-Saharan African countries (Loaiza, 1997) and a study in the SNNPR of Ethiopia (Teller and Yimar, 2000) showed that the higher the level of education, the lower the proportion of undernourished women. In India, according to NFHS-3, malnutrition was common across all women irrespective of their education, however, the type of malnutrition varied with educational level. Among the illiterate women, malnutrition was mostly due to under nutrition (85 percent) and for women with 12 years or more of schooling, malnutrition was due to overweight or obesity (52 percent) as compared to (48 percent) under nutrition (Arnold *et al*., 2009).

Overweight and obesity is another form of malnutrition which also follows a similar trend. Basagoudar and Chandrashekhar (2013) reported that overweight was more common in literates (27.2 %) compared to illiterates (19 %) though it was not statistically significant. They however found that the proportion of being underweight increased as socio-economic status decreased.

Korthari *et al*. (2014) reported a highest form of under nutrition among the women with no education (41.7 %) as compared to those with primary education (34.9 %) and secondary education (30.3 %). However overweight and obesity increased with increase in education, with the highest prevalence in secondary educated women (13.4 % and 4.2 %) for overweight and obesity. Similar trends were observed in other Asian countries like Nepal, Bangladesh and Cambodia though India had the highest prevalence's.

2.2.3.5.2. Household economic status

The economic status of a household is an indicator of access to adequate food supplies, use of health services, availability of improved water sources, and sanitation facilities, which are prime determinants of child and maternal nutritional status (UNICEF, 1990).

A study of most of the DHS surveys conducted in developing countries (Loaiza, 1997) and a study in the Southern Nations, Nationalities and Peoples Region (SNNPR) of Ethiopia (Teller and Yimar, 2000) showed that women from low economic status households were the most affected by malnutrition. A similar study with DHS surveys from many countries between 2005- 2013 reported similar results (Korthari *et al*. (2014). Results of the study reported that 51.5 percent of Indian women from the lowest wealth quintile were too thin, 1.6 percent were overweight and 0.2 percent obese. Under nutrition decreased with increase in wealth but the opposite was observed with overweight and obesity, which increased with increase in wealth. Similar trend was observed for anaemia as well. Analysis of data pertaining to anaemia also reported a similar trend with anaemia being highest in the lowest quintile and prevalence decreasing with increase in wealth (64.3 % as against 46.1 %) in Indian women. Similar trends were observed using DHS data in Bangladesh (2011), Cambodia (2010), Senegal (2011) and Burkina-Faso (2010).

2.2.3.5.3. Employment and Decision making

Women's employment increases household income, with consequent benefit to household nutrition in general and the woman's nutritional status in particular. Employment may increase women's status and power, and may bolster a woman's preference to spend her earnings on health and nutrition. Though employed, women do not have control over their income and this does not enable them realise their dreams and exercise their abilities. Since they do not have decision making authority within the household, they are deprived of economic and social power and the ability to take actions that will benefit their own well-being. Studies in Africa have indicated that, at similar levels of income, households in which women have a greater control over their income are more likely to be food secure (Kennedy and Haddad, 1991).

Chaparro *et al*. (2014) reported that 43 percent and 99 percent of women and men 15–49 years reported being employed respectively. However 24 percent of women reported not being paid for their work compared to only 5 percent of men. Of those women who are paid, only 24 percent reported being able to decide on their own how to use their income and 74 percent reported being paid less than their husbands for the same work.

2.3. Anaemia

Anaemia is the late manifestation of deficiency of nutrient(s) needed for haemoglobin synthesis. Most of the anaemia cases are due to inadequate supply of nutrients like iron, folic acid and vitamin B12, proteins, amino acids, vitamins A, C, and other vitamins of B-complex group *i.e.*, niacin and pantothenic acid are also involved in the maintenance of haemoglobin level.

Normal Hb levels vary according to age, sex and physiological status. The table below represents the cut off values of haemoglobin which is dependent on age, sex/gender and physiological status as per WHO standards.

Table 2. 1 Recommended Cut-Off Values for Haemoglobin levels used to define anaemia.

Age/Sex Groups	**Haemoglobin level (g/dl)**
Children (6-59 months)	**11.0**
Children (5.00-11.99 years	**11.5**
Children (12.00-14 .99 years)	**12.0**
Non pregnant women (15 years of age and above)	**12.0**
Pregnant women	**11.0**
Men (15 years of age and above)	**13.0**

Source: WHO /UNU/ UNICEF (2001).

Anaemia in women is a particularly persistent problem and it is not going away, not even at a slow rate like the other nutritional problems. Forty percent of women are affected, especially in Asia and Africa, but even in South America and the Caribbean one quarter of women are anaemic. An estimated 500 million or more women are anaemic, most of them in Asia (UNSCN, 2010)

Table 2.2. Classification of anaemia as a problem of public health significance

Prevalence of anaemia (%)	Category of public health significance
≤4.9	No public health problem
5.0- 19.9	Mild public health problem
20.0- 39.9	Moderate public health problem
≥40.0	Severe public health problem

Source: adapted from reference (WHO, 2001).

2.3.1. Types of anaemia

There are several types of anaemia affecting all vulnerable groups but the most common of all is iron deficiency anaemia. This is normally due to consumption of foods that hinder iron absorption like phytates which are common in the Indian vegetarian diet. Anaemia can be classified according to (i) Pathophysiology and (ii) Morphology of the RBCs.

2.3.1.1. Pathophysiology.

This is the most common classification of anaemia depending on the cause. Common types of anaemia and their causes include:

Iron deficiency anaemia. Iron deficiency anaemia is caused by a shortage of the element iron in the body. The bone marrow needs iron to make haemoglobin. Without adequate iron, the body can't produce enough haemoglobin for red blood cells. This type of anaemia is often caused by blood loss, such as from heavy menstrual bleeding, an ulcer, cancer, a polyp somewhere in your digestive system, and prolonged use of aspirin or drugs known as non-steroidal anti-inflammatory drugs (NSAIDs).

Vitamin deficiency anaemia. In addition to iron, the body needs folate and vitamin B-12 to produce sufficient numbers of healthy red blood cells. A diet lacking in these and other key nutrients can cause decreased red blood cell production.

Additionally, some people may eat enough B-12, but their bodies aren't able to process the vitamin. This can lead to vitamin deficiency anaemia.

Anaemia of chronic disease. Certain chronic diseases such as cancer, HIV/AIDS, rheumatoid arthritis, Crohn's disease and other chronic inflammatory diseases can interfere with the production of red blood cells resulting in chronic anaemia. Kidney failure also can cause anaemia.

Aplastic anaemia. This very rare life-threatening anaemia is caused by a decrease in the bone marrow's ability to produce red blood cells. Causes of aplastic anaemia include infections, drugs and autoimmune diseases.

Anaemia associated with bone marrow disease. A variety of diseases, such as leukemia and myelodysplasia, can cause anaemia by affecting blood production in the bone marrow. The effects of these types of cancer and cancer-like disorders vary from a mild alteration in blood production to a complete life-threatening shutdown of the blood-making process. Other cancers of the blood or bone marrow such as multiple myeloma, myelo-proliferative disorders and lymphoma also can cause anaemia.

Hemolytic anaemia. This group of anaemia develops when red blood cells are destroyed faster than bone marrow can replace them. Certain blood diseases can cause increased red blood cell destruction. Hemolytic anaemia can be inherited, or you can develop them later in life they are at times caused by consumption of certain drugs like ibrufen, quinidine (Garraty, 2009) and AZT (Shah, 2005 and Munyagwa, 2007).

Sickle cell anaemia. This inherited and sometimes serious anaemia is caused by a defective form of haemoglobin that forces red blood cells to assume an abnormal crescent (sickle) shape. These irregular-shaped red blood cells die prematurely, resulting in a chronic shortage of red blood cells. This disease was first discovered in 1910 by Dr. B. Henrick who found a patient with strange symptoms like asthmatic conditions and blood flow problems including ulcers.

Other types of anaemia. There are several other rarer forms of anaemia, such as thalassemia and anaemia caused by defective haemoglobin production.

2.3.1.2. Classification of anaemia according to morphology.

The morphological classification is based on the size or volume of the red blood cell and may also be classified by the haemoglobin content of the red blood cell. A red blood cell of a normal size or volume is said to be **normocytic**. If the cell volume is decreased, then it becomes an abnormally small cell or it is said to be **microcytic,** and if the volume is increased, it becomes an abnormally large cell and it said to be **macrocytic.**

A morphological classification of anaemia can also be **normochromic**, which means red blood cells with normal haemoglobin content. They could be **hypochromic** (low haemoglobin content) or **hyperchromic** (high haemoglobin content).

This classification is very important though often ignored in community based studies. Categorizing anaemia is useful in determining what is going on in the body and therefore, defining the underlying condition. For example, if tests reveal small red blood cells (microcytic) and low haemoglobin content (hypochromic), then the physician would have a good indication that this patient might be dealing with iron-deficiency anaemia and could prescribe an appropriate treatment plan. Since iron is vital in making blood cells, if it is deficient, then cell volume and haemoglobin will be deficient giving a manifestation of microcytic hypochromic cells. On the other hand, if the tests reveal large red blood cells (macrocytic) along with a normal haemoglobin concentration (normochromic), then the physician might suspect a deficiency of Vitamin B12 *or* folic acid as the underlying condition. This detailed classification is very vital in correct management of anaemia. Since most studies do not cover it, it could be reason why anaemia is a big public health problem despite the efforts to prevent it.

A study in Nigerians on first time donors by Ahmed and Kagu (2011) revealed a diverse aetiology of anaemia with (56.6 %) having microcytic hypochromic anaemia, (19.2 %) with macrocytic anaemia, (17.6 %) with dimorphic anaemia (microcytic and macrocytic anaemia) and (6.6 %) with normocytic normochromic anaemia with no significant differences between the ages of donors. They concluded that in such a mixed population, uniform administration of iron and folic acid tablets in management of anaemia could be ineffective and might have adverse implications in some cases.

2.3.2. Stages of Anaemia

According to Herbert (1992) deviations from normal iron status have been summarized as follows:

Stages I and II negative iron balance (i.e. iron depletion): In these stages, iron stores are low and there is no dysfunction. In stage I negative iron balance, reduced iron absorption produces moderately depleted iron stores. Stage II negative iron balance is characterized by severely depleted iron stores. More than 50 percent of all cases of negative iron balance fall into these stages. When persons in these two stages are treated with iron, they never develop dysfunction or disease.

Stages III & IV negative iron balance (i.e. iron deficiency): Iron deficiency is characterized by inadequate body iron, causing dysfunction and disease. In stage III negative iron balance, dysfunction is not accompanied by Anaemia; however, Anaemia does occur in stage IV negative iron balance.

Stages I & II positive iron balance: Stage I positive iron balance usually lasts for several years with no accompanying dysfunction. Supplements of iron or vitamin C promote progression to dysfunction or disease, whereas iron removal prevents progression to disease. Iron overload disease develops in persons with stage II positive balance after years of iron overload have caused progressive damage to tissues and organs. Again iron removal stops disease progression. Iron status has a variety of indicators. Serum ferritin levels are in equilibrium with body iron stores.

Very early (stage I) positive iron balance may be best recognized by measuring total iron binding capacity (TIBC) (transferrin IBC). Conversely, measurement of serum (plasma) ferritin levels may best reveal early (stages I &II) negative iron balance, although serum total iron- binding capacity may be as good as indicator.

Because anaemia is the last manifestation of chronic long term iron deficiency, the symptoms reflect a malfunction of a variety of blood systems.

2.3.3. Effects

Iron deficiency is responsible for impairment of cognitive performance, behaviour and physical growth of infants, pre-school and school-aged children. It also affects their immune system and increases the risk of morbidity, lowers physical capacity and performance in work for adolescents and adults and adversely affects pregnancy outcomes by increasing the risk of maternal mortality, prenatal and perinatal loss (Singh, 2007 and UNICEF and WHO, 2015).

2.3.4. Symptoms of Anaemia

There are almost 400 types of anaemia. Normally, the symptoms of anaemia vary according to the different types of anaemia and may be associated with other medical conditions such as ulcers, haemorrhage, menstrual disorders, different types of cancers and specific. The most common ones are general body weakness, pale eyes, tongue, palms and feet.

2.3.5. Overall prevalence.

Global prevalence of anaemia between these vulnerable groups remains high but it is highest in south Asia and India in particular despite the National Nutritional Anaemia Prophylaxis Programme (NNAPP) being first launched in India since 1972 during the five year plan in India with the aim to curb the prevalence of anaemia.

Analysis of the National Family Health Survey -2 data for Guajarati's showed that the prevalence rate is high among children with illiterate mothers, low standard of living, working mother, belonging to Scheduled Caste (SC) and those whose mothers are also anaemic (Krishna, 2003). It is also well recognised that unregulated fertility is associated with anaemia and the health hazard increases sharply after the fourth pregnancy. Though anaemia is widely prevalent among women belonging to lower socio-economic strata of the society, it is not rare among the well-to-do classes of the society.

Analysis of the data taken from the District Level Household Survey under the reproductive and child Health programme (DLHS-RCH), 2002-04, conducted by the International Institute for Population Sciences (IIPS) Mumbai, India indicated that more than 95 percent of children, adolescent girls and pregnant women suffer from anaemia with the highest prevalence among adolescents at 97.8 percent. Nearly half of the children were mildly anaemic and 2.9 percent were severely anaemic. More than half of the pregnant women in the country were mildly anaemic and 42.6 percent were moderately anaemic but the situation is the worst for adolescent girls, 27.1 percent of whom are severely anaemic (Ramesh and Lopamudra, 2010).

2.4. Anaemia in children

The persistently high prevalence's of anaemia poses a potential risk on children's health and performance in academic and later in work output as adults. This is because the negative effects of anaemia on cognitive development are irreversible.

2.4.1. Prevalence of Anaemia in children

Several studies have been conducted on anaemia prevalence in children and most them show figures above 40 percent which is considered a public health problem by WHO and these figures have not dropped since the early 70's with most them remaining at above 70 percent. This has been reported to increase mortality and morbidity in children. Some of these studies as below are:

According to Singh (2007) analysis of all India data available on NFHS 3 (2005-2006) for children in the age group (6-35) months, the prevalence of anaemia reported was 70 percent which indicates an improvement of 5 percent over NFHS2 (1998-99) with anaemia being highest in the northern and eastern regions and lowest in the southern regions. The most affected children were 12-33 months as compared to 6-11 months and 24-35 months. He also noted that the prevalence dropped from 77 percent in 1970 to 72 percent in 1971 and remained at 70 percent from then till date.

According to analysis of NFHS-3 data, seven out of every 10 children aged 6-59 months in India are anaemic. Three percent of the children are severely anaemic, 40 percent are moderately anaemic and 26 percent are mildly anaemic across children of that age except in Nagaland where blood was not collected due to local opposition to blood (Arnold *et al.*, 2009).

A study on Prevalence of anaemia and associated factors with severe anaemia among 448 children aged 6-59 months in north western part of Tanzania in a hospital setting from November 2012 to February 2013 revealed a presence of anaemia in 77 percent anaemia in the children with a prevalence of mild, moderate and severe anaemia at (16.5 percent, 33 percent and 27.7 percent) respectively (Rehma, 2013).

Wenlong *et al.* (2013) in his attempt to describe severity of anaemia and explore its determinants among children under 36 months old in rural western China reported an overall prevalence of anaemia of 52.2 percent of which prevalence of mild, moderate and severe anaemia among these children was (27.4 percent, 21.9 percent and 3.2 percent) respectively.

Leite *et al.* (2013) reported an overall prevalence of anaemia at 51.2 percent among 5,397 Brazilian children with an Hb <11g/dl. The highest prevalence was in the north (66.4 percent), followed by the central-west (51.5 percent), south, south-east (48.0 percent) and north-east (41.1 percent). Moderate and severe anaemia was (16.4 percent), also distributed by region with 25.4 percent north, 14.8 percent central, 15.9 percent south, south-east and 10.1 percent north-eastern region, indicating that prevalence of anaemia is also affected by geographical location, with northern regions showing the highest prevalence rates, which are similar to findings in some studies in India with high prevalence reported in the northern states using NFHS-3 data (Singh, 2007).

A recent study in Ghana by Ewusie *et al.* (2014) reported a high prevalence of anaemia among children under five with an overall prevalence of anaemia of 78.4 percent in under-five children in Ghana. Out of 2168 Ghanaian children, 7.8 percent of the children had severe anaemia, 48.0 percent moderate anaemia and 22.6 percent had mild anaemia. The highest prevalence regions were the Upper East, 88.9 percent (N = 158, 95 percent CI: 80.9-94.0) and Upper West 88.1 percent (N = 220, 95 percent CI: 76.4-94.6). This is different from what has been reported in India and Brazil showing a possible continental difference.

2.4.2. Factors that lead to anaemia in children.

2.4.2.1. Age.

Anaemia is documented as most common among younger children less than two years than the older children. This is because most of them are born to anaemic mothers or breastfeed from mothers with iron deficiency anaemia, and therefore end up having low reserves themselves. This leads to some serious permanent problems especially cognitive suppression which persists despite the treatment. Because of this, it culminates into a series of problems to the child as an adult.

Ramesh and Lopamudra (2010) indicated a highest prevalence of severe anaemia among children between ages of 12-23 months and also among infants from SC/ST category with high birth order, born to adolescent mother and low standards of living. This could possibly be due to failure of supplementing nutritious food after six months of breast feeding, due lack of awareness of the symptoms of anaemia, low nutritional status of the mother on account of frequent childbearing, lack of experience of adolescent mothers and lack of iron rich diet among those with low standards of living respectively.

Arlappa *et al.* (2012) conducted a study in a Maharashtra and reported a prevalence of 59.2 percent of rural pre-school children with a significantly higher prevalence of 76.5 percent ($p<0.01$) among 1-3 years children as compared to 53.6 percent in 4-5 years children. The stepwise logistic regression analysis also revealed that the risk of anaemia in 1-3 years old age a group was three times higher or 2.8 at ($p<0.05$).

The prevalence of anaemia was reported to be higher among children under 2 years of age, 85.1 percent (N = 781, 95 % CI: 82.6-87.7) than children 2–5 years of age 74.8 percent (N = 1387, 95 % CI: 72.5-77.1) with no significant difference in prevalence between boys and girls observed (Ewusie *et al.*, 2014). Munyagwa (2007) reported similar results in Ugandan children with HIV at the age < 60 months than those > 60 months.

2.4.2.2. Gender

World over, anaemia has been reported to be higher among female children than male children. In the Indian context, it was worse where there is an existence of preference for a male child and gender discrimination at the food plate level (Ramesh and Lopamudra, 2010).

2.4.2.3. Infections and disease

Infection refers to the presence of worm infestation, malaria, diarrhoea, cough, HIV and other common infections in children which compromise iron store. Several studies have described the role infections play in the genesis of anaemia.

Malaria

This is caused by mosquitoes. It is very common in the tropics and areas with dense vegetation cover.

Kiggundu *et al*. (2013) evaluated the prevalence of malaria and anaemia in 2471 children under five in Rakia district in Uganda and reported an overall prevalence of anaemia at 56.3 percent (17.8 % severe, 13 % moderate and 25.5 % mild anaemia) with a mean haemoglobin level significantly lower in children with parasitemia as compared to children without it (8.3g/dl versus 10.0g/dl). The study also reported the prevalence of anaemia at 69.8 percent among severely malnourished children compared to 55.3 percent among normally nourished children. There was no increased risk of death reported in either anaemic or severely anaemic children which could be due to the fact that a blood transfusion was administered to nearly all severely anaemic children.

Another study conducted in Uganda found a close association of anaemia with moderate to severe anaemia (OR 4.42, 95 % CI 1.72-11.39, p= 0.002) in children with malaria. P. falciparum causes anaemia through direct destruction of both parasitized and un-parasitized red blood cells with increased splenic clearance of these cells and also by direct suppression of the bone marrow through cytokine induced dyserythropoiesis (Munyangwa, 2007).

HIV infection

HIV is the causative agent for AIDS. HIV presence has been found to contribute to anaemia in several ways. It occurs through bone marrow infection and the virus causes hemolysis.

Munyagwa (2007) conducted a study in Uganda in which children with HIV were evaluated for prevalence of moderate to severe anaemia and the contributing factors indicated a prevalence of 50.7 percent with Moderate to severe anaemia being most prevalent among children age 6 to 24 months. The factors independently associated with moderate to severe anaemia were age < 60 months, not taking multivitamin supplementation, previous transfusion, lymphadenopathy and malaria co-infection.

Drugs

Certain drugs used in treatment of disease are known to induce anaemia. Drug induced haemolytic anaemia for example, occurs when a medication you are taking causes your body's immune (defence) system to attack its own red blood cells.

Some drugs can cause the immune system to mistake red blood cells for foreign invaders and make antibodies to attack them. This can cause the immune system to break down red blood cells and lead to anaemia due to lack of enough healthy red blood cells that are required to carry oxygen to the tissues. Cessation of medication can often control the condition but in rare cases, a blood transfusion may be necessary. 125 medications were identified as causing this reaction. Some of these are: cephalosporin antibiotics, dapsone, levodopa, levofloxacin, methyldopa, nitrofurantoin, NSAID pain relievers, such as ibuprofen, penicillin, phenazopyridine, quinidine (Garraty, 2009).

Zidovudine (AZT) is also one of the commonest causes of drug associated anaemia which is used in the treatment of HIV (Northfelt, 1998). Though the mechanism is not known, several studies have shown that it causes a selective red cell aplasia or hypoplasia (Walker *et al*., 1988). The effect of AZT induced anaemia has been reported to improve with dose adjustment. A study in India showed that 12 percent of children had AZT induced anaemia, of these 40 percent had the drug discontinued while 60 percent improved on dose adjustment (Shah, 2005).

Other drugs associated with bone marrow suppression and causing anaemia include cotrimoxazole, phenytoin, carbamazepine, gancyclovir, amphotericin B, flucytosine, sulphonamides, methotraxate and doxorubicin (Means and Krantz, 1992). However HAART in HIV have been greatly associated with a reduced risk of anaemia even on those consuming AZT drugs

2.4.2.4. Literacy levels of family members.

Knowledge about anaemia prevention and management is a vital component in preventing the worst condition of anaemia in children. This encompasses knowledge on the types of food to give the baby (e.g. mashed green leafy vegetables soup which are rich are rich in iron, eggs which contains easily absorbable iron), signs and symptoms of anaemia for early management before it becomes severe.

The knowledge can be through education in school, listening to radio, watching television programmes and reading. Access to media will also influence the knowledge of the parents. Several studies have pointed out that the mother's education level has a great impact on the nutritional status of the child. Ramesh and Lopamudra (2010) in the analysis of data from DHLS-RCH indicated that the percentage of severely anaemic children declined with the increase in mother's educational level from 3.3 percent in non-literate to 2.2 percent in mothers with >11 years of schooling. Moderate anaemia decreased from 52.2 percent in non-literate to 37.7 percent in mothers with >11 years of schooling. A study in Brazil also reported similar findings with lower risk of anaemia among children whose mothers had ten or more years of schooling (Leite *et al.*, 2013).

2.4.2.5. Sanitation factors.

Poor environmental sanitation predisposes the child to recurrent infections like diarrhoea, dysentery, ARIs and worm infestation. Constant illness in children has been associated with a decrease in haemoglobin. To maintain hygiene, access to enough clean water for domestic use, proper disposal of human waste and kitchen/household waste is very vital.

The quality of water also matters as contaminated water increases risk of typhoid, worm infestation, bacteria among others which increase incidences of diarrhoea.

Data has been documented on the protective role of piped water available for domestic use on the occurrence of anaemia around the world (Santos *et al.*, 2004 and Assis *et al.*, 2004). One study in Brazil showed an unexpected association between anaemia and domestic source of water among indigenous children living in households relying on drinking water from rivers and lakes, where the members had a lower rate of anaemia than those in households with access to piped water (Leite *et al.,* 2013).

2.5. Anaemia in adolescents

Adolescence

According to WHO definition, adolescents are in the age group of 10 to 19 years. Girls begin to menstruate at this age. The girl should weigh approximately 42-64 kg and have a height of approximately 155-169 cm. Total nutrient requirements are increased during adolescence age to support a period of dramatic growth and development. Eating the right food at the right time will prevent the nutritional deficiencies, especially iron deficiency disorders (Dorothy *et al.,* 2007). Adolescence is a critical stage in the life cycle when the health of females is affected due to spurt growth, beginning of menstruation, poor intake of iron due to poor dietary habits and gender bias. Iron deficiency anaemia affects over 60 percent of the adolescent girls in India. Anaemia in adolescent girls has far-reaching implications. The anaemic adolescent girls grow into adult women with compromised growth, both physical and mental. These women have low pre-pregnancy weight, and are more likely to die during childbirth and deliver low birth weight babies (UNICEF, 2012).

In adolescence, development occurs in three periods as shown in the table below.

Table 2. 3. Periods of development in adolescence

Early adolescence	(10 -13 years)
Middle adolescence	(14 – 16 years)
Late adolescence	(17 -20 years)

Source: B. Srilakhsmi (2002) Dietetics (4th edition).

2.5.1. Prevalence of anaemia among adolescents

This section will cover the data documented on anaemia prevalence among adolescents in India and other parts of the world starting from earlier studies to the most recent.

2.5.1.1. Outside India

Pastides (1981) initiated a study in order to estimate and compare the occurrence of nutritional anaemia in three groups of adolescents and young adults. The first group comprised 159 individuals aged 14-21 years, who had been previously screened for thalassemia in three cities of England. The second group comprised of 163 Derby High School students, aged 14-18 years, who had also been previously screened for thalassemia. The third group consisted of 118 Yale undergraduate students, aged 16-21 years, who were monitored for nutritional anaemia while undergoing routine physical examinations at the Yale University Health Service. The prevalence of nutritional anaemia varied from (0.0 % to 5.5 %) among the three female groups, and from (4.4 % to 17.9 %) among the three male groups. Only the Yale undergraduate male group was found to be anaemic and the Yale undergraduate females were discovered to have the highest prevalence.

Ayoub (1995) conducted study on girl students of the first and second academic years of Dubai Medical College and found the prevalence of anaemia in 24.62 percent of the group, among which Arab Gulf Nationalities constituted 31.25 percent with Egyptians showing the highest prevalence of anaemia (50 %). The study showed a significant effect of chronic blood loss whether menstrual or from any other causes which affected the Hb level. Also living in the hostel away from parents and families reflected on their dietary habits and had a significant effect on the prevalence of anaemia among the studied group.

A study by Adgeppa *et al.* (1997) in Indonesia including 805 adolescent girls showed that 21.1 percent of the girls (170) were anaemic having haemoglobin level less than 12 g/dl and, according to a review by Kanani *and Ghanekar* (1997), 70 percent of adolescent girls in low income communities had Hb levels, 110 g/L. When the WHO cut off of 120 g/L was applied, the prevalence was even higher (80–90 %). Akkamahadevi *et al.* (1998) reported a prevalence of 23.84 percent severe anaemia, 22.67 percent moderate anaemia and 24.42 percent mild anaemia with a higher prevalence in rural girls (57.8 %) compared to urban counterparts (31.32 %).

Priti *et al*. (2013) reported a general prevalence of anaemia of 52 percent among adolescent girls and boys of which 29.7 percent were females and 22.4 percent males in the far eastern part of Nepal where a hospital based study was carried out. The severity of anaemia was 67.5 percent mild anaemia of which 38.4 percent were females and 29.0 percent were males); 20 percent moderate anaemia of which 10.9 percent were female and 9.1 percent were male; and 12.5 percent severe anaemia of which 7.7 percent were female and 4.8 percent were male). The highest prevalence of anaemia was observed between 18 – 19 years of age with 292 affected of which 82 were male and 210 were female.

2.5.1.2. Indian scenario

Prevalence of anaemia among Indian adolescents has been recorded in several studies over the years. The figures unfortunately remain high (> 40 %) signifying a serious public health problem as per WHO standards of grading. The prevalence remains between (45 % - 75 %) among some adolescent populations in India with several contributing factors reported to be associated. Despite the anaemia prophylaxis programme in India, prevalence still remains high at 70.57 percent (Sidhu *et al.*, 2005), 45.2 percent (Siddharam *et al.,* 2011), 71.5 percent (Santanu *et al.*, 2012) and 60 percent (Deshpande, 2013). This only means that the programme is not addressing the adolescents needs which is having an impact later in life when they attain child bearing stage. It is likely that due to this reason, anaemia still remains high among pregnant women, as some of them are adolescents by virtue of age.

Sidhu *et al.* (2005) conducted a study on 256 adolescent girls aged 11 to 15 years, from the scheduled caste community of Amritsar and concluded that only 29.43 percent girls were normal and 70.57 percent were affected with various grades of anaemic condition, of which 30.57 percent girls were mildly anaemic and 27.17 percent moderately anaemic while 12.83 percent suffered from severe anaemia. Severe anaemia was found to be highest in the age group of 15 years.

Siddharam *et al.* (2011) in a study conducted on adolescent girls aged 10-19 years in selected Anganwadi centers reported the prevalence of anaemia in 45.2 percent with 40.1 percent having mild anaemia, 54.92 percent moderate anaemia and 4.92 percent severe anaemia. A higher prevalence of anaemia was found among those from low economic strata with, 33 percent in class IV and 32.4 percent in class V with none belonging to higher socio class class 1. The study reported a statistically significant association of iron deficiency anaemia, weight loss (60 %) and presence of pallor with anaemia. However they reported no significant association between socio-economic status, attainment of menarche and age group with anaemia. The study suggested regular supply of iron and folic acid tablets at AWCs and to increase the compliance regarding consuming tablets among adolescent girls. Improved nutritional status of adolescent girls was also aimed at through counseling and health education.

Shilpa *et al*. (2012) evaluated anaemia prevalence among 840 adolescent girls between 10 -19 years and reported the prevalence of anaemia as 41.1 percent with severe anaemia being 0.6 percent, moderate anaemia being 6.3 percent and mild anaemia being 34.6 percent. A higher prevalence of anaemia was reported in late adolescence (15-19 years) and among girls from low socio economic status.

Santanu *et al*. (2012) in a study conducted on adolescent girls reported a prevalence of 71.5 percent in the state of Assam. Non-nutritional factors such as helminths were at 24.7 percent with Ascaris lumbricoides as the most frequent infection (10.6 %) followed by T. Trichiura (6.2 %) and hookworm (3.9 %). The type of haemoglobin was also reported to be a contributing factor in anaemia. The Gene frequency of HbE was at 0.188 as a result of north-east and south-east astro Asiatic origin. Highest prevalence of anaemia was in the districts of Dibrugarh as compared to Barpeta, Bangalgoon and Karmrup included in the study. This could have been due the fact that the study reported highest prevalence in gene frequency HbE (0.266) and Helminths infestation (24.71percent) in that district as compared to other districts included in the study.

Results from a cross sectional community based study conducted among 272 adolescent girls in Nagpur reported that 245 (90.1 %) girls were found to be anaemic. Majority of the girls (88.6 %) were having mild to moderate anaemia and only 1.5 percent of the girls were severely anaemic with an overall mean haemoglobin level as 10.33.±1.34 (Kulkarni *et al., 2012*).

Deshpande *et al.* (2013) in a study on 1000 adolescent girls between the ages 12 - 15 who were classified in socio-economic groups using Kuppswamy scale, aimed at reporting the co-relation of anaemia prevalence among the girls with demographic factors reported anaemia prevalence of 60 percent with 18.4 percent mild , 41.3 percent moderate and 0.4 percent severe anaemia with a high prevalence of anaemia seen among girls from socio-economic class III, IV and V, at 81.2 percent, 83.3 percent respectively. SFT of $\leq$ 14.5mm was taken as below normal range and anaemia was reported.

Many Indian studies have evaluated prevalence & type of anaemia but very little data is available for the type of anaemia prevalent on the basis of Blood Indices, red blood cell distribution width (RDW) and very few studies on adolescent boys. A study by Champaneri *et al.* (2014) among 142 anaemic adolescent boys and girls using detailed Blood Indices with RDW were evaluated and reported that MCV, MCH, MCHC was significantly reduced in girls compared to boys while RDW is increased in both sexes which suggests microcytic hypochromic type of anaemia. Anaemia was equally prevalent in both sexes though more severe in girls and it was of iron deficiency type of nutritional anaemia.

Several studies have reported a high prevalence of anaemia among adolescents, and very few studies reported a low prevalence. Gupta *et al.* (2012) reported a lower prevalence of anaemia at 21.4 percent of which 77.3 percent had mild anaemia, 21.9 percent moderate anaemia and 0.5 percent severe anaemia. Another study also reported lower prevalence of anaemia at 20.4 percent among adolescents (Nhien *et al.*, 2007).

Therefore, prevalence of anaemia among adolescent girls remains high as seen from earlier studies to the most recent ones especially for the girls with less education or those attending low quality schools in which there no sufficient facilities to equip them with the knowledge they require to prevent this deleterious effect of iron deficiency.

2.5.2. Factors contributing to anaemia in adolescents.

2.5.2.1. Age

Adolescence has been categorised on the basis of age to encompass individuals between the ages of 10 – 19 (years) during their stage of human development (WHO, 2003). However, Srilakshmi (2002) further classified adolescence into three stages such as early adolescence (10-13 years), middle adolescence (14-16 years) and late adolescence (17-20 years).

Studies have reported an increased prevalence of anaemia (lowering of Hb level) among adolescents with increase in age (Uchida *et al*., 1998, Gupta *et al*., 2012, Priti, 2013). The highest prevalence of anaemia has been indicated in middle and late adolescence as compared to early adolescence because in late adolescence the menstruation cycle is more stable and will mostly occur every month than early adolescence where there are skipped months (Rajanatman *et al.* 2000) .In their study which was conducted in rural Tamil Nadu to assess the prevalence of anaemia among adolescent girls found that there was reduction in the mean Hb as the age increased especially between the ages of 14 and above which was related to menstrual loss as compared to those who were between 10- 14 years where the menstrual cycle was not regular

Sidhu *et al.* (2005) found a prevalence of 12.83 percent severe anemia among adolescent girls in the age group of 15 years. Other studies also reported a higher prevalence of anaemia in late adolescents (15-19yrs) as compared to that in the early adolescents (10-14yrs) with majority of the girls having mild anaemia at 34.6 percent (Shilpa *et al.,* 2012) and anaemia prevalence of 74.8 percent severe or moderate with 27.0 percent severe among adolescents of age group15-19 years as compared to 74.9 percent and 25.4 percent in age group 10-14 years respectively (Ramesh and Lopamudra, 2010).

Priti (2013) also reported the highest prevalence of anaemia being present between 18 – 19 years of age with 292 affected of which 82(Males) and 210(Females) were included in the study. According to this study, adolescent girls are more at risk with anaemia than the boy which was explained by the menstrual cycle which the girls under-go monthly in which blood is lost but Kakkar *et al.* (2006) found that overall prevalence of anaemia was 58.4 percent among adolescent schoolgirls. Level of anaemia was higher ($p<0.05$) in early adolescent (10 -13 Years) age group (81percent) as compared to middle (58.3percent) and late adolescent (17-19 years) age group girls (48.7percent).

However some studies did not find a statistically significant association between age and anaemia among older adolescents (Rawat *et al*., 2001, Chaudhary and Dhage, 2008, Siddharam, 2012).

2.5.2.2. Nutritional factors.

These factors include the type, quality and regularity of meals. Since adolescence is marked with adventure and sense of independence from parental guidance, most them focus on the food that is not healthy nutritionally (burgers, sandwiches, fries) which interfere with proper absorption and utilisation of nutrients. They tend to ignore iron reach foods like the dark green leafy vegetables because they are perceived as for those in low social-economic class.

Imtiyaz (2006) in his study of adolescent diets showed calorie deficit up to (20 percent) of RDA at 10-12 years which reaches up to (25 percent) by 15 years. The deficit was more common among girls. This calorie deficit coupled with other specific nutrient deficiencies like iron, iodine and vitamin A to be significant in lowering nutritional status.

Kurniawan *et al.* (2006) conducted cross sectional study in which 29 (21.8percent) suffered from iron deficiency anaemia which was not significantly related to age and menarche. The study indicated that about 50 percent were underweight and stunted indicating the presence of acute and chronic malnutrition. The study further reported the proportion of thinness as significantly higher among subjects who suffered from iron deficiency anaemia with thin subjects having a 5 fold higher risk of suffering from iron deficiency anaemia than non-thin subjects. Deshpande (2013) concluded that thinness has a bearing on anaemia. Those with SFT(skin fold thickness) <14.5 were likely to be anaemic and NC <27 cm suggested under nutrition with 63.6 percent being anaemic and 297 normal of which 183 had normal NC but 42.4 percent were anaemic and 102 were normal.

Nhien *et al.* (2007) found that the prevalence of anaemia was 20.4 percent among adolescents in rural Vietnam. The incidences of low serum selenium (Se), zinc, and copper in subjects were 15.9 percent, 26.5 percent, and 4.1 percent respectively. The parameter significantly associated with anaemia was the low serum levels of Se. A body mass index <17.00 kg/m2 was also found to be a risk factor for low serum selenium. Results by Bashir (2013) also revealed that 64.7 percent of the anaemic adolescent girls belonged to the low weight category (< 18.5Kg).

Gupta *et al.* (2012) reported more underweight study subjects (60.9percent) were anaemic as compared to normal weight and overweight counterparts although it was not found to be statistically significant. In the univariate analysis, probability of having increased risk of anaemia was significantly higher among adolescents with increasing age, living in urban area, having attained menarche and underweight adolescents. However, the study did not find a significant association between BMI and age of onset of menarche with anaemia

2.5.2.3. Menarche.

Menarche is defined as the beginning of the menstruation period. This stage is what translates a girl into a woman capable of child bearing. There is no specific age as it varies from country to country, races and is also affected other environmental factors besides biological ones. The average age for the start of menstruation is between the ages of 10-13 years but some come earlier as in 8-9 years and others late at 14-15 years.

Kulkarni *et al*. (2012) in a study with 272 girls reported 214(78.67percent) girls had attained menarche by the time of the study. Mean age at menarche was 13.15±1.34 and the range was from 10 to 16 years. Higher prevalence of anaemia was found to be in girls with attainment of menarche (90.65percent) as compared to girls who did not attain menarche (87.93percent). Prevalence of anaemia was noted slightly higher in girls below 14 years (92.2percent) but status of menarche and menarche age was not significantly associated with anaemia ($P>0.05$) which may be due to very high prevalence of anaemia in the study group.

2.5.2.4. Social Economic Status.

It includes the social economic class of the family from which the adolescent comes from or the adolescent belongs as in either rich, middle, low and poor. Kuppswammy scale is used in several studies in India to grade the social-economic status of families.

Analysis of nationwide DHLS-RCH data, 2002-04 showed adolescents as having the highest prevalence of anaemia among the vulnerable groups affected adolescents the most with 97.8 percent prevalence with a high prevalence of moderate or severe anaemia among the girls low standard of living at 78.4 percent with membership from SC/ST at 78.6 percent and 80 percent for the non-literate (Ramesh and Lopamudra, 2010).

Sidhar (2012) reported an anaemia prevalence of 41.1 percent with the highest prevalence of anaemia seen among the girls who belonged to the lower socio-economic groups (43.1 percent in class IV and 100 percent in class V) as compared to the girls who belonged to higher socio-economic groups (4.1 percent in class III) which was statistically significant.

Deshpande *et al*. (2013) used kuppuswamy scale in which the subjects were divided into four classes of socio- economic class. The study reported the following on prevalence of anaemia on the basis of socio-economic class. Socio- economic class I(Upper) out of 224 subjects, 97(43.3percent) were reported to be anaemic with (34percent) mild, (62percent) moderate and (1percent) severe anaemia. Socio–economic class II (Upper middle) out 399 subjects, 195(48.8percent) were anaemic with (68,126 and 1) for mild, moderate and severe anaemia respectively. Socio –economic class III (Lower middle) out of 251 subjects, 204(81.2percent) were reported to be anaemic with (64, 140 and 0) for mild, moderate and severe anaemia respectively. Socio –economic class IV (upper lower) and class V (Lower) out of 126 subjects, 105(83.3percent) were reported to be anaemic with (18, 85 and 2) for mild, moderate and severe respectively.

However Siddharam *et al* (2011), Kulkarni *et al.* (2012) and Bashir (2013) found no significant association between socio-economic statuses with anaemia though they reported it as higher among the low income groups.

2.5.2.5. Level of education.

With education, the girl is empowered with knowledge on the proper foods to eat, causes, signs and symptoms of anaemia which enhances their ability to care for themselves properly.

Prevalence of anaemia decreased with increase in education as this widens the knowledge the adolescents have in containing and reducing anaemia occurrence. Knowledge on the causes, good feeding habits and prevention of anaemia is given through formal education. Their ability to read and write enables them seek further information which can be in newspapers, magazines, hospital notices e.t.c which option illiterates do not have. They are also less likely to fall for "fads" as they have a better command to tell false information apart from the correct legit information. Literate adolescents have lower levels of anaemia because they have better knowledge on how to care for themselves as compared to their illiterate counter parts (Ramesh and Lopamudra, IIPS and MoHFW, 2006).

2.5.2.6. Early Marriage.

This has been singled out as one of the causes of anaemia. In several studies, it is referred to as child marriage in which a child is made to assume responsibilities of a family at an early age when they themselves still need parental guidance.

Child marriage is defined as marrying before the legal age at 18 years for girls and 21 years for boy and is still widespread in India with a multiple set of factors contributing to the persistence of the phenomenon. Gender norms and expectations, traditional practices that surround marriage, safety concerns and family honour, poverty, limited education and livelihood opportunities and weak implementation of the law, Patriarchal values, in particular, play a significant role in child marriage. Girls are considered as a ‘property’ moving from the father’s to the groom’s household and their role as housewives is the only future conceived for girls by their family (IIPS and ORC Macro, 2000 and IIPS and Macro, 2007).

Child marriage affects both boys and girls but impacts girls with higher incidence and more intensity across all generations with important consequences on the development and full growth of the girl as it is associated with increased risks of maternal and child mortality, low levels of education, exposure to violence, isolation and confinement during NFHS-3 (IIPS and Macro, 2007).

In support of this, Ramesh and Lopamudra (2010) in the study where they analysed secondary data from a large nation -wide survey of DHLS-RCH,2002-04 revealed that degree of anaemia was higher among currently married adolescent girls compared to those not currently married because adolescents where physically immature to enter active reproductive life and must make adjustments of living away from maternal home and post marital household diet coupled with the higher physical activities that come with marriage.

2.6. Anaemia in pregnant women.

Pregnancy is a physiological state in which the woman carries a developing foetus normally in her uterus and is accompanied by alteration in hormones (progesterone), increased demand of nutrients to sustain the needs of the woman and support the growth of the unborn child, there may be great increase in appetite. Pregnancy normally lasts for approximately 266 days from the first day of conception until the baby is born or 280 days from the first day of the last menstrual period.

Poor nutrition during pregnancy has been reported by several studies to increase maternal mortality and also give rise to birth of unhealthy babies with multiple nutritional deficiencies, low growth potential of body organs especially the brain hence affecting cognitive potential of the child which is a permanent damage in the child’s life. Iron is a very virtual aspect of nutrition during pregnancies as deficiencies culminates several problems for the mother

2.6.1 Prevalence of anaemia in pregnant women

Global scenario

According to WHO, almost 50 percent of all pregnant women suffer from different types of anaemia globally but the biggest burden still lies on developing countries other than the developed countries.

A cross-sectional hospital-based study was conducted with 380 pregnant women randomly selected living in the highlands of Lhasa, Tibet reported a prevalence rate of anaemia as 70.0 percent, 77.9 percent and 41.3 percent respectively for three altitude-correction methods for haemoglobin (CDC method, Dirren *et al*. method, and Dallman *et al*. method). In this study, gestational age, ethnicity, residence and income were significantly associated with the haemoglobin concentration and prevalence of anaemia among pregnant women in the highlands (Yuan *et al.*, 2009).

Karaoglu *et al.* (2010) conducted a study in turkey with pregnant women and reported a lower overall prevalence of anaemia at 27.1 percent among the studied pregnant women. Not many women had severe anaemia (Hb concentration was < 7.0 g/dl in one women or < 8.0 g/dl in 3 women). Of the anaemic pregnant, 38.1 percent had a microcytic hypochromic anaemia (MCV < 80 fl & MCH < 27 pg), 56.5 percent had a normocytic-normochromic (MCV and MCH within normal range), 0.9 percent had a macrocytic (MCV >98.0 fl) anaemia and 4.5percent had combined morphologic type of anaemia. Iron deficiency was the most prevalent micronutrient deficiency (67.1percent) among microcytic-hypochromic anaemia ($p < 0.05$) and folate deficiency was common in all morphologic types ($p > 0.05$).

In Algeria, Yishu (2009) evaluated the prevalence of iron deficiency anaemia and reported a prevalence of IDA as estimated at 54 percent (n=369) SD of 11.3±2.4g/dl in non-pregnant women and 66 percent (n=39) with a mean SD of 9.9±2.5g/dl in pregnant women.

Indian scenario

Toteja *et al.*, (2006) assessed the status of anaemia among pregnant women and adolescent girls from 16 districts of 11 states in India and reported 84.9 percent of the pregnant women(n=6,923) were anaemic with Hb(<110g/l), 13.1 percent had severe anaemia with Hb (<70g/l) and 60.1 percent had moderate anaemia with Hb (≥ 70 to 100g/l).

A hospital based study conducted in and around Raichur reported a high prevalence of anaemia of 88.64 percent with incidences of severe degree of anaemia among the pregnant women using their venous blood. The study noted that there was poor knowledge about anaemia with only 6.48 percent cases having knowledge and the majority of 93.5 percent having no knowledge of anaemia which could be the strongest factor that led to the high prevalence. Mild degree of anaemia was also observed at 49.18 percent of which 63.24 percent was Microcytic hypochromic anaemia which is caused due to iron deficiency anaemia of nutritional anaemia (Dr.Vijaynath *et al.*, 2010).

Prevalence rate of anaemia irrespective of its severity was 96.2 percent among pregnant women as per results from the DHLS-RCH, 2002-04. The overall percentage of pregnant women in the country was indicated as 2.8 percent with severe anaemia which sharply dropped with the rise in education level from 4.1 percent among non-literate to 1.1 among women with 11+ years of education and standard of living from 4.0 percent in low standard of living to 1.5 percent among those with a high standard of living. Rural residence was also associated with severity of anaemia with prevalence rate being 3.3 percent severe anaemia among rural pregnant women as compared to 1.2 percent among urban pregnant women (Ramesh and Lopamudra, 2010).

Another study in Karnataka, India conducted on women from second trimester onwards from urban field practice area from 1st /march/2010 to 31st /July /2010 revealed a high prevalence of 82.9 percent of anaemia with haemoglobin (≤11.0gm/dl) among 228 pregnant women majority of whom had moderate anaemia (50.4percent) with Hb - 7.0+ 10.0gm/dl and 7.0 percent had severe anaemia with Hb (≤7.0gm/dl). It also reported severity of anaemia as being more in those who are 26 years of ages from nuclear families and those educated up to secondary level, having vegetarian diet with a parity of two or more and those in third trimester with two or more abortions though not statistically significant. However anaemia prevalence was significantly higher among those from class IV socio-economic status with less than two years spacing between previous and index pregnancies and less than two months IFA tablet consumption (Viveki *et al*, 2012).

2.6.2. Maternal consequences of anaemia

Mild anaemia

Women with mild anaemia in pregnancy have decreased work capacity. They may be unable to earn their livelihood if the work involves manual labour. Women with chronic mild anaemia may go through pregnancy and labour without any adverse consequences because they are well compensated.

Moderate anaemia

Women with moderate anaemia have substantial reduction in work capacity and may find it difficult to cope with household chores and child care. Available data from India and elsewhere indicate that maternal morbidity rates are higher in women with Hb below 8gm/dl. They are more susceptible to infections and recovery from infections may be prolonged. Premature births are more common in women with moderate anaemia. They deliver infants with lower birth weight and perinatal mortality is higher in these babies (Prema *et al.,* 1982). They may not be able to bear blood loss prior to or during labour and may succumb to infections more readily. Substantial proportion of maternal deaths due to antepartum and post-partum haemorrhage, pregnancy induced hypertension and sepsis occur in women with Moderate anaemia.

Severe anaemia

Three distinct stages of severe anaemia have been recognized - compensated, decompensate and that associated with circulatory failure. Cardiac decomposition usually occurs when Hb falls below 5.0 g/dl. The cardiac output is raised even at rest, the stroke volume is larger and the heart rate is increased. Palpitation and breathlessness even at rest are symptoms of these changes. These compensatory mechanisms are inadequate to deal with the decrease in Hb levels. Oxygen lack results in anaerobic metabolism and lactic acid accumulation occurs. Eventually circulatory failure occurs further restricting work output. If untreated, it leads to pulmonary oedema and death. When Hb is <5 g/dl and packed cell volume (PCV) below 14, Cardiac failure is seen in a third of cases (Lawson, 1967).

A blood loss of even 200 ml in the third stage produces shock and death in these women. Even today women in the remote rural areas in India reach to the hospital only at this late decompensated stage. Available data from India indicate that maternal morbidity rates are higher in women with Hb below 8.0 g/dl. Maternal mortality rates show a steep increase when maternal Hb levels fall below 5.0 g/dl. Anaemia directly causes 20 percent of maternal deaths in India and indirectly accounts for another 20 per cent of maternal deaths (Registrar General of India, 1997-2003).

2.6.3. Factors contributing to anaemia in pregnant women.

This section covers literature on factors which have been associated to anaemia over the years in several studies during pregnancy. They are divided into age of the mother, use of Health care services, BMI, diet, stage of the pregnancy, number of children/ pregnancies, family type, child spacing, socio-economic status, education, knowledge of anaemia.

2.6.3.1. Age of the mother.

Child bearing is supposed to impact lightly on the woman with just minimal decrease in nutrients as long as optimum nutrition is maintained. There is documented data on the side effects of child bearing at an early age "teenage pregnancy" with increased incidences of anaemia in young mothers below the age of 18 years.

Results from a nation –wide survey reported the severity of anaemia as low in the prime child bearing ages of 20-24 years with 2.5 percent severe ,40.3 percent (severe or moderate) and 25-29 years with 2.4 percent severe, 41.1 percent (severe or moderate) as compared to 2.8 percent (severe) and 42.7 percent (severe or moderate) between the ages of 15- 19 years while still an adolescent and 3.9 percent (severe) and 47.3 percent (severe or moderate) at the 35+ years (Ramesh and Lopamudra, 2010).

Jufar and Zewde (2014) also reported similar findings in a study in Ethiopia where anaemia was 1.21 times significantly associated to older age in pregnant women within the age bracket of 39-45 years (AOR=1.21)) which indicates a higher prevalence of anaemia in aged pregnant mothers.

2.6.3.2. Health care service use (Antenatal care RTH services).

During antenatal care, pregnant women are closely monitored in terms of health, stage of the pregnancy, BMI, BP, Nutritional status (Hb and micro-nutrient serum levels), pre-existing diseases (CVD, DM, and infections, counselling on nutrition, sanitation is also given to the women to maximise the positive outcomes of a pregnancy. However in rural setting where these facilities are minimal and with the general perception of the women and their families on these visits especially the illiterates who have no knowledge on the value of these visits, few of them attend more than twice by the time they give birth especially in developing countries where the health care system is not fully developed.

Mittal (2013) noted that in India, about 75 percent of health infrastructure, medical man power and other health resources are concentrated in urban areas where 28percent of the populations live and only 25 percent of medical facilities are concentrated in rural areas where rest 72 percent people live (NFHS-3 data). Contagious, infectious and waterborne diseases such as diarrhoea, amoebiasis, typhoid, infectious hepatitis, worm infestations, measles, malaria, tuberculosis, whooping cough, respiratory infections, pneumonia and reproductive tract infections dominate the morbidity pattern, especially in rural areas.

Several studies reported increased risk of anaemic pregnant women who are not frequently attending antenatal clinics. Such women are exposed to the dangers of the complications that come with pregnancy ie gestational diabetes, preeclampsia, anaemia as the pregnancy progresses, low BMI, reduced food intake due to loss of appetite and presence of disease/infection all which result in malnutrition and affect growth of the foetus, increase the risk low birth weight babies, increase the risk of neonatal, maternal morbidity and mortality. Moderate and severe anaemia has been documented as a danger to both neonatal and maternal health (Rohilla *et al*, 2010).

Dr. Vijaynath *et al.* (2010) in his study reported a high prevalence of anaemia with incidences of severe anaemia in a hospital based study. During the study, they observed that 94.59 percent of the pregnant women in the 3rd trimester were attending antenatal care for the first time and were between ages 18-24 years which could be one of the reasons a high prevalence of 88.64 percent of anaemia was recorded.

Gustavo *et al.* (2012) indicated a higher risk of moderate to severe anaemia among pregnant women who had < 5 antenatal visits by the second time their Hb level measurements were taken with a lower risk in those with normal Hb levels, high altitude .The study concluded that normal Hb level at first measurement should therefore not be considered as there is a decrease with gestational progress.

The use of proper health facilities by the pregnant women is also dependent on the freedom they have in making their own and family decision. One earlier study in 2001 examined 300 women in Varanasi, India for their autonomy in terms of control of finances, decision making, and freedom of movement and their relationship to maternal health care utilisation. Results of the study indicated women with closer ties to "natal kin" were more likely to have greater autonomy in each of the areas investigated. The study also reported women with greater freedom of movement obtained higher levels of antenatal care and were more likely to use safe health care since they had more control over their lives and other family members in making decisions (Bloom *et al.,* 2001). This was considered as important as education to allow women full control over their families and lives to take care of emergency situations. This also reduces the negative side effects likely to occur.

2.6.3.3. BMI (Body mass index)

BMI is monitored thought the pregnancy with recurrent measurements at each visit as each weight gain enables the doctors monitor the progress and growth of the foetus. This routine check is done in order to maximum the positive outcome of a pregnancy since an unhealthy pregnant woman is likely to give birth to unhealthy child (malnourished child). One study showed a higher risk for anaemia in pregnant women with low BMI (Liabsuetrakul, 2011) and such mothers were likely to give birth to children who are anaemic and less than 2.5kgs who are at higher risk of morbidity and mortality.

Studies have also been conducted on the high risk associated with high BMI during pregnancy. Siyatha *et al*.(2012) in a prospective non-randomised descriptive study among 100 pregnant women with normal BMI and 100 pregnant women with high BMI ($<30kg/m^2$) reported a higher incidence of gestational diabetes, preeclampsia, marcrosomia, high caesarean rate, induction of labour, increased incidence of post partum haemorrhage and infections in women with high BMI. Due to high caesarean rate because of too big infants for gestational age and increased infections, there was increased risk of anaemia (Sheiner, 2004). Usha *et al*. (2005) also reported one to two fold higher risk of caesarean section in pregnant women with a high BMI.

The incidence of pre-term labour is high probably because of early interventions due to preeclampsia. This is consistent with the findings in literature as to significantly increased incidence of elective pre term labour in obese women (Hendler *et al.*, 2005 and Smith *et al.,* 2007). Because of these increased complication, Stringent anti obesity measures need to be implemented in women to prevent the complications of obesity in reproductive years. Nutritional education, behaviour modification, drug treatment and dieting have not been successful in reducing weight in obese adults (Swati *et al.*, 2008 and Abrams *et al.*, 2000). However, a Meta analysis showed that bariatric surgery is more effective than non surgical treatment for weight loss in women with BMI > 40 and previous bariatric surgery is not associated with adverse perinatal outcome although the study showed high caesarean rate and an increased risk of anaemia (Sheiner, 2004). The studies above clearly indicate that poor nutritional status (malnutrition) in pregnant women can result into risks which endanger the woman and unborn child.

2.6.3.4. Diet

The quality of the diet a pregnant woman consumes is very vital in maintaining a healthy nutritional status of the woman. It should meet her personal needs as well as the increased demands that come with pregnancy in order to avoid a negative shift in the body's nutritional profile as well as the growing foetus.

A study in Delhi carried out to determine the effect of different dietary habits on the prevalence of anaemia among 1150 pregnant women had data collected on dietary habits during pregnancy (vegetarians' diet, shalka or halal meat) and had their haemoglobin levels assessed. Study results revealed that 96 percent were anaemic (89.8percent mildly anaemic and 5.3percent severely anaemic). Anaemia was seen in 96.1percent cases in vegetarian women, 95.3 percent in halal meat eaters and 96.2 percent in shalka meat eaters. although the women with <11g/dl Hb was less in the shalka group eating meat more than five times per month than in halal meat eaters and vegetarians, the difference was not statistically significant.(Bentley and Griffiths, 2003).

2.6.3.5. Stage of pregnancy

Pregnancy has three stages and each stage has its demands in-terms of nutrients. It is divided into first trimester, second trimester and third trimester. As the pregnancy progresses, there is an increased demand on nutrients especially iron and for that reason, the mothers Hb decreases with an increase in foetal growth.

A study in turkey reported anaemia prevalence as 2.3 times more prevalent at third trimester. The 21.2 percent prevalence of anaemia at the second trimester increased to 37.5 percent at the third trimester at ($p < 0.05$) and the proportion of the pregnant women with a Hb concentration under 10.5 g/dl at the second trimester was 12.6 percent (Karaoglu *et al.,* 2010).

Jufar and Zewde (2014) conducted a study on anaemia prevalence among pregnant women in Addis Ababa attending antenatal care in a specialised hospital.

Results of the study on analysis of obstetric factors revealed that anaemia was 2.04 times more prevalent at third trimester (AOR=2.04). The 26.2 percent prevalence of anaemia at the first trimester was seen to have increased to 39.28 percent at the third trimester. The authors affiliated these findings to hemodilution and poor prenatal care.

In Peru, a study with 379,816 pregnant women and their babies from 43 maternity units which aimed at determining the changes in Hb concentration at second measurement after first booking during pregnancy at low and high altitudes reported low prevalence of anaemia (21.4 percent) as majority of the women remained with normal Hb levels (71.1percent). Of the anaemic women, only 2.8 percent were reported with moderate/severe anaemia and 3.5 percent with erythrocytosis (Hb >14.5g/dl). It was also reported that the Hb level in the women decreased with progression of the pregnancy form first trimester to the second at all altitudes though it was higher at sea level(Gustavo *et al.,* 2012). Barak *et al*. (In Press) noted that several studies have reported a similar observation where Haemoglobin concentration of pregnant women decreased with increase in gestational age (Yuan *et al., 2009*).

The decrease in Hb level is due to plasma volume expansion as a mechanism to improve arterial uterine flow to the placenta (Steer, 2000). High arterial uterine blood flow has been associated with better birth weight (Julian *et al.*, 2009). Thus, a normal Hb value at first booking in the first trimester does not preclude the presence of anaemia in a second measurement of haemoglobin as pregnancy advances.

2.6.3.6. Number of children.

The number of living children existing has a bearing on the anaemia status of the woman. Several studies have documented evidence where anaemia is more prevalent among the women who have four or more children. This is because for each time a woman is pregnant, the Hb levels decrease because iron demand increases as its needed by the growing foetus to attain full growth potential and a lot of blood is lost during child birth. This is expressed using parity and gravidity as it clearly explains the number of times a woman has been pregnant or given birth to a live baby.

Gravidity and parity.

According to oxford concise medical dictionary (Eighth edition, 2010), Gravidity is defined as the total number of pregnancies a woman has had including the current pregnancy, previous live births, still births, miscarriages and abortions while parity is defined as the number pregnancies a woman has had that have each resulted in the birth of an infant capable of survival as distinct from gravidity.

A multigravida has been pregnant more than once, a multiparous woman has given birth more than once, a grand multipara is a woman who has already delivered five or more infants who have achieved a gestational age of 24 weeks or more, and such women are traditionally considered to be at higher risk than the average in subsequent pregnancies, a grand multigravida has been pregnant five times or more, a great grand multipara has delivered seven or more infants beyond 24 weeks of gestation.

2.6.3.6.1. Relationship of gravidity and parity to risk in pregnancy

The number of previous pregnancies and deliveries will also influence the risks associated with the current pregnancy. Severe anaemia for-example was reported in multiple gravid in a hospital based study among pregnant women in India with a prevalence of 68.03 percent (Dr.Vijaynath et al., 2010). Thirdly "What is considered normal labour varies according to parity": Normal labour in a primagravida is significantly different to normal labour in multiparous women, as physiologically the uterus is a less efficient organ and contractions may be poorly coordinated or hypotonic. The average first stage in a primagravida is significantly slower than in a multiparous woman (primarily due to the rate of cervical dilation) as reported by Vahratian *et al.* (2006). Therefore, progress is expected to be slower but delay longer than expected should prompt augmentation in managed labour.

2.6.3.6.2. Risks associated with nulliparity/primagravidae

These include: Higher risk of developing pre-eclampsia (relative risk 2.91 with confidence interval 1.28-6.61) as reported by Duckitt and Harrington (2005), Delayed first stage of labour though this could be considered normal in a primagravida, Dystocia (or difficult labour) was diagnosed in 37percent of primagravidae in one Danish study (Kjaergaard *et al.*, 2009).

Two studies in India have reported higher prevalence of anaemia with a parity index of four or more children that is a prevalence of (44.1percent) by Karaoglu *et al.* (2010) and 55.0 percent (Ramesh and Lopamudra, 2010) among pregnant women.

Raghuram *et al.* (2012) in a study in south India on women in the reproductive age reported highest prevalence of anaemia among women with a parity index of four followed by those with a parity index of three with a high significant association between anaemia and parity index at 0.01percent level of significance. Anaemia was 2.19 and 1.22 times more prevalent in multiparous, multigravidae respectively. This is may be due the fact that multiparty and multigravidity induces anaemia by reducing maternal iron reserves at every pregnancy and by causing blood loss at each delivery.

2.6.3.7. Family type/structure.

The most commonly found structures is the joint family structure and the nuclear family which is newly adopted because of the change in the socio-economic roles where women are assuming more jobs in the modern market and also industrialisation where more people are moving to cities in search for jobs. Different from what most studies among adolescents and children have reported about the nutritional status being better in joint families as compared to nuclear families because care of the child is a joint effort from grandparents, older siblings and any other family members hence less burden on the biological parents. In such families however, women are always the last to eat after everyone else despite the tireless work living most them with very little to eat despite the increased demand of pregnancy. Abhimanyu (2013) reported 30.2 percent of the women in nuclear families had severe anaemia as compared to 33.3 percent of those in joint families. This was attributed to the less number of family members in nuclear families which allowed for better access to food. Karaoglu *et al.* (2010) reported a significantly higher prevalence of anaemia in nuclear families of 30.0percent at ($p < 0.05$). These results were similar to those in the study by Abhimamnyu (2013). The discrepancy between the two studies clearly states that other than family type, there are other contributing factors to Anaemia in pregnant women which could be biological, cultural or attributed to individual physiology.

2.6.3.8. Socio-economic status

Socio-economic status has been significantly associated with anaemia prevalence rate. This is because it determines the availability of money for the purchase of quality food to enable a woman have a balanced diet especially purchase of easily absorbable iron food sources like meat, fish, liver, eggs are more costly as compared to that from plant food sources like vegetables (green leafy) whose absorption is inhibited by phytates which are high in vegetable food sources.

Results from a study in which anaemia in women and their children was studied reported a high significant association between family monthly income and anaemia. Low income families had 3.3 percent moderate anaemia and 83.4 percent severe anaemia while high income families had 47.8 percent mild and 21.7 percent moderate anaemia which indicates that low income is a cause of poor health (Dr. Abhimanyu, 2013).The proportion of anaemia was significantly higher among those women whose monthly family income was less than 500 million TL (29.1percent) ($p < 0.05$). For the subjects who received financial support (35.8percent) and lived in nuclear families (30.0percent) the occurrence rate of anaemia was significantly higher ($p < 0.05$).

In Tibet, Yuan *et al.*(2009) reported higher haemoglobin levels among women living in rural areas as compared to urban areas (Coeff=10.65,95percentCl:3.04,18.25) with a significantly lower Hb level among those pregnant women with an annual income <$264 as compared to those with an annual income >$264 (Coeff=10.65,95percentCl:3.04,18.25).

Viveki *et al*. (2012) reported a significantly higher prevalence of anaemia among pregnant women from socio-economic class IV with less than two months IFA tablet consumption.

2.6.3.9. Education

Documented literature has reported education to be significantly associated with anaemia prevalence among pregnant women and their children. Whereby, anaemia prevalence decreases with the increase in educational level. Severe anaemia decreased from 4.1 among non-literate pregnant women to 1.1 among those women with 11+ years of schooling. This is because education increases awareness regarding proper nutrition during pregnancy (possibly including the consumption of iron rich foods which aid in the formation of haemoglobin, vitamin C rich foods like fruits which aid in the absorption of iron from food consumed and also consumption of folic acid tablets) to keep the Hb at normal level (Ramesh and Lopamudra, 2010). Dr. Abhimanyu (2013) reported similar findings with anaemia prevalence increasing with decrease in education of a woman.

Another study with 60 women between the ages of 18-49 years with atleast one child investigated mother and child anaemia conditions with socio-cultural, demographic and nutritional context plus their effect on the mother reported a significant association between the education of the women and the symptoms of anaemia. Results indicated that 28 percent were illiterate, 35 percent had up to primary education, 23.4 percent had up to intermediate (12 years of schooling) and 13.2 percent graduation above level of education. 52.9 percent of the illiterate respondents had moderate anaemia and 17.7 percent had severe anaemia, majority (42.8percent) of those who passed primary education had moderate anaemia and majority of the educated (13+years) had mild and moderate conditions of anaemia. The study concluded that as education increased, symptoms of anaemia decreased. Lack of continuity of education for the 35 percent who achieved primary education was due to lack of income resources, long distance to school and cultural values of early marriage (Dr. Abhimanyu, 2013).

The risk of acquiring any form of anaemia was 2.12 times significant among pregnant women who were illiterate (illiterate (AOR=2.12) compared to those with a certain level of education (Jufar and Zewde, 2014). This could be due to ability of those with minimal literacy to read, understand and easily accept information concerning prevention of anaemia during pregnancy, consumption of iron rich foods and folic acid tablets during pregnancy.

Chapter III

MATERIALS AND METHODS

The present study entitled "Meso level situational analysis of nutritional status of children and prevalence of anaemia among children, adolescent girls and pregnant women in selected districts of India" was conducted in collaboration with the Research Program on Markets, Institutions and Policies (RP-MIP) of ICRISAT and the Department of Foods and Nutrition, Post Graduate Research Centre, Rajendranagar, Hyderabad during the year 2014-2015. The study was carried out to analyze the nutritional status of children and women and prevalence of Anaemia in children, Adolescent girls and pregnant women in three states and six districts in India with an attempt to look at changes over time.

This chapter includes the description of study designs, methodology of data selection, its analysis and is presented in various sections and subsections as detailed below:

3.1. Study design.

3.2. Sampling technique.

3.3. Sample group.

3.4. Sample size.

3.5. Sample selection.

3.6. Data sources.

3.7. Data arrangement and selection.

3.8. Statistical analysis.

3.9. Strengths of the methodology.

3.10. Weaknesses of the methodology.

3.1. Study design

The study design employed is a casual correlation and comparative study design. This is a unique study design which will examine the relationships between the dependent variables and also give the direction or extent of effect between the dependent and independent variables.

3.2. Sampling technique.

The study employed a purposive sampling technique. In this, data collected for analysis was limited to a particular group of the population with a focus on socio-economic and demographic variables as determinants of nutritional status in the four study groups listed below. The variables for analysis were also selected to cover socio-economic and demographic characteristics, sanitation, feeding practices, morbidity and immunization (for children). This would give a wider understanding of the persistently contributing factors to poor nutritional status over the years across the target vulnerable population.

3.3. Sample group

The study focused on the most vulnerable groups of population. These included:

Children (five years and below). This group consisted of both male and female children below the age of five at the time of the survey as reported by their mothers or according to immunization cards available for the respective children.

Women (15-49 years). This group consisted of all eligible women falling in the reproductive ages at the time of the survey.

Adolescent girls (15-19 years). This is the late adolescent group. This particular section was chosen for purposes of comparison across the years because the data for early adolescence (10-14) was not consistent in some of the years and also most studies reviewed reported anaemia prevalence as higher in late adolescence as compared to early adolescence (Uchida *et al*., 1998., Ramesh and Lopamudra, 2010., Gupta *et al*., 2012., Shilpa *et al.*, 2012., Priti, 2013).

Pregnant women. This group consisted of women who were pregnant at time of the survey only.

3.4. Sample size.

There was no consistent sample size as it varied from year to year and with each district and state as well. Hence, the sample included in the study was based on the availability of the data/ information required for analysis. For comparison between states, data pertaining to all India weights were used in order to normalize the sample sizes to give accurate results and adjust for over sampling .The code (V005) as per National Family Health Survey (NFHS) data sets was applied as the sample weight for every data during the first set of analysis to give the frequencies. The data on weights from different states were obtained from the NFHS data sets across the years as given by the International Institute for Population Sciences (IIPS) for data sets in 1998/99 and 2005/06.

For each district and state in a particular year, the variable of residence was considered as reference to get the approximate sample size of that population since across all districts it had no missing values and comprised the true representation of the population under study. This was done because there were missing values in some of the responses which made it difficult to have a clear sample size across all variables and where elimination of the missing variables made the sample size reduce considerably, hence making it difficult to have results which can be generalized for each state and district.

3.5. Material selection

3.5.1. Study area.

The study focused on three states with two districts in each of those states as follows:

1. **Andhra Pradesh state** (which is now recently divided into two separate states: Telangana and Andhra Pradesh), including Prakasam district which is located in Andhra Pradesh and Mahbubnagar district which is located in Telangana state were included.
2. **Maharashtra state**: Solapur and Akola districts were included.
3. **Karnataka state:** Bijapur and Tumkur districts were included.

3.6. Data sources

Nationally representative data from NFHS 2 and 3 and NSSO was used as a source of data as this would give a representation of the country's exact situation.

Moreover, the surveys were conducted on a large scale with trained researchers using standard tools of data collection i.e., the questionnaires and methodology used were similar to those used in DHS (Demographic Health Surveys). This means, the results from analysis of this data can be used to make generalizations for the study population and can be compared with results from other countries.

3.6.1. NFHS- 2, 3.

The National Health and Family Survey (NFHS), conducted in India was initiated by the Ministry of Health and Family Welfare (MOHFW), Government of India (GOI) in 1992-93 (IIPS, 1995). The International Institute for Population Science, Mumbai has been the sole agency responsible for the implementation of these surveys. Information from the three available surveys1998-99; 2005-06) has been used in this research. Details of the survey have been discussed below and important links provided in Table 3.1.

Survey design and data collection

The surveys obtained information from married women in the age-group 13-49 years from all 29 states (82- 84). Similar to the methods employed by DHS, samples for NFHS were collected through stratified cluster sampling process. Samples for each state were drawn separately from urban and rural areas that were proportionate to the state's urban and rural population (IIPS and Macro 2007). The rural sample was first selected from villages that comprised the Primary Sampling Units (PSUs), from which households were randomly selected (second stage). In contrast, a three-stage stratification sampling was followed in the urban areas. Urban wards were first selected from the Census file based on PSU followed by a census enumeration block (CEB). In the final stage, households were randomly selected within each selected CEB (IIPS and Macro 2007). In order to adjust for differences in the probability of oversampling of cases, sampling weight (national women's weight) provided by NFHS (IIPS and Macro 2007).was incorporated during data analysis (Table 3.1).

Survey instruments

Questionnaire used to collect primary data with information on household characteristics, participant's demography and anthropometric indicators were collected through questionnaires (household, women and men). The household questionnaire collected demographic information of usual residents and any visitor present from the night before the survey and household infrastructure. In addition to this information, women's questionnaires covered areas of reproductive and general health, nutrition, child immunization and utilization of government services (Table 3.1). The content of the men's questionnaire included similar questions on the women's questionnaire and additional questions administered to men only (Table 3.1).

Table.3. 1.Links to DHS survey methodology and instruments

Title	Link
Overview of DHS methodology	http://www.measuredhs.com/aboutsurveys/dhs/methodology.cfm
DHS recode manual	http://www.measuredhs.com/pubs/pub_details.cfm?ID=739&srchTp=type
DHS methodology: biomarker assessment	http://www.measuredhs.com/pubs/pdf/DHSM7/DHS6_Biomarker_Manual_7Jun2011.pdf
Women survey questionnaire	http://www.measuredhs.com/pubs/pdf/DHSQ5/DHS5-Woman%27s-QRE-22-Aug-2008.pdf
Sample design and data collection: India	http://www.measuredhs.com/pubs/pdf/FRIND3/01Chapter01.pdf
DHS sampling weight	http://www.measuredhs.com/help/Datasets/sampling_weights.htm

Biomarker and anthropometric measurement:

The NFHS III survey collected anthropometric measurements of women and children younger than 5 years, while only children under 4 years were measured in NFHS I and II. During the second and third phase of the survey (NFHS 2 and 3), trained health investigators collected blood samples from women age 15-49, and children aged 6-59 months. Haemoglobin levels were further assessed using HemoCue on the fields. This system uses a single drop of blood from a finger prick (or heel prick in the case of infants under six months old), which is drawn into a cuvette and then inserted into a portable, battery-operated instrument. In less than one minute, the haemoglobin concentration is indicated on a digital read-out (Agarwal *et al*., 1991 and Agarwal *et al*., 2006).

In the present study,, information pertaining to mothers having any child less than 5 years from two surveys, women aged 15-49 years, adolescent girls 15-19 years and pregnant women by the time of the survey was used (IIPS and ORC Macro, 2000 and IIPS and Macro, 2007).

3.6.2. NSSO

The Employment and Unemployment Surveys of National Sample Survey (NSS) are the primary sources of data on various indicators of labour force at National and State levels. NSS surveys on Employment and Unemployment with large sample size of households have been conducted quinquennially from 27th round (October 1972 - September 1973) onwards. The surveys cover data on household consumer expenditure on food and non-food items as well (NSSO 1992-93, 1999-2000 and 2004-2005).

The survey is conducted in one year and normally divided into sub-rounds. The integrated survey of households and informal sector enterprises covered household consumer expenditure, employment-unemployment and informal non-agricultural enterprises (other than those engaged in industrial categories of 'mining & quarrying', electricity, gas and water supply). In 55th quinquennial survey, schedules of Consumer Expenditure and Employment-Unemployment were canvassed in separate set of households unlike in earlier rounds. For the first time, the survey included consumption expenditure on second-hand clothing and second -hand durable goods was included in the consumption of households. Also, wages paid in cash to domestic servant or cook who was classified as a member of the household were also included in the consumption expenditure.

Sample Design: The sample design adopted in the survey was a two stage stratified design. The first stage units were 1991 census villages (panchayat wards for Kerala) for rural sector and Urban Frame Survey (UFS) blocks for urban sector. The second stage units were households, both for consumer expenditure, and employment – unemployment surveys.

Geographical coverage: The geographical coverage of the survey was done for the whole of the Indian Union except for Ladakh and Kargil districts of Jammu & Kashmir, 768 interior villages of Nagaland and 172 villages in Andaman & Nicobar Islands, which remain inaccessible throughout the year. A few other areas of Jammu & Kashmir were also excluded from the survey coverage owing to unfavourable field conditions.

Reference period: The annual series of consumer expenditure surveys, up to the 49th round, used a uniform reference period of 'last 30 days' for all items of consumption. In the bigger surveys of the quinquennial series, an additional reference period of 'last 365 days' was used for some items of consumption – particularly, clothing, footwear and durable goods – but most results were tabulated using the 'last 30 days' data. During the 5st to 54th rounds, one-half of the samples of households was surveyed through schedule type I, which had a reference period of 30 days for all items. In the other half of the sample, a schedule (schedule type 2) with different reference periods for different items was used.

Data conducted at three different points in time was used in this survey (1992-93, 1999-2000 and 2004-2005) for purposes of comparison with the NFHS survey data.

3.7. Data arrangement and selection

Several steps were involved in selection of data for analysis. Data was selected basing on the codes given below (Table 3.2.) to extract only that data for the study areas of interest as per the study.

Table.3. 2.Codes used for data extraction from the NFHS data sets (1-3).

State	District	NFHS Codes		
		1992-1993	1998-1999	2005-2006
Andhra Pradesh(AP)		02	02	28
	Prakasham	08	08	-
	Mahbubnagar	14	14	-
Karnataka (KA)		10	10	29
	Bijapur	06	06	-
	Tumkur	19	19	-
Maharashtra (MH)		13	13	27
	Akolar	23	23	-
	Solapur	13	13	-

Source: IIPS, 1995, 1998 and 2006.

Steps in data selection: Data was extracted using the above codes to separate it based on the area of study. This data was again separated based on the study group of interest creating separate files for each group in all the years. From the created files, the data was studied and variables of interest identified. The variables not required were deleted and the selected ones processed for further analysis by coding to match up with the created categories in the variables.

3.7.1. Variable selection for analysis.

The variables were selected based on the objectives of the study and separately for each study group in order to achieve the required information for the set objectives. From the data set, variables were selected to cover socio-economic and demographic, nutritional and autonomy factors in the society to assess their contribution to the poor nutritional status of the study vulnerable population and also to make comparisons across states and districts under study.

3.7.1.1. Children

For children, there were two dependent variables considered: Nutritional status and Anaemia in children under five years of age.

The independent variables were selected as follows:

1. **Sanitation variables**: source of drinking water, toilet facility. However, after consideration, only availability of toilet facilities was considered for analysis to give required information based on the fact majority of the households had no toilet facility hence a true representation of the poor sanitary conditions (IIPS and ORC Macro, 2000 and IIPS and Macro, 2007).

2. **Socio-economic and demographic variables:** Age, sex, residence, religion, caste, size at birth, sex of the child, size at birth

3. **Maternal factors** like (education and occupation).

4. **Child feeding practices**: Currently breastfeeding,

5. **Morbidity/ infections**: Children having diarrhoea/ blood in stools, fever and cough in the last two weeks prior to the survey were included. Due to lack of complete information on diarrhoea presence in 1998, only fever and cough were considered for purposes of comparison across years.

6. **Immunization**: **Received polio 3, DPT3 and measles.**

When anaemia in children was the dependent variable, stunting, wasting and underweight were run against anaemia as independent variables to find the association and net effect on anaemia prevalence in children below five years.

Analysis was carried out for only two years for nutritional status and anaemia prevalence as well for purposes of comparison that is 1998/99 and 2005/06 only. In NFHS-1 in 1992/93, haemoglobin status of the children was not collected, hence lack of analysis on anaemia prevalence in that year and therefore nutritional status in that year was not analyzed as well. Anaemia was only analyzed for two years (1998/99 at both district and state level and 2005/06 at only state level, as district codes were not disclosed in the NFHS-3 data sets), hence comparison across years was only at state level. Anaemia severity was classified as mild, moderate and severe anaemia (Table.3.3.).

Nutritional status of children was analyzed and grouped as stunting, wasting and underweight in all the years in 1992/93 1998/99 and 2005/06 in all states and districts apart from Andhra Pradesh (AP), where height was not measured in 1992. Hence, analysis of AP data from Prakasam and Mahbubnagar was only for underweight in 1992 (NFHS-1 report). Districts with a sample size below thirty were not analyzed, as it is not acceptable statistically, and their results were not presented. Due to lack of information on height data in AP state, the study focused on discussion and analysis of underweight as representation of both acute and chronic malnutrition in children and for purposes of comparison across the years for all the areas of interest (districts and states). Children whose weight-for-age is below minus two standard deviations from the median of the reference population are classified as underweight. Children whose weight-for-age was below minus three standard deviations (-3 SD) from the median of the reference population are considered to be severely underweight.

Underweight was classified into mild underweight, moderate underweight and severe underweight. Some variables were constructed as believed to give valuable results based on the existing data, i.e. age, size at birth, toilet facility (table 4.1-4.9).

Table.3. 3.Level of Haemoglobin for anaemia according to UNICEF (2001)

Anaemia Level	Haemoglobin level		
	Children	Adolescent girls	Pregnant women
Mild	8.0-10.99g/dl	10.0-11.99 g/dl	8.0-10.99g/dl
Moderate	5.0-7.99g/dl	8.0—9.99g/dl	5.0-7.99g/dl
Severe	<5.0g/dl	<8.0g/dl	<5.0g/dl

Source: NFHS-3.

3.7.1.2. Women

Nutritional status of woman

Dependent variable: nutritional status of women aged 15-49 years of age. BMI classification was used (Table.3.4).

Independent variables: Socio-economic, socio-demographic and autonomy variables were selected.

1. **Socio-demographic variables**: Residence, religion, age of woman, age at which the woman gave birth to first child.

2. **Socio-economic variables**: caste, occupation, educational level, partner's educational level, wealth, toilet facility, place of delivery.

3. **Women autonomy**: Decision on money expenditure and decision on acquisition of health.

Table.3. 4. The International Classification of adult underweight, overweight and obesity according to BMI

Classification	BM1(kg/m^2) Principal cut-off points
Underweight	<18.50
Severe thinness	<16.00
Moderate thinness	16.00 - 16.99
Mild thinness	17.00 - 18.49
Normal range	18.50 - 24.99
Overweight	≥25.00
Pre-obese	25.00 - 29.99
Obese	≥30.00
Obese class I	30.00 - 34.99
Obese class II	35.00 - 39.99
Obese class III	≥40.00

Source: Adapted from WHO, 1995, WHO, 2000 and WHO, 2004).

3.7.1.3. Adolescent Girls.

Dependent variables: Anaemia prevalence in adolescent girls (cut off as per table 3.3).

Independent variables: Socio-economic and Demographic variables.

1. Socio-demographic variables: Residence, religion, age of woman, age of woman at first birth.

2. Socio-economic variables: Caste, educational level, wealth index, occupation. 3.

3. Nutritional factors: BMI (cut off values as per Table .3.4).

3.7.1.4. Pregnant Women

Dependent variables: Anaemia prevalence.

Independent variables:

1. **Socio-demographic variables**: Residence, religion, Age, Age at first birth, number of children below five.

2. **Socio-economic variables**: caste, education level, educational level of partner, wealth and occupation.

3. **Nutritional variables**: BMI (cut off as per Table .3.4).

3.8. Statistical analysis

Data was analyzed using two statistical software's: SAS version 9.3 and SPSS version 20.0.

Chi-square analysis (Pearson, 1990) was performed using SAS version 9.3 to find the association between the dependent and independent variables. Pearson's chi-squared test (χ^2) was applied as our data was categorical and the samples were large. This would enable us to evaluate how likely it is that any observed difference between the sets arose by chance (Gosall *et al.,* 2012). This test shows if there exists an association between any independent variable with the dependent variable but it does not give any further information on the net effect. The formula is as below:

$\chi 2 = \sum (O - E)\ 2 /\ E$

Where, $\chi 2$= Chi Square

O= Observed frequency in each category

E= Expected frequency in corresponding category

Hence, a regression model was also run/ applied to the data. The chi square results generated frequencies as well and percentages for each cell and were calculated to enable for comparison and meaningful discussion.

Regression:

The independent variables were fit into ordinal logistic model to run a regression (Cox, 1958 and Walker and Duncan, 1967). SPSS version 20.0 was used. This enabled us to assess the net effect of each independent variable on the dependent variables and establish a direction of association that is, whether positive or negative between the variables. This model was selected because the dependent variable was categorical and ordinal in nature.

Empirical model.

In many empirical analyses involving dependent ordered variable which has more than two categories, where there are j categories of the response variable, the model consists of j-1 logit equations which are fit simultaneously, a qualitative dependent response model such as ordinal logistic regression which is subclass of the multinomial logistic regression is usually employed. If $J_i \ldots J_n$ are the categorical characteristics to be related to the occurrence of the outcome, then the ordinal logistic model can be given as

$$Y_t^* = X_i\beta + \varepsilon_i$$

$$= c_k(X) = In\frac{P(Y \leq j/X)}{P(Y > j/X)}$$

$$= In\ \frac{\phi_0(X) + \phi_1(X) + \cdots \phi_j(X)}{\phi_{j+1}(X) + \phi_{j+2}(X) + \cdots \phi_j(X)}$$

$$= \tau_j - X'\beta$$

Where $\tau_j$the cut are points between the categories, and $\phi_i(X)$ is the probability of being in class **i** given covariates **x** (Greene, 2003). Based on the above model, our dependent variables were ordered into categories below:

For anaemia, the categories were defined as non-anaemic, mild, moderate and severe anaemia (Table.3.3). For nutritional status in children, the categories were normal, mild, moderate and severe underweight, and for nutritional status of women they were moderately thin, mildly thin, normal, overweight, obese-1, obese-11 and obese-111 (Table.3.4). Hence, the multivariate logistic regression was not suitable or a simple regression would not be appropriate. A positive coefficient to an explanatory variable implies that a unit rise raises the degree of the dependent variable (anaemia, underweight and overweight/obesity).

After the model was run, results were presented in estimates, standard error, significance value and relative risk (RR). The RR was used to compare between the states and districts for the determinants of malnutrition and anaemia across the study populations over the years. All results of the study were considered significant if ($p<0.05$).

3.9. Strengths of the study

The study used two nationally representative data sets of which results can be generalized for the study population and can be compared with that from other countries. This is because the survey data was carried out by trained field researchers using standard tools like questionnaires similar to those used in DHS surveys and hence, collection of valuable data was ensured. The data also covered a large sample which was nation-wide; therefore, results can be used in policy planning for the particular sectors under study. The study also focused on nutritional status across the years. This would facilitate an in-depth analysis of the real situation and its determinants. The use of NSSO data would give an insight into the nutritional status of the population in terms of expenditure on food and food items and also the influence of employment status and expenditure for different items. The results from this analysis would give an understanding of the cultural influence as well on the feeding method and how this would affect the nutritional status of children.

3.10. Weakness of the study

The study is based on secondary data which also basically covered anthropometric data and haemoglobin data only. The researcher had no chance to assess nutritional status based on other nutritional deficiencies and also had no room for observations.

The NFHS-3 data also did not allow for analysis on district level in 2005/06 hence comparison across the years at district level was only limited to NFHS-2. In the data sets, there was also some data missing, as certain responses were not recorded. However, to circumvent this problem, variables were selected in which most responses had been recorded for findings that can be generalized for each group under study.

Chapter IV

RESULTS AND DISCUSSION

Despite improvements in health indicators, the global burden of maternal and child under nutrition is still alarmingly high. Poverty, food insecurity, ignorance, lack of appropriate infant and young child feeding practices, heavy burden of infectious illnesses, and poor hygiene and sanitation are among the factors that are responsible for the high levels of maternal and child under nutrition in developing countries. Maternal under nutrition is a potent contributor to mortality and morbidity plus poor birth outcomes like still births and low birth weight.

However, alongside the high levels of under nutrition, over nutrition is emerging as a new problem leading to dual burden of malnutrition and this has led to rise of non-communicable diseases like Obesity, diabetes and CVD's among many.

Since governments' efforts have not yielded the desired results of eradicating malnutrition among the vulnerable population, the present study was undertaken to determine the nutritional status of children and women and prevalence of anaemia among children, adolescent girls and pregnant women in selected districts of India to enable identify the causes of the persistent problem of malnutrition among this population in different locations and at different points in-time since it is evident that a gap exists between what is perceived to be the contributing factors and what is actually causing the problem.

For that reason, data was analysed and presented under the following headings

4.1. Nutritional status of children and women

4.2. Comparison of nutritional status of children and women with consumption data of NSSO.

4.3. Prevalence of anaemia in children below five years

4.4. Prevalence of anaemia among adolescent girls (15-19 years) of age.

4.5. Prevalence of anaemia among pregnant women.

Comparisons between districts and states were made over years and predicting factors for each documented.

4.1. Nutritional status of children.

This section covers underweight in children below five years and is discussed under the following headings with results of the years 1998/99 first followed by results of 2005/06.

a) Profile of the study population

b) Prevalence of underweight

c) Association of anaemia and selected variables

    i. Children characteristics

    ii. Maternal characteristics

    iii. Morbidity

    iv. Immunization

d) Determinant of anaemia in children (using logistic regression).

e) Trends in underweight prevalence and comparison between states and districts

4.1.1. Prakasam district 1998-99 (NFHS-2) survey.

4.1.1.1 Profile of children below five years in Prakasam district during NFHS-2

Anthropometric data on approximately 56 children below five years was included in the study in Prakasam district. Out of these children, majority resided in rural Prakasam (96.7 %), were of Hindu religion (92.6 %), female (52.0 %), between ages 0-6 months (29.7 %) and >23-≤35 months old (29.8 %), of average size at birth (59.1 %), still breastfeeding (96.3 %) and from OBC (37.1 %). Santosh *et al.* (2013) also reported more female children (52.5 %) than male (47.5 %) with majority in the ages >23-≤35 months old (35 %). Most of the children's mothers were not educated (59.4 %), were unemployed (44.3 %) and lived in households with no toilet facilities.

Data on morbidity and immunization revealed that majority of the children did not suffer from fever (66.6 %) or cough (70.6 %) two weeks prior to the survey and majority had been immunized against polio, BCG, DPT3 but not measles (Table.4.1.3).

Table.4.1. 1. Percentage association and determinants of Underweight in children below five years based on selected socio-economic and demographic factors in Prakasam district during 1998/99

Background characteristic	Percentage of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild -UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Child characteristics								
Residence								
Urban	0.0	0.0	0.0	0.0	2(3.3)	DF=3	NC	NC
Rural	61.7	30.8	15.4	15.4	54(96.7)	X^2=2.837	NC	NC
						P=0.4175		
						(NS)		
Religion								
Hindu	60.4	28.1	16.1	16.1	51(92.6)	DF=3	1.527	0.334(-)
Christian	50.4	50.4	0.0	0.0	4(7.4)	X^2=2.055	RC	
						P=0.5611		
						(NS)		
Sex								
Male	70.0	31.1	23.3	15.6	27(48.0)	DF=3	-0.148	0.875(-)
Female	50.1	28.6	7.2	14.3	29(52.0)	X^2=3.837	RC	
						P=0.2796		
						(NS)		
Age								
0-6	37.7	12.6	12.6	12.6	17(29.7)	DF=15	-1.286	0.219(-)
>6 - ≤ 8	100.0	100.0	0.0	0.0	4(7.4)	X^2=74.401	-0.245	0.870(-)
>8 - ≤ 11	0.0	0.0	0.0	0.0	4(7.4)	P<.0001	NC	NC
>11 - ≤ 17	77.0	77.0	0.0	0.0	8(14.5)	**	-0.673	0.586(-)
>17 - ≤ 23	100.0	0.0	100.0	0.0	6(11.2)		0.851	0.525(-)
>23 - ≤ 35	62.6	25.1	0.0	37.6	17(29.8)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=6	NA	NA
Larger than AV	50.2	0.0	25.1	25.1	17(29.7)	X^2=20.044	1.167	0.447(-)
Average (AV)	69.3	50.4	6.3	12.6	33(59.1)	P=0.0227	0.712	0.602(-)
Smaller than AV	33.3	0.0	33.3	0.0	6(11.2)	**	RC	
Very small	NA	NA	NA	NA	NA		NA	
Currently breastfeeding								
No	100.0	0.0	0.0	100.0	2(3.7)	DF=3	18.506	0.996(-)
Yes	58.1	30.9	15.5	11.6	54(96.3)	X^2=12.286	RC	
						P=0.0065		
						**		
Caste								
SC	71.8	28.7	0.0	43.1	14(26.0)	DF=6	1.183	0.217(-)
ST	NA	NA	NA	NA	NA	X^2=23.300	NA	NA
OBC	60.1	50.1	10.1	0.0	21(37.1)	P=0.0007	-0.408	0.635(-)
NONE	50.5	10.1	30.3	10.1	21(36.9)	**	RC	
Maternal characteristics								
Education of mother								
No education	56.5	31.3	6.3	18.9	33(59.4)	DF=9	0.055	0.950(-)
Primary	66.7	33.3	33.3	0.0	6(11.2)	X^2=11.805	0.238	0.854(-)
Secondary	100.0	50.0	50.0	0.0	4(7.5)	P=0.2245	0.965	0.515(-)
Higher	50.9	17.0	17.0	17.0	12(22.0)	(NS)	RC	
Occupation								
Not working	67.4	25.3	25.3	16.8	25(44.3)	DF=12	**19.204**	**<.0001(4.57^{-9})**
Sales	100.0	0.0	100.0	0.0	2(3.7)	X^2=23.16	**21.205**	**<.0001(6.18^{-9})**
Agric Self-Employed	50.0	50.0	0.0	0.0	4(7.3)	P=0.0264*	**18.877**	**<.0001(6.34^{-9})**
Agric Employed	54.7	36.5	0.0	18.2	23(40.9)		**19.044**	**<.0001(5.36^{-9})**
Unskilled -M	0.0	0.0	0.0	0.0	2(3.7)		**RC**	
Toilet facility								
Flush	NA	NA	NA	NA	NA	DF=3	NA	NA
Pit-latrine	52.8	0.0	52.8	0.0	4(7.1)	X^2=6.000	NC	NC
Bush	60.1	32.0	12.0	16.1	52(92.9)	P=0.1116	NC	NC
						(NS)		
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC=Not computed, NA=not available								

Source. NFHS-2

4.1.1.2. Prevalence of underweight children below five years in Prakasam district during NFHS-2

The overall prevalence of underweight in Prakasam district was 58.8 percent of which 27.8 percent of the children were mildly underweight, 17.4 percent moderately underweight and 13.5 percent severely underweight. Mild underweight is the most prevalent form of malnutrition in this district. RCH survey of 2002-2004 in Andhra Pradesh reported a similar prevalence of overall prevalence of underweight among children (58.6 %) but a higher prevalence of severe underweight (17.3 %) than the current study (IIPS and MoHFW, 2006). Similarly, a prevalence of overall underweight was reported in Madhya Pradesh (55.1 %) and severe underweight in Assam (13.3 %) states of India during NFHS-2. The prevalence is still higher than the national estimates of Indian children (47.0 %) for overall and severe underweight respectively (IIPS and ORC Macro, 2000). However, Alzain (2012) reported a lower prevalence in Palestine children of the same age (45.3 %). The difference in the findings could be due to use of different reference standard where NFHS-2 used the NCHS while the current study used WHO growth standards developed in 2006.

4.1.1.3. Association of underweight and selected variables

These results were based on chi-square to find association between underweight and each independent characteristic

4.1.1.3.1. Children characteristics

Results presented in Table.4.1.1 show that there was a significant association between underweight in children below five years with age, size at birth, breastfeeding status and caste but not with residence, religion and sex of the child.

Figure.4.1.1 showed that male children were more underweight as compared to female children though the difference was not significant (Table.4.1.1). This finding is backed up by an ICRISAT evaluation study, in which the diet of male children was found to be less diverse with only 2-3 food groups in a day as compared to female children whose diet was diverse with more than five food groups included on a daily basis in Prakasam district (Kavitha *et al*., 2015). Santosh *et al.* (2013) however, reported a higher prevalence of underweight among female children, but it was not statistically significant.

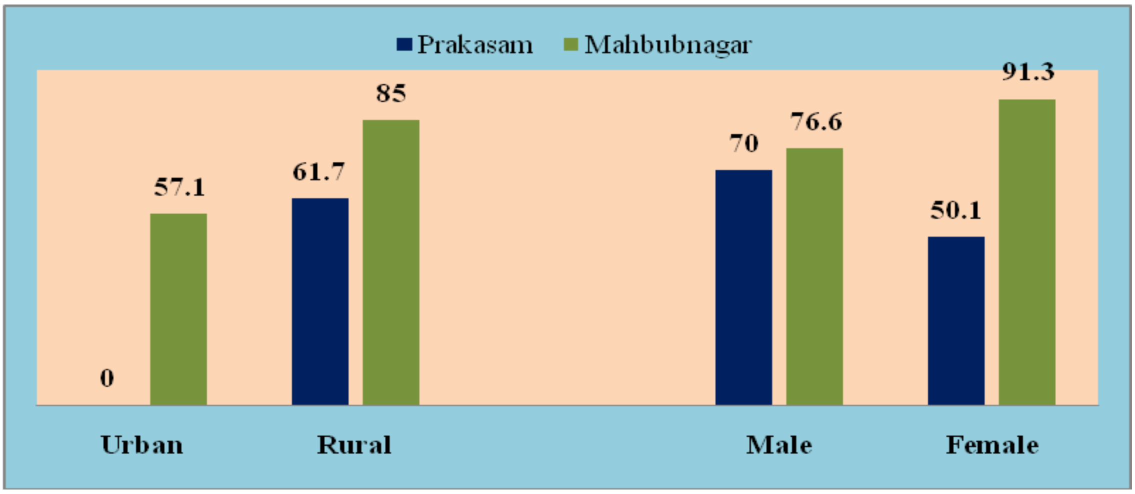

Figure.4.1.1.Prevalence of underweight in children below five by residence and Gender in Prakasam and Mahbubnagar districts

Severe underweight was significantly higher in older children who were between >23-≤35 months old with a prevalence of 37.6 percent. This result indicates that the risk of severe underweight increases with increase in age of the child which can be attributed to exposure to disease causing germs as the child grows through unhygienic surrounding, poorly prepared and cooked food increasing risk of infections. The prevalence of 12.6 percent in children between 0-6 months can be a result of being born to unhealthy mother or poor feeding of the mother during pregnancy leading to a malnourished new born baby as poor nutrition in pregnancy has been associated with poor growth of the unborn child. Dharmalingam *et al*. (2004) examined the data from NFHS 2 (1998-1999) and identified maternal nutritional status as one of the most important determinants influencing intra-uterine growth and therefore the infant's birth weight.

NFHS-2 reported a similar trend with underweight increasing in higher age Indian children (IIPS and ORC Macro, 2000). DLHS-RCH Survey of 2002-2004 in Andhra Pradesh children reported lowest prevalence of overall and severe underweight among 0-6 months old children but highest prevalence was among children aged 12-23 months (47.0 % and 21.7 %) respectively, which is different from findings of the current study (IIPS and MoHFW, 2006).

Children belonging to Scheduled caste (SC) had a significantly higher prevalence of overall underweight (71.8 %) and severe underweight (43.1 %) as compared to children from other caste. Such children are born to less privileged families with limited access to quality facilities like good hospitals and low education of their parents thus having limited access to money and a low purchasing power. Sood (2010) also reported that among the six major states in India, children from SC and ST groups have the highest number of severely malnourished children.

4.1.1.3.2. Maternal characteristics

Results in Table.4.1.1 showed that there was no significant association between child underweight with education of the mother and toilet facility but an association was found with occupation of the mother. Stalin *et al.* (2013) also did not find mothers education to be significantly associated to prevalence of underweight among children below five years in Kancheepuram district, Tamil Nadu but a significant association was reported in NNMB survey of 2001 in the states surveyed (NNMB, 2002).

Though overall prevalence was higher in children with unemployed mothers (67.4 %), severe underweight was higher in children whose mothers were employed in the agricultural sector. This could be due to the fact that women employed on the farms spend long hours working and have limited time to feed and care for their children. These findings are backed up by the report of NNMB in 2001 survey (NNMB, 2002). Some of these women carry the children to work and the children spend long hours being hungry and living under the rough conditions at the farms where most of them tend to eat soil and anything they come across, thus increasing the risk of infestation with worms, which interfere with nutrient absorption thereby deterring normal growth of the child.

4.1.1.3.3. Morbidity

Table.4.1.2.Association and determinants of underweight in children below five years based on morbid conditions in Prakasam district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild -UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No Yes	56.0 66.7	22.4 44.4	16.8 11.2	16.8 11.2	37(66.6) 19(33.4)	DF=3 X^2=2.894 P=0.4083(NS)	-0.307 RC	0.732(-)
Had cough								
No Yes	52.8 76.0	31.6 25.3	10.6 25.3	10.6 25.3	39(70.6) 16(29.5)	DF=3 X^2=5.0682 P=0.1669(NS)	-1.156 RC	0.172(-)

*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight.

Source: NFHS-2

Results presented in Table.4.1.2 show that there is no significant association between underweight and morbidity. This is contradictory to findings of Santosh *et al.* (2013) who reported a significantly higher prevalence of underweight among morbid children. However, similar to the current study, they also reported a higher prevalence of underweight (77.1 %) among children with acute respiratory infection (ARI) and 53.6 percent in children with history of diarrhoea.

4.1.2.3.4. Immunization

Results presented in Table.4.1.3 show there is no significant association between underweight and immunization against measles, BCG, DPT3 except for polio. The results are strange with immunized children having a higher prevalence of underweight. This result is contradictory to Ray *et al*. (2000) in Calcutta west Bengal, who reported a significantly higher prevalence in partially immunized children and non- immunised children. (81.25 % and 88.23 %) respectively as compared to fully immunized children (62.67 %).

Table.4.1.3.Association and determinants of underweight in children below five years based on immunization status in Prakasam district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No Yes	33.4 72.7	22.2 33.6	11.2 16.8	0.0 22.4	19(33.3) 37(66.7)	DF=6 X^2=12.9511 P=0.0438*	-2.835 RC	0.111(-)
Received Measles								
No Yes dk	46.6 72.8 66.7	23.3 36.4 33.3	7.8 27.3 0.0	15.6 9.1 33.3	27(47.8) 23(41.0) 6(11.2)	DF=6 X^2=9.0341 P=0.1717(NS)	0.282 RC	0.788(-)
Received BCG								
No Yes	39.9 64.1	39.9 27.5	0.0 18.3	0.0 18.3	10(18.5) 45(81.5)	DF=6 X^2=8.3767 P=0.2118(NS)	0.081 RC	0.956(-)
Received DPT3								
No Yes	45.6 69.3	27.3 31.5	9.1 18.9	9.1 18.9	23(40.8) 33(59.2)	DF=6 X^2=6.7724 P=0.3424(NS)	0.907 RC	0.576(-)
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mil-UW= Mild underweight, Mod-UW= moderate underweight, Sev-UW= severe underweight.								

Source: NFHS-2

4.1.2.3.4. Determinant of underweight in children.

Results based on logistic regression presented in Table.4.1.1, 4.1.2 and 4.1.3 show that there was no significant correlation between the selected variables with severity of underweight in children except for occupation of the mother and haemoglobin status of the child (Anaemia). This is contradictory to Sengupta *et al.* (2010), Abubakar *et al.* (2012) and Singh *et al*. (2013) who reported age of the child, morbidity and gender to be significantly associated with underweight in children below five years.

The Relative risk (RR) of being severely underweight was higher in children whose mothers were employed in agricultural sector (RR= 5.36 times) as compared to children with mothers who were not working (RR= 4.57 times). This is attributed to the long working hours that the mothers spend on the farms. NNMB (2002) stated a significantly higher prevalence of severe underweight existed in children whose mothers were tenant cultivators (35.2 %), other labourers (28.4 %) and landless agricultural labourers (23.0 %).

The haemoglobin status of the children was negatively correlated with severity of underweight. Children with mild anaemia had a 0.68 times RR of being underweight as compared to children who were not anaemic. This is because in children, anaemia in its mild state will deter linear growth. This result is contradictory to Abubakar *et al.* (2012) who did not find any correlation between underweight and anaemia in children in the Kilimanjaro region of Tanzania.

4.1.2. Mahbubnagar district (NFHS-2)1998/99

4.1.2.1 Profile of children below five years in Mahbubnagar district during NFHS-2.

Data on approximately 123 children below five years was included in the study. Out of these children, the larger majority resided in rural part of the district (89.1 %), were of Hindu religion (98.3 %), male (63.4 %), between >11-≤17 months old (23.3 %), were of average size at birth (78.6 %), still breastfeeding (90.1 %) and belonged to OBC (48.4 %). Majority of the children's mothers were not educated (65.7 %), not working (29.3 %) and lived in households with no proper toilet facilities (84.0 %) hence practiced open defecation in the bushes around the household.

Results presented in Table.4.1.5 and Table.4.1.6 on morbidity and immunization showed that majority of the children did not suffer from fever or cough two weeks prior to the survey and received polio, BCG and DPT3 immunization but not measles.

4.1.2.2. Prevalence of underweight among children below five years in Mahbubnagar district during NFHS-2

Figure.4.1.2 shows that the overall prevalence of underweight in children below five years was 81 percent of which 36.6 percent were mildly underweight, 28.9 percent were moderately underweight and 15.5 percent were severely underweight. A similar prevalence of overall percentage of underweight (82.2 %) was reported among children in Rupandehi in Nepal of which mild underweight was the most prevalent just like in

Table.4.1. 4.Percentage association and determinants of Underweight in children below five years based on selected socio-economic and demographic factors in Mahbubnagar district during 1998/99

Background characteristic	Percentage of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Child characteristics								
Residence								
Urban Rural	57.1 85.0	42.9 32.1	14.3 34.0	0.0 18.9	14(10.9) 109(89.1)	DF=3 X^2=9.529 P=0.023*	**-1.623** **RC**	**0.036(5.07)**
Religion								
Hindu Christian	81.7 100.0	33.9 0.0	30.7 100.0	17.1 0.0	121(98.3) 2(1.7)	DF=3 X^2=4.458 P=0.2161 (NS)	NC NC	NC NC
Sex								
Male Female	76.6 91.3	31.6 36.2	29.1 36.6	15.9 18.5	78(63.4) 45(36.6)	DF=3 X^2=4.182 P=0.2425 (NS)	-0.483 RC	0.322(-)
Age								
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35	69.3 59.8 88.2 86.2 90.7 90.1	61.7 39.1 49.7 21.3 20.3 10.2	0.0 20.7 26.0 57.7 39.5 39.8	7.7 0.0 12.5 7.2 30.8 40.1	27(21.8) 10(8.3) 16(13.2) 29(23.3) 20(16.7) 21(16.8)	DF=15 X^2=50.473 P<.0001**	**-2.874** **-2.934** -1.737 -1.197 -0.509 **RC**	**0.001(17.71)** **0.007(18.80)** 0.055(-) 0.127(-) 0.541(-)
Size at birth								
Very large Larger than AV Average (AV) Smaller than AV Very small	NA 88.0 79.0 100.0 NA	NA 48.8 32.1 20.2 NA	NA 12.9 34.1 39.9 NA	NA 26.4 12.8 39.9 NA	NA 16(13.0) 96(78.6) 10(8.5) NA	DF=6 X^2=11.626 P=0.0708 (NS)	NA -1.368 -1.508 RC NA	NA 0.197(-) 0.090(-)
Currently breastfeeding								
No Yes	68.5 83.5	16.9 35.1	17.0 33.5	34.6 14.9	12(9.9) 111(90.1)	DF=3 X^2=5.891 P=0.117(NS)	0.066 RC	0.932(-)
Caste								
SC ST OBC NONE	87.5 100.0 76.1 66.9	24.8 35.8 31.2 43.9	25.1 42.8 34.4 11.6	37.5 21.4 10.5 11.4	16(13.3) 29(23.8) 59(48.4) 18(14.4)	DF=9 X^2=19.959 P=0.0182*	**1.838** **1.656** 0.692 RC	**0.044(0.16)** **0.040(0.19)** 0.326(-)
Child Anaemia								
Moderate-Anaemia Mild-Anaemia Normal	NC NC NC	NC NC NC	NC NC NC	NC NC NC	NC NC NC	NC NC NC	**2.594** 0.667 RC	**0.016(0.07)** 0.187(-)
Maternal characteristics								
Education of mother								
No education Primary Secondary Higher	92.4 77.8 67.5 44.2	35.8 22.8 67.5 21.5	33.4 55.0 0.0 11.4	23.1 0.0 0.0 11.4	8(65.7) 18(15.0) 6(4.8) 18(14.5)	DF=9 X^2=37.0485 P<.0001**	**2.186** 1.559 0.211 RC	**0.003(0.11)** 0.083(-) 0.867(-)
Occupation								
Not working Agric Self-Employed Agric Employed Household Unskilled -Manual	67.0 78.1 94.1 100.0 86.8	44.6 44.8 17.7 100.0 26.7	22.4 22.4 46.9 0.0 33.4	0.0 10.9 29.5 0.0 26.7	36(29.3) 19(15.1) 35(28.7) 2(1.7) 31(25.2)	DF=12 X^2=32.722 P=0.0011**	-1.739 -1.122 0.536 -1.434 RC	0.011(5.69) 0.153(-) 0.413(-) 0.452(-)
Toilet facility								
Flush Pit-latrine Bush Others	57.1 67.2 86.1 NA	42.9 67.2 30.0 NA	14.3 0.0 36.1 NA	0.0 0.0 20.1 NA	13(10.9) 6(5.1) 103(84.0) NA	DF=9 X^2=22.196 P=0.0083**	-1.784 -1.766 RC	0.023(5.95) 0.119(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC= Not computed, NA=not available								

Source. NFHS-2

the current study as represented by (42.5 %, 33.9 % and 5.8 %) for mild , moderate and severe underweight respectively (Acharya *et al*., 2013). Among Nigerian children, Amonsu *et al*. (2011) reported a prevalence of underweight at 82.1 percent which is almost similar to the findings of the current study. A similar prevalence of severe underweight (16.2 %) was reported in Gujarati during NFHS-2 (IIPS and ORC Macro, 2000). Several studies in India have however reported lower prevalence of underweight than the current study like 40.5 percent (Rao *et al.,* 2005), 54 percent (Damon *et al.,* 2013**)** and 46.8 percent (Shahjada *et al.,* 2014). Variations in prevalence are a result of different classification methods where IAP shows lower prevalence from the WHO growth standards and time and altitude difference during the survey periods**.**

4.1.2.3. Association of underweight and selected variables.

These results are based on chi-square to find association between underweight and the studied variables/characteristics**.**

4.1.2.3.1. Children characteristics

Results presented in Table.4.1.4 show that there is a significant association between underweight in children below five years with residence, age and caste but not with religion, sex, size at birth and breastfeeding status**.**

Rural children had a significantly higher prevalence of underweight (85.0 %) and severe underweight (18.9 %) as compared to urban children with prevalence of 57.1 percent with none being severely underweight (Figure.4.1.1).Similar distribution of underweight was reported in NFHS-2 among Indian children with prevalence of (49.6 % and 19.9 %) among rural children and (38.4 % and 11.6 %) among urban children for overall and severe underweight respectively (IIPS and ORC Macro, 2000). Vinod *et al*. (1999) also reported a higher prevalence of underweight among rural children as compared to urban children during NFHS-1 (57 % vs 46 % respectively).

A significantly high prevalence of underweight was found in older children as compared to younger ones. Severe underweight was highest in children >23-≤35 months old (40.1 %) followed by children between >17-≤ 23 months old (30.8 %). This result is contradictory to findings of Stalin *et al*. (2013) who reported a higher prevalence of underweight in infants (children <12 months of age) with a prevalence of 64.4 percent as compared to other age groups. Just like the current study, Vinod *et al*. (2013) reported a lowest prevalence in infants but the highest prevalence was between 12-23 months and decreased in older children thereafter.

Though sex was not significantly associated with underweight, female children had a higher prevalence of underweight (91.3 %) as compared to male children (76.6 %).

Santosh *et al.* (2013) reported similar findings and did not find a significant difference between males and female children just like in the current study but Stalin *et al*. (2013) found the difference to be significant. Findings of this study are backed up report of ICRISAT, in which male children in Mahbubnagar district fared better in their dietary diversity pattern as compared to the female children which could the reason for their slightly lower prevalence of malnutrition since balanced diet on a daily basis is greatly linked to better nutrition scores (Kavitha *et al*., 2015).

4.1.2.3.2. Maternal characteristics

Results presented in Table.4.1.4 found a significant association between mothers' education, occupation and toilet facility with underweight prevalence in children being higher among children with illiterate mothers (92.7 %), employed and living in households with no toilet facility thus using bush method to dispose-off human waste (86.1 %). Prasot *et al.* (2014) also found a significantly higher prevalence of underweight with children of illiterate mothers (59 %) and living in poor environmental sanitary conditions (72.6 %) just like in the current study.

4.1.2.3.3. Morbidity

Table.4.1.5.Association and determinants of underweight in children below five years based on morbid conditions in Mahbubnagar district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild -UW	Mod-UW	Sev-A			Estimate	Significance (RR)
Had fever								
No Yes	81.7 82.7	34.9 29.3	30.4 35.4	16.4 18.0	88(71.7) 35(28.3)	DF=3 X^2=0.4812 P=0.923(NS)	0.481 RC	0.472(-)
Had cough								
No Yes	75.3 92.0	30.7 37.2	33.4 29.5	11.1 25.4	73(59.9) 49(40.1)	DF=3 X^2=8.6654 P=0.0341*	-1.057 RC	0.098(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight								

Source: NFHS-2

Results presented in Table.4.1.5 below showed that there was no significant association between underweight and morbidity**.** Similarly, Gul and Kiramat (2012) reported no significant association between morbidity and malnutrition in children in Nowshera**.** However, Abubakar *et al*. (2012) reported ill health as a risk factor to underweight which is not in-line with the current findings.

4.1.2.3.4. Immunization

Table.4.1. 6.Association and determinants of underweight in children below five years based on immunization status in Mahbubnagar district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No Yes	76.3 86.1	35.7 31.6	24.3 37.3	16.3 17.3	51(41.8) 71(58.2)	DF=9 X^2=16.0742 P=0.0653(NS)	-1.347 RC	0.42(-)
Received Measles								
No Yes DK	81.5 81.9 100.0	31.2 33.3 100.0	28.2 37.4 0.0	22.1 11.1 0.0	66(53.6) 55(44.8) 2(1.7)	DF=3=12 X^2=10.1748 P=0.6006(NS)	0.206 RC NC	0.662(-)
Received BCG								
No Yes	78.8 83.0	28.7 34.7	21.6 35.0	28.5 13.2	29(23.6) 94(76.4)	DF=9 X^2=24.1299 P=0.0041**	-0.122 RC	0.865(-)
Received DPT3								
No Yes	78.9 84.7	25.1 40.6	28.7 34.6	25.1 9.5	58(47.1) 65(52.9)	DF=9 X^2=17.5987 P=0.0401*	1.121 RC	0.137(-)
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mil-UW= Mild underweight, Mod-UW= moderate underweight, Sev-UW= severe underweight.								

Source: NFHS-2

Results presented in Table.4.1.6 showed that there was no significant association between underweight and immunization against polio and measles in children but there existed an association with immunization of BCG and DPT3 in children below five years. This is contradictory to reports by Bloss *et al.* (2004) and Gul and Kiramat (2012) who found immunization to be significantly associated with underweight prevalence in children.

4.1.2.3.4. Determinant of underweight in children.

The results based on ordinal logistic regression were presented in Tables.4.1.4, 4.1.5 and 4.1.6. Results showed that there was a significant correlation between severity of underweight in children with residence, age of the child, caste, child anaemia, mothers education, mothers occupation and toilet facility in the household but not with religion, sex, size at birth, breastfeeding status, morbidity and immunization status.

Residence was negatively correlated with severity of underweight in children. In comparison to rural children, urban children were at a 5.07 times RR of being underweight. This results means the urban children were five times at a lower risk of being underweight as compared to rural children. Kandala *et al.* (2011) also reported malnutrition to be significantly higher in rural children as compared to urban Congolese children in DRC.

Age was negatively correlated with severity of underweight. This result infers that underweight in children increased with age. The RR of being underweight was 17.71

times and 18.80 times lower in children between 0-6 months and <6-≤8 months old in comparison to older children. The lower risk in children could be due to the fact, that children at this age receive their nutrients through breastfeeding and if correctly done, like breastfeeding on demand and also being breast fed by a well nourished mother, would lead to reduced risks of malnutrition where as older children have an alternative of weaned foods which could be difficult to digest at earlier ages and are not well balanced stand at an increased risk of malnutrition. Abubakar *et al*. (2012) reported that older children were at 0.96 times higher risk of being underweight in comparison to younger children

Occupation of the mother was negatively correlated with severity of underweight. Children whose mothers were not working had a 5.07 times RR of being underweight as compared to children with mothers employed in the unskilled manual labour sector as the mothers spend long hours working and deprive their children of good nutrition and care. Such families will feed on calorie dense foods with no micronutrients and low protein content required for optimal growth, for example, rice and pickle is a common type of food in this category. A significant correlation was reported with increased income playing a protective role in decreasing prevalence of underweight among children of different states (NNMB, 2002).

Child anaemia was also positively correlated with severity of underweight. This result infers that underweight in children increased with degree of anaemia. The RR of being underweight was 0.07 times higher in moderately anaemic children as compared to children with normal haemoglobin status. Soares *et al*. (2011) reported similar findings with underweight being significantly correlated with severity of anaemia with the risk of underweight increasing with severity of malnutrition.

Caste was positively correlated with severity of underweight in children. Children from Scheduled caste (SC) and Scheduled Tribe (ST) sects had the highest prevalence of severe underweight. The RR of being underweight was 0.16 times in children from SC and it was 0.19 times in children from ST as compared to children from other caste. This is because children from SC and ST are among the vulnerable and deprived social groups with limited access to quality hospitals, food, education and hence have the largest number of uneducated mothers, poorly paid parents as they lack skills that solicit good pay, sleeping in poor household structures with no toilet facilities and hence with an increased exposure to recurrent infections (Vinod *et al*., 1999). Two other studies have reported similar findings (IIPS and ORC Macro, 2000 and Abubakar *et al*., 2012).

4.1.2.3.5.Comparison between underweight prevalence in Prakasam and Mahbubnagar districts.

Between the two districts, underweight in children was higher in Mahbubnagar district as compared to Prakasam by 22.2 percent despite being in the same region and state where the way of life and cultures are likely to be similar. This is an indication that child underweight varies from household to household and the causes are more individual related than community (Figure.4.1.1). Kanjilal *et al.* (2010) stated that household's similarity has a stronger correlation than community levels and that's why social economic status shows strong association with malnutrition.

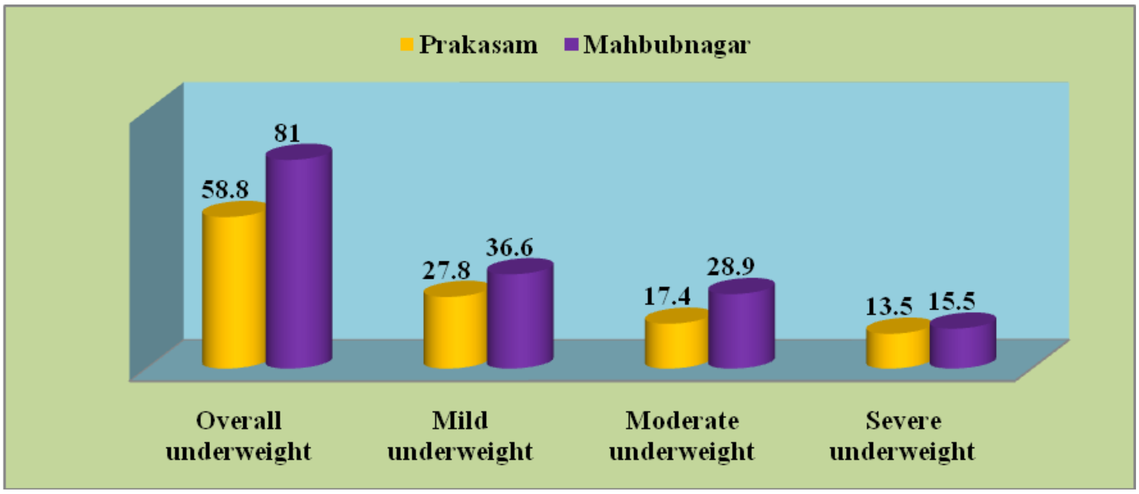

Figure.4.1.2.Prevalence of underweight between Prakasam and Mahbubnagar districts during 1998/99 survey

In both districts, severe underweight was most prevalent in the older children between the age of >23-≤35 months (Figure.4.1.3) and children from SC/ST caste. NNMB (2002) also reported higher prevalence in older children as compared to infants and those children in SC/ST caste. Also in both districts, underweight is most prevalent among rural children (figure.4.1.1). Figure.4.1.1 also shows that prevalence in underweight by gender differed in the two districts. In Prakasam, the male children were more likely to be underweight while in Mahbubnagar, the female children were at a higher risk for underweight. This infers that in Mahbubnagar district, gender discrimination is at its highest hence the very poor situation of female children as also reported by (Kavitha *et al*, 2015).

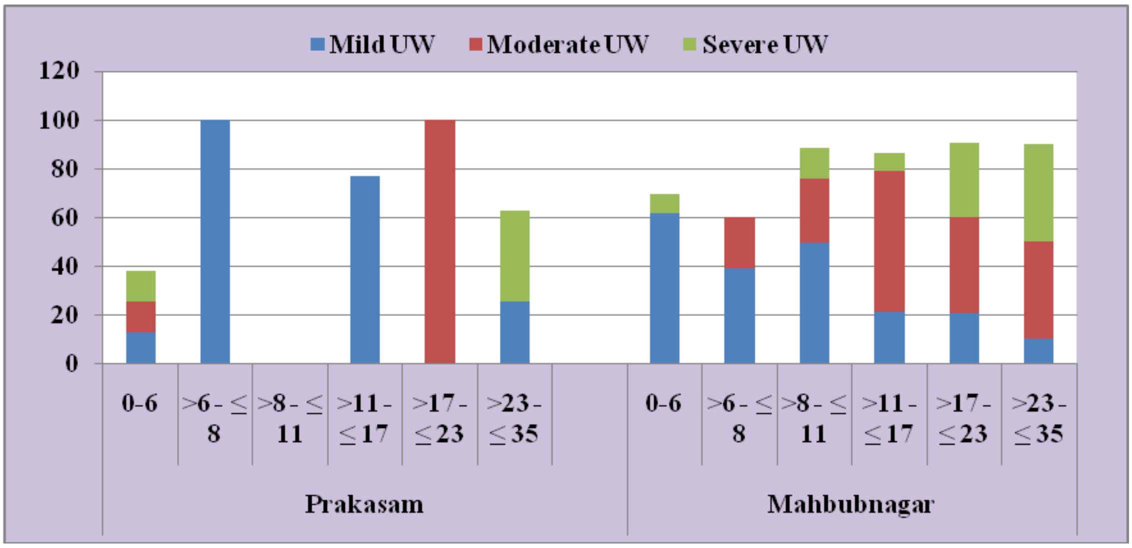

Figure.4.1.3. Severity of underweight in children according to age of the child between Prakasam and Mahbubnagar districts during 1998/99 survey.

Results of logistic regression revealed that in both districts, occupation of the mother and anaemia status of the child were common determinants of underweight in children. However, there was a difference in prevalence and RR with in each district (Table.4.1.1 and Table.4.1.4). The RR of being underweight in children with unemployed mothers was 1.12 times higher in Mahbubnagar district. Also unemployment in women played a protective role in underweight prevalence in children in Mahbubnagar district but in Prakasam, it increased underweight in children.

4.1.3. Andhra Pradesh state (AP) 1998/99.

4.1.3.1 Profile of children below five years in Andhra Pradesh state during NFHS-2

From the state of Andhra Pradesh (pre-divided), data on approximately 1869 children below five years of age was included in the study. Majority of the children resided in rural part of the state (75.0 %), were of Hindu religion (84.9 %), male (50.3 %), between <23-≤35 months old (28.1 %), of average size at birth (71.5 %), still breastfeeding (85.1 %) and belonged to OBC (44.4 %). Majority of the children had mothers who were not educated (53.3 %), with half of the mothers being unemployed (52.3 %) and residing in households with no toilet facility (72.6 %).

Data on morbidity revealed that majority of the children did not suffer from cough or fever two weeks prior to the survey (Table.4.1.8) and majority of the children were fully immunized with polio, Measles, DPT3 and BCG (Table.4.1.9).

Table.4.1. 7. Percentage association and determinants of underweight in children below five years based on selected socio-economic and demographic factors in Andhra Pradesh state during 1998/99

Background characteristic	Percentage UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild -UW	Mod -UW	Sev - UW			Estimate	Significance (RR)
Child characteristic								
Residence								
Urban	66.6	38.0	21.8	6.8	468(25.1)	DF=3	-0.221	0.238(-)
Rural	74.0	33.4	29.2	11.4	1401(75.0)	X^2=23.63	RC	
						P<.0001**		
Religion								
Hindu	72.9	34.9	27.2	10.7	1586(84.9)	DF=9	0.102	0.710(-)
Muslim	70.2	38.6	25.5	6.1	156(8.3)	X^2=15.454	0.219	0.557(-)
Christian	64.6	23.8	30.9	9.9	124(6.6)	P=0.0792	RC	
No religion	100.0	100	0.0	0.0	2(0.1)	(NS)		
Sex								
Male	69.1	33.9	26.3	8.9	941(50.3)	DF=3	-0.210	0.095(-)
Female	75.3	35.1	28.5	11.7	929(49.7)	X^2=11.245	RC	
						P=0.0105*		
Age								
0-6	42.7	31.7	9.2	1.7	350(18.7)	DF=15	**-2.650**	**0.001(14.15)**
>6 - ≤ 8	53.3	33.9	17.0	2.4	178(9.5)	X^2=348.235	**-1.935**	**0.0001(6.92)**
>8 - ≤ 11	68.3	31.4	32.0	4.3	142(7.6)	P<.0001**	**-1.191**	**0.0001(3.29)**
>11 - ≤ 17	81.7	39.0	31.8	11.0	388(20.8)		**-0.467**	**0.011(1.59)**
>17 - ≤ 23	89.7	41.5	33.3	14.9	286(15.3)		-0.073	0.710(-)
>23 - ≤ 35	82.6	30.4	35.0	17.2	526(28.1)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=69	NA	NA
Larger than AV	67.5	35.7	25.1	6.6	312(16.7)	X^2=44.404	**-1.718**	**0.032(5.57)**
Average (A V)	71.0	34.1	27.3	9.6	1335(71.5)	P<.0001**	**-1.573**	**0.046(4.82)**
Smaller than AV	84.8	34.8	30.5	19.5	208(11.2)		-0.760	0.346(-)
Very small	100.0	34.0	49.6	16.3	12(0.7)		RC	
Currently breastfeeding								
No	72.7	35.1	31.3	6.3	279(14.9)	DF=3	-0.290	0.277(-)
Yes	72.1	34.4	26.7	11.0	1591(85.1)	X^2=7.089	RC	
						P=0.0691		
						(NS)		
Caste								
SC	71.5	28.1	29.2	14.2	387(20.8)	DF=9	-2.719	0.060(-)
ST	76.7	31.0	38.3	7.5	113(6.0)	X^2=46.156	0.164	0.451(-)
OBC	74.5	35.4	26.6	12.5	827(44.4)	P<.0001**	-0.156	0.615(-)
NONE	68.2	38.5	24.9	4.8	537(28.8)		RC	
Maternal characteristics								
Education of mother								
No education	79.4	35.4	29.4	14.7	996(53.3)	DF=9	0.510	0.024(1.67)
Primary	68.8	34.4	28.6	5.9	442(23.7)	X^2=111.8006	0.199	0.376(-)
Secondary	70.9	36.7	25.3	9.0	136(7.3)		0.514	0.076(-)
Higher	53.3	30.8	19.9	2.6	296(15.8)	P<.0001**	RC	
Occupation								
Not working	64.8	35.2	23.8	5.8	1015(52.3)	DF=24	**-0.814**	**0.006(2.26)**
Professional	67.7	34.1	33.6	0.0	30(1.6)	X^2=142.351	-0.431	0.468(-)
Sales	83.5	24.3	42.1	17.1	24(1.3)	P<.0001**	-0.698	0.272(-)
Agric Self-Employed	83.0	40.9	29.1	12.9	206(11.0)		-0.579	0.085(-)
Agric Employed	79.8	30.4	31.6	17.9	402(21.5)		-0.331	0.276(-)
Household	86.2	43.2	29.2	13.7	14(0.7)		-0.019	0.980(-)
Service	100.0	100.	0.0	0.0	2(0.1)		-0.785	0.679(-)
Skilled -Manual	82.4	40.3	37.4	4.7	80(4.3)		-0.301	0.461(-)
Unskilled -Manual	83.3	26.3	26.3	30.6	99(5.3)		RC	
Toilet facility								
Flush	62.4	37.4	18.5	6.6	374(20.1)	DF=18	-0.097	0.665(-)
Pit-latrine	61.3	38.2	20.0	3.0	137(7.3)	X^2=94.313	-0.418	0.257(-)
Bush	75.9	33.4	30.5	12.0	1356(72.6)	P<.0001**	RC	
Others	NA	NA	NA	NA	NA			
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC= Not computed, NA=not available.								

Source: NFHS-2

4.1.3.2. Prevalence of underweight children below five years in Andhra Pradesh state during NFHS-2

The overall prevalence of underweight was 74.9 percent of which 36.5 percent of the children were mildly underweight, 29.0 percent were moderately underweight and 9.4 percent were severely underweight. DLHS- RCH 2002-2004 reported a much higher prevalence of severe underweight and lower prevalence of overall underweight among children of Andhra Pradesh (17.3 % and 59.6 %) respectively than the current study. However, the same report found similar prevalence as the current study in other states like overall underweight of 72.9 percent (Jharkand) and 9.3 percent severe underweight in Kerala (IIPS and MoHFW, 2006). Rao *et al*. (2015) reported a much lower prevalence of 42 percent among the chenchu tribal populations of Telangana and Andhra Pradesh regions as well as Anwar *et al*. (2013) in Varanasi (35.2 %).

4.1.3.3. Association of underweight and selected variables

4.1.3.3.1. Children characteristics

Results presented in Table.4.1.7 showed that there was a significant association between residence, sex, age, size at birth and caste with underweight prevalence in children below five years. NNMB (2002) did not find any significant difference between male and female children though male children had a slightly higher prevalence of underweight (91.4 % vs 90.8 %).

Residence was found significant to influence the prevalence of underweight in children with rural children having a higher prevalence of underweight than urban children (74.0 % vs 66.6 %) as seen in figure.4.1.4. NFHS-2 and NFHS-3 found similar results **(**IIPS and ORC Macro, 2000 and IIPS and Macro, 2007).

Figure.4.1.4 shows that female children were found to have a significantly higher prevalence of underweight than male children as represented by 75.3 percent and 69.1 percent respectively. A similar trend was also found in the severe degree of underweight between female and male children (Table.4.1.7). This can be attributed to boy's preference over girls and translates to food at plate with male children having the best of the meals and care and female children the last priority which is a common practice in Asia (Klasen, 2008). This is common in Indian society as female children are viewed as an economic burden to their families while male as a source of wealth. Similarly, Kandala *et al*. (2011) and Prasot *et al*. (2014) also reported higher prevalence of underweight among female children as compared to male children.

Underweight prevalence significantly increased with decrease in size of the child at birth. Smaller than average children and very small children (body weight >2.5kg) at birth had a prevalence of underweight >80 % and higher prevalence of severe underweight (Table.4.1.7). This is because low birth weight babies are prone to recurrent infections which interfere with nutrient absorption and in turn interfere with linear growth of the child. Hasnain and Hashmi (2009) reported a higher prevalence of underweight in low birth weight babies as compared to normal children just like the current study.

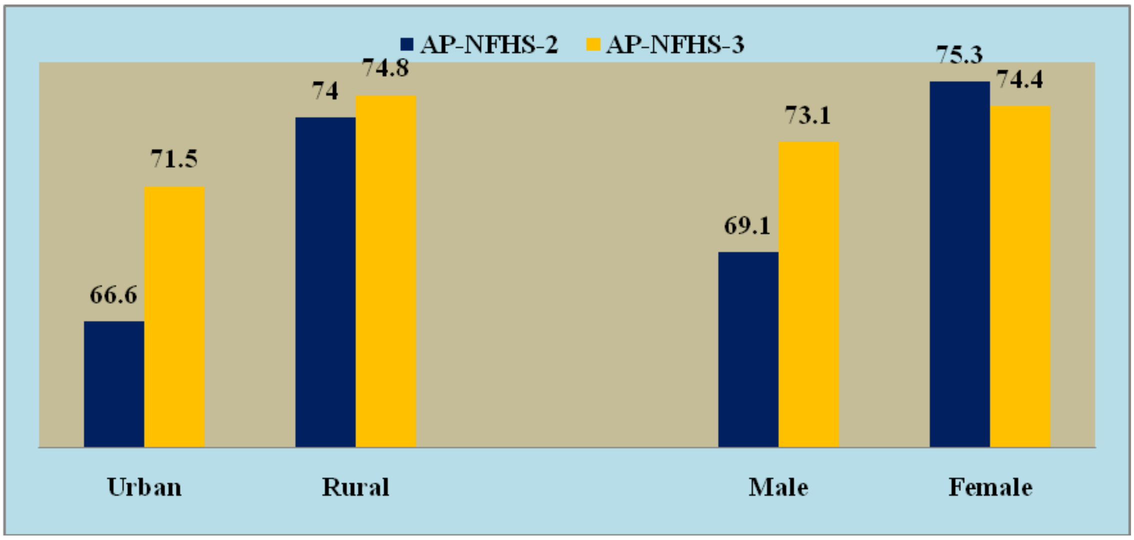

Figure.4.1. 4. Trends in underweight prevalence in children below five by residence and Gender in Andhra Pradesh during NFHS-2 and NFHS-3.

4.1.3.3.2. Maternal characteristics

A result presented in Table.4.1.7 showed that underweight in children was significantly associated with education of the mother, occupation and toilet facility in the household.

Children living in households with no toilet facilities were significantly more underweight (75.9 %) as compared to those in households with flush toilets (62.4 %) and pit latrines (61.3 %). Lack of a toilet facility increases unsanitary conditions as human waste is disposed off in the open (bushes). This in turn increases breeding of diseases causing vectors and when rains come, the waste is washed off to contaminate water sources which are at times used for household work hence increasing risk of recurrent infections in family members like diarrhoea which interfere with food consumption and nutrient absorption hindering proper growth. NNMB (2002) and IIPS and Macro (2007) stated that underweight was most prevalent in children living in households with no access to sanitary toilet facilities or those in households without any access to toilet facilities as these two conditions contribute greatly to unhygienic condition.

4.1.3.3.3. Morbidity

Results presented in Table.4.1.8 below showed that presence of cough two weeks prior to the survey was significantly associated with increased prevalence of underweight. However a similar trend of underweight prevalence was found in children who suffered from fever two weeks prior to the survey though it was not found to be significantly associated. Ujwala and Dhruv (2012) reported ill children to significantly be underweight as compared to their counterparts who are healthy.

Table.4.1. 8.Association and determinants of underweight in children below five years based on morbid conditions in Andhra Pradesh state during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No Yes	71.7 73.3	34.2 35.2	27.4 27.2	10.0 10.9	1329(71.1) 541(28.9)	DF=3 X^2=0.2995 P=0.9601(NS)	-0.481 RC	0.472(-)
Had cough								
No Yes	69.7 76.4	33.0 37.1	25.3 31.0	11.4 8.3	1180(63.1) 689(36.9)	DF=3 X^2=18.2232 P=0.0004**	-1.057 RC	0.098(-)
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mil-UW= Mild underweight, Mod-UW= moderate underweight, Sev-UW= severe underweight								

Source: NFHS-2

4.1.3.3.4. Immunization

Table.4.1. 9.Association and determinants of underweight in children below five years based on immunization status in Andhra Pradesh state during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No Yes DK	62.7 77.5 100.0	29.1 37.6 0.0	25.1 28.5 100.0	8.5 11.3 0.0	672(36.0) 1195(64.0) 2(0.1)	DF=12 X^2=97.3004 P<.0001**	-0.140 -0.341 RC	0.941(-) 0.857(-)
Received Measles								
No Yes DK	64.0 80.1 88.8	30.4 38.4 44.3	23.5 31.1 33.3	10.0 10.5 11.2	930(49.7) 921(49.3) 19(1.0)	DF=12 X^2=108.8028 P<.0001**	-0.673 -0.953 RC	0.388(-) -0.953(-)
Received BCG								
No Yes DK	72.5 72.1 100.0	28.5 35.3 51.0	29.3 27.1 49.0	14.7 9.7 0.0	221(11.8) 1644(88.0) 4(0.2)	DF=12 X^2=79.2134 P<.0001**	NC NC	NC NC
Received DPT3								
No Yes	63.2 76.5	30.3 36.5	23.4 29.2	9.4 10.7	603(32.3) 1266(67.7)	DF=9 X^2=74.0742 P<.0001**	**NC** **NC**	**NC** **NC**
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mil-UW= Mild underweight, Mod-UW= moderate underweight, Sev-UW= severe underweight.								

Source: NFHS-2

Immunization of the child was found to be significantly associated with prevalence of underweight in children. However, results in the Table.4.1.9 showed that immunized children had a higher prevalence of underweight as compared to children who were not immunized. This is contradictory to protective role that immunization is supposed to have on the child by reducing intensity of morbid conditions and recurrent infections in children as reported by Agarwal *et al*. (2014), Ray *et al*. (2000) and Bloss *et al.* (2004).

4.1.3.3.4. Determinant of underweight in children.

Results based on ordinal logistic regression found a significant correlation between underweight in children with age of the child, size at birth, education of the mother and mother's occupation only.

Age of the child was negatively correlated with severity of underweight prevalence. This indicates that younger children had a much lower chance of being underweight which can be due to the fact that at that infant stage most children are breast fed. However, Algur *et al.* (2012) reported higher prevalence of malnutrition in children 13-24 months as compared to other age groups.

Education was positively correlated with severity of underweight in children below five years of age. The prevalence of severe underweight increased by 51 percent among children with uneducated mothers. The RR of being underweight was 1.67 times higher in children with uneducated mothers as compared to their counterparts whose mothers attained higher education. This finding is backed up by findings in Ethiopian children where mothers incompetence due to lack of education was reported as a social risk factor (Amasalu and Tigabu, 2008). The DLHS-RCH survey of 2002-2004 found that in Andhra Pradesh, children of uneducated mothers were as twice at a higher risk of being underweight in comparison to their counterparts whose mothers attained 10 + years of schooling (IIPS and MoHFW, 2006).

Occupation of the mother was positively correlated with severity of underweight in children below five years of age. The RR of underweight prevalence was 2.26 times lower among children of unemployed mothers as compared to their counterparts who had working/ employed mothers. This result infers that however small, the income from a mother increases her autonomy and purchasing power however, it encroaches on the time a mother has to prepare healthy meals for her child hence end up purchasing calorie dense foods like ice creams and snacks that children desire which are inferior in nutrients required for healthy growth. However, Kikafunda *et al*. (1998) did not find occupation of the mother to significantly influence prevalence of underweight in Ugandan children.

4.1.4. Andhra Pradesh state (AP) 2005/06

4.1.4.1 Profile of children below five years in Andhra Pradesh state during NFHS-3.

From the state of Andhra Pradesh (pre-divided), data on approximately 2469 children below five years was included in the study. Out of these children, majority resided in rural part of the district (65.3 %), of Hindu religion (85.1 %), male (53.9 %), between >35-≤47 months, of average size at birth (40.3 %), belonging to OBC (49.9 %) with no toilet facilities in the household (54.2 %).

Table.4.1.11 and 4.1.12 show that majority of the children did not suffer from fever (90.0 %) or cough (84.9 %) and were immunized against polio, measles and DPT3.

4.1.4.2. Prevalence of underweight among children below five years in Andhra Pradesh state during NFHS-2

The overall prevalence of underweight in children below five years in AP state during this survey was 74.1 percent of which 38.4 percent were mildly underweight, 27.7 percent were moderately underweight and 8.1 percent were severely underweight. A similar prevalence of severe underweight was reported in Nagaland (8.2 %), Pondicherry (8.2 %) and Jammu and Kashmir (7.0 %) states of India with the prevalence of severe underweight being lower than what was reported in DLHS-RCH survey(17.3 %) in Andhra Pradesh state (IIPS and MoHFW, 2006). NFHS-3 reported similar prevalence of underweight in Meghalaya state (76.5 %), severe underweight in Delhi (8.7 %), Jammu and Kashmir (8.2) and slightly higher in Andhra Pradesh (9.9 %). In other states, the prevalence was higher that is 87.3 percent in Madhya Pradesh, 82.6

percent in Jharkand while much lower in other states with a prevalence of 36.2 percent in Tamil Nadu and 24.6 percent in Tripura (IIPS and Macro, 2007). Algur *et al.* (2012) reported lower prevalence as well among children of the same age.

Table.4.1. 10. percentage association and determinants of underweight in weight in children below 5 years based on selected socioeconomic and demographic factors in Andhra Pradesh State during 2005/06.

Background characteristic	Percent age of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild-UW	Mod -UW	Sev-UW			Estimate	Significance (RR)
Child characteristics								
Residence								
Urban Rural	71.5 74.8	38.0 33.6	26.4 30.4	7.0 10.9	856(34.7) 1613(65.3)	DF=3 X^2=17.777 P=0.0006**	**-0.154** **RC**	**0.046(1.17)**
Religion								
Hindu Muslim Christian Others	74.3 70.0 71.1 37.8	34.7 40.1 30.9 29.3	29.8 24.2 24.9 8.4	9.7 5.7 15.9 0.0	210(85.1) 263(10.7) 101(4.1) 3(0.1)	DF=15 X^2=22.0697 P=0.106(NS)	0.115 -0090 -0.382 RC	0.856(-) 0887(-) 0562(-)
Sex								
Male Female	73.1 74.4	36.0 34.1	28.5 29.5	8.5 10.5	1331(53.9) 1138(46.1)	DF=3 X^2=4.47 P=0.215(NS)	0.062 RC	0.408(-)
Age								
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35 >35 - ≤ 47 >47 - ≤ 59	35.3 59.7 67.0 74.5 77.9 74.3 77.8 82.1	26.5 31.9 33.3 39.5 32.0 30.7 37.4 39.9	6.2 18.4 25.4 27.9 34.1 32.5 32.6 30.1	2.5 9.4 8.4 7.1 11.8 11.1 7.9 12.1	148(6.0) 140(5.7) 114(4.6) 234(9.5) 242(9.8) 490(19.9) 552(22.4) 549(22.1))	DF=21 X^2=184.5977 P<.0001**	**-2.660** **-0.720** **-0.603** **-0.355** -0.239 -0.075 -0.058 RC	**<.0001(14.30)** **<.0001(2.05)** **0.002(1.83)** **0.015(1.43)** 0.114(-) 0.531(-) 0.630(-)
Size at birth								
Very large Larger than AV Average (AV) Smaller than AV Very small DK	69.6 72.7 74.7 78.6 90.3 80.3	32.9 34.5 36.2 35.0 38.8 47.7	31.9 26.7 29.1 33.2 37.0 32.3	4.9 11.4 9.4 10.4 14.5 0.3	341(13.8) 922(37.4) 992(40.3) 156(6.3) 31(1.3) 22(0.9)	DF=15 X^2=28.2234 P=0.0202*	-0.356 -0.209 -0.133 0.107 -0.050 RC	0.400(-) 0.614(-) 0.748(-) 0.810(-) 0.920(-)
Currently breastfeeding								
No Yes	75.4 72.5	40.0 31.7	28.5 29.4	7.0 11.4	1015(41.1) 1454(58.9)	DF=3 X^2=25.8157 P<.0001**	NC NC	NC NC
Caste								
SC ST OBC NONE	77.2 75.1 74.1 69.3	32.6 31.1 34.1 40.9	35.6 30.5 29.3 22.5	9.0 13.6 10.7 5.9	449(18.2) 221(9.0) 1231(49.9) 567(23.0)	DF=9 X^2=42.9026 P<.0001**	**0.353** 0.202 **0.285** RC	**0.002(0.70)** 0.185(-) **0.001(0.75)**
Child Anaemia								
Severe-Anaemia Moderate-Anaemia Mild-Anaemia Normal	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	0.641 **0.417** 0.158 RC	0.480(-) **0.015(0.66)** 0.101(-)
Maternal characteristics								
Education of mother								
No education Primary Secondary Higher	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	**0.953** **0.901** **0.658** **RC**	**<.0001(0.39)** **<.0001(0.41)** **<.0001(0.52)**
Occupation								
Not working Professional Clerical Sales Agric Employed Services Unskilled -Manual	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	**-0.289** **-0.653** -0.659 -0.387 0.112 0.023 RC	**0.044(1.34)** **0.009(1.92)** 0.2189(-) 0.287(-) 0.502(-) 0.929(-)
Toilet facility								
Flush Pit-latrine Bush Others Not dejure res	100.0 58.4 79.4 62.4 63.6	53.9 34.4 34.6 43.6 30.1	39.8 20.8 31.5 12.4 25.0	6.3 3.3 13.3 6.4 8.5	563(22.8) 59(2.4) 1337(54.2) 30(1.2) 219(8.9)	DF=27 X^2=115.3578 P<.0001**	**0.507** **0.819** **0.901** RC	**<.0001(0.60)** **0005(0.44)** **<.0001(0.41)**
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC= Not computed, NA=not available.								

4.1.4.3. Association of underweight and selected variables

4.1.4.3.1. Children characteristics

Results presented in Table.4.11.10 showed that there was a significant association between underweight in children with residence, age of the child, size at birth, breastfeeding and caste but not with religion and sex.

Age was found significant to influence prevalence of underweight in children below five years. The highest prevalence was in older children between >47-≤59 months old with an overall prevalence of 82.1 percent and severe underweight at 12.1 percent while the least prevalence was in the younger children 0-6 months old with a prevalence of 35.3 percent (figure.4.1.6). Mengistu *et al.* (2013) reported similar distribution of underweight prevalence based on age groups. However, this contradictory to reports by Kumar *et al.* (2006) and Hasnain and Hashmi (2009) who reported underweight prevalence as highest in the second year of life and decreased as the age of the child increased.

Prevalence and severity of underweight increased with decrease in size of the child at birth. Low birth weight children had the highest prevalence of underweight (90.3 %) as compared to their counterparts. This is because very small child are prone to morbid condition and minimal survival rate which interferes with normal growth. This can be attributed to poor antenatal care and use of services secondary to paucity of health services especially where majority occupy rural areas as seen in this study (Vella *et al*., 1992). These results are backed up by NNMB (2002).

Breastfeeding was also significant to influence the prevalence of underweight in children. Overall prevalence of underweight was higher in non- breastfeeding children (75.4 %) as compared to breastfeeding children (72.5 %). Gul and Kiramat (2012) reported underweight to be significantly higher among non- breastfed children (65 %) as compared to breastfed children (4 %). Caufield *et al*. (2004) stated that among Sudanese children, breastfeeding has a positive impact and had been encouraged in many countries to lessen the burden of malnourishment among children.

4.1.4.3.2. Maternal characteristics

Results based on chi-square found a significant association between child underweight and toilet facility in the household with children in households lacking toilet facilities (bush) presenting the highest prevalence of severe underweight (13.3 %)

compared to their counterparts from households with toilet facilities (Table.4.1.10). Poor sanitary environment has been associated with an increased spread of communicable diseases in children and adults as well (IIPS and Macro, 2007).

4.1.4.3.3. Morbidity.

Table.4.1. 11.Association and determinants of anaemia in children below five years based on morbid conditions in Andhra Pradesh state during 2005/06

Background	Percentage of U.W children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No	73.4	35.0	28.5	9.9	2222(90.0)	DF=6	**1.660**	**0.014(0.19)**
Yes	76.2	35.0	34.6	6.6	242(9.8)	X^2=15.6878	**1.563**	**0.024(0.21)**
DK	100.0	100.0	0.0	0.0	5(0.2)	P=0.0155*	**RC**	
Had cough								
No	74.0	34.5	29.0	10.5	2095(84.9)	DF=6	**2.953**	**0.010(0.05)**
Yes	71.6	38.4	28.0	4.2	372(15.1)	X^2=19.8317	**3.118**	**0.007(0.04)**
DK	100.0	100.0	0.0	0.0	3(0.1)	P=0.0003**	**RC**	
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mil-UW= Mild underweight, Mod-UW= moderate underweight, Sev-UW= severe underweight								

Source: NFHS-3

Results presented in Table.4.1.11 show there is a significant association between morbidity and prevalence of underweight in children below five years of age. Children with fever were more underweight as compared to their counterparts who never suffered from fever two weeks prior to the survey. This is because in presence of fever, there is increased body metabolism which results into rapid loss of lean body mass due to increased body temperatures. Santosh *et al.* (2013) reported a significant association between morbidity and underweight prevalence especially with ARI and diarrhoea just like the current study.

4.1.4.3.4. Immunization

Results presented in Table.4.1.12 showed that there was a significant association between underweight in children and immunization. Gul and Kiramat (2012) reported a significant association.

Table.4.1.12.Association and determinants of anaemia in children below five years based on immunization status in Andhra Pradesh state during 2005/06

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No	66.4	30.4	25.4	10.6	594(24.2)	DF=12	-0.376	0.366(-)
Yes	75.9	36.6	29.9	9.4	1846(75.0)	X^2=46.1374	-0.127	0.759(-)
DK	98.3	44.2	54.1	0.0	20(0.8)	P<.0001**	RC	
Received Measles								
No	66.6	29.9	27.9	8.8	786(32.0)	DF=12	**-0.321**	**<.0001(1.38)**
Yes	77.3	38.3	28.6	10.4	1519(61.8)	X^2=58.6056	**RC**	
DK	74.3	31.8	37.8	4.9	152(6.2)	P<.0001**		
Received DPT3								
No	73.5	34.9	27.0	11.6	974(39.5)	DF=12	**-0.968**	**0.009(2.63)**
Yes	73.4	35.3	29.9	8.1	1454(59.0)	X^2=27.652	**-0.813**	**0.030(2.25)**
DK	87.9	37.4	43.6	6.9	36(1.5)	P=0.0062**	**RC**	
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mil-UW= Mild underweight, Mod-UW= moderate underweight, Sev-UW= severe underweight								

4.1.4.3.5. Determinant of underweight in children.

Results based on ordinal logistic regression presented in Table.4.1.10, Table.4.1.11 and Table.4.1.12 below showed that there was a significant correlation between residence, ethnicity, toilet facility, occupation, fever, cough, education of mother, child anaemia, immunization and age of the child but not with sex, religion and breastfeeding.

Residence was negatively correlated with underweight prevalence in children. Urban children were at a 1.17 times lower RR of being anaemic as compared to rural children. This is because in rural areas, there is scarcity of modernised well equipped health facilities and urban areas have easily accessible health facilities with modern technology coupled with the availability of electricity supply to ease running of these technology especially in the private sector (Kamalapur and Reddy, 2013).

Age was positively correlated with severity of underweight prevalence in children below five years. This result infers underweight increased with increase in age of the child. Children 0-6 months were at 14.30 times lower RR of being underweight as compared to older children (>47-≤59) months. The NNMB technical report No.24 stated that underweight prevalence was lowest in children <6 months and increased with age in children >6 months just like the current study (NNMB, 2006).

Child anaemia was positively correlated with severity of underweight. Moderately anaemic children had a higher RR of 0.66 times of being underweight as compared to children with normal haemoglobin levels.

Ethnicity was positively correlated with severity of underweight in children. Underweight increased by 35.3 percent among children from SC and by 28.5 percent among children from OBC. The RR of being underweight was 0.70 times among children from SC and it was 0.75 times among children from OBC. This can be a result of low immunization status among the low social classes increasing risk of morbidity and hence malnutrition due recurrent infections. UNICEF (2001) stated that only 32 percent of the children from SC/ST were fully immunized compared to 49 percent of the children who belonged to other social classes.

An inverse relationship was observed between mother's education and severity of underweight. Among uneducated, the risk of underweight increased by 95.3 percent with a RR of 0.39 times. The RR was 0.41 times among children whose mothers attained primary education and secondary education (RR= 0.52 times) in comparison to children whose mothers attained higher education. Similar observation was seen in developed countries as well as developing countries with mother's education having a strong association with child malnutrition (de Benoist *et al*., 2008).

Occupation of the mother was negatively correlated with severity of underweight prevalence. Underweight decreased by 28.9 percent among children of non-working mothers with a RR of 1.34 times while the RR was 1.92 times among children of professional mothers in comparison to their counterparts whose mothers were skilled-manual labourers. This result indicates the protective role unemployment of a mother plays in reducing prevalence of underweight in children as the mothers have ample time spent with their children and are in a position to prepare them food as well as keep them in a clean surrounding free from disease causing vectors. Yeleswarapa and Nallapu (2012) reported that children of unemployed mothers weighed higher and stood taller as compared to children of employed mothers who spent less than one hour in day with their children while the unemployed spent three to four hours a day with their children.

Toilet facility was positively correlated with severity of underweight. The prevalence of severe underweight increased by 90.1 percent among children living in households without a toilet facility. The RR of being underweight was 0.60 times, 0.44 times and 0.41 times among children from households with flush toilets, pit latrines and those using bush method to dispose-off human waste in comparison to their counterparts using other methods to dispose-off human waste.

Morbidity was positively correlated with severity of underweight in children. Among morbid children, prevalence of severe underweight increased by almost 100 percent. The RR of being underweight was 0.21 times and 0.04 times among children who suffered from fever and cough two weeks prior to the survey respectively. Ahmed *et al.* (2012) reported that Bangladesh children with diarrhoea had 1.44 times odds of being underweight but other illnesses were not significantly associated.

Immunization was also negatively correlated with prevalence of underweight in children. The RR of being underweight was 1.38 times and 2.63 times among children who did not receive measles and DPT3 vaccine respectively by time of the survey. Ayaya *et al*. (2004) found that incomplete immunizations were a risk factor for the development of malnutrition and Iqbal *et al*. (1999) found that incomplete Bacille Calmette-Guerin (BCG) vaccination against tuberculosis (TB) increased the risk for the development of severe protein energy malnutrition (PEM) in Bangladesh.

4.1.4.3.7. Trends in prevalence of underweight in children between 1998-2006

Figure.4.1.5 below shows there was a slight decrease in prevalence of underweight over the years by 0.7 percent. Moderate and severe underweight decreased over the years but mild underweight increased by 1.9 percent. The minimal reduction can be attributed to failure of government initiatives to curb the threatening problem of malnutrition in the state. This can also be attributed to the poor performance of Angawandi centres in which supervision and monitoring is not effective, poor sanitation which remains a big problem with a high percentage of households lacking toilet facilities despite the improvement (Table.4.1.7 and Table.4.1.10).

Figure.4.1.4 also shows that underweight in children consistently increased in both urban and rural children, in male children but decreased slightly in female children over the years or between the two surveys. The slight decrease in female children can be attributed to the vigorous educational awareness created in the community about the value of girl child and government efforts to eliminate gender discrimination. However, the challenge still stands high in India.

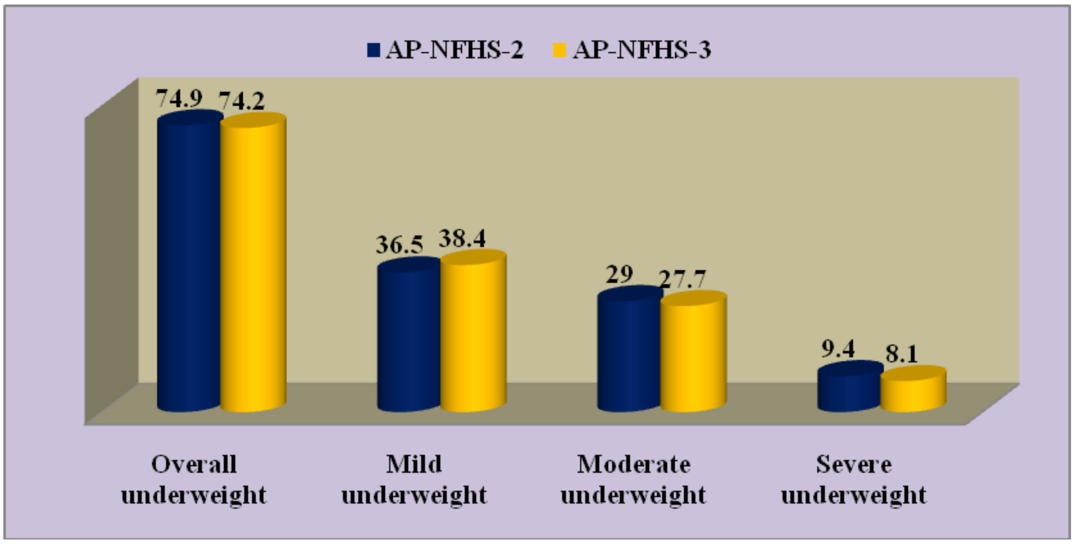

Figure.4.1. 5. Trends of underweight in Andhra Pradesh state during 1998- 2006

In both NFHS-2 and NFHS-3, age of the child, mother's education and occupation were predictor factors for underweight in children (Tables.4.1.7 and 4.1.10) but with variations in RR across the years. The RR decreased by 0.92 times and 1.28 times among children with non working and uneducated mothers respectively by NFHS-3 which partly explains the reduction in underweight over the years.

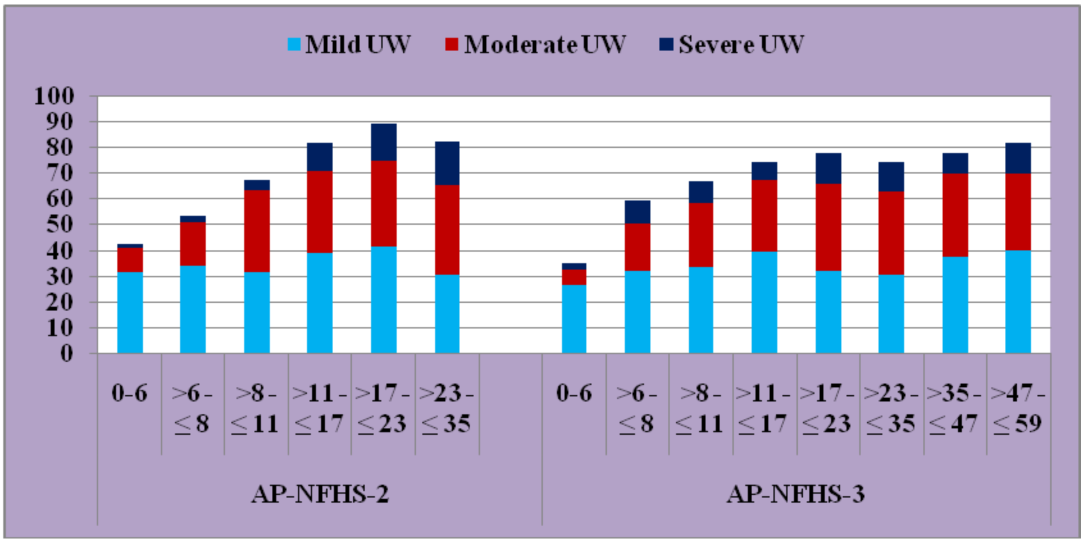

Figure.4.1. 6. Prevalence of underweight in Andhra Pradesh state by age during 1998- 2006

4.1.5. Akola district (NFHS-2) 1998/99

4.1.5.1 Profile of children below five years in Akola district during NFHS-2.

Data on approximately 49 children below five years was included in the study. Out of these children, majority resided in rural part of the district (61.3%), were of Hindu religion (95.7 %), female (59 %), between >23-≤ 35 months old, were of average size at birth (54.6 %), were still breastfeeding (74.0 %) and belonged to neither SC, ST or OBC sect groups. Majority of the children's mothers had attained higher education (44.2 %), were unemployed (58.1 %) and lived in households with flush toilet facilities.

Results presented in Table.4.1.13 showed that majority of the children did not suffer from fever (53.3 %) but half of them suffered from cough (50.0 %). Data on immunization also revealed that majority of the children had been immunized fully (Table.4.1.1).

4.1.5.2. Prevalence of underweight children below five years in Akola district during NFHS-2.

The overall prevalence of underweight was 83.7 percent of which 32.5 percent were mildly underweight, 48.3 percent were moderately underweight and 2.9 percent were severely underweight. Moderate underweight is the most prevalent degree of malnutrition in this study. A similar prevalence of underweight among children was reported in Rajasthan (86.5 %) and severe underweight in Arunchal Pradesh (2.9 %) states of India (IIPS and MoHFW, 2006). NFHS-3 reported similarly high prevalence in Bihar (80.0 %), Jharkand (82.6 %) and severe underweight in Sikkim (4.9 %) and 4.7

Table.4.1. 13. Percentage association and determinants of underweight in children below five years based on selected socio-economic and demographic factors in Akola district during 1998/99

Background characteristic	Percentage of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban	77.8	55.6	22.2	0.0	19(38.7)	DF=3	-0.860	0.332
Rural	84.8	15.2	62.1	7.4	30.61.3)	X^2=11.9489	RC	
						P=0.0076**		
Religion								
Hindu	81.0	32.2	44.3	4.8	47(95.7)	DF=3	0.860	0.783(-)
Muslim	NA	NA	NA	NA	NA	X^2=2.5435	NC	NC
Christians	NA	NA	NA	NA	NA	P=0.4675	NC	NC
Others	100.0	0.0	100.0	0.0	2(4.3)	(NS)	RC	
Sex								
Male	89.4	32.9	56.5	0.0	20(40.6)	DF=3	-0.354	0.637(-)
Female	77.0	29.4	39.9	7.7	29(59.4)	X^2=3.3262	RC	
						P=0.344 (NS)		
Age								
0-6	0.0	0.0	0.0	0.0	2(4.3)	DF=15	-1.544	0.446(-)
>6 - ≤ 8	100.0	100.0	0.0	0.0	4(8.6)	X^2=32.3934	-0.003	0.998(-)
>8 - ≤ 11	100.0	0.0	100.0	0.0	2(4.8)	P=0.0057**	3.224	0.310(-)
>11 - ≤ 17	68.5	33.4	35.1	0.0	7(13.6)		-0.364	0.665(-)
>17 - ≤ 23	100.0	33.3	50.1	16.7	14(27.3)		2.336	0.60(-)
>23 - ≤ 35	77.4	20.8	56.7	0.0	21(41.4)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=6	NC	NC
Larger than AV	78.7	59.6	19.1	0.0	11(22.5)	X^2=11.5614	NC	NC
Average (AV)	75.9	24.1	43.4	8.4	27(54.6)	P=0.0725	NC	NC
Smaller than AV	100.0	0.0	100.0	0.0	9(18.7)	(NS)	NC	NC
Very small	100.0	100.	0.0	0.0	2(4.3)		NC	NC
Currently breastfeeding								
No	66.0	49.5	16.5	0.0	13(26.0)	DF=3	-1.517	0.145(-)
Yes	87.7	24.3	57.3	6.2	37(74.0)	X^2=8.6891	RC	
						P=0.0337*		
Caste								
SC	100.0	0.0	100.0	0.0	2(10.0)	DF=6	1.745	0.441(-)
ST	100.0	100.0	0.0	0.0	2(4.7)	X^2=9.702	0.210	0.914(-)
OBC	74.3	23.0	51.3	0.0	9(20.5)	P=0.1377	0.269	0.799(-)
NONE	85.4	37.8	47.6	0.0	29(64.7)	(NS)	RC	
Maternal characteristics								
Education of mother								
No education	100.0	0.0	100.0	0.0	9(19.2)	DF=9	2.535	0.064(-)
Primary	100.0	48.6	51.4	0.0	9(18.2)	X^2=24.2366	0.980	0.372(-)
Secondary	49.7	23.3	26.0	0.0	9(8.4)	P=0.0039**	-0386	0.712(-)
Higher	80.6	40.0	30.3	10.3	22(44.2)		RC	
Occupation								
Not working	77.0	37.8	39.1	0.0	29(58.1)	DF=12	-1.934	0.435(-)
Professional	100.0	100.0	0.0	0.0	2(4.3)	X^2=21.7508	-1.400	0.408(-)
Agric Self-Employed	100.0	0.0	100.0	0.0	5(9.6)	P=0.0404*	-0.389	0.902(-)
Agric Employed	80.4	19.6	41.2	19.6	12(23.3)		-1.415	0.630(-)
Skilled -Manual	100.0	0.0	100.0	0.0	2(4.8)		RC	
Toilet facility								
Flush	68.8	45.6	23.2	0.0	29(57.6)	DF=3	-1.625	0.052(-)
Pit-latrine	NA	NA	NA	NA	NA	X^2=22.3242	NA	NA
Bush	100.0	10.8	78.5	10.8	21(42.4)	P<.0001**	RC	
Others	NA	NA	NA	NA	NA		NA	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC= Not computed, NA=not available								

Source: NFHS-2

percent in Manipur (IIPS and Macro, 2006). In Mysore, a very low prevalence (21.5 %) was reported (Santosh *et al.*, 2013).

4.1.5.3. Association of underweight and selected variables

4.1.5.3.1. Children characteristics

Results presented in Table.4.1.13 showed that there was a significant association between prevalence of underweight in children with residence, age, size at birth and breastfeeding status but not with religion, sex and caste.

Study results presented in Table.4.1.13 revealed that all children between >17-≤ 23 months were underweight and the only ones with an association to severe underweight as compared to their counterparts in other age brackets (Figure.4.1.9). Ergin *et al*. (2007) did not find age to be significantly associated with underweight prevalence in children below five years in Turkey.

Also, children who were still breastfeeding by the time of the survey were more underweight as compared to those who were not breastfeeding. This is because majority of the children (68.7 %) were above two years of age. At that stage, breast milk cannot provide the required calories a child needs to cater for their rapid growth and increased activity. Inadequate nutrition during the initial two years of life is an important preventable risk factor of childhood morbidity and mortality (Penny *et al*., 2005). Unavailability of food is not the sole cause of malnutrition. Feeding practices in a community (Memon *et al.,* 2010), lack of awareness and knowledge about age-appropriate food items, food quantity and frequency also contribute significantly to poor nutritional status of a child. Hence, delayed or inadequate weaning has been positively associated with severe malnutrition (Badar, 2007 and Jamro *et al*., 2012).

4.1.5.3.2. Maternal characteristics

Education of the mother, occupation and toilet facility in the household were significantly associated with prevalence of underweight in children below five years of age. Children whose mother's attained higher education had a higher association with severe underweight compared to other children of less educated mothers. Imdad *et al.* (2011) pooled analysis and systemic review of the impact of maternal education on complementary feeding in developing countries showed a mean weight gain of 300±260 g and a mean length gain of 0.49±0.5 cm. However, the maximum impact of maternal education on infant's mean weight gain of 940 and 570 g respectively were shown by Guldan *et al*. (2000) in china and Roy *et al.* (2005) in Bangladesh after a follow study on nutrition education and breastfeeding practices, complementary and weaning foods. .

4.1.5.3.3. Morbidity

Results presented in Table.4.1.14 below showed that there was a significant association between morbidity and prevalence of underweight in children. Children who suffered from cough and fever two weeks prior to the survey had a very high prevalence of underweight as represented by 90.9 percent and 90.2 percent respectively. Sarpong *et al.* (2015) and Kikafunda *et al.* (1998) similarly reported a significantly higher prevalence of underweight in children with poor health status.

Table.4.1.14.Association and determinants of underweight in children below five years based on morbid conditions in Akola district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild -UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No Yes	74.9 90.2	49.3 9.8	17.0 80.5	8.6 0.0	26(53.3) 23(46.7)	DF=3 X^2=20.4989 P=0.0001**	**-4.059** **RC**	**0.010(57.92)**
Had cough								
No Yes	73.2 90.9	35.4 26.3	28.7 64.6	9.1 0.0	25(50.0) 25(50.0)	DF=3 X^2=8.1612 P=0.0428*	1.375 RC	0.193(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight.								

Source: NFHS-2

4.1.5.3.4. Immunization

Results presented in Table.4.1.15 below showed that there was no significant association between prevalence of underweight and immunization status in children.. However, Sarpong *et al.* (2015) and NNMB (2006) reported underweight prevalence to be significantly associated with immunization status in children below five with unimmunized children being at higher risk of underweight.

Table.4.1. 15.Association and determinants of underweight in children below five years based on immunization status in Akola district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No Yes	66.1 87.9	32.1 30.4	33.9 51.3	0.0 6.2	13(26.8) 36(73.2)	DF=6 X^2=8.6219 P=0.196(NS)	-0.028 RC	0.985(-)
Received Measles								
No Yes	83.6 81.5	49.1 24.3	34.6 51.0	0.0 6.2	13(26.3) 37(60.1)	DF=6 X^2=10.503 P=0.105(NS)	-0.936 RC	0.440(-)
Received BCG								
No Yes	100.0 81.2	0.0 32.3	100.0 44.1	0.0 4.8	2(4.6) 47(95.4)	DF=6 X^2=5.4508 P=0.487(NS)	.-1.583 RC	0.463(-)
Received DPT3								
No Yes	75.0 83.5	50.0 26.8	25.0 51.2	0.0 5.5	9(17.2) 41(82.8)	DF=6 X^2=7.4274 P=0.2831(NS	0.390 RC	0.816(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight.								

Source: NFHS-2

4.1.4.3.5. Determinant of underweight in children.

These results are based on ordinal logistic regression and are presented in Table.4.1.13, Table.4.1.14 and Table.4.1.15. They showed that the studied variables were not significantly correlated with underweight in children below five years except for fever (p>0.05). Education of the mother (p=0.064) and toilet facility (p=0.052) was slightly significant in influencing underweight prevalence in children.

Fever was negatively correlated with severity of underweight. Among children who did not suffer from fever two weeks prior to the survey, the RR of being severely underweight was 57.92 times lower as compared to children who suffered from fever two week prior to the survey. This is because fever is a symptom of presence of an illness and in moments of fever, there is increased metabolism leading to loss of lean body mass and dehydration. Sarpong *et al.* (2015) found a correlation between underweight and fever with presence of fever increasing the risk of underweight in children just like in the current study.

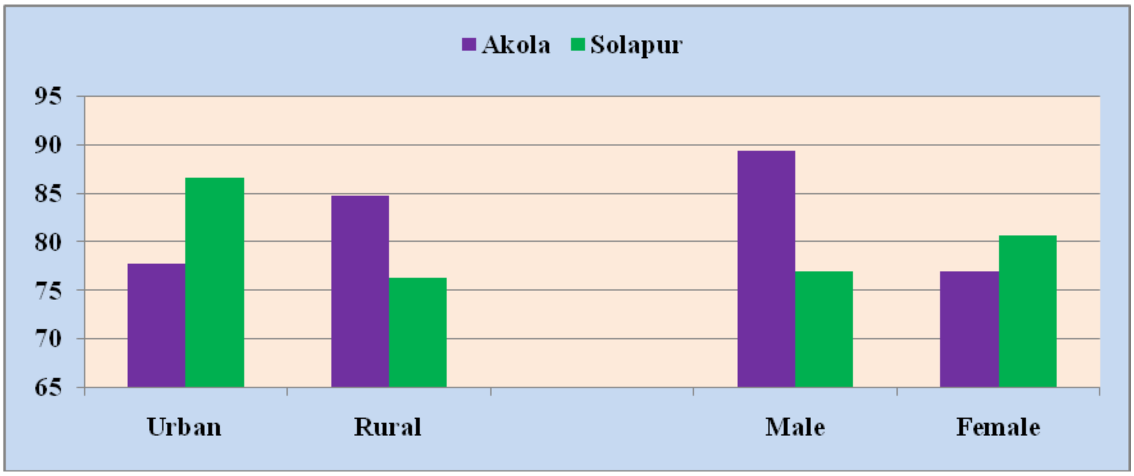

Figure.4.1.7.Prevalence of underweight by residence and gender in Akola and Solapur districts during 1998/99 survey.

4.1.6. Solapur district (NFHS-2)1998/99

4.1.6.1. Profile of children below five years in Solapur district during NFHS-2

Data on approximately 119 children below five years was included in the study. Majority of the children resided in rural part of the district (73.1%), were of Hindu religion (89.8%), female (59.7 %), between >23-≤35 months old (25.9%), were of average size at birth (57.7%), still breastfeeding (88.7%) and belonged to other caste groups. More than half of the children’s mothers were educated at different levels (Table.4.1.16), were not working (58.7 %) and lived in households with no toilet facilities (83.8%).

Table.4.1. 16. Percentage association and determinants of underweight in children below five years based on selected socio-economic and demographic factors in Solapur district during 1998/99

Background characteristic	Percent age of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Child characteristics								
Residence								
Urban Rural	86.7 76.4	13.3 24.5	60.0 35.7	13.3 16.1	32(27.0) 87(73.1)	DF=3 X^2=5.9356 P=0.1148(NS)	0.696 RC	0.224(-)
Religion								
Hindu Muslim Christian Others	79.1 75.0 NA 100.0	23.9 0.0 NA 0.0	42.5 25.0 NA 100.0	12.6 49.9 NA 0.0	107(89.8) 10(8.2) NA 2(2.0)	DF=6 X^2=14.5549 P=0.024*	-1.437 0.255 NA RC	0.479(-) 0.910(-)
Sex								
Male Female	77.0 80.7	24.2 19.7	43.3 41.6	9.5 19.4	48(40.3) 71(59.7)	DF=3 X^2=2.2983 P=0.5129(NS)	-0.551 RC	0.309(-)
Age								
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35	32.0 66.6 80.4 100.0 85.8 93.2	16.0 23.1 19.4 43.1 8.1 28.5	16.0 31.9 60.9 56.9 56.4 35.3	0.0 11.6 0.0 0.0 21.4 29.4	14(11.3) 21(17.7) 11(9.3) 11(9.5) 30(25.4) 32(26.9)	DF=15 X^2=44.578 P<.0001**	**-2.843** -1.286 -0.848 -0.607 -0.269 RC	**0.006(17.7)** 0.112(-) 0.386(-) 0.532(-) 0.710(-)
Size at birth								
Very large Larger than AV Average (AV) Smaller than AV Very small	NA 43.9 80.3 100.0 100.0	NA 10.6 27.1 10.4 34.6	NA 33.3 46.6 39.6 34.6	NA 0.0 6.7 50.0 30.8	NA 20(16.9) 69(57.7) 23(19.5) 7(5.9)	DF=9 X^2=48.7985 P<.0001**	NA -1.455 -0.130 2.461 RC	NA 0.322(-) 0.924(-) 0.106(-)
Currently breastfeeding								
No Yes	68.0 80.6	18.0 21.9	34.1 43.3	15.9 15.3	13(11.3) 106(88.7)	DF=3 X^2=1.2417 P=0.743(NS)	-0.951 RC	0.287(-)
Caste								
SC ST OBC NONE	85.3 75.2 78.2 79.6	42.6 9.3 21.7 20.9	42.6 57.7 33.3 38.4	0.0 8.2 23.1 20.3	16(13.8) 26(21.8) 21(17.7) 56(46.7)	DF=9 X^2=12.871 P=0.1685(NS)	-0.432 0.239 0.244 RC	0.608(-) 0717(-) 0.735(-)
Maternal characteristics								
Education of mother								
No education Primary Secondary Higher	84.6 82.3 66.4 100.0	28.0 0.0 27.4 0.0	36.0 64.8 32.7 100.0	20.6 17.6 6.3 0.0	58(48.5) 25(20.6) 34(28.9) 2(2.0)	DF=9 X^2=21.0833 P=0.0123*	-0.659 -0.282 -1.759 RC	0.731(-) 0.885(-) 0.368(-)
Occupation								
Not working Agric S-E Agric E	74.2 67.3 93.8	13.0 50.0 26.9	48.4 17.3 40.0	12.7 0.0 26.9	70(58.7) 14(11.8) 35(29.5)	DF=6 X^2=21.8087 P=0.0013*	-1.088 **-1.866** RC	0.114(-) **0.05(6.46)**
Toilet facility								
Flush Pit-latrine Bush Others	100.0 NA 75.1 NA	0.0 NA 25.6 NA	77.8 NA 35.4 NA	22.2 NA 14.1 NA	19(16.2) NA 100(83.8) NA	DF=3 X^2=17.2758 P=0.0006**	1.770 RC	0.018(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, RC= reference category, NA=not available								

Source: NFHS-2

Data on child morbidity presented in Table.4.1.17 showed that majority of the children did not suffer from either fever (76.1%) or cough (77.6 %) two weeks prior to the survey. Also majority of the children were fully immunized by the time of the survey (Table.4.1.18) though immunization coverage against measles was still low with almost 43.6 percent of the children not being immunized against measles which is one of the six killer diseases in children below fives of age. Also Sharma (2003) shows that measles is most commonly missed vaccination in Haryana as compared to other vaccines with only 72 percent of the children immunized against measles.

4.1.6.2. Prevalence of underweight in children below five years in Solapur district during NFHS-2

The overall prevalence of underweight in children below five years was 79.2 percent of which 19.8 percent were mildly underweight, 44.2 percent were moderately underweight and 15.2 percent were severely underweight. This result shows that moderate underweight was the most prevalent degree of underweight in children. Other national surveys have reported similar prevalence in children underweight. IIPS and MoHFW (2006) reported a prevalence of 78.4 percent underweight in states of Uttar Pradesh and Uttaranchal each and severe underweight in Orissa (15.2 %), Gujarat (15.4 %) and Maharashtra (15.0 %) during the DLHS-RCH survey of 2002-2004. During NFHS-2, a similar prevalence of overall underweight was reported in Bihar (79.9 %), Madhya Pradesh (79.4 %) and severe underweight in Gujarat (16.2 %) states of India (IIPS and ORC Macro, 2000). Other smaller studies have reported mixed findings of 46.4 % in Madhya Pradesh (Shahjada *et al.,* 2014) and 45.5 percent in Visakhapatnam, Andhra Pradesh (Ujwala and Dhruv, 2012) underweight prevalence.

4.1.6.3. Association of underweight and selected variables

4.1.6.3.1. Children characteristics

Underweight prevalence in children was significantly associated with religion, age and size at birth but not with residence, sex, breastfeeding and caste.

Religion was found significant to influence prevalence of underweight in children with overall prevalence of underweight being highest among Hindu children (79.1 %) while severe underweight was most prevalent among Muslim children (49.9 %). Similar results were reported in DLHS-RCH survey of 2002-2004 (IIPS and MoHFW, 2006) but NFHS-2 found Muslim and Hindu children to equally be underweight with higher prevalence compared to other religions (IIPS and ORC Macro, 2000).

According to results presented in Table.4.1.16, all children born with a weight below average were underweight. These children also recorded very high prevalence of severe underweight. Motta *et al*. (2005) and Hein and Kam (2008) also reported a significant influence low birth weight has on underweight in children compared to those who had birth weight >2.5 g.

4.1.6.3.2. Maternal characteristics

Results presented in Table.4.1.16 showed a significant association between prevalence of underweight and mother's education, occupation and toilet facility in the household. Also children of unemployed mothers had lower prevalence of underweight (74.2 %) as compared to their counterparts with mothers employed in the agriculture sector (93.8 %). Similar to the current findings, Popkin (1980) and Aaby *et al*. (1999) stated that mothers of most malnourished children worked outside their homes. However, Ergin *et al.* (2007) found no significant association between mothers' education, occupation and sanitary conditions with prevalence of underweight in children.

4.1.6.3.3. Morbidity

Results presented in Table.4.1.17 below showed that there was no significant correlation between prevalence of underweight and morbidity in children. This result is in conformity with the findings of Ergin *et al.* (2007) and Ahmed *et al.* (2012).

Table.4.1. 17.Association and determinants of underweight in children below five years based on morbid conditions in Solapur district during 1998/99

Background	Percentage of children who are UW	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild -UW	Mod -UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No Yes	80.1 75.7	25.4 8.1	39.6 51.5	15.2 16.1	92(77.6) 27(22.4)	DF=3 X^2=3.756 P=0.289(NS)	-0.084 RC	0.922(-)
Had cough								
No Yes	79.7 77.3	20.8 23.6	43.4 38.6	15.5 15.1	91(76.1) 28(23.9)	DF=3 X^2=0.2611 P=0.9672 (NS)	-0.139 RC	0.872(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight.								

Source: NFHS-2

4.1.6.3.4. Immunization

Results presented in Table.4.1.18 below showed that there was a significant association between underweight prevalence in children and immunization with DPT3 and measles but not polio and BCG. The results are not in line with findings which report immunization to have a protective effect on prevalence of underweight by preventing recurrent infections and hospitalisation as immunized children were more underweight (Semba *et al.* 2007 and Chowdhury *et al*. 2006).

Table.4.1. 18.Association and determinants of underweight in children below five years based on immunization status in Solapur district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No Yes	70.5 83.5	23.1 20.1	29.3 48.5	18.2 14.1	39(32.3) 81(67.7)	DF=6 X^2=8.508 P=0.2032(NS)	-1.180 RC	0.251(-)
Received Measles								
No Yes	64.7 90.4	13.5 27.7	42.4 42.2	8.8 20.5	52(436) 67(56.4)	DF=9 X^2=28.062 P=0.0009**	-1.032 RC	0.120(-)
Received BCG								
No Yes	66.0 80.8	16.0 22.2	31.9 43.6	18.1 15.0	13(11.3) 106(88.7)	DF=9 X^2=2.8152 P=0.9712(NS)	-0.942 RC	0.402(-)
Received DPT3								
No Yes	66.6 82.9	16.7 22.9	24.5 47.6	25.4 12.4	28(23.1) 92(76.9)	DF=9 X^2=14.6512 P=0.0232*	2.100 RC	0.130(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight..								

Source: NFHS-2

4.1.4.3.5. Determinant of underweight in children below five years in Solapur district during NFHS-2.

Results based on ordinal logistic regression analysis showed that among all the risk factors examined, only agriculture self employment, age bracket 0-6 months and moderately anaemic children were significantly correlated to prevalence of underweight in children. Hasnain and Hashmi (2009) did not find gender and age of the child to predict occurrence of underweight in Pakistani children. Sharma (2003) also found underweight to be more prevalent in older children as compared to younger ones which can be attributed to to protective effect of breastfeeding in younger children as has been reported in most states with an improvement in earlier initiation of breastfeeding within the hour after birth, longer months of breast feeding and adoption of exclusive breastfeeding in children (IIPS and Macro, 2007) during NFHS-3.

4.1.3.6. Comparison between Akola and Solapur districts.

Figure.4.1.8 below shows that overall prevalence of underweight was higher in Akola district children by 4.5 percent. However, severe underweight was most prevalent in children of Solapur district by 12.3 percent. The higher prevalence of severe underweight in Solapur district children could be due poor social economic status of the households in which they live which is evidenced by the high percent of households with no toilet facilities (83.8 %) and uneducated mothers (48.5 %)

Age wise prevalence between the two districts shows that between >6 - ≤ 8 months, the age at which complementary feeding is initiated, children in Akola district fared better on anthropometric indices as all were mildly underweight while children in Solapur of the same age had all grades of underweight from mild to severe (Figure.4.1.9). This result can only mean, that the supplementation with complementary foods and other weaning and child feeding practices are not practiced correctly in Solapur district. Probably the foods are not well balanced and inferior with nutrients required for optimal growth like first class proteins, micronutrients like iron and vitamin A, E and C among many. A study in India, reported delayed initiation of breastfeeding, improper complementary feeding as significant risk factors of underweight in children (Kumar *et al*., 2006).

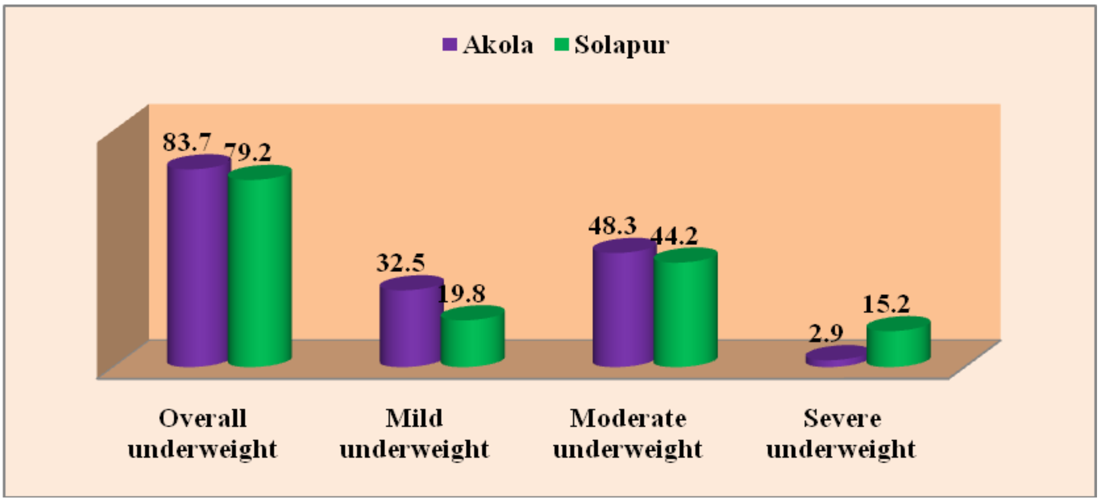

Figure.4.1. 8.Prevalence of underweight in Akola and Solapur districts during 1998/99 survey.

In Akola district, uderweight was most prevalent among rural and male children while in Solapur district, underweight was higher in urban and female children (Figure.4.1.7). This result could mean that sex preference is very high in solapur district hence endangering the female children through discrimination which could be by short periods of breastfeeding female children in an attempt to conceive with hope of a male child (Sharma, 2003).

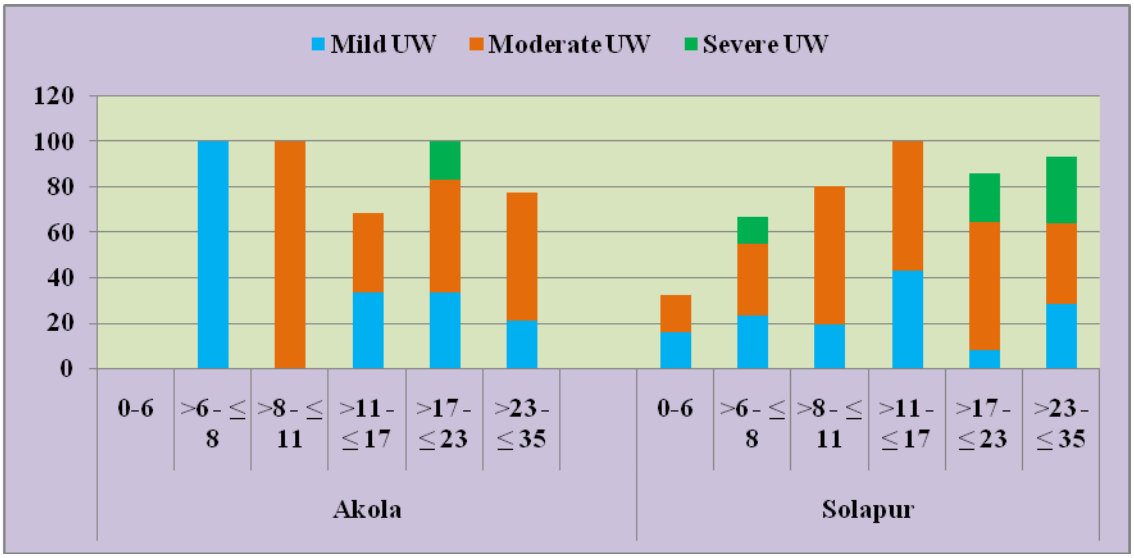

Figure.4.1. 9.Prevalence of underweight by Age in Akola and Solapur districts during 1998/99 survey.

4.1.7. Maharashtra state (MH) 1998/99

4.1.7.1 Profile of children below five years in Maharashtra state during 1998-99 (NFHS-2) survey.

Data on approximately 2521 children below five years was included in the study. Out of these children, the larger majority resided in rural part of the state (60.6 %), were of Hindu religion (76.5 %), male (52.6 %), between >23-≤35 months old (31.2 %), of average size at birth (63.0 %), were still breastfeeding by the time of the survey (81.9 %) and belonged to different caste other than SC, ST and OBC (54.5 %). Over 60.8 percent of the children had educated mothers at different levels (Table.4.1.19). Most of the children's mothers were not employed (54.9 %) and lived in households with no toilet facilities (59.6 %).

Data on morbidity presented in Table.4.1.20 showed that majority of the children did not suffer from either fever or cough two weeks prior to the survey and majority were immunized fully (Table.4.1.21).

4.1.7.2. Prevalence of underweight children below five years in Maharashtra state during 1998-99 (NFHS-2) survey.

The overall prevalence of underweight among children below five years was 75.5 percent of which 28.0 percent were mildly underweight, 31.3 percent were moderately underweight and 16.2 percent were severely underweight. This prevalence is much higher than the prevalence of underweight reported in NFHS-2 for Maharashtra state (67.2 %) but the prevalence of severe underweight is slightly lower than what was reported (17.6 %). In NFHS-2 however, a similar prevalence was reported in Orrisa

Table.4.1. 19. Percentage association and determinants of underweight in children below five years based on selected socio-economic and demographic factors in Maharashtra state during 1998/99

Background characteristic	Percentage of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban	76.0	31.9	33.2	10.9	992(394)	DF=3	**-0.563**	**<.0001(0.57)**
Rural	81.3	28.1	31.1	22.1	1529(60.0)	X^2=54.827	**RC**	
						P<.0001**		
Religion								
Hindu	79.9	28.5	31.9	19.5	1930(76.5)	DF=21	0.262	0.142(-)
Muslim	79.2	34.0	31.6	13.6	359(14.2)	X^2=77.445	0.133	0.504(-)
Christian	64.7	30.8	17.5	16.5	41(1.6)	P<.0001**	-0384	0.291(-)
Others	74.3	32.2	35.8	6.3	176(7.0)		RC	
No religion	100.0	0.0	100	0.0	2(0.9)			
DK	83.3	33.6	32.5	7.2	14(0.6)			
Sex								
Male	79.3	30.0	32.4	16.9	1326(52.6)	DF=3	-0.015	0.867(-)
Female	79.2	29.1	31.5	18.9	1195(47.4)	X^2=3.504	RC	
						P=0.3202(NS)		
Age								
0-6	40.4	34.1	5.0	1.2	370(14.7)	DF=15	**-2.411**	**<.0001(11.15)**
>6 - ≤ 8	64.4	36.0	20.1	8.4	241(9.6)	X^2=627.207	**-1.505**	**<.0001(4.50)**
>8 - ≤ 11	85.2	37.6	35.7	11.9	237(9.4)	P<.0001**	**-0.512**	**0.002(1.67)**
>11 - ≤ 17	87.5	26.4	40.7	20.5	376(14.9)		-0.073	0.616(-)
>17 - ≤ 23	90.1	24.4	41.0	24.7	510(20.2)		0.080	0.548(-)
>23 - ≤ 35	89.2	28.0	37.1	24.1	787(31.2)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=9	NA	NA
Larger than AV	68.3	31.8	25.0	11.5	371(14.7)	X^2=91.736	**-1.050**	**<.0001(2.86)**
Average (AV)	78.7	29.5	33.4	15.8	1587(63.0)	P<.0001**	**-0.515**	**0.014(1.67)**
Smaller than AV	88.0	26.0	34.3	27.7	410(16.3)		0.151	0.514(-)
Very small	87.1	34.8	27.7	24.6	153(6.1)		RC	
Currently breastfeeding								
No	83.6	34.0	35.7	13.8	457(18.1)	DF=3	**-0.580**	**<.0001(1.79)**
Yes	78.3	28.6	31.1	18.5	2064(81.9)	X^2=15.815	**RC**	
						P=0.0012**		
Caste								
SC	80.2	28.9	36.1	15.2	342(13.7)	DF=9	0.236	0.097(-)
ST	89.0	23.6	30.0	35.3	280(11.2)	X^2=90.309	**0.999**	**<.0001(0.37)**
OBC	81.9	33.7	34.3	13.9	517(20.6)	P<.0001**	0.184	0.184(-)
NONE	75.9	29.5	30.6	15.8	1366(54.5)		RC	
Child Anaemia								
Severe- A	NC	-	-	-	-	-	**1.935**	**0.004(0.14)**
Moderate-A	NC	-	-	-	-	-	**0.899**	**<.0001(0.35)**
Mild- A	NC	-	-	-	-	-	**0.471**	**<.0001(0.60)**
Normal	NC	-	-	-	-	-	**RC**	
Maternal characteristics								
Education of mother								
No education	84.4	27.1	32.2	25.1	988(39.2)	DF=9	**1.092**	**<.0001(0.34)**
Primary	82.0	28.6	37.0	16.3	668(26.5)	X^2=131.317	**0.899**	**<.0001(0.41)**
Secondary	75.6	35.3	25.8	14.5	369(14.6)	P<.0001**	**0.471**	**0002(0.62)**
Higher	67.9	31.6	29.2	7.0	497(19.7)		**RC**	
Occupation								
Not working	74.6	30.6	30.3	13.7	1384(54.9)	DF=30	**-1.276**	**<.0001(3.58)**
Professional	80.5	34.5	32.9	13.1	50(2.0)	X^2=128.581	**-1.173**	**0.011(3.23)**
Clerical	19.0	19.0	0.0	0.0	3(0.1)	P<.0001**	**-3.934**	**0.001(51.11)**
Sales	80.7	19.3	61.4	0.0	17(0.7)		-0.751	0.233(-)
Agric S-E	85.5	30.6	35.9	19.0	453(18.0)		-0.666	0.052(-)
Agric E	86.1	28.4	28.7	29.1	411(16.3)		-0.417	0.228(-)
Household	83.0	31.6	31.1	20.4	23(0.9)		-0.459	0.380(-)
Service	74.3	61.8	12.5	0.0	4(0.2)		**-2.050**	**0.021(7.77)**
Skilled -M	81.3	24.9	42.3	14.1	109(4.3)		**-0.790**	**0.043(2.20)**
Unskilled -M	87.0	13.7	37.2	36.1	68(2.7)		RC	
Toilet facility								
Flush	74.2	34.1	29.2	10.9	913(36.2)	DF=21	-1.445	0.265(-)
Pit-latrine	75.3	30.9	28.5	15.8	100(4.0)	X^2=118.753	-1.162	0.379(-)
Bush	82.4	26.7	33.9	21.8	1503(59.6)	P<.0001**	-0.748	0.564(-)
Others	NA	NA	NA	NA	NA		RC	

*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, RC= reference category, NA=not available

state (75.1 %) and severe underweight in Gujarat (16.2 %) and West Bengal (16.3 %) but very low prevalence in Kerala (31.6 %) and Arunachal Pradesh (32.1 %) states of India (IIPS and ORC Macro, 2000). A similar prevalence of severe underweight was reported in Tamil Nadu (16.6 %) and Maharashtra states (15.0 %) during the DLHS-RCH survey of 2002-2004 (IIPS and Mo HFW, 2006). A study from Pakistan reported a prevalence of 54.3 percent underweight among children (Hasnain and Hashmi, 2009) which was lower than that of the current study. This could be due to use of different measurement methods i.e IAP, NCHS and WHO growth standards in addition to difference in sample size and study variables.

4.1.7.3. Association of underweight and selected variables

Results in this section are based on chi-square to find association between underweight and selected factors/variables in children.

4.1.7.3.1. Children characteristics

Results presented in Table.4.1.19 showed that there was a significant association between prevalence of underweight among children below five years of age with residence, religion, age, size at birth, breastfeeding status and caste but not with sex of the child.

Figure.4.1.10 shows that rural children had a higher prevalence of underweight (81.3 %) as compared to their urban counterparts (76.0 %). This could be due to the cultural ties that are strongly obeyed in rural communities. In rural areas, food taboos greatly influence the type of weaning diet a child is placed on. Tumwine and Barugahare (2002) in Uganda and NNMB (2006) in India reported similar findings with higher prevalence of underweight among rural children.

4.1.7.3.2. Maternal characteristics

A significant association was found between prevalence of underweight in children and education of mother, occupation and toilet facility in the household.

An inverse relationship was found with prevalence of underweight decreasing with increase in educational level of the children's mothers from 84.4 percent among children with uneducated mothers to 67 percent among children with mothers who attained higher education. Findings are backed up by Rahim *et al.* (2013) and Abubkar *et al*. (2012) and national surveys (IIPS and ORC Macro, 2000 and NNMB, 2006).

4.1.7.3.3. Morbidity

Table.4.1. 20.Association and determinants of underweight in children below five years based on morbid conditions in Maharashtra state during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild -UW	Mod -UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No	76.6	30.1	30.2	16.3	1563(62.0)	DF=6	-0.152	0.154(-)
Yes	83.6	28.8	34.8	20.0	957(38.0)	X^2=25.06211	-0.580	0.160(-)
DK	0.0	0.0	0.0	0.0	1(0.02)	P=0.0003**	RC	
Had cough								
No	76.8	29.8	29.7	17.3	1490(59.1)	DF=6	0.607	0.638(-)
Yes	82.8	29.3	35.2	18.3	1030(40.9)	X^2=17.7686	0.865	0.503(-)
DK	51.1	0.0	51.1	0.0	1(0.04)	P=0.0068**	RC	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight.								

Source: NFHS-2

Results presented in Table.4.1.20 below showed that there was a significant association between child morbidity and prevalence of underweight. Children who suffered from fever and cough two weeks prior to the survey had a higher prevalence of underweight as compared to their counterparts who did not suffer from these morbid conditions. Several studies have reported similar findings and this is because malnutrition and morbidity are related synergistically (NNMB, 2003, NNMB, 2006 and Ahmed *et al.,* 2012).

Table.4.1.20.Association and determinants of underweight in children below five years based on morbid conditions in Maharashtra state during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild -UW	Mod -UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No	76.6	30.1	30.2	16.3	1563(62.0)	DF=6	-0.152	0.154(-)
Yes	83.6	28.8	34.8	20.0	957(38.0)	X^2=25.06211	-0.580	0.160(-)
DK	0.0	0.0	0.0	0.0	1(0.02)	P=0.0003**	RC	
Had cough								
No	76.8	29.8	29.7	17.3	1490(59.1)	DF=6	0.607	0.638(-)
Yes	82.8	29.3	35.2	18.3	1030(40.9)	X^2=17.7686	0.865	0.503(-)
DK	51.1	0.0	51.1	0.0	1(0.04)	P=0.0068**	RC	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight.								

Source: NFHS-2

4.1.7.3.4. Immunization

A significant association was found between immunization and prevalence of underweight in children. Results presented in Table.4.1.21 showed that immunized children had a highest association with underweight which infers that immunization of the children did not protect them from becoming underweight. Contrary, Semba *et al.* (2007) reported 9 times higher risk of underweight among non-immunized children. This is because weight gain is more dependent on diet the child takes and if fully balanced, then growth will be observed as long as the body is able to utilise the nutrients from food.

Table.4.1. 21.Association and determinants of underweight in children below five years based on immunization status in Maharashtra state during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No	66.7	30.2	22.6	13.9	739(29.3)	DF=12	-2.447	0.077(-)
Yes	84.5	29.4	36.0	19.1	1777(70.5)	X^2=164.6495	-1.816	0.188(-)
DK	55.7	0.0	0.0	55.7	5(0.2)	P<.0001**	RC	
Received Measles								
No	64.1	31.8	20.2	12.1	925(36.7)	DF=12	**-1.076**	**0.044(2.93)**
Yes	87.9	28.3	38.7	21.0	1583(62.8)	X^2=270.9176	-0.230	0.666(-)
DK	96.1	31.4	48.6	16.2	13(0.5)	P<.0001**	RC	
Received BCG								
No	71.0	30.5	18.2	22.3	276(11.0)	DF=9	0.638	0.403(-)
Yes	80.2	29.5	33.6	17.1	2245(89.1)	X^2=71.4133	0.807	0.282(-)
						P<.0001**	RC	
Received DPT3								
No	62.3	30.7	16.4	15.3	608(24.1)	DF=12	**0.892**	**<.0001(0.41)**
Yes	84.6	29.3	37.0	18.3	1903(75.5)	X^2=207.2378	**RC**	
Dk	80.7	19.2	20.0	14.4	11(0.4)	P<.0001**		
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight.								

Source: NFHS-2

4.1.4.3.5. Determinant of underweight among children below five years in Maharashtra state during 1998-99 (NFHS-2) survey.

Results based on ordinal logistic regression presented in Tables.4.1.19, 4.1.20 and 4.1.21 showed that a significant correlation existed between underweight in children with residence, ethnicity, occupation, immunization, and size at birth, education of the mother, child anaemia and age of the child only. Similarly, NNMB (2006) reported an association between mothers' occupation and educational level with underweight in children below five years. Sharghi *et al.* (2011) did not find infections, lack of hygienic latrines to be predictors of underweight in children just like in the current study. Contrary, Ergin *et al.* (2007) and Ghazi *et al.* (2013) did not find mothers education, level of employment and gender to be correlated to severity of underweight in children below five years.

Similar to the current findings in which underweight increased by almost 100 percent in children with mothers who had no education while it increased by only 47.1 percent in children whose mothers enrolled in secondary education (Table.4.1.19), Rahman *et al.* (2009) demonstrated that enrolment of women in secondary education has been responsible for 43 percent of the total 15.5 percent decline in childhood underweight in developing countries during 1970-1995.

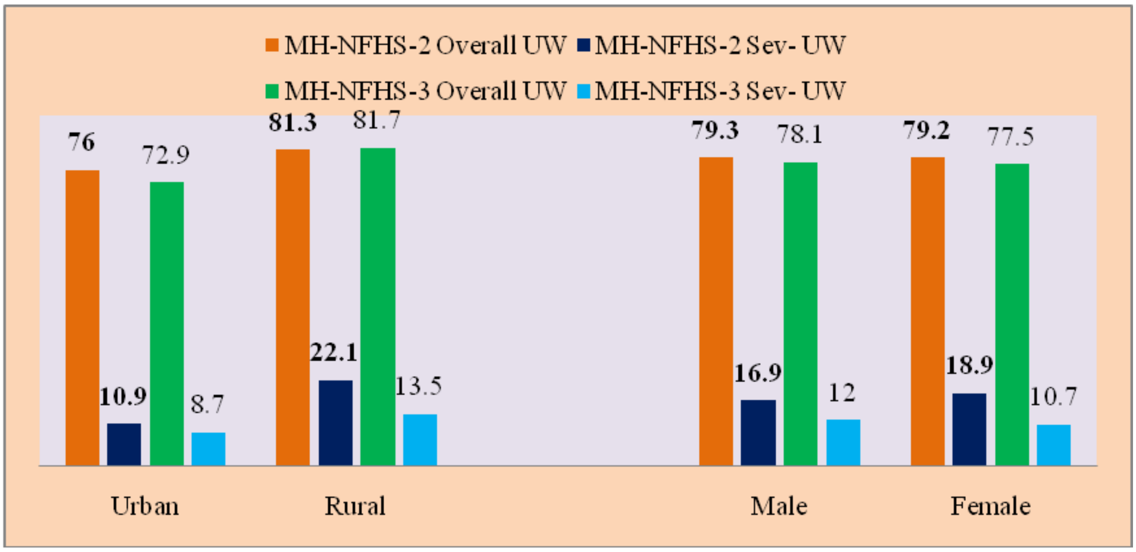

Figure.4.1.10. Trends in overall and severe underweight in children between NFHS-2 and NFHS-3 Surveys.

Similar to the current findings, several earlier studies have reported the positive effect of low birth weight on occurrence of underweight in children below five years (Ronaghy et al., 1968, Ayatollali, 1993., Majlesi et al., 2001 and Anoop et al., 2004).

4.1.8. Maharashtra state (MH) 2005/06

4.1.8.1 Profile of children below five years in Maharashtra state during NFHS-3) .

Data on 3209 children was included in the study. Out of these children, majority resided in rural part of the state (55.9 %), were of Hindu religion (75.4 %), male (53.9 %), between >47-≤59 months (21.3 %), of average size at birth (53.4 %), still breastfeeding (61.5 %) and belonged to other caste groups other than SC, ST and OBC (41.1 %). Majority of the households had flush toilet facilities for disposal of human waste.

Majority of the children did not suffer from fever (88.1 %) or cough (85.1 %) two weeks prior to the survey. Results presented in Table.4.1.24 revealed that majority of the children were immunized fully.

4.1.8.2. Prevalence of underweight among children below five years in Maharashtra state during NFHS-3)

The overall prevalence of underweight in children was 79.7 percent of which 32.4 percent were mildly underweight, 32.9 percent were moderately underweight and 14.4 percent were severely underweight. A similar prevalence was reported among children in Bihar (80 %), Jharkand (82.6 %) and severe underweight in Haryana (14.2 %) during

Table.4.1. 22. Percentage association and determinants of underweight in children below five years based on selected socio-economic and demographic factors in Maharashtra state during 2005/06

Background characteristic	Percentage of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban Rural	72.9 81.7	35.0 33.7	29.2 34.5	8.7 13.5	1415(44.1) 1794(55.9)	DF=3 X^2=50.820 P<.0001**	-0.207 RC	0.003(1.23)
Religion								
Hindu Muslim Christian Others	78.5 72.2 90.2 79.2	34.4 34.8 51.8 31.6	32.4 30.2 37.2 32.4	11.7 7.2 1.2 15.2	2420(75.4) 423(13.2) 20(0.6) 345(10.7)	DF=24 X^2=42.129 P=0.0125**	-0.010 -0.327 0.137 RC	0.940(-) 0.042(1.39) 0.685(-)
Sex								
Male Female	78.1 77.5	35.0 33.4	31.1 33.4	12.0 10.7	1729(53.9) 1480(46.1)	DF=3 X^2=3.101 P=0.3763 (NS)	-0.001 RC	0.982(-)
Age								
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35 >35 - ≤ 47 >47 - ≤ 59	32..0 57.0 74.2 85.6 80.6 79.8 85.4 83.5	24.1 31.2 40.2 36.8 36.5 32.4 36.8 33.5	5.6 19.3 22.6 34.9 30.2 34.2 36.5 39.1	2.3 6.5 11.3 13.9 13.7 13.2 12.2 10.5	200(6.2) 190)5.9) 148(4.6) 368(11.5) 342(10.7) 648(20.2) 628(19.6) 684(21.3)	DF=21 X^2=376.214 P<.0001**	-2.309 -0.740 -0.339 -0.032 0.077 0.156 0.053 RC	<.0001(10.06) <.0001(2.10) 0.045(1.40) 0.795(-) 0.555(-) 0.137(-) 0.617(-)
Size at birth								
Very large Larger than AV Average (AV) Smaller than AV Very small	76.9 79.6 76.6 77.5 87.3 77.9	34.2 36.8 35.8 26.2 35.4 25.2	26.0 32.4 31.5 36.5 31.6 33.5	16.7 104 9.2 14.7 20.2 19.2	140(4.4) 681(21.2) 1712(53.4) 401(12.5) 130(4.1) 145(4.5)	DF=15 X^2=57.046 P<.0001**	0.125 0.161 0.026 0.127 0.386 RC	0.589(-) 0.360(-) 0.874(-) 0.492(-) 0.100(-)
Currently breastfeeding								
No Yes	79.8 76.6	38.6 31.6	31.2 32.7	10.0 12.3	1237(38.5) 1972(61.5)	DF=3 X^2=18.480 P=0.0004**	0.085 RC	0.199(-)
Caste								
SC ST OBC NONE DK	81.4 81.9 78.1 74.7 100.0	31.0 22.3 40.0 35.6 0.0	34.8 37.5 29.9 30.9 66.7	15.7 22.1 8.2 8.2 33.3	586(18.4) 407(12.8) 884(27.7) 1314(41.1) 3(0.1)	DF=12 X^2=120.402 P<.0001**	-1.113 -1.096 -1.341 -1.627 RC	0.222(-) 0.229(-) 0.140(-) 0.073(-)
Child Anaemia								
Severe-A Moderate-A Mild-A Normal	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	-0.289 0.303 0.124 RC	0.781(-) 0.062(-) 0.143(-)
Maternal characteristics								
Education of mother								
No education Primary Secondary Higher	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	0.412 0.270 0.424 RC	<.0001(0.64) 0.056(-) <.0001(0.65)
Occupation								
Not working Professional Clerical Sales Agric E Service Skilled -M	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	NC NC NC NC NC NC NC	-0.105 -0.356 -0.549 -0.506 -0.324 -0.014 RC	0.469(-) 0.134(-) 0.245(-) 0.103(-) 0.042(1.38) 0.951(-)
Toilet facility								
Flush Pit-latrine Bush Others Not dejure resident	74.6 90.1 83.2 100.0 59.9	38.2 40.1 31.9 33.3 20.6	29.6 20.4 36.1 33.3 25.0	6.8 29.6 15.2 33.3 14.3	1521(47.5) 23(0.7) 1464(45.7) 3(0.1) 191(6.0)	DF=30 X^2=187.692 P<.0001**	0.412 0.990 0.790 RC	0.004(0.66) 0.040(0.37) <.0001(0.45)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC= Not computed, NA=not available.								

NFHS-3 (IIPS and Macro, 2007). Other studies in India reported lower prevalence of 66 percent (Algur *et al*., 2012) using IAP classification and 61.6 percent (Rao *et al*., 2005).

4.1.8.3. Association of underweight and selected variables

The findings in this section are based on chi-square for association between underweight and the selected variables/ factors.

4.1.8.3.1. Children characteristics

There was a significant association between residence, religion, age of the child, size at birth, breastfeeding and caste but not sex of the child.

The highest prevalence of underweight was with rural children (figue.4.1.10), of Christian faith, between >11-≤17 months of age, very small size at birth, who were not breastfeeding and from SC/ST caste. Galab et al. (2003), IIPS and Macro (2007) and Ergin et al. (2007) reported a significant association with rural residents, low birth weight, age, low social class and no association with sex with no significant differences between male and female children (Ghazi et al., 2013) just like in the current study.

4.1.8.3.2. Maternal characteristics

Mother's education, occupation and toilet facility significantly affected prevalence of underweight in children. Children from uneducated mothers, with low paying jobs and lacking toilet facilities in the household were at a higher risk of underweight. Phengxay *et al*. (2007) and Rikimaru *et al*. (1998) reported a significant relationship of child malnutrition with illiteracy of the mother and occupation while the relationship between unsanitary latrines in the home and childhood malnutrition has been shown in studies by El-Sayed *et al* (2001) in Egypt and Mitra *et al* (2004) in India. This may reflect the effect of poor environmental health, exposing the child to multiple infections, which has the long-term effect of growth problems and childhood malnutrition.

4.1.8.3.3. Morbidity

Results presented in Table.4.1.23 below showed that there was no significant association between child underweight and morbidity. However, Sharghi *et al.* (2011) reported an association with infectious diseases.

Table.4.1. 23.Association and determinants of underweight in children below five years based on morbid conditions in Maharashtra state during 2005/06

Background	Percentage of UW children who are	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Had fever								
No	77.5	33.6	32.4	11.5	2823(88.1)	DF=6	3.085	0.127(-)
Yes	79.7	38.1	30.5	11.1	376(11.7)	X^2=5.4841	3.361	0.097(-)
DK	100.0	51.7	48.3	0.0	5(0.2)	P=0.4834(NS)	RC	
Had cough								
No	77.9	33.8	32.3	11.8	2721(85.1)	DF=6	-1.407	0.441(-)
Yes	76.8	36.0	31.4	9.3	470(14.7)	X^2=0.78055	-1.405	0.442(-)
DK	100.0	34.8	65.2	0.0	7(0.2)	P=0.2527(NS)	RC	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight..								

Source: NFHS-3

4.1.8.3.4. Immunization

Immunization was significantly associated with prevalence of underweight in children. Santosh *et al.* (2013) and Gul and Kiramat (2012) found an association with immunization of infectious diseases through increasing the body's defences against such diseases.

Table.4.1. 24.Association and determinants of underweight in children below five years based on immunization status in Maharashtra state during 2005/06

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No	71.5	30.8	26.6	14.1	827(25.9)	DF=12	**-0.372**	**<.0001(1.45)**
Yes	80.1	35.6	34.1	10.5	370(74.0)	X^2=70.`1262	**RC**	
DK	50.0	0.0	50.0	0.0	4(0.1)	P<.0001**		
Received Measles								
No	61.3	27.9	22.6	10.8	67(21.0)	DF=12	**-0.775**	**<.0001(0.46)**
Yes	82.3	36.3	34.6	11.4	2481(77.6)	X^2=172.2363	**RC**	
DK	76.5	19.5	31.6	25.4	44(1.4)	P<.0001**		
Received DPT3								
No	72.1	27.3	32.0	12.8	823(25.7)	DF=12	**-0.440**	**<.0001(1.55)**
Yes	79.9	36.8	32.2	10.9	2365(73.8)	X^2=57.1876	**RC**	
	67.7	28.4	28.1	11.2	17(0.5)	P<.0001**		
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight..								

Source: NFHS-3

4.1.4.3.5. Determinant of underweight in children.

Results based on ordinal logistic regression presented in Table.4.1.22, Table.4.1.23 and Table.4.1.24 showed that there was a correlation between severity of underweight with residence, religion, age, education of mother occupation and immunization against polio but not with sex, size at birth, caste, toilet facility, morbidity and child *anaemia.* This result is contradictory to findings of Medhin *et al. (2010)* and Sanghvi *et al*. (2001) who reported birth weight and access to sanitary toilet facilities as predictors of underweight in children, Residence was negatively correlated with prevalence of underweight in children below five years. This result infers that among the urban children, underweight decreased by 20.7 percent. The RR of being underweight was 1.23 times lower among urban children as compared to their rural counterparts (RR=0.81 times). Thus, underweight prevalence was higher among rural children. Rural residence significantly predicted underweight and stunting at twelve months of age in African countries (Medhin *et al.,* 2010).

In younger children <17 months, severity of underweight was negatively correlated while it was positively correlated in older children (> 17 months of age). The RR of being underweight was 10.06 times, 2.10 times and 1.40 times in children aged 0-6 months, >6-≤8 months and >8-≤11 months of age in comparison to older children between >47-≤59 months of age. This result infers that underweight increased with age significantly. This can be attributed to full attention given to child in absence of a sibling as compared to children >17 months and above where there is likely to be a new born sibling which will lead to sudden cessation of breastfeeding and abrupt weaning coupled with reduced care. Galab *et al.* (2003) and Saleem *et al.* (2014) reported underweight to be higher in older children of Andhra Pradesh state.

Religion was also negatively correlated with severity of underweight and the RR of being severely underweight was 1.39 times higher among Muslim children in comparison to their counterparts of other religions. This is could be a result of religious practices like one month fasting among Muslims which definitely affects the types of meals and timing hence children though not fasting will not get their best and frequent meals as the care takers in most cases are involved in the fast which time is enough to perpetuate malnutrition. NNMB (2006) found a significant association between religion and underweight prevalence among Indian children.

4.1.4.3. Trends in prevalence of underweight in children in Maharashtra state during 1998 -2006.

Over the years, the prevalence of underweight increased by 4.2 percent between NFHS-2 and NFHS-3.The increment was due to mild underweight with an increment of 4.4 percent. However, there was decrease in cases of severe underweight in children by 1.8 percent (figure.4.1.11). This trend with severe underweight can be attributed to the improvement of toilet facilities in the households as seen with an increase in households with flush toilets from (36.2 % in NFHS-2 to 47.5 % in NFHS-3) and concurrently a decrease in households using bush method to dispose off their human waste from (59.6 % in NFHS-2 to 45.7 % in NFHS-3). There was also a decrease in children with morbid conditions between the two surveys (Table.4.1.20 and Table.4.1.23).

Also prevalence of severe underweight in older children decreased over the years (Figure.4.1.12) which could be due to improved supervision of government intervention programmes like nutritional education of child feeding and care practices, free immunization for all children and vaccination for mothers and also better enrolment of mothers in the formal education system and improvement in sanitary conditions.

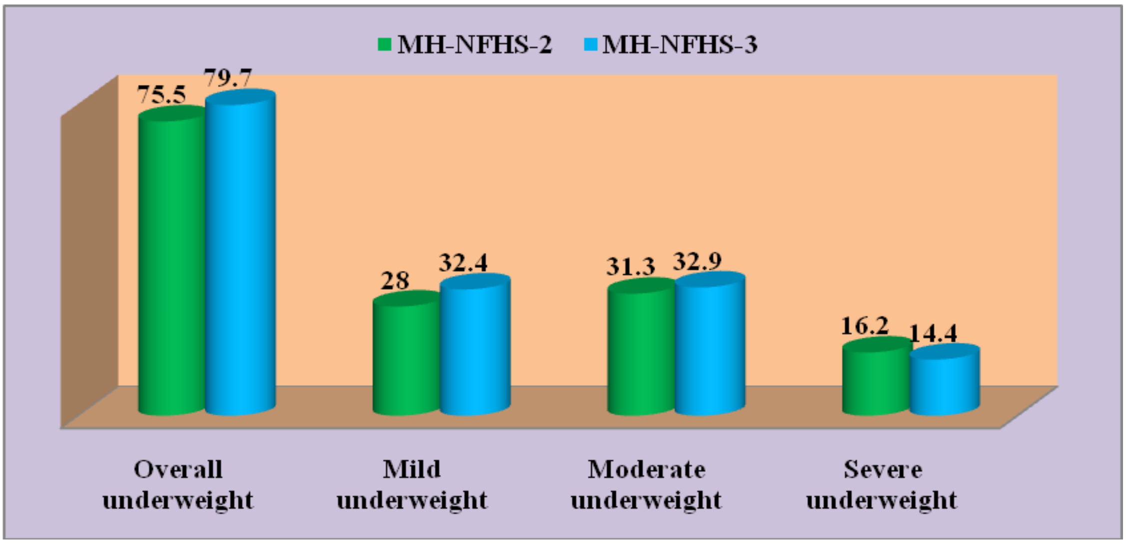

Figure.4.1.11. Trends in underweight prevalence during NFHS-2 AND NFHS-3 in Maharashtra state

Figure.4.1.10 shows that underweight slightly increased in rural children over the years but on the positive side towards achievement of the millennium goals, severe underweight decreased irrespective of location and gender.

Over the years, age of the child, residence, occupation, education of the mother and immunization remained predictors of underweight in children (Tables.4.1.19 - 4.1.24). This indicates that underweight prevalence in the state is multi-faceted and predictors are interrelated with rural residence limiting access to quality education, in turn low paying jobs and hence low purchasing power due to limited income which affects use of health facilities like immunization and access to quality health care.

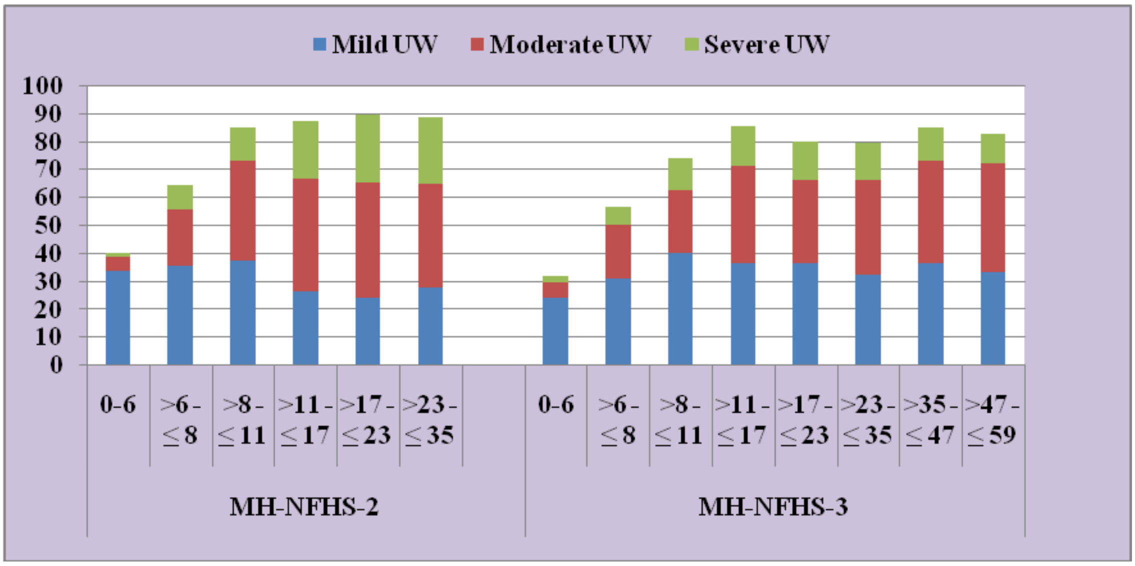

Figure.4.1.12. Trends in Prevalence of underweight in children at different ages during NFHS-2 and NFHS-3 surveys

4.1.9. Bijapur district 1998/99 (NFHS-2)

4.1.9.1 Profile children below five years in Bijapur district during NFHS-2

Data on approximately 74 children below five years of age was included in the study. Majority of the children were rural residents (72.3 %), of Hindu religion (76.6 %), male (51.5 %), between 0-6 months old (27.8 %), of average size at birth (36.5 %), still breastfeeding (83.7 %) and belonged to other social groups besides SC,ST or OBC caste groups. Majority of the children's mothers had no education (66.3 %), were unemployed (58.6 %) and lived in households with no toilet facility (91.2 %).

Table.4.1.26 shows that majority of the children did not suffer from either fever (71.6 %) or cough (70.3 %) two weeks prior to the survey and the larger majority had been immunized fully (Table.4.1.27).

4.1.9.2. Prevalence of underweight among children below five years in Bijapur district during NFHS-2

The overall prevalence of underweight in children was 73.1 percent of which 20.2 percent were mildly underweight, 34.0 percent were moderately underweight and 18.9 percent were severely underweight. Moderate underweight was the most prevalent degree of underweight. During NFHS-2, a similar prevalence was reported in Uttar Pradesh (73.6 %) and severe underweight in Karnataka (16.5 %), Orissa (20.7 %) and Rajasthan (20.8 %) though much lower prevalence was also reported in Jammu & Kashmir (42.8 %) and Tripura (24.8 %) during the same survey in the same age group (IIPS and ORC Macro, 2000). During the DLHS-RCH, prevalence similar to the current

Table.4.1. 25. Percentage association and determinants of underweight in children below five years based on selected socio-economic and demographic factors in Bijapur district during 1998/99

Background characteristic	Percent age of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban Rural	84.2 67.3	26.3 22.3	31.6 30.3	26.3 14.7	21(27.7) 54(72.3)	DF=3 X^2=2.7546 P=0.431(NS)	**1.278** **RC**	**0.030(0.28)**
Religion								
Hindu Muslim Christian	69.3 79.8 100.0	26.9 13.1 0.0	24.7 46.8 100.0	17.7 19.9 0.0	57(76.6) 16(21.9) 1(1.5)	DF=6 X^2=6.1419 P=0.4075(NS)	-2.153 0.634 RC	0.259(-) 0.736(-)
Sex								
Male Female	74.3 69.6	25.6 21.2	28.3 33.2	20.4 15.2	38(51.5) 36(48.5)	DF=3 X^2=0.7204 P=0.8684(NS)	0.103 RC	0.813(-)
Age								
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35	52.5 74.9 59.4 50.5 91.1 93.7	36.8 25.6 0.0 12.3 26.9 17.5	15.7 49.2 39.7 24.7 45.4 29.1	0.0 0.0 19.7 13.5 18.8 47.2	21(27.8) 9(12.0) 6(7.4) 9(11.7) 12(16.0) 19(25.1)	DF=15 X^2=31.0001 P=0.0088**	**-2.973** **-1.828** -1.547 **-2..471** -1.031 RC	**<.0001(19.55)** **0.025(6.22)** 0.103(-) **0.003(11.83)** 0.156(-)
Size at birth								
Very large Larger than AV Average (AV) Smaller than AV Very small	NA 74.9 71.9 65.0 100.0	NA 29.3 19.9 23.1 0.0	NA 24.8 40.1 17.3 100.0	NA 20.8 11.9 24.6 0.0	NA 26(35.4) 27(36.5) 19(25.2) 2(2.9)	DF=9 X^2=9.173 P=0.4215 (NS)	NA -0.743 -0.912 -0.980 RC	NA 0.578(-) 0.494(-) 0.470(-)
Currently breastfeeding								
No Yes	90.8 68.4	17.6 24.6	63.5 24.3	9.7 19.5	12(16.3) 62(83.7)	DF=3 X^2=7.6685 P=0.0534*	0.410 RC	0.595(-)
Caste								
SC ST OBC NONE	63.8 75.0 78.0 70.4	18.1 50.0 27.9 20.5	17.3 0.0 33.3 20.5	28.4 25.0 16.8 14.7	12(16.9) 4(5.8) 20(26.8) 37(50.4)	DF=3 X^2=3.5043 P=0.3202 (NS)	1.050 0.554 1.133 RC	0.162(-) 0.573(-) 0.076(-)
Child anaemia								
Severe A Mod –A Mild-A Normal	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	**3.084** 0.106 0.023 RC	**0.015(0.05)** 0.899(-) 0.964(-)
Maternal characteristics								
Education of mother								
No education Primary Secondary Higher	73.4 82.9 0.0 78.2	28.8 16.6 0.0 14.0	28.5 33.4 0.0 42.9	16.0 32.9 0.0 21.2	49(66.3) 7(8.8) 3(4.4) 15(20.6)	DF=9 X^2=12.0332 P=0.2114 (NS)	-0.598 0.356 -21.206 RC	0.280(-) 0.688(-) NC
Occupation								
Not working Professional Sales Agric S-E Agric E Service Skilled Unskilled -M	70.0 66.1 100.0 50.1 88.3 100.0 80.3 66.7	20.1 33.0 0.0 16.6 54.2 0.0 20.1 0.0	37.5 33.0 100.0 33.5 0.0 0.0 40.1 0.0	12.4 0.0 0.0 0.0 34.0 100.0 20.1 66.7	44(58.6) 3(4.4) 1(1.4) 6(8.6) 10(13.5) 1(1.4) 5(7.3) 4(4.7)	DF=21 X^2=28.6996 P=0.1214 (NS)	-21.297 **-2.510** 4.440 1.382 0.666 21.372 -0.154 RC	0.997(-) **0.031(0.08)** 0.091(-) 0.288(-) 0.440(-) 0.998(-) 0.866(-)
Toilet facility								
Flush Pit-latrine Bush Others	50.0 100.0 52.9	24.7 0.0 24.1	25.3 100.0 28.8	0.0 0.0 0.0	4(5.9) 2(2.9) 68(91.2)	DF=9 X^2=11.752 P=0.2277 (NS)	-1.039 0.809 RC	0.287(-) 0.535(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC= Not computed, NA=not available.								

Source.NFHS-2

study of 72.9 percent was reported in Jharkand and severe underweight of 19.2 percent in Chhattisgarh (IIPS and MoHFW, 2006). Smaller studies in India reported much lower prevalence of 21.5 percent and 38.38 percent in Mysore and Tripura respectively (Santosh *et al*., 2013 and Mittal *et al*., 2007).

4.1.9.3. Association of underweight and selected variables

4.1.9.3.1. Children characteristics

Results presented in Table.4.1.25 show there was no significant association between underweight with any of the studied variables except for age.

Underweight prevalence sharply increases between 6-8 months but it was highest in older children (>23-≤35) months old (93.7 %) with 47.2 percent of the children being

severely underweight. Age and underweight have a linear relationship. This because after six months, there is introduction of solid food as a process of weaning the children

some of which might not be easily digestible especially if not specifically made for the child to meet their needs or early initiation of weaning before six months which has been associated with underweight prevalence (Ergin *et al.,* 2007). Other studies also found age to be significantly associated with underweight in Indian children (Rao, 2005, Sengupta *et al*., 2010 and Singh *et al*., 2013).

4.1.9.3.2. Maternal characteristics

None of the studied variables was significantly associated with prevalence of underweight in children (Table.4.1.25). Similar results were reported among Turkish children of the same age bracket (Ergin *et al*., 2007).

4.1.9.3.3. Morbidity

Table.4.1. 26.Association and determinants of underweight in children below five years based on morbid conditions in Bijapur district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No Yes	67.4 83.6	24.5 20.9	24.4 46.5	18.6 16.2	53(71.6) 21(28.4)	DF=3 X^2=3.9743 P=0.2643(NS)	-0.119 RC	0.872(-)
Had cough								
No Yes	66.6 84.8	24.8 20.1	27.0 39.4	14.8 25.2	52(70.3) 22(29.8)	DF=3 X^2=3.7161 P=0.2938(NS)	-0.991 RC	0.150(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight..								

Source: NFHS-2

Morbidity was not significantly associated with underweight prevalence in children below five years as seen in Table.4.1.26 below and regression did not find morbidity as a predictor factor for underweight among these children. Though some studies have reported association between the two, Ergin *et al*. (2007) and Sharghi *et al.* (2011) had results that back up findings of the current study.

4.1.9.3.4. Immunization

Results presented in Table.4.1.27 below show that there is no significant association between immunization status and underweight prevalence in the children. However, children who were immunized had the highest prevalence of underweight compared to the children who were not immunized. This result indicates that immunization did not protect the children from being underweight.

Table.4.1. 27.Association and determinants of underweight in children below five years based on immunization status in Bijapur district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No Yes	67.7 76.4	20.7 26.3	32.0 29.3	15.0 20.8	37(50.2) 37(49.8)	DF=6 X^2=1.5774 P=0.9542(NS)	-0.449 RC	0.487(-)
Received Measles								
No Yes DK	65.7 86.0 66.7	24.8 23.8 0.0	26.9 38.2 33.3	14.0 24.0 33.3	48(65.0) 23(30.7) 3(4.3)	DF=6 X^2=7.2858 P=0.6074(NS)	-1.644 -0.108 RC	0.162(-) 0.926(-)
Received BCG								
No Yes	79.4 69.1	31.7 20.2	26.1 32.5	21.6 16.4	21(28.1) 54(71.9)	DF=9 X^2=4.8283 P=0.849(NS)	1.220 RC	0.058(-)
Received DPT3								
No Yes	76.1 65.4	26.2 18.9	35.4 23.1	14.5 23.4	46(61.9) 28(38.2)	DF=6 X^2=3.9947 P=0.6774(NS)	0.747 RC	0.276(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight..								

Source: NFHS-2

4.1.10.3.5. Determinants of underweight in children

Results are based on ordinal logistic regression and presented in Table.4.1.25, 4.1.26 and 4.1.27. Results show there was a significant correlation between severity of underweight in children with residence, occupation, age of the child and child anaemia.

Residence was positively correlated with underweight in children with children in urban residence having a higher prevalence of underweight as compared rural residents. The RR of being severely underweight was 0.28 times higher among urban children than rural children. This can be attributed to high prevalence of malnutrition in urban slums as reported by several studies (NNMB, 2006 and IIPS and ORC Macro, 2000).

Occupation was negatively correlated with underweight in children whose mothers were employed in professional work. The RR of being underweight was 12.30 times lower in children with professional mothers than children whose mothers are employed in other sectors. (Table.4.1.25). This can be attributed to higher income that comes with professional employment which enables access to modern health facilities, sanitary environment hence reducing the risk of morbidity and also increased chances of immunization. Vaccination was reported to increase with household status with only 78 percent of the children in poorest households being immunized against 91 percent in children from well do families (Galab *et al*. 2003). NNMB (2006) found mothers' occupation to significantly influence underweight prevalence in children.

Age was negatively correlated with severity of underweight in children. Children 0-6 months were at a 19.55 times lower risk of being severely underweight as compared to children >23-≤35 months. This can be attributed to the protective effect of proper child care practices which are common in infants in absence of siblings or index pregnancy. Similar findings have been reported by NNMB (2006), Sengupta *et al.* (2010) and Singh *et al*. (2013).

Child anaemia was positively correlated with severity of underweight among children. The RR of being underweight was 0.05 times higher among severely anaemic children as compared to children with normal haemoglobin levels.

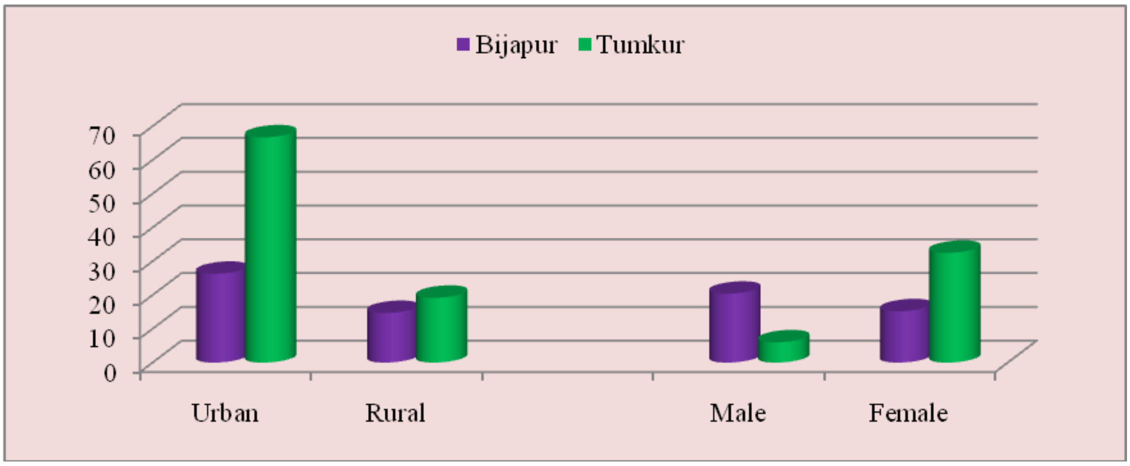

Figure.4.1.13. Prevalence of severe underweight in children by residence and gender in Bijapur and Tumkur districts during 1998/99

4.1.10. Tumkur district 1998/99

4.1.10.1 Profile of children below five years in Tumkur district during NFHS-2.

Data on approximately 85 children was included in the study. Out of these children, the larger majority were rural residents (96.0 %), Hindu (98.6 %), females (56.6 %), between >23-≤35 months old (34.3 %), were larger than average at birth (44.8 %), were still breastfeeding (68.4 %) and belonged to OBC caste (42.3 %).

Majority of the children's mothers were not educated (50.2 %), not working (48.6 %) and lived in households with no proper toilet facilities (94.8 %). Also data on morbidity revealed that majority of the children did not suffer from cough or fever two weeks prior to the survey (Table.4.1.29). Also, results in Table.4.1.30 show that majority of the children were fully immunized with polio, measles, BCG and DPT3.

4.1.10.2. Prevalence of underweight in children below five years in Tumkur district during NFHS-2.

The overall prevalence of underweight in children was 79.0 percent of which 25.4 percent were mildly underweight, 28.8 percent were moderately underweight and 24.8 percent were severely underweight**.** This prevalence is higher than the national estimates. This study shows a very high prevalence of severe underweight among children as was reported in Madhya Pradesh (24.3 % and 24.1 %) and Bihar (25.5 % and 23.5 %) during NFHS-2 and DLHS-RCH 2002-2004 surveys respectively (IIPS and ORC Macro, 2000). A smaller study in Uttar Pradesh reported a lower prevalence of 54.8 percent (Prasot *et al*., 2014) while another study in rural Meerut district in India found a prevalence of 57.4 percent underweight (Singh *et al*., 2012).

4.1.10.3. Association of underweight and selected variables

4.1.10.3.1. Children characteristics

Results of Table.4.1.28 show there is a significant association between underweight and sex, age and breastfeeding but not with residence, religion, size at birth and caste.

Female children had a high prevalence of underweight as compared to male children. The prevalence of severe underweight was almost 5.5 times higher in female children than male children (32.5 % vs 6.0 %) between female and male children. This result clearly explains that female children are vulnerable to acute and chronic

Table.4.1. 28. Percentage association and determinants of underweightin children below five years based on selected socio-economic and demographic factors in Tumkur district during 1998/99

Background characteristic	Percent age of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban	100.0	0.0	33.3	66.7	3(4.0)	DF=3	2.312	0.069(-)
Rural	76.8	30.1	27.6	19.2	82(96.0)	X^2=5.3024	RC	
						P=0.1509(NS)		
Religion								
Hindu	77.4	29.0	28.2	20.0	84(98.6)	DF=3	NC	NC
Christian	100.0	0.0	0.0	100.0	1(1.32)	X^2=4.2693	NC	NC
						P=0.2338(NS)		
Sex								
Male	63.6	36.4	21.3	6.0	37(43.4)	DF=3	**-1.626**	**<.0001(5.08)**
Female	88.5	23.1	32.8	32.5	48(56.6)	X^2=15.0717	**RC**	
						P=0.0018**		
Age								
0-6	43.5	37.2	6.3	0.0	18(21.0)	DF=15	**-3.161**	**<.0001(23.6)**
>6 - ≤ 8	57.6	14.6	43.1	0.0	8(9.2)	X^2=34.2257	**-2.080**	**0.011(8.0)**
>8 - ≤ 11	87.7	37.5	38.0	12.2	9(10.6)	P=0.0032**	-1.125	0.131(-)
>11 - ≤ 17	87.3	24.8	37.8	24.7	9(10.5)		-0.638	0.388(-)
>17 - ≤ 23	82.1	27.4	36.6	18.1	12(14.5)		-1.025	0.123(-)
>23 - ≤ 35	96.1	26.8	27.0	42.3	29(34.3)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=9	-0.750	0.683(-)
Larger than AV	85.4	41.3	29.6	14.6	38(44.8)	X^2=14.5696	-0.204	0.913(-)
Average (AV)	70.8	11.6	17.9	41.3	19(22.3)	P=0.1035(NS)	-0.937	0.612(-)
Smaller than AV	70.7	24.7	29.3	16.7	27(31.6)		RC	
Very small	100.0	0.0	100.0	0.0	1(1.3)			
Currently breastfeeding								
No	87.6	12.5	29.3	45.8	27(31.6)	DF=3	**1.399**	**0.008(0.25)**
Yes	73.1	36.5	27.1	9.6	58(68.4)	X^2=16.9481	**RC**	
						P=0.0007**		
Caste								
SC	81.6	27.2	36.3	18.2	25(28.9)	DF=9	1.153	0.058(-)
ST	83.2	49.9	16.8	16.6	7(8.0)	X^2=12.7801	0.776	0.373(-)
OBC	87.6	31.1	31.6	24.9	36(42.3)	P=0.1728(NS)	**1.380**	**0.016(0.25)**
NONE	50.0	18.7	12.6	18.7	18(20.8)		RC	
Child anaemia								
Mod-A	NC	NC	NC	NC	NC	NC	**1.535**	**0.049(0.14)**
Mild-A	NC	NC	NC	NC	NC	NC	0.676	0.130(-)
Normal	NC	NC	NC	NC	NC	NC	RC	
Maternal characteristics								
Education of mother								
No education	89.4	26.3	31.7	31.4	43(50.2)	DF=9	**2.002**	**<.0001(0.14)**
Primary	77.8	0.0	44.4	33.4	10(11.8)	X^2=24.532	**2.210**	**0.004(0.11)**
Secondary	71.2	28.6	42.6	0.0	8(9.2)	P=0.0035**	0.777	
Higher	59.2	45.4	9.3	4.5	24(28.7)		RC	
Occupation								
Not working	67.6	40.4	19.0	8.2	41(48.6)	DF=15	-2.330	0.151(-)
Sales	50.0	50.0	0.0	0.0	2(2.7)	X^2=29.1586	16.023	0.999(-)
Agric S-E	91.9	16.9	50.3	24.8	14(16.0)	P=0.0153*	-0.684	0.684(-)
Agric E	85.7	19.0	33.5	33.8	23(27.5)		-0.634	0.706(-)
Skilled-M	100.0	0.0	0.0	100.0	2(2.6)		18.407	0.998(-)
Unskilled -M	100.0	0.0	49.5	50.5	2(2.7)		RC	
Toilet facility								
Flush	NA	NA	NA	NA	NA	DF=3	NA	NA
Pit-latrine	100.0	50.2	24.9	24.9	4(5.2)	X^2=1.8279	0.852	0.427(-)
Bush	76.5	27.7	28.0	20.8	81(94.8)	P=0.6089(NS)	RC	

*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC= Not computed, NA=not available

Source.NFHS-2

malnourishment as compared to boys which can be a result of the discrimination and preference of male children over the female as the female children are considered an economic burden especially in the Hindu culture where the expense of marriage is a big burden to the girls family and boys are considered a source wealth contrary to the girls.

Kandala *et al.* (2011) and Gul and Kiramat (2012) reported higher malnourished female children than male of the same age group.

There was a significant association between underweight and age of the child with older children having a higher prevalence of underweight than the younger ones. Children in ages >23-≤ 47 months had the highest prevalence of overall and severe underweight as compared to their counterparts in other age brackets as represented by 96.1 percent and 42.3 percent. This contradictory with Chakraborty *et al*. 2006) and Prasot *et al*. (2014) who reported a higher prevalence of underweight in younger children 1-3 years (71.2 %) and lower prevalence in older children 4-6 years (46.6 %).

Children who were not breastfeeding had a significantly higher prevalence of severe underweight (45.8 %) as compared to children who were breastfeeding. This can be a result of nutritious state of breast milk which contains nutrients in their balance form and the low infection rate that surrounds breastfeeding as compared to artificial bottle feeding. Benefits of prolonged breastfeeding have been discussed by several studies (Kumar *et al.,* 2006, Siddique *et al.,* 2006 and Rayhan and Khan, 2006).

4.1.10.3.2. Maternal characteristics

Results in table.4.3.28 showed that there was a significant association between mother's education, occupation and toilet facility in the household with prevalence of underweight in children. These findings have been backed up by reports from IIPS and MoHFW (2006), Ahmed *et al*. (2012) and Ghazi *et al*. (2013).

4.1.10.3.3. Morbidity

Table.4.1. 29.Association and determinants of underweight in children below five years based on morbid conditions in Tumkur district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No Yes	77.9 76.9	30.1 23.1	27.1 30.9	20.7 22.9	71(82.9) 15(17.2)	DF=3 X^2=0.2995 P=0.9601(NS)	-0.140 RC	0.798(-)
Had cough								
No Yes	78.6 72.6	30.7 18.3	27.9 27.4	20.0 27.1	73(85.5) 12(14.5)	DF=3 X^2=0.9893 P=0.8038(NS)	-0.156 RC	0.790(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight..								

Source: NFHS-2

Results presented in Table.4.1.29 show there was no significant association between underweight and morbidity in children though severe underweight was slightly higher in children who suffered from cough and fever two weeks prior to the survey. Gul and Kiramat (2012) did not find morbidity to be associated with malnourishment where as Ray *et al.* (2000) found malnourishment to be highest in morbid children (70 % in children with ARI).

4.1.10.3.4. Immunization

Results presented in Table.4.1.30 showed that there was a significant association between underweight in children with immunization in measles and slightly with DPT3 but not with polio and BCG. This result is contradictory to the known protective effect of immunization on nutritional status. In here, all children who were immunized against polio, measles and DPT3 had higher prevalence of underweight except for BCG in which children who did not get immunized were more underweight. A study in IDPS of Noshwera by Gul and Kiramat (2012) reported that partially immunized children had highest prevalence of malnutrition (64 %) as compared to non- immunized children (33 %) and the association was significant.

Table.4.1. 30.Association and determinants of underweight in children below five years based on morbid conditions in Tumkur district during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No Yes	65.3 84.1	26.7 30.0	23.3 30.2	15.3 24.0	29(34.2) 56(65.8)	DF=6 X^2=8.508 P=0.2032(NS)	-0.753 RC	0.088(-)
Received Measles								
No Yes	62.1 87.3	34.4 25.5	17.3 34.3	10.4 27.6	32(38.1) 53(61.9)	DF=3 X^2=13.8133 P=0.0318*	**-1.398** **RC**	**0.002(4.05)**
Received BCG								
No Yes	83.6 77.2	16.4 29.9	33.3 27.3	33.8 19.9	7(7.8) 79(92.2)	DF=6 X^2=4.029 P=0.6727(NS)	0.693 RC	0.369(-)
Received DPT3								
No Yes	61.5 86.1	26.8 30.0	19.4 32.2	15.3 24.0	29(34.1) 56(65.9)	DF=6 X^2=12.367 P=0.0543	**-0.990** **RC**	**0.027(2.69)**
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight..								

Source: NFHS-2

4.1.10.3.5. Determinants of underweight in children

Results based on logistic regression were presented in Table.4.1.28, Table.4.1.29 and Table.4.1.30. The results showed that there was a significant correlation between age of child, child anaemia, sex of the child, breastfeeding, caste, education of the mother and immunization but not with residence, religion, occupation of the mother and morbidity.

Sex was negatively correlated with severity of underweight in children. The RR of being underweight was 5.08 times in male children in comparison to their female counterparts of the same age. Ahmed *et al*. (2012) found male children to have 0.80 times odds of being underweight. In children of the same age, growth is more rapid for male children coupled with the higher physical activity (Kikafunda *et al*. 1998).

Child anaemia was positively correlated with underweight in children. The RR of being underweight was 0.22 times in children who were moderately anaemic in comparison to children with normal haemoglobin status. This is because chronically malnourished children are likely to be anaemic and the relationship is synergistic with anaemic children being at 1.31 times RR of being underweight among Brazilian children (Leite *et al*., 2013).

Age was negatively correlated with severity of underweight in children. The RR of being underweight was 23.6 times (0-6 months) and 8.0 times (in >6-≤8 months) old children as compared to their counterparts who between >23-≤35 months old. This result infers that underweight decreased by 100 % in younger children. Older children were more underweight which can be attributed to improper weaning, recurrent infections making the age group vulnerable (Gupta *et al*., 1991).

Breastfeeding was positively correlated to severity of underweight in children. Children who were not breastfeeding by the time of the survey had a 0.25 times increased risk of being anaemic as compared to their counterparts who were still breastfeeding. This finding infers the protective role of breastfeeding against underweight as nutrients in breast milk are easily absorbed and the reduced risk of infection during breastfeeding.

Education of a mother was positively correlated with severity of underweight in children. This result infers that underweight increased with a decrease in mother's education. The RR of being severely underweight increased with a decrease in mothers' educational level. The RR of being underweight was 0.14 times and 0.11 times in children with mothers who had no education and those whose mothers attained primary education respectively. Many studies have demonstrated that improvements in secondary school enrolment rates among females are estimated to be responsible for 43 percent of the total 15.5 percent decline in the childhood underweight rate in developing countries during the period 1970–1995 (Rahman *et al*., 2009).

Immunization against measles and DPT3 was negatively correlated with prevalence of underweight. Children who were not immunized with measles and DPT3 had a RR of 4.05 times and 2.69 times of being underweight respectively as compared to other children who were fully immunized. This finding is similar to Ahmed *et al*. (2012) where children who did not receive measles vaccination in Bangladesh had 1.44 odds of being underweight.

4.1.2.3.5. Comparison between underweight prevalence in Bijapur and Tumkur districts.

Figure.4.1.14 shows that prevalence of underweight was higher in Tumkur district children by 5.9 percent as compared to children in Bijapur district. More children in Tumkur district were severely underweight as compared to their counterparts in Bijapur district. Figure.4.1.15 shows that severe anaemia was most prevalent in older children in both districts.

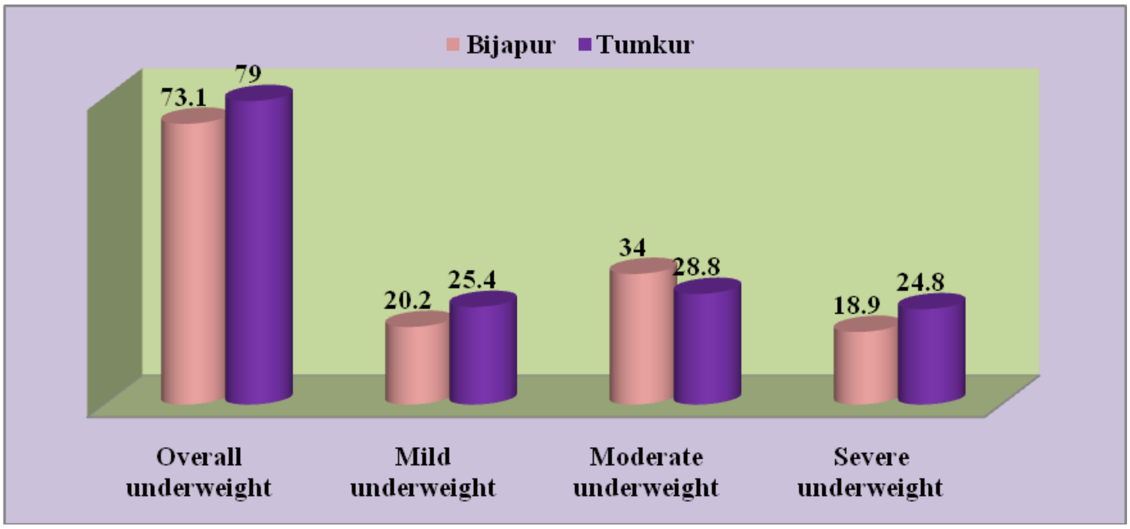

Figure.4.1.14. Prevalence of severe underweight in children by residence and gender in Bijapur and Tumkur districts during 1998/99.

Figure.4.1.13 showed that severe underweight was highest among urban, rural and female children in Tumkur district as compared to children in Bijapur district where as it was highest among male children. This indicates that, female child discrimination is highest in Tumkur district.

In both districts, age of the child, and child anaemia stood as predictor variables for underweight prevalence in children below five years. Generally, the prevalence of severe underweight was very high in both districts (figure.4.1.15) which can be attributed to the poor sanitary conditions in the two districts with <90 percent of the households lacking toilet facilities and hence practice open defecation (Table.4.1.25 and Table.4.1.28).

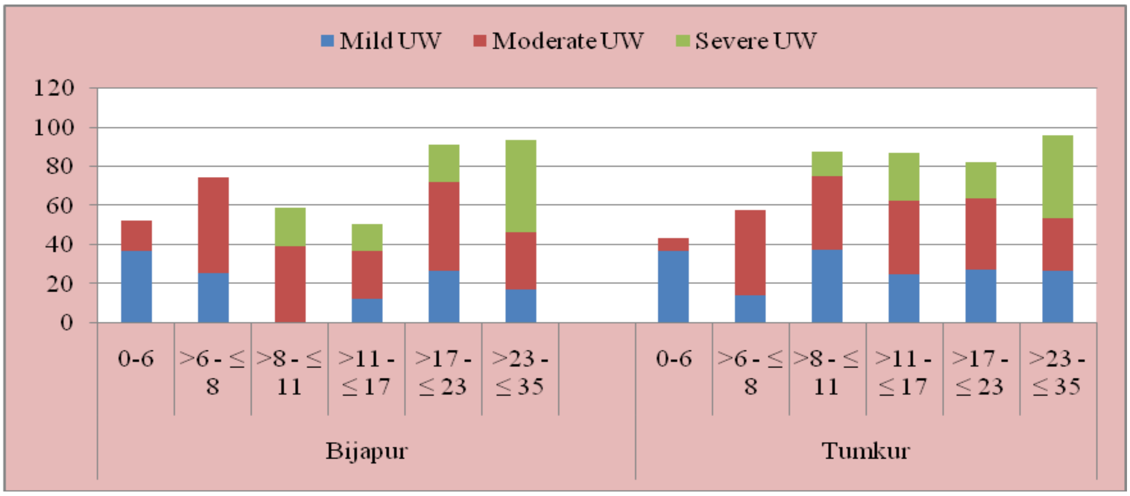

Figure.4.1. 15 Figure.4.1.15. Prevalence of severe underweight in children by residence and gender in Bijapur and Tumkur districts during 1998/99

4.1.11. Karnataka state (KA) 1998/99

4.1.11.1 Profile of children below five years in Karnataka state during NFHS-2

Data on approximately 1159 children below five years was included in the study. Out of these children, the larger majority were urban residents (67.9 %), of Hindu religion (80.7 %), between >23-≤35 months old (30.2 %), of average size at birth (41.6 %), were still breastfeeding (73.8 %), and belonged to other social groups (caste) other than SC, ST and OBC. Most of the children had mothers who were not educated (49.5 %), were not working (61.4 %) and belonged to households with no toilet facilities (65.5 %).

Results in Table.4.1.32 revealed that 72.3 percent of the children did not suffer from fever and 77.1 percent did not suffer from cough two weeks prior to the survey. Majority of the children had been completely immunized with only half having received measles immunization (Table.4.1.33).

4.1.11.2. Prevalence of underweight among children below five years in Karnataka state during NFHS-2

The overall prevalence of underweight in children during this survey was 70.9 percent of which 25.1 percent were mildly underweight, 28.0 percent of the children were moderately underweight and 17.8 percent of the children were severely underweight. An almost similar prevalence of severe underweight has been reported among children in Andhra Pradesh (17.3 %) and Karnataka (15 %) but the overall

Table.4.1. 31. Percentage association and determinants of underweight in children below five years based on selected socio-economic and demographic factors in Karnataka state during 1998/99

Background characteristic	Percent age of UW children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild -UW	Mod -UW	Sev -UW			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban Rural	68.6 74.8	29.2 28.6	28.9 26.7	9.9 19.5	37(32.1) 787(67.9)	DF=3 X^2=18.4575 P=0.0004**	**-0.360** **RC**	**0.003(1.43)**
Religion								
Hindu Muslim Christian Others No religion	72.5 73.7 81.3 64.1 0.0	28.7 29.4 40.9 0.0 0.0	27.0 27.0 35.9 64.1 0.0	16.8 16.4 4.6 0.0 0.0	935(80.7) 195(16.8) 25(2.1) 3(0.3) 1(0.1)	DF=12 X^2=11.0676 P=0.5231(NS)	0.580 0.614 0.533 RC	0.526(-) 0.505(-) 0.590(-)
Sex								
Male Female	72.0 73.7	29.8 28.1	27.3 27.5	14.8 18.1	592(51.1) 567(48.9)	DF=3 X^2=2.5343 P=0.4691(NS)	-0.119 RC	0.289(-)
Age								
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35	31.4 53.5 79.1 81.3 86.7 87.2	25.0 25.9 26.1 32.2 30.9 29.9	6.4 23.1 39.5 29.7 34.1 31.9	0.0 4.5 13.6 19.4 21.7 25.4	190(16.4) 120(10.4) 90(7.8) 208(17.9) 202(17.4) 349(30.2)	DF=15 X^2=292.3399 P<.0001**	**-2.739** **-1.606** -0.422 **-0.375** -0.100 RC	**<.0001(15.47)** **<.0001(4.98)** 0.061(-) **0.025(1.45)** 0.550(-)
Size at birth								
Very large Larger than AV Average (AV) Smaller than AV Very small	NA 67.3 70.8 77.7 100.0	NA 33.2 28.9 25.9 21.7	NA 25.5 26.1 27.8 57.6	NA 8.7 15.6 24.0 20.6	NA 307(26.5) 482(41.6) 333(28.7) 37(3.2)	DF=9 X^2=57.0067 P<.0001**	NA **1.396** **1.103** **-0.684** RC	NA **<.0001(4.04)** **0.001(3.01)** **0.040(1.98)**
Currently breastfeeding								
No Yes	78.7 70.7	33.2 27.5	30.3 26.4	15.2 16.9	304(26.2) 855(73.8)	DF=3 X^2=9.4661 P=0.0237*	-0.127 RC	0.090(-)
Caste								
SC ST OBC NONE	77.0 85.5 69.6 72.1	24.3 29.9 29.7 30.8	29.8 26.9 27.8 25.8	22.9 28.7 12.0 15.5	223(19.5) 70(6.1) 405(35.4) 447(39.0)	DF=9 X^2=27.6445 P=0.0011**	**0.397** **0.613** -0.123 RC	**0.010(0.67)** **0.011(0.54)** 0.342(-)
Child anaemia								
Severe-A Mod-A Mild-A Normal	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	NC NC NC NC	0.641 **0.417** 0.158 RC	0.480(-) **0.015()** 0.101(-)
Maternal characteristics								
Education of mother								
No education Primary Secondary Higher	80.2 75.1 63.1 59.5	23.8 31.3 28.5 38.0	31.9 31.1 26.2 16.0	24.5 12.7 8.4 5.6	574(49.5) 200(17.3) 106(9.1) 279(24.1)	DF=9 X^2=114.1822 P<.0001**	**1.286** **0.781** 0.322 RC	**<.0001(0.28)** **<.0001(0.46)** 0.143(-)
Occupation								
Not working Professional Clerical Sales Agric S-E Agric E Household Service Skilled-M Unskilled -M	69.1 60.1 0.0 79.2 78.7 82.0 82.6 100.0 75.6 69.9	33.6 20.3 0.0 19.9 24.9 19.6 0.0 0.0 29.6 14.7	24.5 26.2 0.0 39.3 36.8 31.6 48.4 0.0 31.6 9.7	11.0 13.6 0.0 19.9 17.0 30.8 34.2 100 14.4 48.5	711(61.4) 17(1.4) 1(0.1) 16(1.4) 123(10.6) 213(18.4) 7(0.6) 1(0.1) 45(3.9) 22(1.9)	DF=30 X^2=105.3585 P<.0001**	**-0.855** -0.950 -4.558 -0.258 -0.313 0.176 0.650 -0.455 RC	**0.032(2.35)** 0.120(-) 0.192(-) 0.678(-) 0.464(-) 0.671(-) 0.441(-) 0.348(-)
Toilet facility								
Flush Pit-latrine Bush	59.5 66.1 78.1	29.3 32.3 28.0	23.7 23.9 29.3	6.6 9.9 20.8	207(17.9) 193(16.6) 759(65.6)	DF=18 X^2=73.3346 P<.0001**	**-0.903** **-0.648** **RC**	**<.0001(2.47)** **<.0001(1.91)**
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC= Not computed, NA=not available								

Source: NFHS-2

prevalence was lower than that of the current study with prevalence of 59.4 percent (IIPS & MoHFW, 2006) during DLHS- RCH 2002-2004. Studies outside India reported different findings with higher prevalence than the current study in Nigerian children (82.13 %) and lower prevalence in Ethiopian children (36.6 %) which could be due difference in race of study population and data collection methods employed (Amonsu *et al*., 2011 and Zewdu, 2012) respectively.

4.1.11.3. Association of underweight and selected variables

4.1.11.3.1. Children characteristics

Results presented in Table.4.1.31 showed that there was a significant association between residence, age, size at birth, currently breastfeeding, and caste but not with religion and sex.

Prevalence of underweight increased with increase in age of the child with younger children having the lowest prevalence (31.4 %) and the highest among the older children (87.2 %). Singh *et al*. (2013) also found a significantly higher prevalence of underweight among older children (80 %) among >35-≤47 months as against younger children. Findings of this study are backed up by Kandala *et al.* (2011) who found an inverse linear relationship association of underweight with age.

Similar to findings of (IIPS & MoHFW, 2006), children from ST sect had the highest prevalence severe underweight and overall underweight prevalence in the current study with a prevalence of 85 percent overall underweight and 28.7 percent. This is because of the low socio-economic status; they are likely to live in "Kutcha or semi- pucca shelters" which have been associated to increase malnutrition in children due to the increase in morbidity through communicable diseases (NNMB, 2002). Also the children are likely to consume nutrients below the RDA due to low purchasing power as seen in households of low social economic status.

4.1.11.3.2. Maternal characteristics

Bivariate analysis found a significant association between prevalence of underweight and education of mother, occupation and type of toilet facilities. Similar results have been reported by several studies (NNMB, 2000, Sharghi *et al.,* 2011, Kandala *et al*., 2011).

4.1.11.3.3. Morbidity

Results presented in Table.4.1.32 showed that morbidity was not significantly associated with prevalence of underweight in children in Karnataka state. This contradictory to findings of Rahim *et al.* (2013) and Santosh *et al.* (2013) who found morbidity to be significantly associated to prevalence of undernourishment in children.

Table.4.1. 32. Association and determinants of underweight in children below five years based on morbid conditions in Karnataka state during 1998/99.

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild -UW	Mod -UW	Sev -UW			Estimate	Significance (RR)
Had fever								
No Yes	70.9 78.5	29.2 28.4	25.9 31.8	15.8 18.3	861(72.3) 297(25.6)	DF=6 X^2=11.2214 P=0.0818(NS)	4.687 RC	0.237(-)
Had cough								
No Yes DK	72.2 75.1 50.0	29.1 28.5 0.0	26.6 29.9 50.0	16.4 16.7 0.0	893(77.1) 264(22.8) 2(0.2)	DF=6 X^2=3.2872 P=0.772(NS)	-0.368 -0.343 RC	0.840(-) 0.851(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight..								

Source: NFHS-2

4.1.11.3.4. Immunization

Results presented in Table.4.1.33 showed that immunization was significant to influence the prevalence of underweight in children below five years in this state. Nandy *et al*. (2005) and Rahim *et al.* (2013).

Table.4.1. 33.Association and determinants of underweight in children below five years based on morbid conditions in Karnataka state during 1998/99

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No Yes	65.3 84.1	26.7 30.0	23.3 30.2	15.3 24.0	29(34.2) 56(65.8)	DF=6 X^2=8.508 P=0.2032(NS)	NC NC	NC NC
Received Measles								
No Yes	62.1 87.3	34.4 25.5	17.3 34.3	10.4 27.6	32(38.1) 53(61.9)	DF=3 X^2=13.8133 P=0.0318*	**-1.076** **RC**	**0.044(2.93)**
Received BCG								
No Yes	83.6 77.2	16.4 29.9	33.3 27.3	33.8 19.9	7(7.8) 79(92.2)	DF=6 X^2=4.029 P=0.6727(NS)	**0.693** **RC**	**<.0001(0.44)**
Received DPT3								
No Yes	61.5 86.1	26.8 30.0	19.4 32.2	15.3 24.0	29(34.1) 56(65.9)	DF=6 X^2=12.367 P=0.0543	0.298 RC	0.163(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight...								

Source: NFHS-2

4.1.11.3.5. Determinants of underweight in children

Results based on ordinal logistic regression are presented in Table.4.1.31, 4.1.32 and 4.1.33. Results show that there was a significant correlation between residence, ethnicity, age and size at birth, breastfeeding, education of mother and occupation, toilet facility in the household, child anaemia and immunization.

These findings are backed up national surveys like IIPS and ORC Macro (2000), NNMB (2002), NNMB (2006), IIPS and Macro (2007) and other smaller studies like Santosh *et al*. (2013).

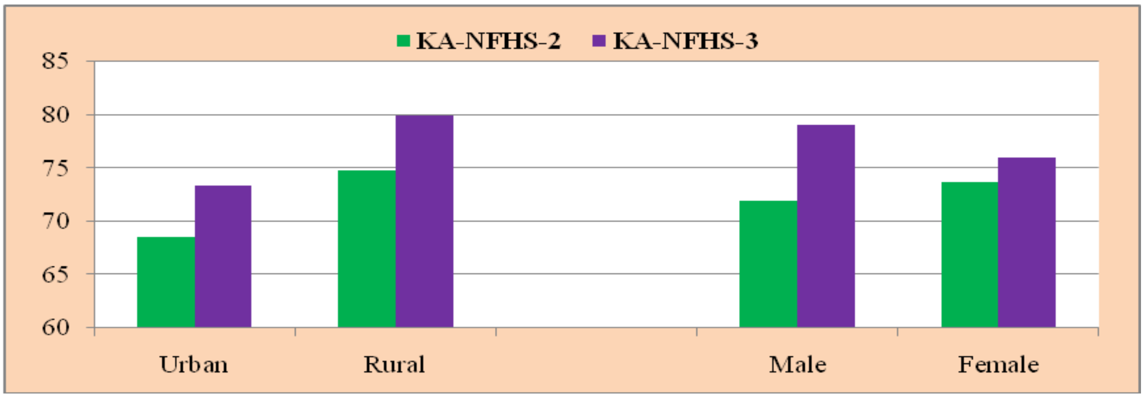

Figure.4.1. 16. Trends in underweight prevalence in children below five by residence and Gender in Karnataka state during NFHS-2 and NFHS-3

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4.1.12. Karnataka state (KA) 2005/06

4.1.12.1 Profile of children below five years in Karnataka state during NFHS-3

Data on approximately 1790 children was included in the study. Out of these children, the larger majority were of rural residency (64.6 %), Hindu religion (83.3 %), male (52.7 %), between the ages <23-≤59 months old, were of average size at birth (45.6 %), were still breastfeeding (57.0 %) and from OBC caste (57.7 %). Majority of the children also belonged to richer households (25.9 %) and in households with no toilet facilities (53.1 %).

Data on morbidity revealed that majority of the children did not suffer from cough, fever or diarrhoea two weeks prior to the survey (Table.4.1.35). Also, data in Table.4.1.36 shows that majority of the children were fully immunized against Polio (69.7 %), measles (66.6 %) and DPT3 (68.7 %).

4.1.12.2. Prevalence of underweight among children below five years in Karnataka state during NFHS-3

The overall prevalence of underweight among children was 76.0 percent of which 33.4 percent were mildly underweight, 28.8 percent were moderately underweight and 13.7 percent were severely underweight. Similar prevalence of severe underweight

Table.4.1. 34. Percentage association and determinants of underweight in children below five years based on selected socio-economic and demographic factors in Karnataka state during 2005/06

Background characteristic	Percentage of Underweight children	Percentage of children with			Number of children (%)	Chisquare & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Child characteristics								
Residence								
Urban	73.4	36.5	26.3	10.6	634(35.4)	DF=3	-0.295	<.0001(1.34)
Rural	80.0	31.8	34.0	14.2	1156(64.6)	X^2=22.2313	RC	
						P<.0001**		
Religion								
Hindu	77.7	32.6	31.5	13.7	1488(83.3)	DF=12	0.141	0.762(-)
Muslim	78.4	37.8	29.5	10.9	253(14.2)	X^2=17.777	0.152	0.750(-)
Christian	72.3	32.6	39.7	0.0	32(1.8)	P=0.1226	-0.275	0.611(-)
Others	66.4	58.2	8.2	0.0	14(0.8)	(NS)	RC	
Sex								
Male	79.1	35.5	31.5	12.1	943(52.7)	DF=21	0.054	0.480(-)
Female	76.0	31.3	31.0	13.1	847(47.3)	X^2=156.1749	RC	
						P=0.1617*		
Age								
0-6	31.1	27.2	3.9	0.0	68(3.8)	DF=21	-2.808	<.0001(16.58)
>6 - ≤ 8	60.1	35.2	19.8	5.1	96(5.4)	X^2=156.1749	-0.810	<.0001(2.25)
>8 - ≤ 11	75.7	39.2	29.1	7.3	100(5.6)	P<.0001**	-0.242	0.205(-)
>11 - ≤ 17	80.9	34.4	28.7	17.8	200(11.2)		-0.035	0.817(-)
>17 - ≤ 23	78.7	37.3	28.0	13.4	180(10.1)		-0.050	0.748(-)
>23 - ≤ 35	73.1	26.4	33.3	13.3	382(21.3)		-0.081	0.518(-)
>35 - ≤ 47	85.9	35.4	37.2	13.3	386(21.6)		-0.089	0.474(-)
>47 - ≤ 59	81.7	35.5	34.4	11.7	377(21.1)		RC	
Size at birth								
Very large	65.2	37.4	20.4	7.5	133(7.5)	DF=15	-0.192	0.652(-)
Larger than AV	73.4	35.3	25.5	12.6	437(24.5)	X^2=51.3626	0.055	0893(-)
Average (AV)	78.7	33.5	33.1	12.1	813(45.6)	P<.0001**	0.088	0.829(-)
Smaller than	84.3	30.0	39.0	15.3	273(15.3)		0.145	0.725(-)
AV	85.5	29.3	37.7	18.4	112(6.3)		-0.128	0.763(-)
Very small	76.7	39.2	15.0	22.5	16(0.9)		RC	
Currently breastfeeding								
No	77.1	36.8	29.8	10.5	769(43.0)	DF=3	-0.046	0.552(-)
Yes	78.1	31.0	32.4	14.7	1020(57.0)	X^2=63.9087	RC	
						P<.0001**		
Caste								
SC	78.3	30.5	32.2	15.6	292(16.3)	DF=12	-0.114	0.566(-)
ST	82.1	28.5	33.2	20.9	123(6.9)	X^2=21.3704	-0.219	0.326(-)
OBC	78.2	33.7	32.1	12.3	1032(57.7)	P=0.0452*	-0.019	0.919(-)
NONE	75.0	36.8	27.8	10.4	248(13.9)		-0.092	0.656(-)
DK	71.2	39.0	24.4	7.8	93(5.2)		RC	
Child Anaemia								
Severe-A	NC	NC	NC	NC	NC	NC	2.150	0.119(-)
Moderate-A	NC	NC	NC	NC	NC	NC	0.433	0.022(0.65)
Mild-A	NC	NC	NC	NC	NC	NC	0.028	0.797(-)
Normal	NC	NC	NC	NC	NC	NC	RC	
Maternal characteristics								
Education of mother								
No education	NC	NC	NC	NC	NC	NC	-0.367	0.561(-)
Primary	NC	NC	NC	NC	NC	NC	-0.179	0.779(-)
Secondary	NC	NC	NC	NC	NC	NC	-0.518	0.412(-)
Higher	NC	NC	NC	NC	NC	NC	-0.670	0.294(-)
DK							RC	
Occupation								
Not working	NC	NC	NC	NC	NC	NC	-0.173	0.222(-)
Professional	NC	NC	NC	NC	NC	NC	-0.465	0.114(-)
Clerical	NC	NC	NC	NC	NC	NC	0.014	0.974(-)
Sales	NC	NC	NC	NC	NC	NC	-0.121	0.784(-)
Agric E	NC	NC	NC	NC	NC	NC	0.300	0.52(-)
Services	NC	NC	NC	NC	NC	NC	0.572	0.114(-)
Unskilled -M	NC	NC	NC	NC	NC	NC	RC	
Toilet facility								
Flush	71.1	39.6	24.2	7.3	573(32.1)	DF=27	0.623	<.0001(0.54)
Pit-latrine	69.3	38.2	24.3	6.7	116(6.5)	X^2=110.6874	0.546	0.005(0.58)
Bush	83.7	30.3	36.4	17.0	948(53.1)	P<.0001**	0.955	<.0001(0.38)
Others	66.7	33.3	0.0	33.3	4(0.2)		RC	
Not dejure resid	70.6	25.5	32.4	12.6	145(8.1)			

*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC= Not computed, NA=not available

Source. NFHS-3(13.4 %) was reported in Orissa and Karnataka (12.8 %) with overall prevalence (50.4 %) which is much lower than that of the current study during NFHS-3 survey (IIPS and Macro, 2007). However, Teshome *et al.* (2006) and Kebede (2007) reported underweight prevalence of 49.2 percent and 23.5 percent in West Gojam and Gimbi districts of Ethiopia respectively.

4.1.12.3. Association of underweight and selected variables

Results in this section are based on bivariate analysis using chi-square to find association of the studied variables with underweight in children below five years

4.1.12.3.1. Children characteristics

Results presented in Table.4.1.34 show that there was a significant association between residence, sex, age, size at birth, breastfeeding status and caste with prevalence of underweight in children. NNMB (2002) stated that a strong association existed between underweight with age, size at birth and caste but not sex of the child similar to the current study and Abubakar *et al*. (2012).

Similar to DHS (2000) in Sri Lanka where low birth weight children (<2.5 kgs) had a higher prevalence of underweight compared to children with normal weight at birth (>2.5 kgs) with a prevalence of 47 percent as against 25 percent respectively, the current study reported a prevalence of 85.5 percent and 84.3 percent among very small and smaller than average children as against 65.2 percent in very large babies at birth. This result is backed up by findings of Anoop *et al.* (2004).

The study results also show an unexpected trend in underweight prevalence with breastfeeding children having a slightly higher prevalence of underweight as compared to non-breastfeeding children (78.1 % vs 77.1 %) which was significant. This result is not in-line with several reports that have noted the protective role of breastfeeding (WHO, 2012). This result could be due to mixed feeding or early introduction of other diets before six months which have been strongly associated with diarrhoeal illness and pneumonia leading to increased risk of malnutrition among Chinese children (Amsala and Tigaba, 2008 and Bloss et al., 2004.

4.1.12.3.2. Maternal characteristics

Similar to NNMB (2002), NNMB (2006) and Singh *et al.* (2013), the current study found educational level of the mother, access to toilet facility and occupation to be significantly associated with prevalence of underweight in children below five years with higher prevalence in children with uneducated mothers who are employed in the agricultural sector as labourers and living in households without access to toilet facility. Also studies on education intervention programmes for mothers for a short duration follow-up failed to show any significant difference between educational intervention group compared to controls (Bhandari *et al*., 2004), Bhandari *et al*., 2001) in Haryana and Santos *et al*., 2001 in Brazil).

4.1.12.3.3. Morbidity

Table.4.1. 35.Association and determinants of underweight in children below five years based on morbid conditions in Karnataka state during 2005/06

Background	Percentage of children who are UW	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Had fever								
No	77.2	33.2	31.3	12.7	1537(86.1)	DF=3	**2.955**	**0.004(0.05)**
Yes	80.4	34.9	31.6	14.0	249(14.0)	X^2=1.5143	**2.999**	**0.003(0.05)**
DK						P=0.679(NS)	**RC**	
Had cough								
No	78.1	33.1	32.0	13.0	1553(87.4)	DF=36	**2.786**	**0.006(0.06)**
Yes	74.1	34.5	27.5	12.2	223(12.6)	X^2=10.8856	**2.830**	**0.005(0.06)**
DK	100.0	0.0	0.0	100.0	1(0.1)	P=0.092(NS)	**RC**	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight...								

Source: NFHS-3

Results presented in Table.4.1.35 below show that there was no significant association between underweight prevalence in children with morbidity (Gul and Kiramat, 2012).

4.1.12.3.4. Immunization

Table.4.1. 36Table.4.1.36.Association and determinants of underweight in children below five years based on morbid conditions in Karnataka state during 2005/06

Background	Percentage of UW children	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-UW	Mod-UW	Sev-UW			Estimate	Significance (RR)
Received Polio								
No	76.3	31.7	31.7	12.9	523(29.4)	DF=12	**-0.411**	**<.0001(1.51)**
Yes	78.3	34.3	31.2	12.8	1241(69.7)	X^2=30.2127	**RC**	
DK	85.3	35.7	42.6	1.0	17(1.0)	P=0.0026**		
Received Measles								
No	75.8	32.3	27.5	16.0	581(32.6)	DF=12	**-0.400**	**<.0001(1.49)**
Yes	78.6	34.5	32.7	11.4	1186(66.6)	X^2=37.1298	**RC**	
DK	67.0	17.0	42.0	8.0	15(0.8)	P=0.0002**		
Received DPT3								
No	78.6	29.4	31.9	17.4	551(30.9)	DF=12	**-0.321**	**<.0001(1.38)**
Yes	77.1	35.3	30.9	10.4	1226(68.7)	X^2=35.192	**RC**	
DK	86.9	43.5	43.5	0.0	9(0.5)	P=0.0004**		
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight...								

Source: NFHS-3

Results presented in Table.4.1.36 below show that there is a significant association between underweight in children with complete immunization. Children who were not immunized fully had a higher prevalence of severe underweight as compared to the other children who were immunized fully**.** Rahim *et al*. (2013) reported similar findings with lack of complete vaccination in children showing a higher prevalence of Underweight.

4.1.12.3.5. Determinants of underweight in children

Results in this section based on ordinal logistic regression are presented in Table.4.1.34, 4.1.35 and 4.1.36. Findings revealed that the only variables that were significantly correlated with underweight include residence, age, child anaemia, toilet facility, morbidity and immunization status only despite bivariate analysis showing a significant association with sex, size at birth, breastfeeding, caste.

Residence was negatively correlated with prevalence of underweight in children. This result infers that among urban children, underweight decreased by 29.5 percent. The RR of being underweight was 1.34 times lower among urban children compared to their rural counterparts.

Age of the child was also negatively correlated with severity of underweight in children. In comparison to older children, the RR of being underweight was 16.58 times lower in younger children (0-6 months) and it was 0.65 times among (>6-≤8 months) old children. The sharp increase in prevalence between the 6^{th} and 8^{th} month is due to introduction of weaning foods some of which are nutritionally inferior especially being traditional based foods like porridge which a low in essential amino acid to support the rapid growth.

As stated in NMMB (2002) in 2001 rural household survey, type of toilet facility (latrine) was a predicting factor to chronic malnutrition as was seen in this study with lack of access to a facility and unhygienic toilet facilities increasing the risk of underweight in children. The RR of underweight prevalence among children was 0.38 times, 0.58 times and 0.54 times among children living in households with no access to toilet facilities, pit latrines and flush toilets (Table.4.1.34). The higher risk in children living in households with access as compared to those without access to toilet facility could be an issue related to hygiene. Access alone is not enough to avert the occurrence of communicable diseases. These facilities need to be maintained clean to avoid spread of communicable diseases. Unsanitary toilet facility has been linked to prevalence of underweight through reoccurrence of morbid conditions in children (IIPS and ORC Macro, 2000 and IIPS and Macro, 2007) during NFHS-2 and NFHS-3.

Childhood anaemia was positively correlated with severity of underweight prevalence. The RR of being underweight was 0.65 times among moderately anaemic children.

Morbidity was positively correlated with severity of underweight. The RR of being underweight was 0.05 times and 0.06 times among children who suffered from fever and cough respectively. Rahim *et al*. (2013) reported a significant correlation between underweight and morbidity similar to NNMB (2002) with children with morbid conditions having higher incidence of underweight.

Immunization is an essential intervention to prevent childhood infections and malnutrition (Nandy *et al.,* 2005). The RR of being underweight was 1.49 times, 1.51 times and 1.38 times among children who were not immunized with measles, polio and DPT3 vaccine. Such children were prone to malnutrition through compromised immunity. Rahim *et al.* (2013) also found incomplete or lack of immunization as risk factor for underweight in children.

4.1.12.3.6. Trends in prevalence of underweight in children between 1998-2006

Figure.4.1.17 below shows that prevalence of underweight in children increased over the years by 5.1 percent. However, severe underweight decreased by 4.1 percent between the two surveys. This difference can be a result of difference in age groups analyzed between the two surveys that is 0-3 years in NFHS-2 and 0-5 years in NFHS-3 and as seen higher prevalence being in older children.

Between the two surveys, underweight presently remained higher in rural children indicating a worse-off situation in the rural part (Figure.4.1.16) of the state which could be due to low socio-economic status limiting access to quality services and food. Also figure.4.1.18 shows a decrease in severe underweight prevalence among older children which can be attributed to improved child feeding practices.

Over the years, residence, Age, toilet facilities, child anaemia and immunization remained as persistent predictors of underweight but at different RR (see Tables.4.1.32-36).

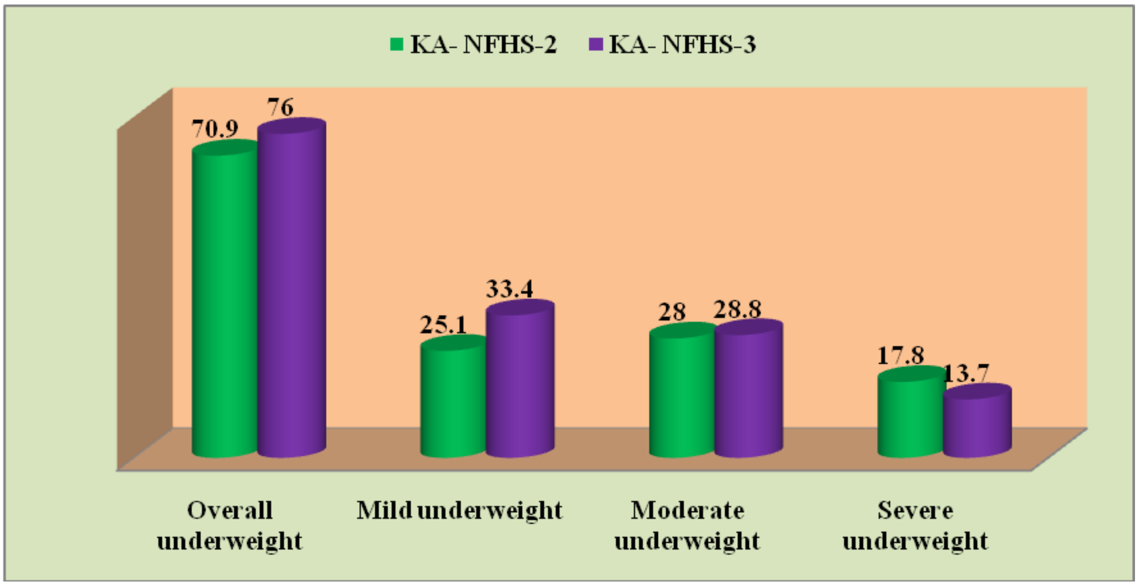


Figure.4.1.17. Trends in prevalence of underweight in children in Karnataka state during NFHS-2 and NFHS-3 surveys

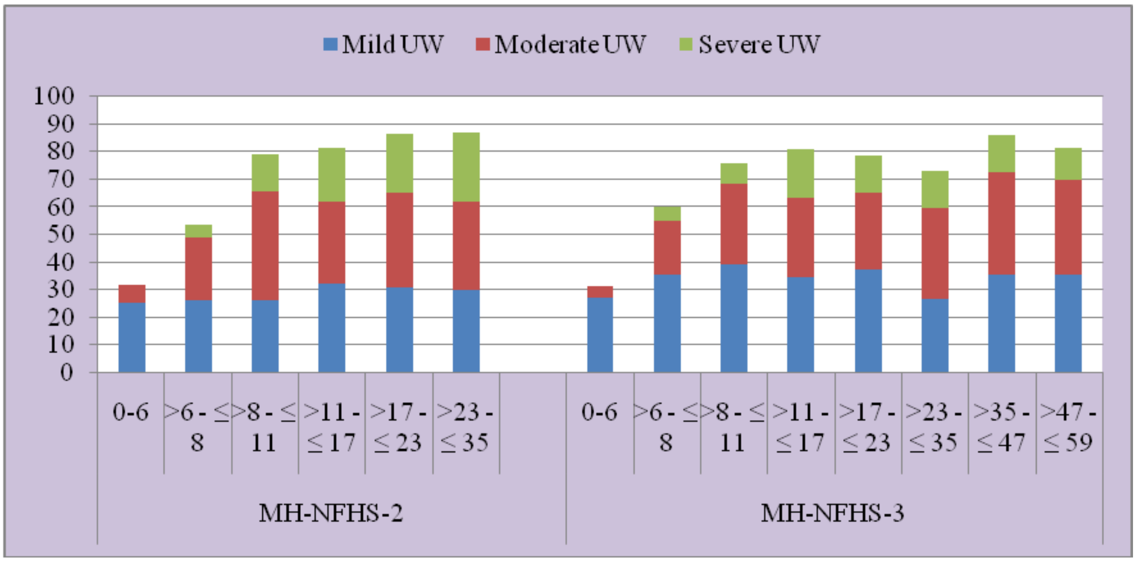


Figure.4.1. 18. Trends in prevalence of underweight in children by age in Karnataka state during NFHS-2 and NFHS-3 surveys.

4.1.12.3.7. Conclusion.

In all districts and states studied, the prevalence of underweight was extremely high with prevalence ranging from 58 percent to 84 percent with rural children being more underweight than urban children. This is contradictory to reports of NFHS-3 and Kenyan trend analysis which show a decline in underweight prevalence over the years (IIPS and Macro, 2007 and Matanda *et al*., 2014).

Over the years, underweight increased slightly but severe underweight continued to decrease. From the findings in all study areas, older age, low birth weight, child anaemia, mother's employment and illiteracy, lack of access to sanitary toilet and immunization were the strongest risk factors associated with underweight. This study found women employment to contribute to underweight prevalence, requiring a policy change where the working environment for women should be made friendly to allow for proper child care as the women work. This is because enhancing a woman's access to money does not seem to be the only solution to underweight as seen in one study area where children with professional mothers were highly underweight (Yeleswarapa and Nallapu, 2012). Nutritional education and hygiene has also shown its relevance hence keeping a clean surrounding should be advocated for as one of the methods to try and curb malnutrition threat in children and adults as well (NNMB, 2006).

4.1 (B). Nutritional status of women.

Data was analyzed at two points in time (1998/99 and 2005/06) and the results are presented for both years under the following headings:

a) Background characteristics of the study population
b) Prevalence of malnutrition in women.
c) Association of malnutrition with selected characteristics (socio-economic, socio-demographic and autonomy).
d) Anaemia prevalence.
e) Comparisons between districts and states
f) Trends in nutritional status among women during 1998-2006.

4.1.13. Nutritional status of women (15-49 years) in Prakasam district during NFHS-2.

4.1.13.1. Background characteristics of the women (15-49 years) in Prakasam district during NFHS-2

Data on 260 women between the ages 15-49 years was included in the study and results presented in Table.4.1.37. Out of these women, almost all were living in rural Prakasam (91.4 %), belonged to OBC, of Hindu religion (76.2 %), between the ages 20-24 years. Out of the women included in the study, only 219 gave a response on when they had their first child. Analysis of this data shows that majority of these women had their first child between the ages15-19 years (66.6 %) an indication adolescent pregnancy/ child marriage in the district. By the time of the survey, most women had no living child (59.7 %).

Results presented in Table.4.1.37 show that atleast (30.5 %) of the women were not working. Among those working, majority were employed in agricultural sector (54.8 %). Data on women education and their partners reveals that less women were educated as compared to their partners hence men remain superior in education over women despite the role women play in management of family affairs (58.0 % Vs 39.8 %) of those with no education and (2.9 % Vs 13.6 %) among those with higher education between women and men respectively. In this study population, majority of the women belonged to middle class households as regards wealth (32.9 %) and despite the fair socio-economic environment, majority of the women came from households

Table.4.1. 37. Prevalence of Malnutrition among women (15-49 years) in Prakasam district during 1998/99 survey.

without proper toilet facilities (88.2 %) an indication of very poor sanitary conditions. Also most of the women (71.6 %) reported to have delivered their children from home an indication of poor use of government health facilities which have subsidized medical charges and others free especially in pregnancy.

Data on women autonomy shows women have more authority in taking independent decisions as regards money expenditure (34.2 %) but the authority to acquire health care lies more on their partners (47.4 %).

It was established that overall malnutrition in women was 47.5 percent. Out of these, 34.9 percent had chronic energy deficiency (CED) while 12.6 percent were overweight/ obese (OW/OB) at different degrees (figure.4.1.19). The same figure further shows that 15.1 percent and 19.8 percent are moderately thin and mildly thin respectively while 7.2 percent are overweight and 5.4 percent are obese. This result is consistent with findings in India during 1998 survey with 31.5 percent CED and 13.0 percent OW/OB among women 20-49 years However, in other countries surveyed during 1998/99 reported higher prevalence of OW than CED among the women: Cameroon (6.7 % vs 25.2 %), Cote d'Ivoire (6.8 % vs 27.6 %) and Ghana (7.0 % vs 32.5 %) for CED and OW/OB respectively in the same study (Corsi *et al*., 2011). Chaparro *et al* (2014) reported a similar prevalence of CED (33 %) in between 1998-99 (DHS) and IIPS and ORC Macro (2000) reported a similar prevalence in Uttar Pradesh (35.8 %).

4.1.13.3. Association of malnutrition with selected characteristics

Results presented in Table.4.1.37 show a significant association between malnutrition in women and all the selected characteristics/variables except for decision in money expenditure.

4.1.13.3.1. Socio-demographic factors

Total malnutrition was found higher among the urban women (50.0 %) and most of it was due to OW/OB (33.3 %) while only (16.7 %) had CED. On the other hand, only 43.6 percent of the rural women were malnourished with most of them being undernourished (37.5 %) and (6.1 %) over-nourished. Shafique *et al*. (2007**)** reported a similar trend between CED and OW/OB among the rural and urban poor women in Bangladesh with (38.8 % vs 4.1 and 29.7 % vs 9.1 %).

Total malnutrition was highest among the women in the ages 25-29 years (71.7 %). Women in this age bracket had the worst nutritional status as they were facing both a burden of CED (57.3 %) and OW/OB with overweight (14.4 %) which was highest compared to all other age groups. This however deviates from findings of NFHS-2 among Indian women in which CED was highest among 20-24 year old women (41.8 %) while OW/OB was highest in older women 35-49 years just like in this current study (IIPS and ORC Macro. 2000).

Age at which a woman had their first child had a great impact on their nutritional status with the teenage women being affected the most (10-19) years of age. The study result found the highest association of over-nourishment with women who had their first child between ages 15-19 years. This could be because as children themselves, they lack the proper knowledge and experience to feed well and care for themselves. As adolescents, they feed unhealthy (e.g. fried foods, snack a lot and soft drinks which are energy dense) coupled with weight gain that comes with pregnancy and some of this weight persists even after child birth. However, among Bangladesh women, the reverse was true with higher prevalence of overweight in women who had their first child above 18 years as compared to women who had their child while below 18 years (Kamal *et al.*, 2015).

Results of this study also found the least prevalence of CED in women without any child below five years and it increased with increase in number of children <5 years from (29.3 %) among women without a child to (44.9 % and 45.5 %) among women with one child and two or more children respectively. However, OW/OB was more associated with lack of a child (11.6 %) of which (9.1 %) were OW and (2.5 %) were obese in class-I. Findings of this study are in line with Chaparro (2012) who found significantly lower odds of being overweight among women with more number of children <5 years as compared to women who had fewer children below five years and the reverse was true with underweight though it was not significant.

4.1.13.3.2. Socio-economic factors

Occupation is believed to allow a woman more access to facilities like quality food, proper health care and sanitary environment. The result of this study found a significantly lower prevalence of malnutrition among women who were not working (40.5 %) compared to those who were employed in agricultural sector (47.9 %) and (50.0 %) among those employed in skilled and unskilled manual labour. This was also found true for under-nourishment and over-nourishment. However, Kamal *et al*. (2015) and Ramesh (2011) did not find women's employment to significantly influence their nutritional status in Bangladesh and Kerala, India respectively.

Findings of the study revealed a significant association between nutritional status of a woman and wealth, her education and that of her husband. CED decreased with increase in education of the woman and her partner (from 38.5 % to 25.0 % and 38.0 % to 22.2 %) among lack of an education and higher education respectively. Whereas OW/OB increased with increase in education of both the woman and her partner with those with higher education having the highest prevalence of OW/OB (25.0 % and 27.5 %) respectively. Similarly, wealth had a protective effect against CED with women from richest households having a very low prevalence of CED (7.0 %) but highest prevalence of OW/OB (13.9 % and 21.7 %) respectively. A study by Kamal *et al.* (2015) found a significantly strong association of woman education and wealth with nutritional status in Bangladesh women. Also these findings are backed up by NFHS-2 report in Indian women (IIPS and ORC Macro, 2000). This result indicates that education and wealth have a protective effect against CED among women but increases the risk of OW/OB which could be due to better paying employment that is acquired with good education which boosts up more than adequate food supplies and lesser physical activity than women belonging to poor socio-economic status.

The study results also revealed that poor environmental sanitation in which the women lived had the strongest association with CED with women from households with no toilet facility (practice open defecation in the bush) having the highest prevalence of CED (37.0 %) compared to women who came from households with either pit latrines (31.4 %) or flush toilets (0 %). On the other hand, use of flush toilets had the highest association with over-nourishment among women (66.7 %). This could be due to the fact that there is limited exercise while using flush toilets as they are normally located within the house or just around it as compared to pit latrines which should atleast be 100meters from the main house for purposes of maintaining sanitary environment. Chaparro (2012) found 1.42 and 1.30 greater odds of being OW/OB among women who had access to toilet and sewage system as they are associated with higher socio-economic status (SES) but did not find an association with CED.

4.1.13.3.3. Women's autonomy

Study results also revealed that CED was higher among women whose partners took an independent decision on money expenditure and acquisition of health care (45.2% and 33.4%) as compared to women who took independent decisions in both cases (41.6% and 32.2%) respectively for money expenditure and acquiring health care. This result indicates that a woman's lack of control on money expenditure, limits her decision on quantity and quality of food purchase. FAO (2010) stated a better nutritional status was observed in families in which the woman had control over decision making.

4.1.14. Mahbubnagar district 1998.

4.1.14.1. Background characteristics of the women (15-49 years) in Mahbubnagar during NFHS-2.

Data on 468 women aged 15-49 years was included in the study and results presented in Table.4.1.38. The majority was living in rural Mahbubnagar (91.0 %), from OBC (52.7 %) and of Hindu religion (97.4 %). There was an equal count of women in the ages 15-19 years and 25-29 years each represented by (19.0 %). Out of all these women, only 392 women gave information on when they had their first child. Results presented in Table.4.1.38 show that most of the women had their first child between the ages 15-19 years (66.8 %) an indication of existence of adolescent marriage at high percentage. By the time of the survey, almost half of the women had no child. Among those who had children, 30.5 percent had one child.

Majority of the women were working (76.9 %) and involved in several occupations with most women employed in agricultural sector (51.0 %). However, almost a quarter of the women were not working (23.1 %). Majority of the women had no education however; more women were not educated compared to men (73.5 % Vs 57.3 %). Among the educated women and their partners, fewer women attained higher education compared to their partners represented by (0.8 % Vs 12.9 %). Data on the women's wealth shows that majority belonged to poorest and poorer households (31.9 % and 25.0 %) respectively with only 12.9 percent belonging to the richest households. Sanitary conditions were very poor in this district as majority of the women (84.8 %) did not have toilet facilities in their households so were using bush to dispose off human waste, 76.2 percent of the women delivered from home and only (3.0 %) in government

Table.4.1.38. Prevalence of Malnutrition among women (15-49 years) in Mahbubnagar district during 1998/99 survey

facilities an indication of poor use of the facilities hence a failure of government initiatives to reach the targeted group of people.

Results on women autonomy in Table.4.1.38 shows that women have less power in decision making as regards money expenditure and acquisition of health care as most of the decisions are made by their partners independently represented by (23.4 % Vs 36.6 %) for money expenditure and (20.1 % Vs 40.1 %) for acquisition of health care for women and men respectively. This affects independence of a woman to care for herself.

4.1.14.2. Overall levels of malnutrition

The overall prevalence of malnutrition was 46.7 percent of which 35.1 percent of the women were CED while 11.6 percent were OW/OB (Figure.4.1.19). This result indicates that the women are more burdened by under-nourishment than over-nourishment. Kothari *et al*. (2014) reported similar prevalence of OW/OB in Burkina Faso during 2010 DHS and Congo (DRC) during 2007 with a prevalence of (11.7 % and 11.5 %) respectively. IIPS and ORC Macro (2000) reported a similar prevalence of CED in Uttar Pradesh, Andhra Pradesh and Gujarat during NFHS-2 (35.8 %, 37.0 % and 37.4 %) respectively. This result shows CED was more prevalent than OW/OB in women which is backed by findings in Bangladesh women a neighboring country with a prevalence of (26.6 % vs 6.4 %) for CED and OW/OB respectively during 2007 (Kinnunen and Neupune, 2014).

4.1.14.3. Association of malnutrition with selected characteristics

Study results show a significant association with malnutrition in women and almost all the selected socio-economic and demographic variables except for religion, number of children and place of delivery.

4.1.14.3.1. Socio-demographic factors

In Mahbubnagar, CED was significantly higher among rural women (40.0 %), between 20-24 years (64.3 %) and among those who gave birth between 25-29 years (40.3 %) where all were underweight and none obese. Girma and Timotiows (2002) reported similar findings about rural women and younger age in Ethiopia.

On the other hand, OW/OB was significantly higher among urban women with none being underweight (36.4 %) as seen in figure.4.1. 20, among older women between 45-49 years (18.8 %) and women who gave birth to their first child between 20-24 years of age (16.3 %). Shafique *et al.* (2007) also found higher prevalence of

OW/OB among older women of high SES and higher education (atleast 14 years of education). This is because they are characterized with minimal activity as they grow older and with good employment, they can afford well paying jobs so most will own transportation like cars and bikes so no walking exercises. Also the rich will use energy saving machines for house duties like washing machines e.t.c.

The difference in existence of rural women and urban women is due to the difference in their dietary patterns where urban women depend mostly on high calorie and refined foods compared to rural women, multiparity, bad feeding habits and also menopause in older women.

4.1.14.3.2. Socio-economic factors

They were all significant in influencing nutritional status in women ($p<0.05$).

CED was higher significantly higher among women from OBC (44.4 %), among the employed women as compared to the women who were not working represented by (44.9 % and 44.7 %) among women employed in agricultural work and skilled manual and unskilled labour respectively, uneducated women with partners who attained primary education (45.0 % and 50.0 %) respectively, women from poorer households (52.8 %) and with no toilet facilities in their households (42.1 %). A similar study finding in rural Bangladesh indicates that women with at least primary education have more probability of becoming nourished compared to women with no education (Rahman and Nasrin, 2009)**.**

OW/OB was significantly higher among unemployed women (31.2 %), with higher education (50.0 %) and whose partners are highly educated (26.4 %), from richest households (39.0 %) and have flush toilet facilities in the house (29.6 %). Basagoudar and Chandrashekhar (2013) reported that OW/OB was more prevalent among literate women and increased with higher SES.

4.1.14.3.3. Women autonomy

CED was significantly higher among women who have someone else decide on money expenditure (58.7 %) and their partners (50.0 %) as compared to when they the decision is done individually by the woman (37.3 %). Having someone else decided where a woman acquires health care was associated with OW/OB (27.8 %) and joint decision between a woman and her partner was found to have a protective effect on over-nourishment (5.6 %) than when the decision is taken independently by the woman

(10.4 %) or her partner (8.7 %) or jointly with someone else (7.1 %). Tebekaw (2011) noted that women with low decision autonomy were likely to have CED.

A woman's decision on acquisition of health care affects her and health and nutritional status of her family members and has been noted to improve the welfare of her family members especially children. Bharati *et al.* (2014) noted that in families where a woman had autonomy on health acquisition, the nutritional and immunization status of the children was much better than in families in which women lacked autonomy. On the other hand, contrary to the perception of literacy improving a woman's autonomy, NFHS-3 found that much as almost 65 are literate, only 35.

4.1.14.3.3. Comparison between Prakasam and Mahbubnagar districts.

Figure.4.1.19 below shows that total malnutrition was slightly higher among women in Prakasam district by only 0.8 percent and this variation was due to OW/OB as CED prevalence among the women was the same in the two districts. Overweight was higher in Prakasam district while Obesity was higher in Prakasam district (figure4.1.19). This clearly states out the variations in cultural norms which surround the women and their welfare and the fact that the SES of women in Prakasam district was somehow better than their counterparts on Mahbubnagar district as seen in Table.4.1.37 and Table.4.1.38.

Figure.4.1.20 shows variations in malnutrition distribution across residence and results show that CED remained higher in rural areas of both districts while OW/OB remained higher in the urban women. However, urban women in Mahbubnagar only suffer from OW/OB as none was found with CED while in Prakasam, the urban women suffer from both CED and OW/OB as with the rural women in both districts. This indicates that rural women are at a risk of NCD at the same time deficiency diseases. As seen in many studies, anaemia is also higher among rural women (NNMB, 2006).

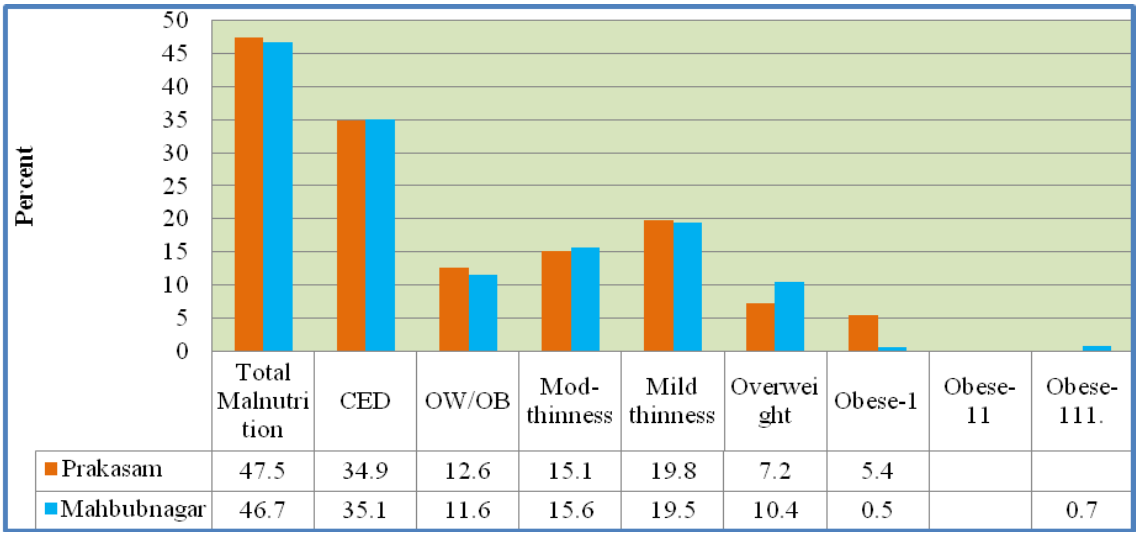


Figure.4.1. 19.Prevalence of malnutrition among women in Prakasam and Mahbubnagar district during 1998/99.

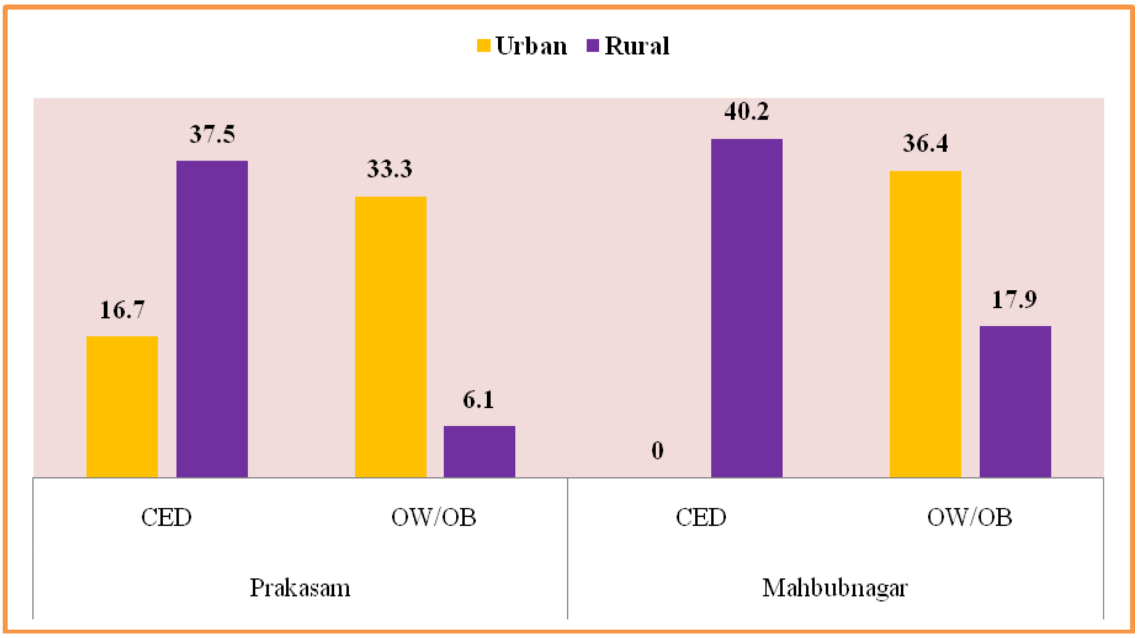


Figure.4.1.20.Prevalence of malnutrition among women in Prakasam and Mahbubnagar districts by residence during 1998/99

4.1.15. Andhra Pradesh District (AP) 1998/99

4.1.15.1. Background characteristics of the women (15-49 years) in Andhra Pradesh state during NFHS-2.

From the state of Andhra Pradesh (pre-divided), data on 8075 women was included in the study. Of these, (75.1 %) were residing in rural Andhra Pradesh and (24.9 %) in urban area of the state. Almost half of the women in the state (44.3 %) belonged to OBC caste and the rest either in ST, SC or belonged to none of the three caste groups (Table.4.1.39). Majority of the women worshiped Hindu religion and the

Table.4.1.39. Prevalence of Malnutrition among women (15-49 years) in Andhra Pradesh state during 1998/99 survey

rest were either Muslims (6.7 %) or Christians (5.9 %). No other religions were found in this group of women.

Women were grouped in five years basis and results show, most of the women were between the ages 25-29 years (20.0 %) and 20-24 years (19.1 %). Out of the women included in the study, only 7137 women gave information on when they had their first child. Results show that in Andhra Pradesh state, majority had their first child in the ages 15-19 years (62.7 %) which is in line Sachan *et al.* (2012) who stated that the effective age of marriage in Andhra Pradesh was 19 years as compared to India which was 20 years. By the time of the survey, more than half of the women had no child below five years of age (54.5 %).

The percentage of women who were not working and those involved in agricultural work was consistent. That is (41.5 %) of the women were not working and (41.3 %) were involved in agricultural work. When data on their education and their partners was tabulated, results show that majority were not educated that is (59.1 %) for women and (41.7 %) for their partners with only (2.3 % and 13.8 %) of the women and their partners attained higher education respectively. More than 20.0 percent of the women belong to middle class household according to wealth classification. Despite that majority of the women belonged to middle class households, 72.4 percent of these women came from households with no proper toilet facility so were using the bush to dispose-off human waste or practicing open defecation. The results in this table also show atleast half (50 %) of the women delivered their children from home (Table.4.1.39).

Results also show that in Andhra Pradesh, decision on money expenditure mostly lies with the women (32.1 %) but decision on acquisition of health mostly lies with the women's partners (37.8 %).

4.1.15.2. Prevalence of malnutrition in women (15-49 years) during NFHS-2.

Figure.4.1.23 showed overall malnutrition was 51.8 percent among the women of which 38.3 percent had CED and only 13.5 percent were OW/OB. In this state, results revealed CED was the most prevalent form of malnutrition among women as opposed to over OW/OB. This is an indication of existence of the dual burden malnutrition among women from Andhra Pradesh. A similar prevalence of CED was reported in Andhra Pradesh (37.4 %), Madhya Pradesh (38.2 %) and Karnataka (38.8 %) during NFHS-2 (IIPS and ORC Macro, 2000). The higher prevalence of CED could be due to the larger percentage of rural women in the state where under-nourishment remains a persistent form of malnutrition with over-nourished being more prevalent in the urban areas of the state. A similar prevalence of OW/OB was reported in Bangladesh women (14.0 %) during 2011 (Kinnnunen and Neupane, 2014) and Guinea during 1999 (13.4 %), Ghana during 1993 (13.4 %) and India during 1998 (13.0 %) using DHS data (Corsi *et al*. 2011).

4.1.15.3. Association of malnutrition with selected characteristics

Chi square results show a significant association between malnutrition in women and all the selected socio-economic and demographic variables that were selected ($p<0.05$).

4.1.15.3.1. Socio-demographic factors

CED was significantly higher among rural women (43.6 %), younger women between 15-24 years of age (44.9 %), of Hindu religion (39.2 %) and women with more than two children below five years by the time of the study (43.2 %). Hindin (2006) reported a significant association between CED with rural residency in Malawi and Zambia and younger age in Zambia and Zimbabwe. Kamal *et al.* (2015) findings are in line with the current study with higher prevalence of CED among younger and rural women.

OW/OB was significantly higher among the urban women (24.2 %), of Muslim religion (27.5 %), older women between 45-49 years (24.4 %), women who had their first child between 35-39 years (23.3 %) and without any child below five years of age by the time of the survey (13.9 %). NFHS-3 found OW/OB higher among urban women but of sikh religion and in older women as the current study (IIPS and Macro, 2007).

In Urban area of the state however, both under and over nourishment show consistent prevalence's with (22.1 %) CED and (24.2 %) OW/ OB. The urban showed a higher association with OW/OBI compared to rural women (19.6 % Vs 6.1 % and 3.6 % Vs 1.1 %) respectively. This is because, in developing countries, there is evidence of nutrition transition and India is one of the countries hence the existence of both CED and OW/OB especially in urban areas (Shukla *et al.,* 2002 and Griffiths and Bently, 2001).

This could be due to difference cultural practices like the high vegetarian diets common among the Hindu are dense in fiber as compared to the Muslim women who promote consumption of animal protein which also contains high solid fat and no fiber. The high fiber diets bind nutrients and hence will quicken the passing of food in the GI (Gastro-intestinal) tract and also control the release of sugars in the blood stream hence maintain an optimal blood sugar and energy levels so the body need not convert excess to glycogen and store it as fats.

4.1.15.3.2. Socio-economic factors

Results presented in Table.4.1.39 CED deficiency was significantly higher among women from SC sect, employed in the agricultural sector, uneducated, with uneducated partners, from poorest households and lack toilet facilities. Kothari *et al.* (2014) reported similar findings with education and SES (Wealth) in DHS of Nepal (2011), Tajikstan (2012), Ghana (2008) and Uganda (2011).

On the other hand, OW/OB increased with increase in education level of both woman and her partner, wealth, presence of toilet facility and having delivered from a private hospital (Table.4.1.39). This is because all these are associated with high SES of a woman and studies have reported OW/OB to be most prevalent among them (IIPS and ORC Macro, 2000). However, Parker (2003) and Sidik and Rampal (2009) reported contradicting results with OW/OB being highest among women who never attended schooling and with no educational level.

4.1.15.3.3. Women Autonomy.

Women independently taking decision in expenditure of family money and acquisition of health showed a protective role in controlling both types of malnutrition (under and over nourishment) as compared if decisions in both sectors are taken by partners or jointly with partner or someone else. FAO (2010) stated that nutritional status of individuals was much better in families where a woman had high autonomy especially in purchase of food items and seeking health care.

4.1.16. Andhra Pradesh District (AP) 2005/06

4.1.16.1.Background characteristics of the women (15-49 years) in Andhra Pradesh state during NFHS-3

In Andhra Pradesh (pre-divided), data on 6893 women was included in the study. Of these women, majority were urban residents (65.6 %) an indication of urban rural migration from the previous years, of Hindu religion (75.0 %). Table.4.1.40. shows that majority of the women were equally distributed between 15-29 years. Only 4874 women gave information on when they had their first child and out of these, majority had their first child between 15-19 years (52.5 %) and most did not have a child below five years by the time of the survey (68.3 %).

Data on socio-economic status reveals that majority of the women were not employed (58.1 %), were educated (65.4 %) with educated partners (69.1 %), from richest households (34.1 %), with flush toilet in their households (62.7 %) and delivered from private hospitals. Majority of the women were allowed to go to hospital alone but decision on money expenditure was carried out jointly by the woman and her partner (48.3 %).

4.1.16.2.Prevalence of malnutrition among women (15-49 years) in Andhra Pradesh state during NFHS-3.

The overall prevalence of anaemia was 54.5 percent of which 31.3 percent were CED and 23.2 percent were OW/OB. During this year, the prevalence of both forms of malnutrition was high (figure.4.1.23). A similar prevalence of CED was reported among Ethiopian women (30.). Corsi *et al.* (2011) reported a similar prevalence of OW/OB in Nigeria (23.3 % and 24.1 %) during 2003 and 2008 DHS, Liberia (24.3 %) during 2007 and Zimbabwe (22.7 %) during 1994 DHS. Similar prevalence of CED was reported in Haryana (31.3 %) and Uttaranchal (30.0 %) while OW/OB was reported to be (20.9 %) in Tamil Nadu and (20.2 %) in Goa which is almost similar to findings of the current study (IIPS and Macro, 2007). Some studies reported very higher rates of OW/OB as compared to CED (Mendez *et al*., 2005).

4.1.16.3. Association of malnutrition with selected characteristics

Results in Table.4.1.40 shows there is a significant association between malnutrition in women with all the studied variables.

4.1.16.3.1. Socio-demographic factors

CED was significantly most prevalent among rural women (40.5 %), Hindu (32.6 %), women between the ages 15-19 years (46.8 %), who gave birth to their first child between 15-19 years (29.1 %) and who had one child below five years by the time of the survey (34.1 %). Milton *et al*., 2010 and Tebekaw, 2011) also reported high prevalence of CED among rural women (34 % and 32.1 %) respectively. Kamal *et al*. (2015) reported contradictory results to the current study with women who had their first child below 18 years being less likely to suffer from CED.

Table.4.1.40. Prevalence of Malnutrition among women (15-49 years) in Andhra Pradesh state during 2005/06 survey

OW/OB was most prevalent among urban women (27.9 %), Muslims (29.2 %), who were between 40- 44 years of age (40.9 %), who had their first child between 35-39 years of age (62.5 %) and who had no child below five years by the time of the survey. Kamal *et al*. (2015) also found that women with less children <5 years were less likely to be CED and more likely to be OW/OB. Corsi *et al*. (2011) stated that urbanization attenuates OW/OB among a population as it comes with change in feeding habbits and other life style changes.

4.1.16.3.2. Socio-economic factors

Results presented in Table.4.1.40 showed that occupation, woman education, partners education, wealth, toilet facility and place of delivery were all significant in influencing prevalence of malnutrition in women.

CED prevalence was most prevalent among women employed in agricultural sector (44.7 %), with no education (35.7 %) and having partners with no education (35.3 %), living in poorest households (49.1 %), lacking toilet facilities (42.9 %), who delivered from home (48.6 %) and from ST sect (43.1 %). Haque *et al.* (2015) stated that CED was most prevalent among illiterate women (43.5 %) and housewives and the association was significant.

OW/OB on the other hand were most prevalent among professional women, who attained higher education (32.9 %) and women with partners that attained higher education (46.2 %), living in richest households (36.2 %), using flush toilets (28.6 %), who delivered from private facilities (26.1 %) and women who did not belong to SC, ST or OBC sect (30.2 %). Gulliford *et al*. (2003), Fernald (2007) and Haque *et al.* (2014) support the findings of the current study with differences in SES.

This is because among high SES there is dominancy of sedentary life style with limited physical activity and abundance of food especially high calorie foods which are considered prestigious among the elite sectors of the community i.e excessive television watching, consumption of burgers, French fries, chocolates all which are affordable to women with money and irregular eating patterns in professional women resulting into excessive snacking and the opposite applies in low SES women.

4.1.16.3.3. Women Autonomy.

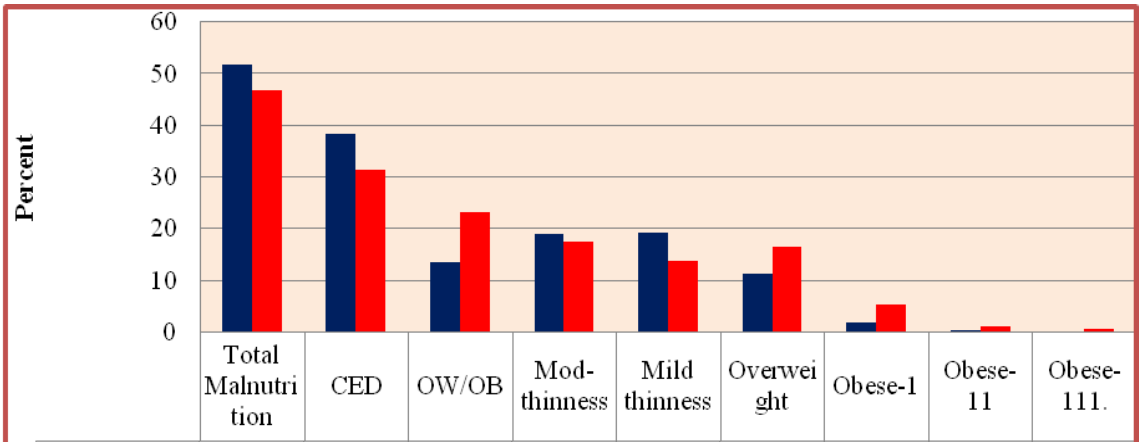
CED was most prevalent among women who had someone else decide on how money is spent (54.5 %) and among women who were not allowed to go to hospital

(34.4 %). In Malawi, the more decisions which a woman's partner had a final say in, increased the risk of CED in women by 1.08 times (Hindin, 2006).

On the other hand, overweight/ obesity was significantly prevalent in women who took independent decisions on money expenditure and who were allowed to go to hospital alone. Hindin (2006) noted that allowing male dominated decision making or promoting women's complete independence in decision making may be harmful for women's health as seen in the current study with OW/0B could lead to rise of NCDs which are becoming the leading cause of maternal mortality.

4.1.16.3.4. Trends in malnutrition among women between 1998-2006.

Figure.4.1.21 shows that malnutrition among women in Andhra Pradesh state decreased over the years by 5.1 which were due to a decrease in CED by 7.0 percent while OW/OB increased by 9.7 percent. Similar findings were reported by Kamal *et al.* (2015) among women in Bangladesh in which CED decreased by 9.9 percent while OW/OB increased by 4.2 percent during 2004-2011. Corsi *et al.* (2011) reported a similar trend in CED and OW/OB among women in Zambia during 1996-2007, Nepal during 1996-2006 and Jordan during 1997-2007 DHS.



	Total Malnutrition	CED	OW/OB	Mod-thinness	Mild thinness	Overweight	Obese-1	Obese-11	Obese-111.
AP-NFHS-2	51.8	38.3	13.5	19	19.3	11.2	1.9	0.3	0.1
AP-NFHS-3	46.7	31.3	23.2	17.5	13.8	16.5	5.2	1	0.5

Figure.4.1. 21. Trends in prevalence of malnutrition among women in Andhra Pradesh state during 1998-2006

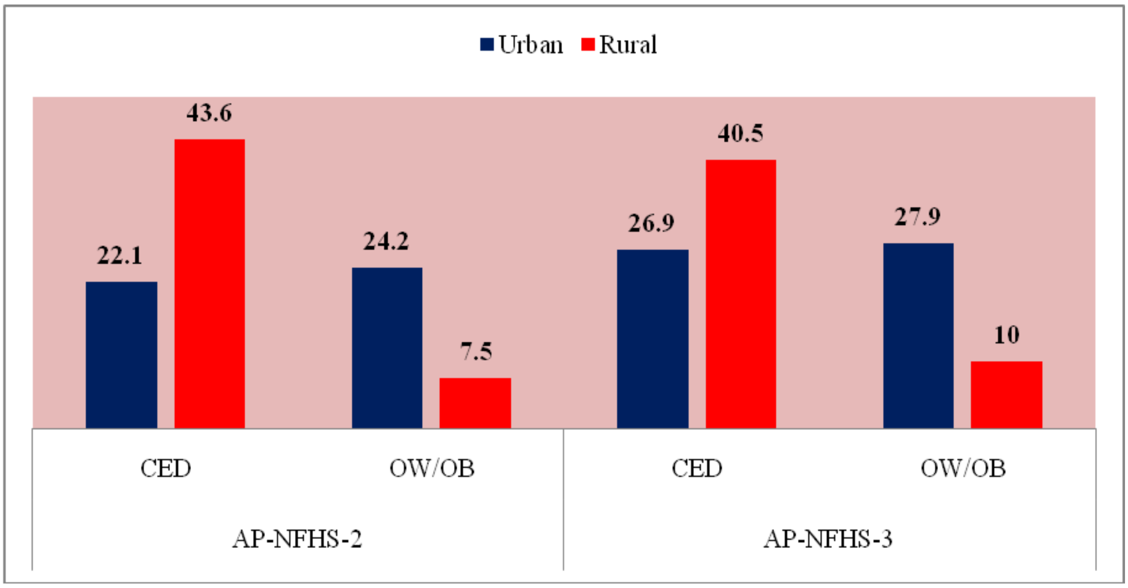


Figure.4.1. 22. Trends in prevalence of malnutrition among women in Andhra Pradesh state during 1998-2006 by residence.

The higher prevalence of CED during 1998/99 can be attributed to higher percentage of women in rural areas, low SES i.e higher percentage with no education in the women and their and partners, few women belonging to the richest households and with no toilet facilities while half of them delivered from home. However, over the years, SES of women improved with education for the women and their partners, more women belonging to the richer and richest households and use of toilet facilities especially flush toilets and more use of hospital facilities for child delivery which are all associated with higher SES hence the increase in OW/OB (Table.4.1.39 and Tabl.4.1.40). This improvement can be attributed to government and non-government intervention programmmes which create awareness on nutritional issues and advantage of living in a clean environment plus use of hospital facilities for delivery.

Over the years, CED decreased by 3.1 percent in rural women while OW/OB increased by 2.5 percent while in urban women, both CED and OW/OB increased by (4.8 % and 3.7 %) respectively (Figure.4.1.22). Mendez *et al*. (2005) stated that though overweight remained substantially high in urban areas, the prevalence in rural areas was substantial and a similar trend was observed for underweight.

SES had a significant impact in increasing malnutrition in women over the years. Among the unemployed women, OW/OB increased by 18.3 percent from (7.1 % to25.3 %)

This result indicates a dual burden in malnutrition in the state and an increased risk of NCDs among the women. This can be attributed to the fact that most nutritional interventional programs existing focus on eradicating CED and ignore the emerging threat of OW/OB among this population which mostly caused by nutritional transition in all sects of this population both rich and poor.

4.1.18. Akola district 1998

4.1.18.1. Background characteristics of the women (15-49 years) in Akola district during NFHS-2.

Data on 164 women was included in the study. Out of these women, 66.3 percent were residing in rural Akola and 33.7 percent in the urban area of the district. Majority of the women (68.8 %) did not belong to SC, ST or OBC castes, worshiped Hindu religion (86.1 %), were between the age of 25-29 years (31.9 %) and out of the 164 women included in the study, only 152 women gave information on when they had their first child with majority of the women having had their first child between 20-24 years (48.6 %). A few of the women in this district had their first child in early adolescence between 10-14 years (1.6 %) which is an indication of fewer marriages at that stage. The result presented in Table.4.1.41 also shows that of those with children, majority had only one child by the time of the survey (39.6 %).

Among this study population, 47.1 percent of the women were not working. Out of the ones who were working, majority was employed in agricultural work (39.5 %) and only 5.3 percent were involved in professional work. Majority of the women had attained secondary education (39.4 %), with husbands who also attained secondary education (43.9 %), belonged to richest households (30.2 %), had no toilet facilities in their households (52.1 %) but almost half of the other women with toilet facilities were using flush toilets (46.6 %) and the remaining few pit latrines. Half of the women delivered in government facilities (50.0 %) but a big percentage also delivered from home (32. 9 %). Results in this district reveal that the women's partner had more autonomy in the households. Majority of the women's partners took an independent decision on money expenditure and acquisition of health care (44.0 % and 55.1 %) while only (33.9 % and 30.1 %) of the women took independent decisions on the same respectively.

Table.4.1.41. Prevalence of Malnutrition among women (15-49 years) in Akola district during 1998/99 survey

4.1.18.2. Prevalence of malnutrition among women (15-49 years) in Akola district during NFHS-2.

The overall prevalence of malnutrition is 49.3 percent of which 32.4 percent of the women were CED and 16.8 percent are OW/OB at varying degrees (figure.4.1.27). Milton *et al.* (2010) reported similar prevalence of CED among rural women (34 %) and Bharati *et al*. (2007) reported a prevalence of 31.2 percent CED among Indian women but Haque *et al*. (2015) reported higher prevalence of 67 percent CED while lower prevalence was reported (22 % and 27.1 %, 29.0 %) in Maldives and India (Goa and Tamil Nadu) respectively (Golden *et al*., 2001 and IIPS and ORC Macro, 2000). Mittal (2013) reported similar prevalence of OW/OB (16%). The difference is a sign of how diverse the causes of malnutrition are among women of varied locations.

4.1.18.3. Association of malnutrition with selected characteristics

Table.4.1.41 results showed an association of selected background characteristics and malnutrition. A significant association was found between selected background characteristics and malnutrition in women apart from religion and decision on money expenditure ($p<0.05$).

4.1.18.3.1. Demographic factors

CED was significantly higher among the rural women (40.4 %), older women in the ages 40-44 years (62.5 %), who gave birth to their first child in the ages 15-19 years (45.4 %) and women who had no child below five years by the time of the survey (45.5 %). Subramanian and Smith (2006) and Shukla *et al.* (2002) reported higher prevalence of CED among rural women similar to findings of the current study. However, Kamal *et al* (2015) reported contradicting results with CED being more prevalent among younger women and who gave birth to their first child <18 years..

On the other hand, OW/OB was most prevalent among urban women (42.3 %), between 35-39 years (19.5 %), who gave birth to their first child between 25-30 years of age (33.3 %) and no child below five years of age by the time of the survey (16.4 %). Koch *et al*. (2008) and Kamal *et al*. (2015) noted that women with fewer or no children below 5 years were more likely to be obese than women who had more than <3 children below five years..

4.1.18.3.2. Socio-economic factors

All socio-economic variables were found significant to influence malnutrition in women ($p<0.05$) and results presented in Table.4.1.41.

CED was significantly higher among women from SC sect (50.7 %), employed, with no education (63.6 %) and with partners who lack education (50.5 %), living in poorer households (77.5 %), with no toilet facilities in the household (45.9 %), and who delivered their children from home (58.0 %). But OW/OB was significantly higher among in other castes (17.4 %), professionally employed women (50.0 %), who attained higher education (40.0 %) and whose partners attained higher education (39.5 %), belonging to the richest households (51.6 %) and who delivered their children in a private facility (25.0 %). Similar finding are reported by NFHS-2 and NFHS-3 (IIPS and ORC Macro, 2000 and IIPS and Macro, 2007).

4.1.18.3.3. Women autonomy.

Both CED and OW/OB was significantly higher in women who took independent decision on money expenditure and those who jointly made decisions with someone else to acquire health care (Table.4.1.41). This could be due to poor priorities where some women choose jewellery and dressing over feeding hence end up spending less on food to buy all these items they desire and at the same time, a woman would have to wait for the person with whom decisions are made on health hence hindering immediate medical attention which could worsen the illness and increase malnutrition in them.

4.1.17. Solapur district 1998.

4.1.17.1. Background characteristics of the women (15-49 years) in Solapur district during NFHS-2

Data on 347 women was included in the study and results presented in Table.4.1.42. Of these women, majority (80.3 %) was residing in rural Solapur, worshiped Hindu religion (94.4 %) and was between 20-24 years (25.7 %). Out of the women in the study, only 306 gave a response on when they had their first child. Results show that 79.7 percent of the women in this study had their first child between 15-19 years which is an indication of child marriage. The study result also revealed that majority (55.4 %) of the women had no child below five years by the time of the survey.

Results also showed that (43.0 %) of the women were not working and among those working, (55.1 %) were employed in agricultural work and the remaining in other occupations. The larger majority (53.8 %) and none of the women attained higher educational level. When data for their partners was analyzed, results show that 42.7 percent of the women's partners attained secondary level of education and only 26.7 percent were not educated which is lower compared to women. Majority of the women belonged to the poorest households (54.1 %), with no toilet facilities (88.3 %), delivered their children from home (>60 %) and lack autonomy as regards money expenditure and acquisition of health care.

4.1.17.2. Prevalence of malnutrition.

Overall prevalence of malnutrition was 54.1 percent of which 50.4 percent of the women were underweight and only 3.7 percent were overweight/ obese. This result indicates undernourishment as the most significant form of malnutrition among these women. In this district, CED is a major problem with minimal OW/OB. Low levels of OW/OB were reported in eastern states namely Bihar, Jharkand and Orrisa with a prevalence of OW/OB (4.6 %, 5.4 and 6.6 %) and CED (45.1 %, 43.0 and 41.4 %) respectively (IIPS and Macro, 2007).

4.1.17.3. Association of malnutrition with selected characteristics

Study results found a significant association of malnutrition prevalence with most of the selected background characteristics ($p<0.05$) except for religion, age at first birth, number of children and toilet facility.

4.1.17.3.1. Socio-demographic factors

Results of this study found total malnutrition higher among the urban women (56.2%) as compared to rural women (52.8%). The composition of total malnutrition varies across the place of residence with (46.9%) of the malnourished in urban women being undernourished and (9.4%) were over-nourished (overweight/obese). Among the rural women who were malnourished, (50.2%) were under-nourished and only (2.6%) were over-nourished. This result shows under- nourishment is still a bigger problem in both types of residence but more in rural women while overweight/obesity is on the rise but much of a bigger problem among the urban women. Similar results were reported by Girma and Timotiows (2002) in Ethiopia when data from DHS-2000 was analyzed who also found CED (Chronic Energy Deficiency) to be higher in rural women compared to urban women.

Table.4.1.42. Prevalence of Malnutrition among women (15-49 years) in Solapur district during 1998/99 survey

4.1.17.3.2. Socio-economic variables

Socio-economic variables like caste, occupation, education of woman, partners education, wealth and place of delivery were all significant in influencing the prevalence of malnutrition among the women under study ($p<0.05$) except for toilet facility.

CED was significantly higher among employed women, with primary educational level (55.0 %), with educated partners up to primary level (60.2 %), living in the poorest households (59.3 %) and who delivered from a government facility (62.1 %).

OW/OB was significantly higher among unemployed women (7.7 %), with secondary education and living with partners who higher education (10.7%), belonging to the richest households (21.6%) and who delivered from private facilities (9.9 %). This could be due to lack f enough exercise among non-employed women hence higher levels of malnutrition. Among the employed women, most of the malnutrition was due to under-nourishment which could mean energy expenditure was higher than what was replaced which can be caused by busy scheduled resulting into skipping meals.

4.1.17.3.3. Women's autonomy

Decision of spending money was also found significant to influence malnutrition in women. All the women whose decision on money expenditure was taken jointly with someone else were all under-nourished. For the women who took an independent decision on money expenditure were experiencing dual existence of malnutrition with (61.1%) under-nourishment and (5.2%) over-nourishment. This result indicates that despite the authority given to woman on money expenditure, malnutrition was still higher than when her husband decides or when decision is taken jointly with her husband represented by (40.4% and 43.5%) respectively. The high prevalence of malnutrition among women who independently decide on money expenditure could be to lack of proper knowledge (nutritional), poor planning and expenditure on none food items like jewellery and clothing which would be controlled if the husband takes the decision independently or jointly with the woman.

Decision on acquisition of health care was also found significant to influence malnutrition among women ($p=0.0019$). Total malnutrition was highest among women who jointly took a decision on obtaining health care with someone else (62.3%) of which all were under-nourished. The lowest prevalence of total malnutrition was with women who jointly took decisions with their partners in acquisition of health care.

4.1.17.4. Comparison between Akola and Solapur districts

Figure.4.1.23 shows that CED was higher in Solapur women by 17.9 percent while OW/OB was higher by 13.1 percent in Akola district women. This can be attributed to the better SES of women in Akola district with majority of the women belonging to richest households (30.2 %), using flush toilet facilities (46.6 %) and having delivered from either government or private facility rather than home and more women having achieved some level of education though most were unemployed hence higher prevalence of OW/OB as compared to the lower SES in Solapur where CED was higher due to more than half of the women being employed in agricultural sector where the payment is low to compensate for the increased energy expenditure through food hence they end up in a negative energy balance where more is expended than what is taken in as most these women have inadequate intake of calories and proteins. Also in Solapur, there is a higher percentage of uneducated women (53.8 %) living in the poorest households (31.1 %) and lack toilet facilities (88.3 %) which could increase the risk of communicable diseases hence leading to loss of weight.

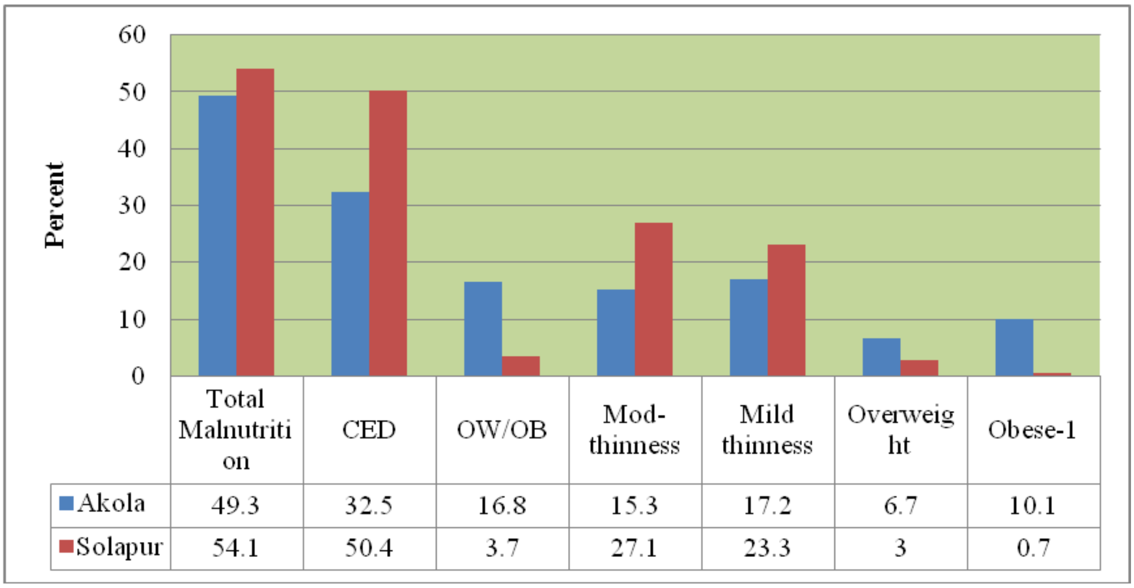


Figure.4.1.23. Trends in prevalence of malnutrition among women in Akola and Solapur districts during 1998 survey.

Figure.4.1.24 shows differences in distribution of malnutrition in women basing on their residency. CED remained higher in both rural and urban areas but the women in urban Solapur district were suffered more CED as compared to OW/OB which was higher in Akola district. This clears shows variations within the same state hence the need to target intervention programs at household level so as to address the dual burden of malnutrition.

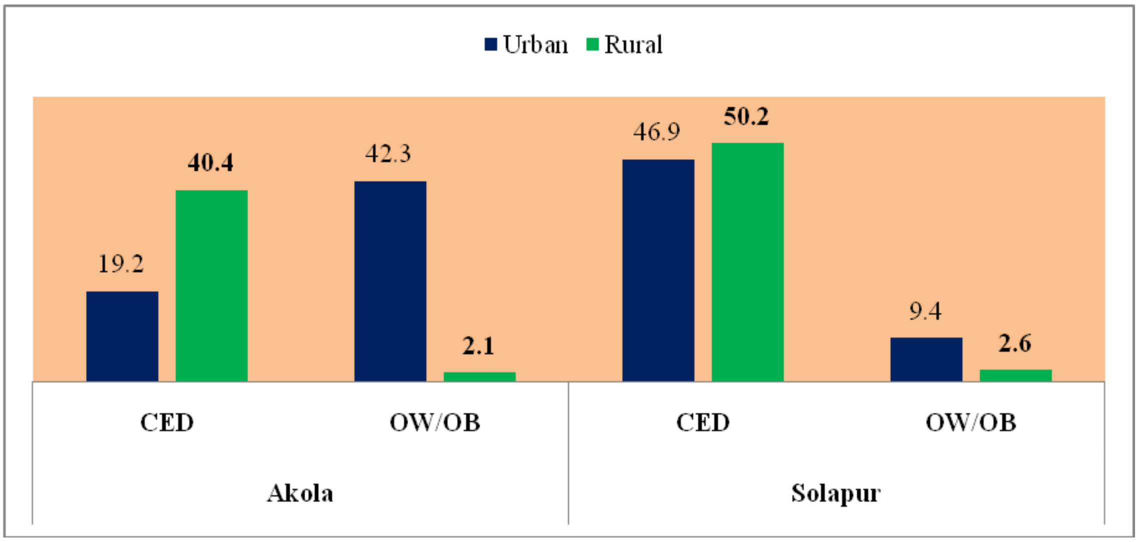


Figure.4.1. 24. Trends in prevalence of malnutrition among women in Akola and Solapur districts during 1998-2006.

4.1.19. Maharashtra state 1998/99

4.1.19.1. Background characteristics of the women (15-49 years) in Maharashtra state during NFHS-2

Data of 8706 women between 15-49 years in Maharashtra state was included in the study and results presented in Table.4.1.43. Out of these women, 58.7 percent were residing in rural Maharashtra and the remaining (41.3 %) in the urban area of the state. Results in Table.4.1.43 also showed that majority of these women belong to none of the mentioned castes that are SC, ST or OBC castes (table.4.1.43). Majority of the women in this state worshiped Hindu religion (80.1 %), were in the ages 25-29 years (20.3 %). Out the women whose data was included in the study, 7817 women gave information on when they had their first child. Results in table show that majority had their first child between the age of 15-19 years (60.6 %). By the time of the survey, more than half of these women did not have any child (52.7 %).

Almost half of the women were not working (44.5 %) and among those working, (38.8%) were involved in agricultural work and only (3.0 %) in professional work. As regards the women's educational level, data revealed that (38.4%) of the women were not educated and among those who were educated, only 4.8 percent had higher education. When data of their partner's education was analyzed, less than 20.0 percent had no education and atleast (21.0%) of these men attained higher education. This result clearly shows that the women are less educated than the men.

Results also found most women belonged to richest households (28.2 %) and only (12.1 %) belonged to the poorest households which could be a result of their partner's better education level. Despite majority belonging to the richest households, more than half of the households (56.0%) in which these women belonged to households lacking a proper toilet facility and disposed off their waste in the bush. However atleast (39.6 %) of those who had toilet facilities used flush toilets. Most of the women also reported to have delivered their children from home (46.8 %) and indication of poor use of proper health facilities which increases the risk to malnutrition. Table.4.1.13 also shows that women had more autonomy in decisions on money expenditure (39.2 %) than acquisition of health care (35.4 %) which was predominantly decided by their partner (40.8 %).

4.1.19.2. Prevalence of malnutrition in women (15-49 years) in Maharashtra state during NFHS-2

The overall prevalence of malnutrition is 51.5 percent of which 38.6 percent were underweight and 12.9 percent were overweight at varying degrees (figure.4.1.31).

4.1.19.3. Association of malnutrition with selected characteristics

Prevalence of malnutrition was significantly associated with all the selected background characteristics ($p<0.05$).

4.1.19.3.1. Socio-demographic factors

CED was significantly higher among rural women (50.4 %), of Hindu religion (43.6 %), between the 15-19 years of age (50.2 %), who had their first child between 10-14 years (48.3 %) and women who had two children or more below five years by the time of the survey (46. 8 %). Similar to NFHS-3, CED was most prevalent among Hindu women and younger women and was seen to decrease with increase in age of the woman (IIPS and Macro, 2007).

On the other hand, overweight/ obesity was significantly higher among urban women (21.0 %), Christians (30.1 %), between 40-44 years of age (20.4 %), those who gave birth to their first child between 35-39 years (38.5 %) and without any child below five years of age (13.9 %).

Table.4.1.43. Prevalence of Malnutrition among women (15-49 years) in Maharashtra state during 1998/99 survey

4.1.19.3.2. Socio-economic factors

CED was significantly higher among women from ST sect (53.9 %), women employed in agricultural sector (54.2 %), uneducated women (50.0 %0 and those having uneducated husbands (53.1 %), women from the poorest households (60.9 %), lacking toilet facilities (51.7 %) and who delivered from home (55.1 %). Tebekaw (2011) reported similar findings with higher prevalence of CED among agricultural employed women, uneducated women as they lack the knowledge and money to cater for their nutritional needs as the value of agricultural products is normally low especially during season of harvest leading to nutritional changes.

OW/OB was significantly higher among women who belonged to other caste (13.3 %), employed in the clerical work (40.2 %), educated to a higher level (20.5 %) and those having uneducated partners (20.5 %), belonging to the richest households (27.1 %), with flush toilets (21.6%) and delivered their children from the private facilities (10.2 %).

4.1.19.3.3. Women autonomy

CED was significantly higher among women whose partners took independent decision on money expenditure and health care acquisition while OW/OB was higher women who independent decision on money expenditure and acquisition of health care.

4.1.20. Maharashtra state (2005/06)

4.1.20.1.Background characteristics of the women (15-49 years) in Maharashtra state during NFHS-3

Data on 7654 women was included in the study. Majority of these women were urban residents (71.1) as seen in Figure.4.1.25, did not belong to SC, ST nor OBC sect, were of Hindu religion (74.3 %). The distribution of women across age brackets was almost uniform with smaller variation with in each age bracket. However, most of them were between 15-19 years (18.2 %). Out of the women included in the study, only 5967 gave information on when they had their first child. Results show that majority of the women had their first child between 15-19 years (47.0 %). However, 65.4 percent of the women had no child by the time of the survey.

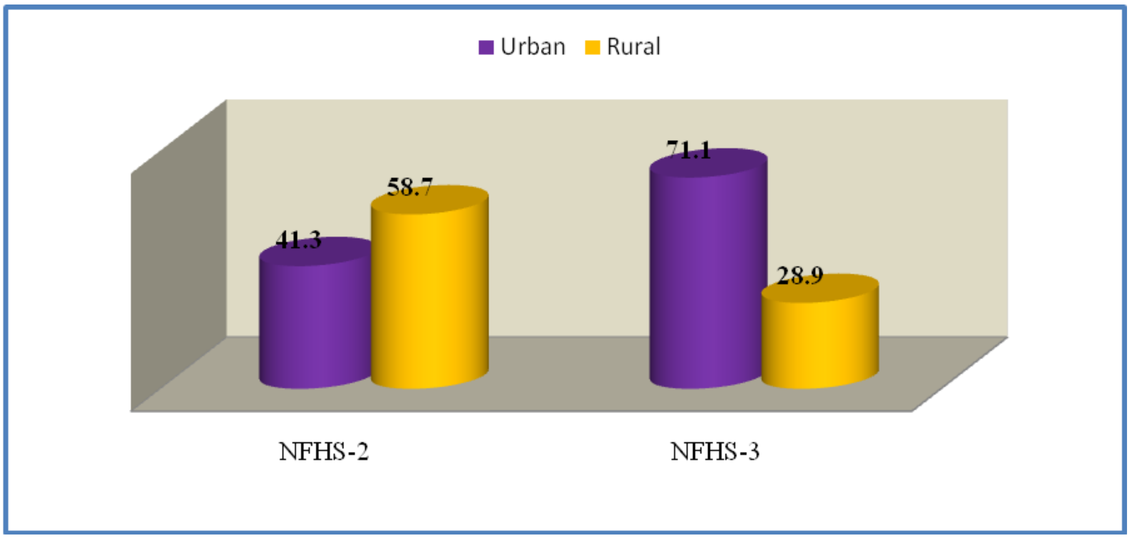


Figure.4.1. 25. Percentage distribution of women by residence during NFHS-2 and NFHS-3 survey

Results on socio-economic factors showed that more than half of the women were unemployed (57.7 %) and among the employed, the biggest number were employed in the agricultural sector (17.9 %), attained secondary education (54.1 %) and their husbands as well (55.1 %). The high standards of living in these women is seen with majority belonging to the richest households, using flush toilets to dispose off human

Table.4.1. 44. Prevalence of Malnutrition among women (15-49 years) in Maharashtra state during 2005/06 survey

waste (69.8 %) and having delivered their children from the private hospital (40.0 %). Decision on money expenditure was jointly carried out by the woman and her partner (58.1 %) and 65.3 percent of the women were allowed to go to hospital alone.

4.1.20.2. Prevalence of malnutrition among women in Maharashtra state during 2005/06

Overall prevalence of malnutrition was 54.7 percent of which 37.9 percent of the women were underweight while 16.8 percent were overweight/ obese. Similar prevalence of CED was reported in Rajasthan- Indian women 36.1 percent (Singh *et al.*, 2005) and 36 percent (Chaparro *et al*., 2014). During NFHS-3, a prevalence of 36.2 percent CED and 14.5 percent OW/OB was reported for Maharashtra state. Similar prevalence of CED to the current study were reported in Tripura (36.9%), Rajasthan (36.7 %) and OW/OB in Jammur and Kashmir (16.7 %) and Gujarati (16.7 %) using NFHS-3 data (IIPS and Macro, 2007). The similarity in prevalence to other states is an indication that malnutrition affects all women in the country irrespective of location. Hence , the causes could be more biological and individualized coupled with cultural effect.

4.1.20.3. Association of malnutrition with selected characteristics in Maharashtra state during 2005/06

All the studied variables were significantly correlated to the prevalence of malnutrition in women.

4.1.20.3.1. Socio-demographic variables

Results presented in Table.4.1.44 showed that CED was significantly higher among rural women (47.4 %), of Muslim religion (41.4 %) between 15-19 years of age (56.7 %), who had their first child between 15-19 years of age (36.3 %) and with two or more children (43.1 %).The same results show that OW/OB was significantly higher among women of urban residence (19.3 %), Christians (20.8 %), between 45-49 years of age (32.2 %) and women who had no child below five years of age (17.1 %). These findings are backed up by Islam *et al.* (2004) and Janghorbani *et al.* (2007) women in Bangladesh and Iran respectively.

4.1.20.3.2. Socio-economic factors

CED was significantly higher among women, who belonged to ST sect (50.0 %), employed in the agricultural sect (50.7 %), uneducated women (42.2 %), with uneducated partners (43.8 %), belonging to the poorest households (59.2 %) with no toilet facilities (49.0 %) and who delivered their children at home (57.2 %). A comparative study on maternal malnutrition in ten sub-Saharan African countries and a study in the SNNPR of Ethiopia support this finding: the higher the level of education the lower the proportion of women with CED (loaiza, 1997, Teller and Yimer, 2000, Tsegaye *et al.*, 2003). This might be because education may enable women to make independent decisions and to have greater access to household resources or income control and health care that are important to maternal nutrition. Therefore, education plays a significant role by influencing health-seeking behaviors, attitudes and practices towards appropriate feeding and care.

OW/OB was also significantly higher among women other castes (18.0 %), women with higher education (20.1 %) and whose partners attained higher education (28.8 %). These findings are backed up by Islam *et al.* (2004) and Janghorbani *et al.* (2007) women in Bangladesh and Iran.

4.1.20.3.3. Women autonomy

CED was significantly higher among women whose partners took decisions on money expenditure and who had no liberty to go to hospital alone that is those who were only allowed to go to hospital with someone else. Tebekaw (2011) reported similar findings among women in Ethiopia where CED was higher if the final decision was made by the woman's' partner.

On the other hand, OW/OB was significantly higher among women who were allowed to go to hospital and decide on money expenditure alone. This result clearly indicates that personal decision making in women played a significant role in prevalence of obesity. This is because women are likely to buy calorie dense foods like ice creams, chocolates and also use the most comfortable form of transport with minimum exercises if given the opportunity to decide on money expenditure.

4.1.20.4. Trends in malnutrition among women of Maharashtra state between 1998-2006.

Total malnutrition among women of Maharashtra state increased by 3.2 percent which was due to increase in OW/OB by 3.9 percent while CED decreased by 0.7 percent over the years (Figue.4.1.26). This can be attributed to migration and higher percentage of women in urban Maharashtra as compared to rural Maharashtra over the years as seen more women were urban residents in NFHS-3 (Figure.4.1.26) and yet it is documented of the high prevalence of OW/OB in urban centers where nutrition transition is very high with the western feeding habbits taking over the traditional diets.

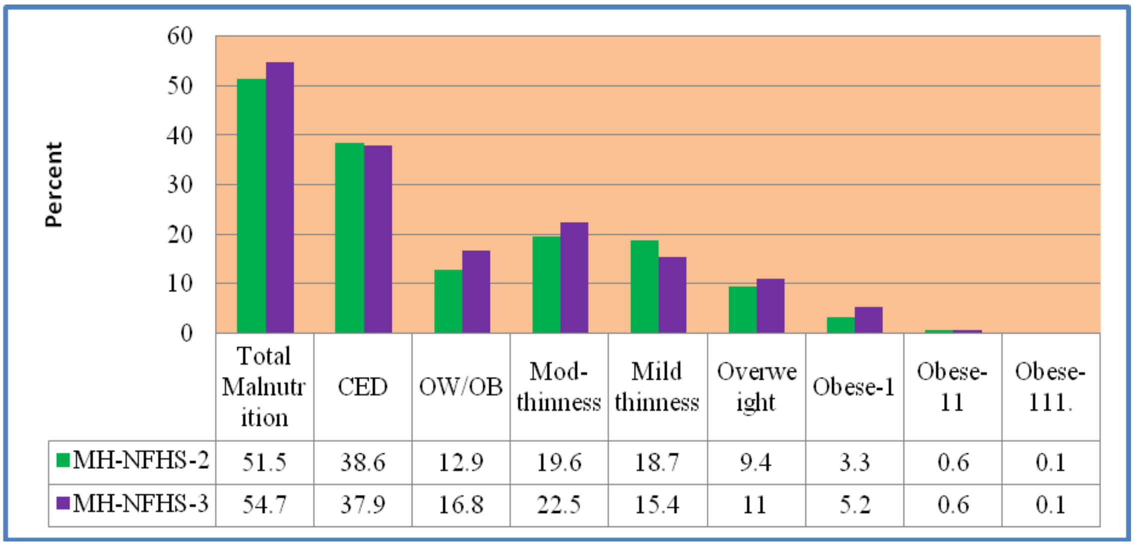


Figure.4.1.26. Trends in malnutrition prevalence among women in Maharashtra state between 1998-2006

Figure.4.1.27 shows that CED decreased in rural women by 3.0 % and increased by in urban women by 7 percent among urban women while OW/OB increased by 3 percent among the rural women but decreased drastically by 16.6 percent among the urban women. This is because urban women have more access to information inform of media in which several nutritional programs are advised hence many are dieting which explains the increase in CED as some will starve themselves in attempt to lose weight. Also this variation can be a result of migration from the rural areas to the urban areas hence increasing the CED as seen in figure.4.1.25 where most women were urban residents in NFHS-3 as compared to NFHS-2

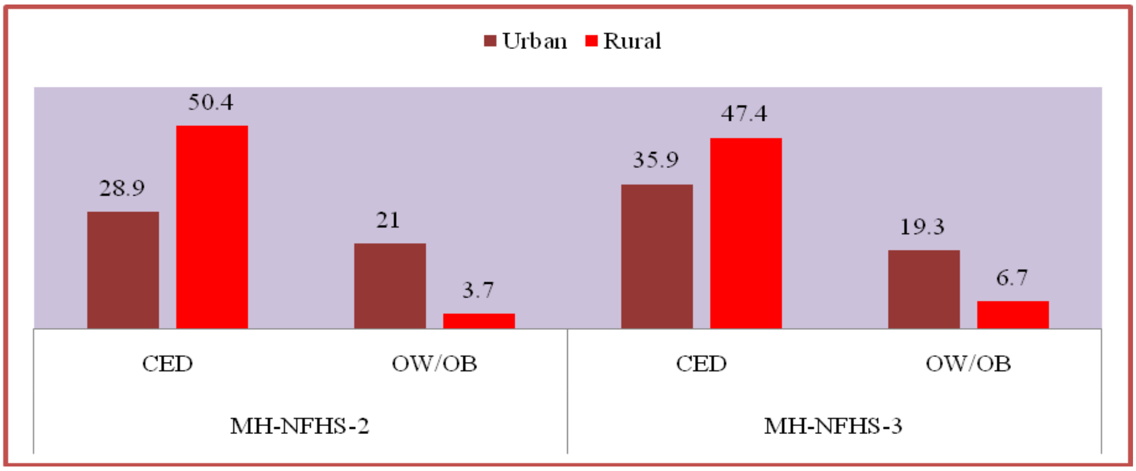


Figure.4.1. 27. Trends in malnutrition prevalence among women in Maharashtra state between 1998-2006

4.1.21. Bijapur district 1998/99

4.1.21.1. Profile of women (15-49 years) in Bijapur district during 1998/99.

Data on approximately 277 women of reproductive age between 15 and 49 years was included in the study. Results in (Table.4.1.45), shows that majority of the women were rural residents (66.0 %), Hindu (82.0 %), belonged to other caste (46.6 %). Most the women were between 35-39 years and had no children by the time of the survey. Out of the women included in the study, only 246 gave information on they had their first child and majority were found to have had their first child between 15-19 years of age (65.2 %) an indication of adolescent marriages.

Data on socio-economic variables also showed that 55.2 percent of the women were employed with majority in agricultural sector (32.5 %) and only 44.8 percent of the women were unemployed. As regards education, majority of the women were uneducated (66.5 %) but 57.7 percent of their partners were educated at different levels with most having attained secondary education which illustrates the low status of women in this district. However, due to their partner better education, most of the women belonged to richest and richer households (37.1 % and 25.4 %). However, despite the better wealth, 92.9 % of the households had no access to a proper toilet facility hence were practicing open defecation in the bushes and also delivered their children from home (57.5 %). Decision on money expenditure and obtaining health care was mostly carried out by the women's partners alone (36.1 % and 53.7 %).

4.1.21.2. Prevalence of malnutrition among women in Bijapur district during NFHS-2

Figure.4.1.36 showed that the overall prevalence of malnutrition was 56.7 percent of which 50.5 percent of the women were underweight and only 6.2 percent of the women were overweight/ obese. In this district, underweight is the most prominent form of malnutrition among the women which can be attributed to rural residence in which CED remains a prominent nutritional problem. Similar results were reported in Uganda in women in an IDP camp with prevalence of 48.7 percent, 3.5 percent and 1.0 percent for CED, overweight and obesity respectively (Agetta, 2010). IIPS and ORC Macro (2000) reported a similar prevalence of CED in Orrisa (48.0 %) and OW/OB in Madhya Pradesh (6.1 %), and Utta Pradesh (7.8 %) and Manipur (5.8 %). The prevalence in this study is higher than the national estimates for India (35.8 % CED and 2.2 % OW/OB).

Table.4.1.45. Prevalence of Malnutrition among women (15-49 years) in Bijapur district during 1998/99 survey

However, NFHS-3 reported a similar prevalence of CED in Bihar (45.1 %) and OW/OB in Chhattisgarh (5.6 %) and Orissa (6.6 %) but still higher than the national estimates during NFHS-3 survey (IIPS and Macro, 2007). Gosh –jerath *et al*. (2013) reported a prevalence of 42.4 % among women in Madhya Pradesh.

4.1.21.3. Association of malnutrition with selected characteristics

4.1.21.3.1. Socio - demographic factors

Residence and age of the woman were found significantly associated to the prevalence of malnutrition in women but not with religion, age at first birth and numbers of children below five years were found not significant to influence prevalence of malnutrition in women in Bijapur district.

CED was most prevalent among rural women though the difference with the urban women was marginal (49.0 % vs 48.3 %) respectively (figure.4.1.37) and younger women <24 years of age by the time of the survey (Table.4.1.45). Garenne (2011) found BMI to increase with increasing age of the woman in countries studied.

On the other hand, overweight/ obesity was most prevalent among urban women (9.2 %) and women between 30-34 years with a prevalence of 31.3 percent. This result is contradictory to findings of several reports which found overweight/ obesity to increase with advancing age of the woman (Prakruthi and Praksah, 2013 and IIPS and ORC Macro, 2000).

4.1.21.3.2. Socio-economic factors

Among the socio-economic factors, only wealth of the household in which the woman lived and toilet facility were found significant to influence malnutrition in women. The rest like occupation, education level of the woman and her partner and place of delivery were not significantly associated with malnutrition in women.

CED was most prevalent among women from the poorest households (80 %) with no toilet facilities (50.8 %) in the households while OW/OB was significantly higher among women from the richest households (32.8 %) living in households with flush toilets (25.4 %). This result is backed up national surveys (IIPS and ORC Macro, 2000, IIPS and Macro, 2007) and others studies Kothari *et al* (2014) and Fernald (2007).

Though not significantly associated, CED was most prevalent among women with higher education (figure.4.1.38) which is contradictory to most studies which report underweight as highest among the illiterate. However, this result can be attributed to the eating disorders which are common among the elite/ highly educated women like bulimia and anorexia nervosa in attempt to lose weight and attain the slim structure idealized among the educated and rich sects of a population despite the ability to afford quality food. The absence of OW/ OB among the highly educated women could be due to proper feeding and choice of healthy food which are greatly affected by the acquired nutritional knowledge (Ramesh and Lopamudra (2010). Garenne (2011) reported a similar pattern in developed countries in which OW/OB were more prevalent among the low SES and thinness among the elite sectors of the population. This is because in the developed world, it's the rich who can afford all the expensive diet which minimize weight while the poor feed on calorie dense foods as they are cheaper.

4.1.21.3.3. Women's autonomy

Study results found decision on money expenditure to significantly influence nutritional status of a woman but not decision on health acquisition.

CED was significantly higher among women who took an independent decision on money expenditure (65.7 %) yet several reports acknowledged that a woman's access to resources like money would improve her status health wise (FAO, 2010). This result indicated that women's autonomy on money expenditure did not protect them from malnutrition which could be due to lack of formal education which is required to enable the women make informed decisions as seen that 66.5 percent of the women in this district were not educated. IIPS (1995) also stated that CED was most common among the illiterate women.

4.1.22. Tumkur district 1998/99

4.1.22.1. Profile of the women (15-49 years) in Tumkur district during NFHS-2.

Data on approximately 442 women between 15-49 years was included in the study. Out of these women, 89.9 percent were rural residents; belong to OBC sect (42 %) and of Hindu religion (95.9 %). There was almost an equal distribution of women between the ages 20-39 years (Table.4.1.46) and only 314 women gave information on when they had their first child results showed majority their first child between 15-19 years of age and had no children by the time of the survey (62.5 %).

Table.4.1. 46. Prevalence of Malnutrition among women (15-49 years) in Tumkur district during 1998/99 survey

Data on socio-economic factors revealed that majority of the women were employed in the agriculture sector (53.5 %), were not educated (56.7 %) but had their husbands educated at different levels that is only 39.0 percent of the women were not educated. Majority of the women lived in richer and richest households (22.1 % and 20.7 %) respectively but in households without proper toilet facilities (90.7 %) and delivered their children from home (47.8 %). In this district, women lacked autonomy on money expenditure and health acquisition and it was the husband who took most of the decisions independently (Table.4.1.46).

4.1.22.2. Prevalence of malnutrition among women (15-49 years) in Tumkur district during NFHS-2

The overall prevalence of malnutrition among women in Tumkur district was 51.8 percent of which 41.6 percent were CED and 10.2 percent were overweight at varying degrees (Figure.4.1.). None of the women included in this study were found to be obese during this survey. Gosh- Jerath *et al.* (2013) reported a similar prevalence of CED (42.4 %) among in Madhya Pradesh. During NFHS-2, a prevalence of 43.7 percent CED was reported in west Bengal and

4.1.22.3. Association of malnutrition with selected characteristics

Results in this section are based on chi-square to find association between malnutrition in women and selected variables.

4.1.22.3.1. Demographic factors

Results in this section show there is no significant association with residence, religion and number of children but age of the woman and age at first birth were found significant to influence prevalence of malnutrition in women.

CED was most prevalent among women who had their first child 10-14 years while overweight increased with age at which the women had their first child (Table.4.1.46). Kamal *et al* (2015) reported an increment in OW/OB with increase in age at which the women had their first child that it was higher among women who had their first child 18+ years as compared to below thought CED was the same in both groups.

4.1.22.3.2. Socio-economic factors

There was a significant association between occupation, education of the woman and her partner's education, wealth but not with place of delivery and toilet facility (Table.4.1.46).

CED was significantly higher in women from SC sect (55.4 %), those who were uneducated (56.4 %), with uneducated partners (53.3 %), from the poorer households (64.2 %). Findings are backed up by national reports (IIPS and ORC Macro, 2000, and IIPS and Macro, 2007 and NNMB, 2002).

Overweight/ obesity were most prevalent in women with higher education, whose husbands attained secondary education, from richest households, with flush toilets and who delivered from a government facility. This result is an indication socio-economic status plays a significant role in prevalence of OW/OB in women (Subramanian *et al.* (2009) and Mowafi *et al*. (2011) similar to the current study. However, Savy *et al*. (2006) reported a significant decrease in BMI with Dietary Diversity among the educated and employed women with these two supporting dietary diversity and in turn reduction in dependence on high calorie foods.

Also a similar trend was observed with caste as with wealth and education but both underweight and overweight/ obesity were most prevalent among employed women which could raise questions on employment of women in relation to malnutrition. NNMB (2002) and IIPS (1995) reported similar findings with CED being prevalent among SC and ST women.

4.1.22.3.3. Women’s autonomy

There was no significant association between malnutrition in women and decision on money expenditure and acquisition of health care.

4.1.22.4. Comparison between women in Bijapur and Tumkur districts

In the two districts, total malnutrition was higher in Bijapur by 4.9 percent and none of the women was found to be obese in Tumkur district where as a small percent of the women in Bijapur district were obese at grade-1. However, underweight was higher in Bijapur district women by 8.9 percent but overweight/ obesity was higher by 4 percent in Tumkur district women. This can be attributed to lower SES among women in Bijapur district as compared to the women in Tumkur i.e more women were not employed, educated and having more uneducated partners all of which affect the choice of quality food consumed due to ignorance of healthy eating habits.

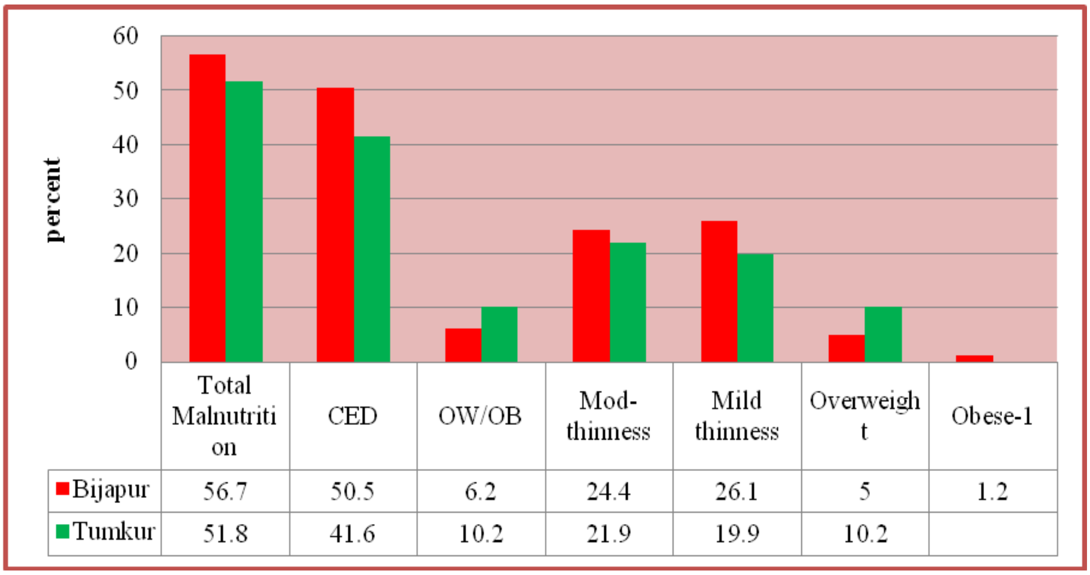


Figure.4.1.27. Prevalence of malnutrition among women (15-49 years) in Bijapur and Tumkur district during 1998/99 survey.

Figure.4.1.28. shows that CED was very high in both urban and rural women of both districts. Variations occurred in prevalence of OW/OB. In Bijapur, OW/OB was higher among urban women while OW/OB was higher among rural women in Tumkur district. This finding is backed up by Prakruth and Prakash (2013) who reported similar trend in rural women of Mandya district. This can attributed to nutrition transition and low Dietary diversity hence dependence on high calorie diets.

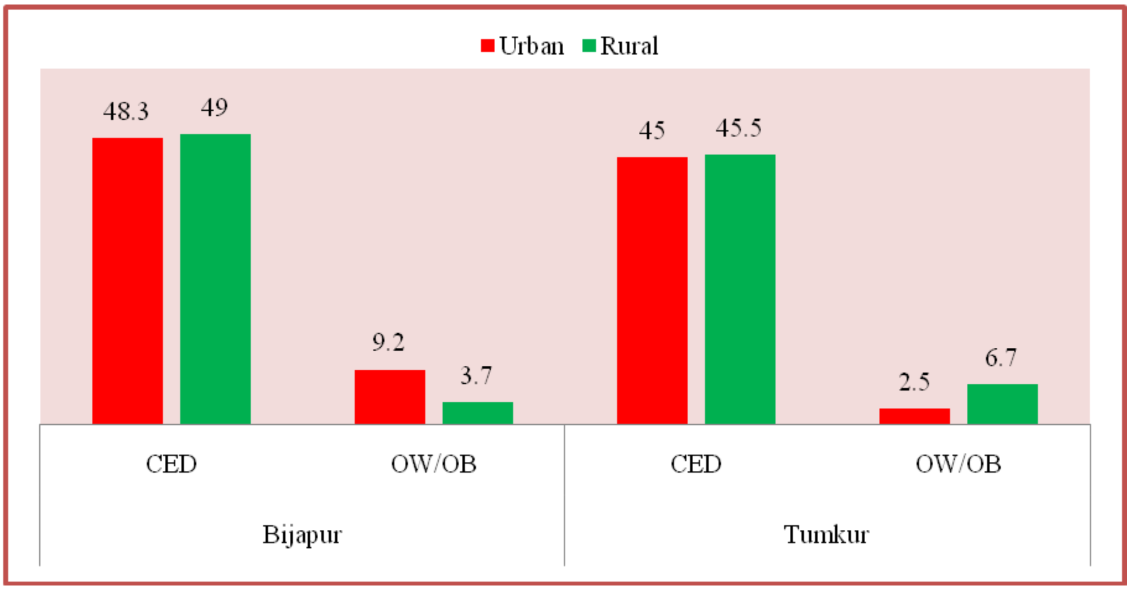


Figure.4.1. 28.Prevalence of malnutrition among women (15-49 years) in Bijapur and Tumkur districts by residential area during 1998/99 survey

4.1.23. Karnataka state 1998/99

4.1.23.1. Profile of the women (15-49 years) in Karnataka state during NFHS-2

Data on approximately 4858 women between the ages 15-49 years was included in the survey. Out of these women, majority were rural residents (65.2 %), of Hindu religion (85.5 %), between 25-29 years (19.7 %). Out of these women, only 4361 women gave a response to when they had their first child and results show that majority had their first child between 15-19 years of age (57.9 %) but most of the women had no child below five years by the time of the survey (54.4 %).

Results on socio-economic status showed that more than half of the women were employed (52.0 %) and only 48.0 percent were not working, were educated at different levels (50.1 %) with educated partners (66.0 %) with more men attaining higher education than the women, from middle class households (23.8 %), delivered at home (47.6 %) and living in households with no toilet facilities (63.5 %).
Independent decisions on money expenditure were carried out by the woman (40.5 %) but acquisition of health care was the responsibility of their partners (43.0 %) with only 25.6 percent taking independent decisions concerning health care.

4.1.23.2. Prevalence of malnutrition in women (15-49 years) in Karnataka state during NFHS-2

Overall prevalence of malnutrition in women was 52.1 percent of which 37.8 percent were underweight and 14.3 percent were overweight at different degrees (figure.4.1). Similar results have been reported in Karnataka state during NFHS-2 with a prevalence of chronic energy deficiency (CED) of 38.8 percent, overweight of 11.0 percent and obesity of 4.4 percent (IIPS and ORC Macro, 2000). However, in a neighbouring country like Bangladesh, a higher prevalence of CED (52 %) was reported among women in 1997 (Ahmed *et al*., 2012).

4.1.23.3. Association of malnutrition with selected characteristics

Results presented in Table.4.1.showed there is a significant association between malnutrition in women and all studied variables

4.1.23.3.1. Demographic factors

CED was most prevalent among rural women (48.4 %), women between the 20-24 years of age (47.3 %), who had their first child between 19-14 years of age and those with two or more children. NFHS-2 reported similar results with underweight being

Table.4.1. 47. Prevalence of Malnutrition among women (15-49 years) in Karnataka state during 1998/99 survey

most prevalent among rural women (40.6 %) and women between 20-24 years (41.8 %) in India (IIPS and ORC Macro, 2000).

On the hand, overweight/ obesity was most prevalent among urban women (25.6 %), between 45-49 years of age and those without any child below five years by the time of the survey. Prakruthi and Prakash (2013) also reported a gradual transition to higher BMI with advancing age which they owed to lower physical activity rather than higher energy intake.

4.1.23.3.2. Socio-economic factors

Results in Table.4.1 showed that CED was most prevalent among women from ST and SC sect (51.5 % and 45.0 %) respectively, employed women in the agricultural sector (54.3 %), un educated (50.8 %) with uneducated husbands (53.0 %), from poorest and poorer households (54.6 % and 54.1 %), living in households with no toilet facilities (50.0 %) and who delivered their children from home (52.6 %). This is because all these characteristics are associated with low socio-economic status which hinders accessibility to quality resources like food and medical facilities, access to information as such women are also less likely to own television, radio and transportation like cars and motorcycles to ease transportation to health facilities. This finding is backed up findings from a national report during NFHS-2 (IIPS and ORC Macro, 2000) and Rao *et al.* (2010). Also NFHS-2 report states that women of low SES are less likely to eat a balanced diet with a good dietary diversity. Krishna and Shaahidhar (2012) also found CED to be highest among women from SC and ST sects as they are unprivileged with limited access to quality education and employment.

On the other hand, the same study found a significantly higher association of overweight/ obesity among women with clerical jobs (39.5 %), who attained higher education (33.6 %) with husbands who attained higher education (24.8 %), living in richest households (34.9 %), using flush toilets (28.8 %) and who delivered their children in private hospitals (12.8 %). This situation is similar for other studies Subramanian and Smith (2006), Kinnunen and Neupane (2014) and Uthman and Aremu (2008) but Monteiro *et al*. (2004) stated that being poor is highly associated with risk of obesity in middle income countries as opposed to the rich in the same country as opposed to low income countries.

4.1.23.3.3. Women's autonomy

CED was most prevalent among women who jointly took decisions with someone else on money expenditure (60.9 %) and those who let someone else other than herself and partner make decisions on acquisition of health care (46.9 %). On the other hand, OW/OB was most prevalent among women who took independent decisions on money expenditure (10.7 %) and acquisition of health care (18.1 %). This could be due to the low educational level among the women and their husbands which affects their decision, jobs they get and hence earnings to afford quality meals and health services.

4.1.24. Karnataka state 2005/06

4.1.24.1. Profile of the women (15- 49 years) in Karnataka state during NFHS-3.

Data on approximately 5740 women aged 15-49 years was included in the study. Out of these women, majority were rural residents (61.8 %), belonged to OBC sect (58.6 %), of Hindu religion (85.9 %), between 15-19 years (18.4 %). Among these women included in the study, only 4103 gave information on when they had their first child and results show that majority of the women had their first child between 15-19 years (51.0 %) an indication of existence of adolescent pregnancy. However, by the time of the survey, majority of the women never had a child below five years of age (64.3 %).

Socio-economic data shows that majority of the women unemployed (52.7 %), educated up to secondary level (44.9 %) and with partners who attained secondary education (42.2 %), were living in middle class households (24.9 %), however with no toilet facilities (50.7 %) but delivered their children from government facility (35.9 %) as opposed to home delivery (32.9 %). Also results in Table.4.1. showed that majority of the women lacked autonomy ad decision on money expenditure and hospital attendance was singly carried out by the woman's partner.

4.1.24.2. Prevalence of malnutrition in women of Karnataka state

The overall prevalence of malnutrition was 54.3 percent of which 37.9 percent were CED while 16.4 percent were OW/OB at varying degrees. A similar prevalence of OW/OB (16 %) was reported among women in Haryana (Mittal, 2013).

Table.4.1. 48. Prevalence of Malnutrition among women (15-49 years) in Karnataka state during 2005/06 survey

4.1.24.3. Association of malnutrition with selected characteristics

Results presented in Table.4.1. showed there was significant association between malnutrition in women and all the studied variables except for number of children below five years of age that a woman had by the time of the survey.

4.1.24.3.1. Demographic factors

Residence, age of the woman, age at first birth and religion were found significant to influence the prevalence of malnutrition among women but not number of children below five years.

CED was most prevalent among rural women (44.6 %), those who belonged to other religions (53.8 %), adolescent women and decreased with increase in age of the woman from 54.5 percent in women between 15-19 years of age to 28.5 percent in older women between 45-49 years of age. CED was also highest among women who gave birth to their first child between 35-39 years (41.2 %) while OW/OB was most prevalent among urban (23.3 %) and Muslim women (24.7 %) women, steadily increased with increase in age of the woman and age at which the first baby was delivered. It was highest in women between 40-44 years of age (26.0 %) and in those who gave birth to their first child between 30-34 years of age. Bharati *et al*. (2007), Ramesh (2011) and IIPS and Macro (2007) reported similar findings.

4.1.24.3.2. Socio-economic factors

All social economic variables like caste, occupation, education of the women and their partners, wealth, toilet facilities and place of delivery were significant in influencing malnutrition in women.

CED was highest to women who belonged to ST sect (52.2 %), employed in the agriculture sector (48.2 %), with no level of formal education (43.9 %) and whose partners are not educated (45.0 %), living in poorest households (52.6 %) and delivered their children from home (54.9 %). All these are associated with low socio-economic status which has been proven paramount in the occurrence of under-nutrition especially in developing countries.

On the other hand, OW/OB was significantly associated and most prevalent among women who did not belong to either SC, ST or OBC (16.6 %). However among women from ST and OBC, an equally high prevalence of OW/OB was found as represented by (11.0 % and 15.2 %) which signifies an increasing dual burden of malnutrition among the poor sects of the developing communities. This can be a result of over dependence on cheap calorie dense foods like high starch rice varieties normally consumed by this sect of the community.

Also overweight and obesity was most prevalent among employed sedentary women that is clerical and professional sectors (26.2 % and 24.4 %) respectively, with higher education (39.8 %) and with partners who attained higher education (45.5 %), living in richest households (32.4 %) and who delivered from private facilities (22.7 %). All these are associated with high socio-economic status. These findings are backed up the report of NFHS-3 in which the prevalence of overweight and obesity is three times higher among women with 12 or more years of schooling than those with no education.
the report also noted that the percentage of women who are OW/OB is highest in Punjab (30 %), followed by Kerala (28 %) and Delhi (26 %), all of which are relatively richer states (IIPS and Macro. 2007).

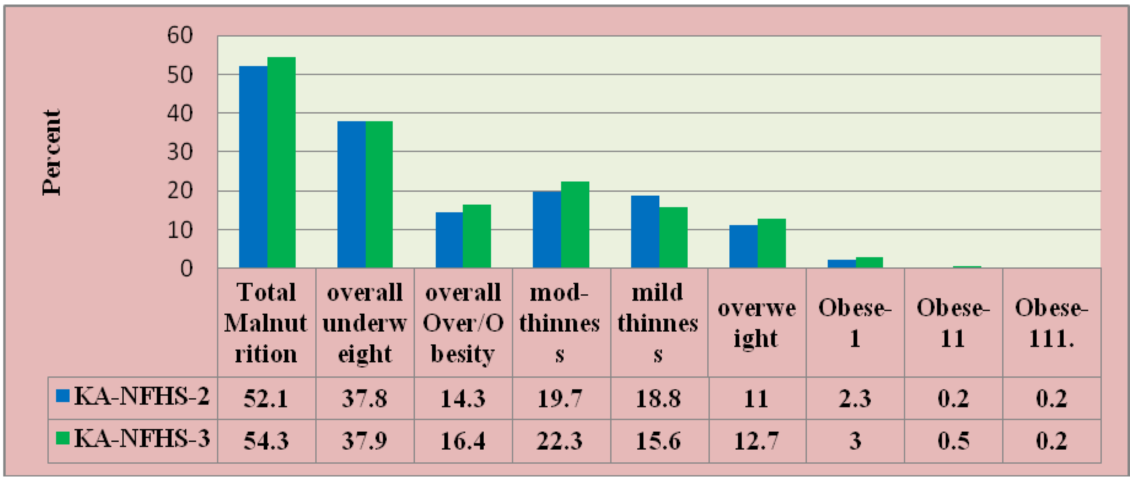
4.1.24.3.3. Women's autonomy

Results presented in Table.4.1 showed that women had little autonomy as regards decision on money expenditure and hospital attendance.

CED among them was most prevalent among women who let someone else decide on how to spend money (52.8 %) and among those who were not allowed to go to hospital at all (46.8 %) while OW/OB was most prevalent among women who took an independent decision on money expenditure (15.1 %) and were allowed to go to hospital alone. This result indicates that autonomy in women was associated with prevalence of overweight and obesity in women.

4.1.24.4. Trends in malnutrition among women (15- 49 years) between 1998-2006

Figure.4.1.29 shows that during the two surveys, total malnutrition in women increased by 2.2 percent in 2005/06 which was mainly due to overweight/ obesity as underweight prevalence remained the same just as reported in Namibian and Ghanaian women of reproductive age (Garenne, 2011). However, severity of malnutrition varied between the two surveys with an increment in moderate thinness but decrease in mild thinness and an increment in overweight and obesity as seen in figure.4.1.40 above. This result indicates that the nutritional status of women worsened with increment in both severity of underweight and overweight/ obesity prevalence which is a shift towards existence of dual burden of malnutrition.



	Total Malnutrition	overall underweight	overall Over/Obesity	mod-thinness	mild thinness	overweight	Obese-1	Obese-11	Obese-111.
KA-NFHS-2	52.1	37.8	14.3	19.7	18.8	11	2.3	0.2	0.2
KA-NFHS-3	54.3	37.9	16.4	22.3	15.6	12.7	3	0.5	0.2

Figure.4.1. 29. Prevalence of Malnutrition in women 15-49 years of Karnataka state during NFHS-2 and NFHS-3 surveys

Figure.4.1.30 shows the influence SES on malnutrition distribution in women of Karnataka state over the years. Over the years, malnutrition increased on the account of SES. This highlights the strong impact SES has on women health and nutrition with low SES showing greater increment of malnutrition.

4.1.24.5. Conclusion.

India is facing the dual burden of Underweight (CED) and Overweight (OW/OB) in women of reproductive age. In all the studied population, it is evident that CED remains a daunting problem though OW/OB seems to rise rapidly irrespective of SES. The findings of the study suggest that nutritional status of women is related to individual, SES and environment in which the women live. SES status remained was consistent in defining the type of malnutrition in women with CED being higher among women of low SES (poor/ low income, lack of sanitary toilets, agricultural employment, lack of education in both woman and her partner and home delivery) and the reverse was true for OW/OB among higher SES (educated up to 10 plus, use of flush toilets, professional employment and rich class).

The study also observed urban and rural differences. Though CED remained higher in rural areas as compared to urban areas where OW/OB was most prevalent, in Andhra Pradesh, the prevalence of CED and OW/OB was almost equal in urban women. However, Maharashtra, Karnataka and Bijapur, the prevalence of CED was higher than OW/OB among urban women. This could be attributed to urbanization and migration from rural to urban areas increasing the population of urban poor who live in sorrowful conditions and have to work a lot to meet the expenses of living in cities thus increasing energy expenditure hence low weight.

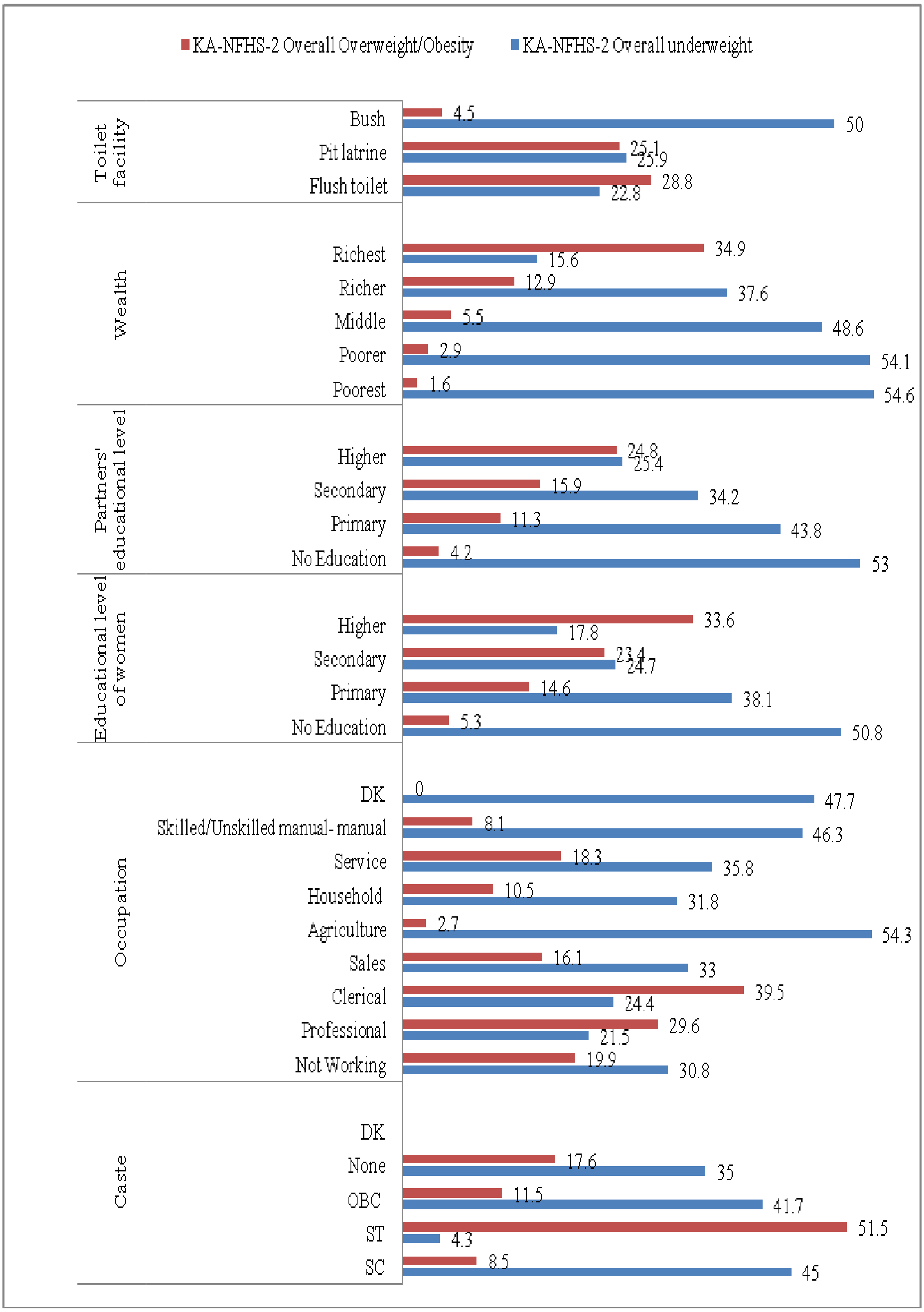


Figure.4.1. 30. Prevalence of Malnutrition in women 15-49 years of Karnataka state during NFHS-2 and NFHS-3 surveys

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In Tumkur district, it was observed that the prevalence of OW/OB was higher in rural women compared to urban women which can be attributed to nutrition transition affecting all sectors of the population. With this, there is less dependence on traditional diet and more of calorie dense diets. Prakruth and Prakash (2013) also found a similar pattern in OW/OB prevalence among women from Mandhya district in Karnataka state.

With these mixed findings, it is evident that, the pattern of malnutrition among rural and urban areas will continue to evolve, therefore, intervention programs should be tailored to tackle both under nutrition and over nutrition at the same time at household level or district level to achieve effective results and cater for the co-existence of the two forms of malnutrition in the same household. Intervention programs should aim to reduce poverty among women, educate them on nutrition and sanitation irrespective of educational level to equip them with knowledge to make informed decisions on food choices for themselves and the family. Lastly systemic and regular monitoring and surveillance of social trajectory of nutritional status of women is crucial to develop opposite strategy that addresses the persistent CED and emerging OW/OB.

4.2. Correlation between NFHS and NSSO.

4.2.1. Prakasam district.

Results presented in Table.4.2.1 and Table.4.2.2 showed that generally, there was inadequate consumption of both calories and proteins but adequate consumption of fat. No differences between genders in consumption pattern were observed. During 1999-2004 survey, consumption of calories and proteins decreased but remained highest among the very rich yet it was highly inadequate among the poor sectors of the community (very poor and poor).

On the other hand, consumption of fat increased slightly across the years in all income groups and remained high among the very rich, rich, higher middle and lower middle but was inadequate among the very poor and poor. This explains the high levels of CED among the poor sectors of the community as their bodies are practically starved and yet they expend a lot of energy during their manual jobs which need is not met by the food consumed. At the same time, the high income groups consume excess which is not expended as most of them are employed in well paying jobs with minimal movement of the body, have excess supply of food as they can afford and indulge in sedentary life style hence high prevalence of OW/OB. These findings are backed by findings from Kothari *et al*. (2014) in which CED was most prevalent among low income groups and OW/OB was most prevalent in high income groups in most of the countries in both Africa and Asia.

4.2.2. Mahbubnagar district.

Results presented in Table.4.2.1 and Table.4.2.2 showed that generally, there was an inadequate intake of calories and proteins but adequate intake of fat. No observable differences were seen between calories and protein intake but were available for fat with more males consuming fat than females in 1999 survey.

Calorie and protein consumption was very high and adequate among the very rich people but remained inadequate among the very poor and poor groups. This explains the absence of CED among women who belonged to richest households as none suffered from CED (Table.4.1.38).

4.2.3. Andhra Pradesh state

Results presented in Table.4.2.1 and Table.4.2.2 showed that generally, there was inadequate consumption of both calories and proteins but fat consumption was adequate in the state. Overall, females consumed more calories, proteins than the males though it was inadequate.

Calorie and protein consumption was highest and adequate among the very rich while it decreased with decrease in income groups over the years. Fat consumption on the other hand was very high above the RDA for the very rich and rich groups but remained inadequate among the very poor despite increasing over the years.

Table.4.2. 1.Average Daily intake of Calories, Proteins and Fats from total food in Prakasam, Mahbubnagar district and Andhra Pradesh state during 1999- 2004.

Nutrients	RDA	Prakasam		Mahbubnagar		Andhra Pradesh	
		1999	2004	1999	2004	1999	2004
Calories	2230 (kcal)	2009.9	1814.4	1990.5	2072.1	1966.2	1925.4
Proteins	55.0 (g)	48.9	46.9	50.0	54.0	49.5	48.6
Fats	25 (g)	28.5	34.3	26.8	34.4	31.4	34.8

Table.4.2. 2.Average Daily intake of Calories, Proteins and Fats from total food in Prakasam, Mahbubnagar district and Andhra Pradesh state by income groups and gender during 1999- 2004

	Calories (kcal)		Proteins (g)		Fats (g)	
	1999	2004	1999	2004	1999	2004
Prakasam						
Income group						
Very rich	2898.95	2270.32	74.33	62.9	54.75	57.78
Rich	2458.9	2044.28	61.94	55.63	47.27	45.49
Higher middle	2080.97	1863.96	51.27	47.97	30.61	33.15
Lower middle	1949.72	1697.61	46.59	41.65	24.85	27.38
Poor	1766.51	1538.13	41.67	36.96	19.16	21.28
Very poor	1422.8	1335.56	32.76	31.81	13.95	16.17
Gender						
Female	1835.83	2015.33	59.61	61.73	34.16	42.41
Male	2207.34	1896.54	69.87	58.49	54.15	46.05
Mahbubnagar						
Income group						
Very rich	3463.2	3379.9	97.5	95.0	72.0	77.6
Rich	2527.3	2355.7	66.3	62.9	36.8	41.7
Higher middle	2184.3	2102.3	55.4	54.2	28.6	30.9
Lower middle	2014.2	1734.3	50.2	43.9	36.8	41.7
Poor	1771.4	1630.7	43.1	40.1	23.5	20.4
Very poor	1400.4	1311.6	33.2	31.7	15.4	13.9
Gender						
Female	1899.1	2115.8	47.1	54.6	24.1	35.1
Male	2035.9	2064.3	51.5	54.0	28.2	34.2
Andhra Pradesh						
Income group						
Very rich	2835.72	2775.11	76.89	76.29	68.14	66.14
Rich	2320.86	2165.67	60.27	56.21	44.02	44.31
Higher middle	2114.02	1971.55	53.37	49.02	34.21	34.97
Lower middle	1928.88	1816.97	47.66	44.57	28.37	29.68
Poor	1696.37	1637.04	41.65	39.59	21.28	23.8
Very poor	1357.46	1288.78	32.59	31.13	15.16	16.41
Gender						
Female	1978.9	2017.1	50.25	50.08	31.02	36.7
Male	1961.0	1911.8	49.24	48.42	31.51	34.53

4.2.4. Akola district

Results presented in Table.4.2.3 and Table.4.2.4 showed generally there was adequate consumption of protein during 1999-2004 but consumption of calories was slightly below average recommended while fat consumption was below RDA.

Among the very rich, there was adequate consumption of calories which increased during 1999-2004. It was also increased among the poor and very poor though it remained highly inadequate below RDA. However, protein consumption was adequate among the rich, higher middle and lower middle but it was inadequate among the very rich during 1999. Fat consumption on the other hand increased over the years and was highest among the very rich and remained inadequate among the poorest of the community. This explains the increasing trend of OW/OB among women from wealthy households who face dual burden of malnutrition (12.6 % CED and 51.6 % OW/OB) while among the poorer and poorest CED deficiency continues to prevail at high levels (77.5 % and 56.6 %) respectively with none being OW/OB (Table.4.1.41).

4.2.5. Solapur district.

Results presented in Table.4.2.3 and Table.4.2.4 showed that generally, there was inadequate consumption of calories but protein and fat was inadequate during 1999-2004. Consumption of calories and proteins was highest among the very rich and increased between the two surveys and remained inadequate in other groups. It was lowest among the very poor and decreased over the years. However, fat consumption was adequate for all groups and increased over the years but was still highest among the very rich and least among the very poor.

Calorie consumption was inadequate in both males and females but increased over the years for both but protein and fat was adequate in both gender. This explains why children of the same gender are affected with malnutrition equally (Table.4.1.16).

4.2.6. Maharashtra state.

Results presented in Table.4.2.3 and Table.4.2.4 showed that generally, calorie and protein consumption decreased over the years and was inadequate while fat consumption among the populations increased over the years and was high above the

RDA. Minimal differences were observed in gender –wise consumption of calories but females consumed proteins and fat better than males.

Calorie consumption decreased and remained inadequate over the years across all income groups except for the very rich in 1999 and was least among the very poor. Protein consumption also decreased across all income groups but remained adequate only among the very rich, rich and higher middle where as it was inadequate among the lower middle, poor and very poor people. However, fat consumption was very high among the very rich but also remained adequate for all income groups during 1999-2004 though it was lowest among the very poor.

Table.4.2. 3. Average Daily intake of Calories, Proteins and Fats from total food in Akola and Solapur districts and Maharashtra state during 1999- 2004.

Nutrients	RDA	Akola		Solapur		Maharashtra	
		1999	2004	1999	2004	1999	2004
Calories	2230 (kcal)	2106.7	1903.9	1960.6	2232.4	1909.5	1791.3
Proteins	55.0 (g)	67.1	58.7	60.8	77.2	56.3	53.0
Fats	25 (g)	48.7	45.8	47.9	68.2	42.4	43.9

Table.4.2. 4. Average Daily intake of Calories, Proteins and Fats from total food in Akola and Solapur districts and Maharashtra state by income groups and gender during 1999- 2004

	Calories (kcal)		Proteins (g)		Fats (g)	
	1999	2004	1999	2004	1999	2004
Akola						
Income group						
Very rich	2551.67	2618.97	51.35	78.83	67.89	80.8
Rich	2486.72	2004.74	83.37	60.61	55.24	55.07
Higher middle	2152.77	1861.68	70.39	57.91	39.05	43.88
Lower middle	1846.31	1842.43	60.39	59	35.61	35.09
Poor	1366.56	1605.99	43.51	49.21	23.57	29.65
Very poor	1062.44	1294.13	33.53	40.39	14.93	20.8
Gender						
Female	1835.83	2015.33	59.61	61.73	34.16	42.41
Male	2207.34	1896.54	69.87	58.49	54.15	46.05
Solapur						
Income group						
Very rich	2564.66	3097.07	78.98	86.73	75.56	74.31
Rich	2140.18	2196.94	66.32	70.11	56.5	63.15
Higher middle	1892.16	2142.96	59.49	61.06	43.32	56.58
Lower middle	1785.39	2485.39	55.22	50.9	38.25	36.17
Poor	1506.78	1655.46	46.04	50.82	29.71	34.13
Very poor	1403.39	1227.44	43.27	37.65	27.4	23.29
Gender						
Female	1845.98	2236.52	56.76	66.24	43.91	40.74
Male	1994.05	2083.45	61.94	71.41	49.04	57.42
Maharashtra						
Income group						
Very rich	2835.72	2775.11	76.89	76.29	68.14	66.14
Rich	2320.86	2165.67	60.27	56.21	44.02	44.31
Higher middle	2114.02	1971.55	53.37	49.02	34.21	34.97
Lower middle	1928.88	1816.97	47.66	44.57	28.37	29.68
Poor	1696.37	1637.04	41.65	39.59	21.28	23.8
Very poor	1357.46	1288.78	32.59	31.13	15.16	16.41
Gender						
Female	1978.9	2017.1	50.25	50.08	31.02	36.7
Male	1961.0	1911.8	49.24	48.42	31.51	34.53

This results is clearly reflected in findings of NFHS-2 and NFH-3 in which CED was persistently highest among the poorest with an increase of OW/OB among the poorest over the years from (0.4 % to 2.3 %) and the worsening of the nutritional status of the women in the richest category as seen in tables.4.1.43-44.

4.2.7. Bijapur district.

Results presented in Table.4.2.5 and Table.4.2.6 showed that generally, there was inadequate consumption of calories which also decreased over the years. On the other hand, there was adequate consumption of protein during 1999 but decreased below RDA over the years. Fat consumption remained high and increased over the years. Negligible differences were observed between genders but fat consumption was higher among females

Consumption of calories, proteins and fat was adequate and highest among the very rich and decreased over the years except for fat consumption which increased over the years in all income groups.

4.2.8. Tumkur district.

Results presented in Table.4.2.5 and Table.4.2.6 showed that generally, there was inadequate intake of calories and proteins but fat intake was adequate as per daily requirement. Minimal differences were observed between females and males in consumption pattern.

Consumption of calories, proteins and fats was adequate for the very rich population and remained inadequate among the poor across the years and increased during 1999-2004. These findings are in line with results presented in Table.4.1.46 about the prevalence of CED and OW/OB among the women of different socio-economic status.

4.2.9. Karnataka state.

Results presented in Table.4.2.5 and Table.4.2.6 showed that generally, calorie and protein consumption were inadequate below RDA while fat consumption was adequate during 1999-2004. No gender differences were observed between the male and female consumption which is for calories and proteins but the females consumed more fat than males during 1999 but over the years, consumption was similar.

Over the years, calorie and protein consumption was adequate and increased with fat consumption which could be the cause of obesity rise over the years.

Table.4.2. 5. Average Daily intake of Calories, Proteins and Fats from total food in Bijapur, Tumkur districts and Karnataka state during 1999- 2004.

Nutrients	RDA	Bijapur		Tumkur		Karnataka	
		1999	2004	1999	2004	1999	2004
Calories	2230 (kcal)	2096.5	1794.0	1764.4	1771.5	1875.4	1713.9
Proteins	55.0 (g)	64.2	53.3	48.1	47.2	52.7	47.8
Fats	25 (g)	38.6	39.6	31.5	31.2	35.1	33.3

Table.4.2. 6.Average Daily intake of Calories, Proteins and Fats from total food in Bijapur and Tumkur districts and Karnataka state by income groups and gender during 1999- 2004.

	Calories (kcal)		Proteins (g)		Fats (g)	
	1999	2004	1999	2004	1999	2004
Bijapur						
Income group						
Very rich	2945.8	2453.8	91.5	74.5	63.4	74.7
Rich	2542.7	2168.8	78.5	65.0	52.9	52.9
Higher middle	2186.1	1969.4	66.6	58.4	38.6	43.1
Lower middle	1864.2	1677.5	57.1	49.9	33.8	36.7
Poor	1659.7	1608.8	50.6	47.5	25.3	31.6
Very poor	1357.3	1340.8	39.7	38.4	17	26.9
Gender						
Female	2121.0	1900.9	63.9	56.1	38.3	44.5
Male	2083.6	1777.6	64.4	52.9	38.7	38.9
Tumkur						
Income group						
Very rich	2280.07	2715.84	65.46	75.41	46.16	47.4
Rich	2014.79	2047.11	57.83	56.85	43.74	35.96
Higher middle	2011.58	1907.7	52.51	51.26	39.81	34.53
Lower middle	1490.1	1721.84	41.28	45.17	25.32	30.68
Poor	1657.43	1546.71	43.1	40.39	22.21	26.48
Very poor	1071.07	1440.07	27.94	36.3	13.78	23.45
Gender						
Female	1720.95	1892.66	47.01	50.14	32.74	33.66
Male	1775.81	1759.9	48.35	46.92	31.2	30.92
Karnataka						
Income group						
Very rich	2515.81	2155.03	71.04	64.08	58.99	55.15
Rich	2183.84	2030.1	61.37	57.67	42.39	43.19
Higher middle	1939.86	1904.99	54.14	53.97	34.43	37.03
Lower middle	1792.79	1686.54	50.61	46.49	33.41	31.93
Poor	1500.24	1525.65	42.2	41.76	24.39	27.31
Very poor	1191.94	1260.1	33.63	33.92	17.45	20.71
Gender						
Female	1934.03	1759.95	53.86	48.43	37.42	33.69
Male	1853.3	1705.33	52.29	47.73	34.18	33.26

4.2.10. Conclusion.

In all studied areas, pattern of dietary consumption clearly shows a positive correlation between diet and nutritional status. In all studied areas, there were no noticeable differences between males and females which indicate that both genders are equally at a risk of malnutrition if their diet does not meet the required needs.

The results of the study above also indicated that socio-economic status (SES) directly influences the dietary pattern and feeding habbits of a population with inadequate consumption of calories and proteins being common among low SES and consumption of the two nutrients improved with SES. In almost all, the SES, fat consumption was adequate though it remains lower for low SES and improves with SES being highest among the very rich. This pattern clearly explains the higher dual burden of malnutrition across SES but more clearly the higher prevalence of OW/OB among high SES across all studied population. This is because, they have the ability to afford enough food but are conflicted with what is healthy to eat and what society perceives as food for the elite class. They are also the highest victims of food fads in terms of weight loss and gain as they can afford it coupled with ignorance on nutritional education despite being learned. Several studies confirm the impact of SES on nutritional status of women and those in their household (Kamal *et al*., 2015, Basagoudar and Chandrashekhar (2013), Subramanian and Smith, 2006, Shukla *et al.* 2002 and IIPS and Macro, 2007).

4.3. Anaemia in children.

This sector covers anaemia in children below five years and is discussed under the following headings with 1998/99 results first followed by 2005/06.

f) Profile of the study population

g) Prevalence of anaemia

h) Association of anaemia and selected variables

   v. Children characteristics

   vi. Maternal characteristics

   vii. Morbidity

   viii. Nutritional status

i) Determinants of anaemia in children (using logistic regression).

j) Trends in anaemia prevalence and comparison between states and districts**.**

4.3.1. Prakasam district.

4.3.1.1 Profile of study population during 1998-99 (NFHS-2) survey.

Data on approximately 64 children below the age of five was included in the study. Out of these children, majority resided in rural Prakasam (97.1 %), were of Hindu religion (93.6 %), female (55.0 %) and the remaining 44.9 percent were male. Majority of the children were in the age bracket >23-≤ 35 months old (29.2 %) and 0-6 months old (29.1 %), were of average weight at birth (54.7 %), were still breast feeding (96.8 %) and belonged to neither SC, ST or OBC caste (41.9 %).

Most of the children's mothers were not educated (54.9 %), not working (45.1 %), and were lacking toilet facilities in their households and were therefore practicing open defecation. Table.4.3.2 shows that majority of the children in this district never suffered from fever or cough two weeks prior to the survey represented by 70.9 percent and 74.4 percent and had normal anthropometric measurements based on stunting, wasting and underweight forms of malnutrition (Table.4.3.3).

Table.4.3 1. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Prakasam district during 1998/99

Background characteristic	% of children with any Anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban	0.0	0.0	0.0	0.0	2(2.9)	DF=3	NC	NC
Rural	66.6	59.9	3.3	3.3	62(97.1)	X^2=3.5043	NC	NC
						P=0.3202 (NS)		
Religion								
Hindu	62.3	55.3	3.5	3.5	60(93.6)	DF=3	1.527	0.334(-)
Christian	100.0	100.0	0.0	0.0	4(6.4)	X^2=3.1568	RC	
						P=0.3681 (NS)		
Sex								
Male	79.1	71.9	0.0	7.2	29(44.9)	DF=3	-1.114	0.159(-)
Female	52.9	47.0	5.9	0.0	35(55.0)	X^2=3.5043	RC	
						P=0.3202(NS)		
Age								
0-6	33.1	33.1	0.0	0.0	19(29.1)	DF=15	3.068	0.017(21.5)
>6 - ≤ 8	50.4	50.4	0.0	0.0	4(6.4)	X^2=38.6548	2.387	0.177(-)
>8 - ≤ 11	100.0	66.5	33.5	0.0	6(9.7)	P=0.0007**	-1.425	0.369(-)
>11 - ≤ 17	61.3	61.3	0.0	0.0	10(15.9)		1.996	0.151(-)
>17 - ≤ 23	66.7	66.7	0.0	0.0	6(9.7)		1.728	0.277(-)
>23 - ≤ 35	88.9	77.7	0.0	11.1	17(29.2)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=6	NA	NA
Larger than AV	54.4	36.2	9.1	9.1	23(35.6)	X^2=11.5614	0.499	0.710(-)
Average (AV)	71.0	71.0	0.0	0.0	35(54.7)	P=0.072 (NS)	0.440	0.737(-)
Smaller than AV	66.7	66.7	0.0	0.0	6(9.7)		RC	
Very small	NA	NA	NA	NA	NA		NA	NA
Currently breastfeeding								
No	100.0	0.0	0.0	100.0	2(3.3)	DF=3	-34.197	0.992(-)
Yes	63.5	60.2	3.4	0.0	62(96.8)	X^2=63.9087	RC	
						P<.0001**		
Caste								
SC	85.6	71.3	0.0	14.4	14(22.6)	DF=3	-1.265	0.240(-)
ST	NA	NA	NA	NA	NA	X^2=3.5043	NA	NA
OBC	63.6	63.6	0.0	0.0	23(35.5)	P=0.3202(NS)	0.062	0941(-)
NONE	54.3	46.5	7.8	0.0	27(41.9)		RC	
Maternal characteristics								
Education of mother								
No education	70.5	64.6	5.9	0.0	35(54.9)	DF=9	-2.263	0.769(-)
Primary	60.0	60.0	0.0	0.0	10(16.2)	X^2=10.5705	0.252	0.828(-)
Secondary	50.0	50.0	0.0	0.0	4(6.5)	P=0.3063(NS)	0.608	0.701(-)
Higher	58.0	43.5	0.0	14.5	14(22.4)		RC	
Occupation								
Not working	50.3	43.1	0.0	0.0	29(45.1)	DF=12	-18.120	<.0001
Sales	66.7	6.7	0.0	0.0	6(9.7)	X^2=19.7303	-17.948	<.0001
Agric S-E	50.0	50.0	0.0	0.0	4(6.38)	P=0.0724(NS)	-16.715	<.0001
Agric E	90.9	81.8	9.1	0.0	23(35.6)		-18.728	0.061(-)
Unskilled -M	0.0	0.0	0.0	0.0	2(3.3)		RC	
Toilet facility								
Flush	NA	NA	NA	NA	NA	DF=3	NA	NA
Pit-latrine	0.0	0.0	0.0	0.0	4(6.2)	X^2=7.6755	NC	NC
Bush	68.9	62.0	3.5	3.5	60(93.9)	P=0.0532(NS)	NC	NC
Others	NA	NA	NA	NA	NA		NA	NA
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-UW= mild underweight, Mod-UW= moderate underweight, Sev-UW= Severe underweight, NC=Not computed, NA=not available								

Source: NFHS-2

4.3.1.2. Prevalence of anaemia

The overall prevalence of anaemia based on all selected variables was 62.3 percent of which 53.7 percent of the children were mildly anaemic, 2.8 percent were moderately anaemic and 5.1 percent were severely anaemic (Figure.4.3.1). This result reveals that more children in this district were severely anaemic than moderately anaemic. Kotecha (2011) reported an almost similar prevalence of total anaemia in West Bengal (61.0 %), Tripura (62.9 %) and severe anaemia in Punjab (6.6 %) and Haryana (4.3 %). Also in Bangladeshi children, prevalence of 60 percent was reported (Uddin *et al*., 2011). Sinha *et al*., (2008) reported a higher prevalence of 80.3 percent in rural wardha children in India. The prevalence of this population is lower than the estimated national prevalence of 74.3 percent in Indian children but with a similar prevalence of severe anaemia at 5.4 percent and total anaemia in Assam of 63.2 percent (IIPS and ORC Macro, 2000). The similarity in prevalence to other parts of the world is an indication of child anaemia being a global public health problem.

4.3.1.3. Association of anaemia and selected variables

4.3.1.3.1. Children characteristics

Bivariate analysis based on chi-square results revealed there was significant association between anaemia in children with sex, age, breast feeding status and caste but not with residence, religion and size at birth.

Anaemia was highest among male children (79.1 %) with severe anaemia (7.2 %) as compared to female children with overall anaemia of 52.9 percent. Studies in Ghana have reported similar findings with anaemia being higher in male than female children below five years (Muhe *et al.,* 2000 and Owusu-Agyei *et al*., 2002). This could be due to the higher growth rate of male children than their female counterparts at the same age.

Anaemia was mostly associated with age >23-≤ 35 months with an overall prevalence of 88.9 percent and severe anaemia at 11.1 percent (Figure.4.3.3). However, Ayoya *et al*. (2013) reported anaemia to be highest among children 6-11 months (51.5 %) and in NFHS-2 anaemia was reported to be highest in children 12-23 months old with a total prevalence of 77.7 percent and severe anaemia at 6.3 percent (IIPS & ORC Macro, 2000). Ong'echa *et al*. (2006) did not find age to be significantly associated with child anaemia.

Caste was found to significantly influence prevalence of anaemia in children. Anaemia was highest among children from SC (85.6 %) and they alone had an association with severe anaemia (14.4 %) compared to children from other caste groups. Similar to the current study, Sinha *et al*., (2008) reported the highest prevalence of anaemia among children from the SC (87.1 %) which was also significant. This is because children in SC come from underprivileged societies with limited access to quality resources like housing, food and health care.

4.3.1.3.2. Maternal characteristics

Results presented in Table.4.3.1 did not reveal a significant association between anaemia and mothers' education, occupation and toilet facility in the household.

Overall prevalence of anaemia was highest among children whose mothers had no education (70 %) and decreased with acquisition of formal education. However even among children whose mothers attained higher education, more than half (58.0 %) were anaemic with a high association with severe anaemia (14.5 %). This is a clear indication of how pervasive anaemia is in this population. Arnold *et al*. (2009) reported similar results among Indian children in NFHS-3 where anaemia was 75 percent in children whose mothers had no education and reduced to 55 percent in children whose mothers attained 12+ years of schooling. Findings of Alawadi (1996) were also similar to findings of the current study among children in Kuwait.

Though occupation of the mother was not significant in influencing anaemia prevalence in children, anaemia was highest among children whose mothers were employed in the agricultural sector (90.9 %). However, children whose mothers were not working were the only ones found with an association with severe anaemia (7.2 %). Hussein and Mohammed (2014) reported similar findings with the current study in which anaemia was high among children, as majority of their parents were farmers with limited education and it was not significant as in the current study. This is because mothers who are farmers spend most of the time away from home while working on the fields.

4.3.1.3.3. Morbidity

Results in Table.4.3.2 showed that presence of cough two weeks prior to the survey was significantly associated with prevalence of anaemia in children below five years of age but not the presence of fever. Children who suffered from cough had an association with severe anaemia (12.7 %) which was not found in children without cough. Semedo *et al.* (2014) reported similar results in Cape Verde children of the same age bracket who suffered from diarrhea. They had a higher prevalence of anaemia than those without diarrhea (61.2 % vs 50.1 %).

Table.4.3.2.Association and Determinants of anaemia in children below five years based on morbid conditions in Prakasam district during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Had fever								
No Yes	63.9 66.7	59.3 55.6	7.1 5.9	0.0 11.2	88 (71.6) 19 (29.1)	DF=3 X^2=5.9678 P=0.1132 (NS)	0.957 RC	0.344(-)
Had cough								
No Yes	51.5 56.6	69.5 50.7	4.4 0.0	0.0 12.7	48 (74.4) 16 (25.6)	DF=3 X^2=9.5065 P=0.0233 **	-1.196 RC	0.221(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia.								

Source: NFHS-2

4.3.2.3.3. Nutritional status.

Table.4.3 3. Association and determinants of anaemia in children below five years based on morbid conditions in Prakasam district during 1998/99

Background	% of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
STUNTING								
Normal Mild –S Mod –S Sev- S	60.6 100.0 71.4 60.0	60.0 100.0 42.9 60.0	0.0 0.0 14.3 0.0	0.0 0.0 14.3 0.0	20(36.7) 10(18.5) 15(26.1) 10(18.7)	DF=9 X^2=19.062 P=0.0247*	-1.019 -2.759 -3.401 RC	0.611(-) 0.178(-) **0.045*(30)**
WASTING								
Normal Mild –W Mod-W Sev-W	71.3 67.6 100.0 0.0	64.1 56.3 100.0 0.0	7.2 0.0 0.0 0.0	0.0 11.3 0.0 0.0	29(52.0) 18(33.1) 6(11.2) 2(3.7)	DF=9 X^2=14.307 P=0.1118 (NS)	NC NC NC NC	NC NC NC NC
UNDERWEIGHT								
Normal Mild-uw Mod- uw Sev- uw	73.3 75.2 50.0 75.0	64.0 75.2 50.0 50.0	9.2 0.0 0.0 0.0	0.0 0.0 0.0 25.0	22(40.4) 17(29.8) 8(14.9) 8(14.9)	DF=9 X^2=17.151 P=0.0464*	0.942 1.867 2.611 RC	0.720(-) 0.354(-) 0.196(-)
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight, NC= Not computed.								

Source: NFHS-2

Results presented in Table.4.3.3 show that stunting and underweight were found significant in influencing prevalence of anaemia in children below five years but not wasting.

Severe anaemia was associated with moderate stunting in children with a prevalence of 14.3 percent. Severely underweight children had a high prevalence of severe anaemia (25.0 %). This is because underweight and stunting are a representation of chronic deprivation of nutrients some of which include nutrients responsible for the production of haemoglobin like iron, Vitamin B_{12} and vitamin C to aid absorption of iron from food.

4.3.2.3.4.Determinants of anaemia in children

These results are based on logistic regression and are presented in Tables: 4.3.1, 4.3.2 and 4.3.3 above. Results revealed that occupation, moderate stunting and age were significantly correlated with severity of anaemia in children but not underweight, residence, religion, caste, education of mother, morbidity (cough and fever), sex, breastfeeding status and size at birth. Since almost all the children were from households with no toilet facility, these results were not computed.

Stunting was negatively correlated to severity of anaemia in children while age of the child was positively correlated. Ramesh and Lopamudra (2010) found age to be positively correlated to anaemia prevalence in children similar to findings of the current study. Moderately stunted children had a RR of 30 times of being anaemic as compared to their counterparts who were severely stunted. This is because stunting is a representation of chronic deficiency over a period of time. This could include deficiency of nutrients responsible for manufacture of haemoglobin over a period of time like iron, vitamins and for a fact undernourished children are often anaemic (Osorio *et al*., 2001).

Children between the age bracket 0 - 6 months had 21.5 times RR of being anaemic as compared to their counterparts in other age brackets. This is could be a result of being born to an anemic mother, being breastfed by an anaemic mother or short term breast feeding and early introduction of prelacteal fluids like cow's milk (IIPS & ORC Macro, 2000). Two studies reported child's age, stunting and mother's anaemia as predictors of anaemia in children (Ngine-Teta *et al*., 2007 and Zhao *et al*., 2012).

The RR of being anaemic was highest among children whose mothers were employed in comparison to their counterparts who were unemployed. Ong'echa *et al*. (2006) reported housewives to have a protective association with anaemia in their children compared to children whose mothers were in other professions. This is because working women have limited time to care for their children as compared to housewives whose sole job is to care for their home and the people in it.

4.3.2. Mahbubnagar district.

4.3.2.1. Profile of study population during 1998-99 (NFHS-2) survey.

Data on approximately 122 children below five years of age was included in the study. Out of these children, majority resided in rural Mahbubnagar (90.7 %), were of Hindu religion (98.3 %), male (59.9 %) and 40.1 percent were female. Majority of the children belonged to the age bracket 11-17 months (21.7 percent), were of average weight at birth, still breastfeeding (90.1 %) and from OBC (51.7 %).

Majority of the children had mothers with no education (67.3 %), employed in the agriculture sector (30.3%) and 27.8 percent of the children's mothers were not working. For the children included in the study, majority came from homes with no toilet facility (85.6 %).

Results presented in Table 4.3.2 and Table4.3.3 on morbidity and malnutrition revealed that majority of the children had not suffered from fever (71.6 %) or cough (61.4 %) in the previous two weeks before the survey, were not stunted or wasted but mildly underweight (33.4 %).

4.3.2.2. Prevalence of anaemia among children below five in Mahbubnagar district.

The overall prevalence of anaemia in children below five years in this district based on the selected variables was 52.0 percent of which 46.6 percent were mildly anaemic and 5.4 percent were moderately anaemic (Figure.4.3.1). None of the children in this district were found to be severely anaemic by the time of the survey. A similar prevalence was reported among children of western rural China with a prevalence of 52.2 percent (Wenlong *et al.*(2013) and Brazilian children with a prevalence of 51.2 percent (Leite *et al.*, 2013). However, Ramesh and Lopamudra (2010) reported a very high prevalence of 96.8 percent among Indian children. The differences could be a result of difference in the location and cultures of the study population.

Table.4.3 4. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Mahbubnagar district during 1998/99

Background characteristic	% of children with any Anaemia	Percentage of children with		Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A			Estimate	Significance(RR)
Child characteristics							
Residence							
Urban Rural	50.0 53.8	50.0 46.4	0.0 7.4	11(9.3) 111(90.7)	DF=2 X^2=0.9108 P=0.6342(NS)	0.268 RC	0.751(-)
Religion							
Hindu Muslim	54.4 0.0	47.6 0.0	6.8 0.0	121(98.3) 2(1.7)	DF=2 X^2=2.395 P=0.3019	NC NC	NC NC
Sex							
Male Female	70.4 46.0	50.0 41.9	20.3 4.2	74(59.9) 49(40.1)	DF=2 X^2=2.2115 P=0.331(NS)	-0.522 RC	0.318(-)
Age							
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35	33.3 60.8 43.9 54.2 60.5 72.7	33.3 60.8 43.9 38.7 60.5 54.6	0.0 0.0 0.0 15.5 0.0 18.1	25(20.1) 10(8.2) 18(14.8) 27(21.7) 20(16.6) 23(18.5)	DF=10 X^2=19.9609 P=0.0296*	1.892 0.911 1.453 0.791 0.911 RC	0.032(-) 0.394(-) 0.112(-) 0.335(-) 0.297(-)
Size at birth							
Very large Larger than AV Average (AV) Smaller than AV Very small	NA 71.4 52.4 39.9 NA	NA 71.4 44.0 39.9 NA	NA 0.0 8.4 0.0 NA	NA 14(11.4) 98(80.1) 10(8.5) NA	DF=4 X^2=5.5482 P=0.2355(NS)	NA -1.143 -0.658 RC NA	NA 0.344(-) 0.494(-) NA
Currently breastfeeding							
No Yes	50.1 53.9	50.1 46.4	0.0 7.5	12(9.9) 110(90.1)	DF=2 X^2=0.9704 P=0.6156(NS)	0.504 RC	0.566(-)
Caste							
SC ST OBC NONE	71.4 42.8 61.6 24.2	57.1 35.8 55.1 24.2	14.3 7.0 6.6 0.0	14(11.7) 29(23.8) 64(51.7) 16(12.9)	DF=6 X^2=11.5699 P=0.0723(NS)	-2.584 -1.164 -1.880 RC	0.085(-) 0.386(-) 0.110(-)
Maternal characteristics							
Education of mother							
No education Primary Secondary Higher	55.1 55.5 51.8 44.3	45.1 55.5 51.8 44.3	10.0 0.0 0.0 0.0	83(67.3) 18(14.9) 4(3.2) 18(14.6)	DF=6 X^2=4.7924 P=0.5707(NS)	-0.567 -0.385 -0.197 RC	0.440(-) 0.678(-) 0.898(-)
Occupation							
Not working Agric S-E Agric E Household Unskilled -M	53.2 44.4 55.5 0.0 60.3	47.1 44.4 44.5 0.0 53.7	6.2 0.0 11.0 0.0 6.6	34(27.8) 19(15.1) 37(30.3) 2(1.6) 31(25.2)	DF=8 X^2=5.6659 P=0.6846(NS)	-0.366 0.138 -0.451 16.335 RC	0.704(-) 0.883(-) 0.579(-) 0.996(-)
Toilet facility							
Flush Pit-latrine Bush Others	50.0 67.2 53.0 NA	50.0 67.2 45.2 NA	0.0 0.0 7.9 NA	11(9.3) 6(5.1) 105(85.6) NA	DF=6 X^2=2.3174 P=0.8883(NS)	-0.545 -0.402 RC	0.678(-) 0.780(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available							

Source: NFHS-2

4.3.2.3. Association of anaemia and selected variables

These results are based on bivariate analysis using chi-square and presented in Tables. 4.3.4, Table.4.3.5 and Table.4.3.6.

4.3.2.3.1. Children characteristics

Variables like residence, religion, sex, size at birth, currently breast feeding and caste were not found significantly associated to the prevalence of anaemia among children below five years but only age. Mwanziva *et al*. (2010) also did not find sex to be significantly associated to anaemia in Masai children.

Though not significantly associated, anaemia was higher among male children (70.4 %) than the female children (46.0 %). This could be due to the rapid growth in male children and also the fact that they are more active than female children. Woldie *et al.* (2014) reported anaemia to be higher among male Ethiopian children than female children with a prevalence of 55.4 percent.

Age was significantly associated with anaemia prevalence in children below five years. Anaemia was mostly associated with children >23- ≤ 35 months (72.7 %) and the least prevalence was found among children aged 0- 6 months (33.3 percent) as seen in figure.4.3.3. The low prevalence in 0-6 month old children could be a result of the protective effect of breastfeeding which minimizes infections that are common with artificial feeding and the fact that children absorb iron 3 times better in breast milk than artificial formula or cow milk, where only 5 percent of the iron is absorbed (Glader, 2007). However, Ramesh and Lopamudra (2010) reported the highest prevalence in children 12- 23 months (98.1 %) and the least prevalence among older children (48-71 months) with a prevalence of 95.1 percent which is contradictory to the present findings.

4.3.2.3.2. Maternal characteristics

None of these factors were found significant to influence the prevalence of anaemia among the children in Mahbubnagar but differentials were found within each category**.** Ong'echa *et al*. (2006) did not find anaemia to be significantly associated to mother's education among Kenyan children.

4.3.2.3.3. Morbidity

Suffering from fever two weeks prior to the survey was found significant in influencing prevalence of anaemia among the children. Anaemia was highest among children who had fever (70.2 %) as compared to those without fever (46.9 %). Similarly, children who had cough had higher prevalence of anaemia (56.6 %) as compared to those without cough (51.5 %) but it was not significant ($p<0.05$). Hussein and Mohamed (2014) did not find a significant association between morbidity and anaemia in Sudanese children especially in absence of severe anaemia.

Table.4.3 5. Association and determinants of anaemia in children below five years based on morbid conditions in Mahbubnagar district during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with		Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A			Estimate	Significance (RR)
Had fever							
No Yes	46.9 70.2	39.8 64.3	7.1 5.9	88(71.6) 35(28.4)	DF=2 X^2=6.182 P=0.0455*	1.200 RC	0.120(-)
Had cough							
No Yes	51.5 56.6	46.1 47.8	5.5 8.7	75(61.4) 47(38.6)	DF=2 X^2=0.647 P=0.7236 (NS)	-0.312 RC	0.666(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia.							

Source: NFHS-2.

4.3.2.3.4. Nutritional status.

Table.4.3 6. Association and determinants of anaemia in children below five years based on morbid conditions in Mahbubnagar district during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with		Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A			Estimate (SE)	Significance (RR)
STUNTING							
Normal Mild –S Mod –S Sev- S	35.4 46.6 81.5 55.2	35.4 46.6 62.7 44.2	0.0 0.0 18.8 11.1	34(29.5) 31(26.3) 33(28.3) 18(15.8)	DF=2 X^2=22.642 P=0.0009 **	-0273 -0.641 **-2.468** RC	0.846(-) 0.611(-) **0.030*(11.79)**
WASTING							
Normal Mild –W Mod-W Sev-W	46.0 59.4 57.3 67.3	46.0 41.1 57.3 67.3	0.0 18.3 0.0 0.0	53(44.7) 45(38.0) 14(12.1) 6(5.2)	DF=6 X^2=15.955 P=0.014*	-2.018 -2.814 -2.671 RC	0.295(-) 0.117(-) 0.154(-)
UNDERWEIGHT							
Normal Mild-uw Mod- uw Sev- uw	36.4 47.5 66.6 66.9	36.4 47.5 55.4 44.9	0.0 0.0 11.3 22.0	22(18.9) 39(33.4) 37(31.7) 19(15.9)	DF=6 X^2=16.016 P=0.0137*	2.040 2.051 1.524 RC	0.263(-) 0.179(-) 0.207(-)
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight.							

Source: NFHS-2.

Malnutrition based on anthropometric analysis revealed a significant association of stunting, wasting and underweight with anaemia prevalence in children below five years.

The highest association of anaemia was with moderately stunted children (81.5 %), severely wasted children (67.3 %) and children who were severely underweight (66.9 %) as compared to children with normal anthropometric measurements who registered the least prevalence of anaemia in all cases as seen in Table.4.3.3 below. Sinha *et al.* (2008) reported highest prevalence of anaemia in severely underweight (91.9 %).

4.3.2.3.5. Determinant of anaemia in children

Results of ordinal logistic regression in were presented in Table.4.3.4, 5, 6 which revealed that all the selected variables were not found to be significantly correlated with anaemia in children in this district except for stunting which was negatively correlated to degree of anaemia. Moderately stunted children had a RR of 11.79 times of being anaemic as compared to their counterparts. Woldie *et al*. (2014) reported Ethiopian stunted children were 2.7 times more likely to be anaemic than their counterparts. Similar findings were reported in Brazil (Osorio *et al*., 2001) and in Bangladesh (Uddin *et al*., 2011).

4.3.2.3.6. Comparison between Prakasam and Mahbubnagar districts.

Figure.4.3.1 shows that anaemia prevalence was higher in Prakasam district than Mahbubnagar district by 10.3 percent. Among children in the two districts, severe anaemia was only present in Prakasam district and none of the children in Mahbubnagar district was severely anaemic. This difference in prevalence and severity of anaemia between the two districts could be a result of different cultures which would affect the feeding practices of the mothers and children during weaning as was observed in results presented in Table.4.3.1 and Table.4.3.4 where data shows that anaemia was higher in Prakasam children (88.9 %) than Mahbubnagar children (72.7%) after two years of age. The sanitary condition in Prakasam was worse than Mahbubnagar district with more households using bush method to dispose off human waste which increases the spread of communicable diseases (93.9 % vs 85.6 %) which could be the reason for higher prevalence in Prakasam district.

In the two districts, only stunting was a common determinant of anaemia in children, which is an indication of chronic malnutrition in both areas as a result of the poor education of mothers in the two districts where the larger majority had no formal education (Table.4.3.1 and Table.4.3.4). The RR of being anaemic was higher by 18.21 times among children in Prakasam district as compared to their counterparts in Mahbubnagar district.

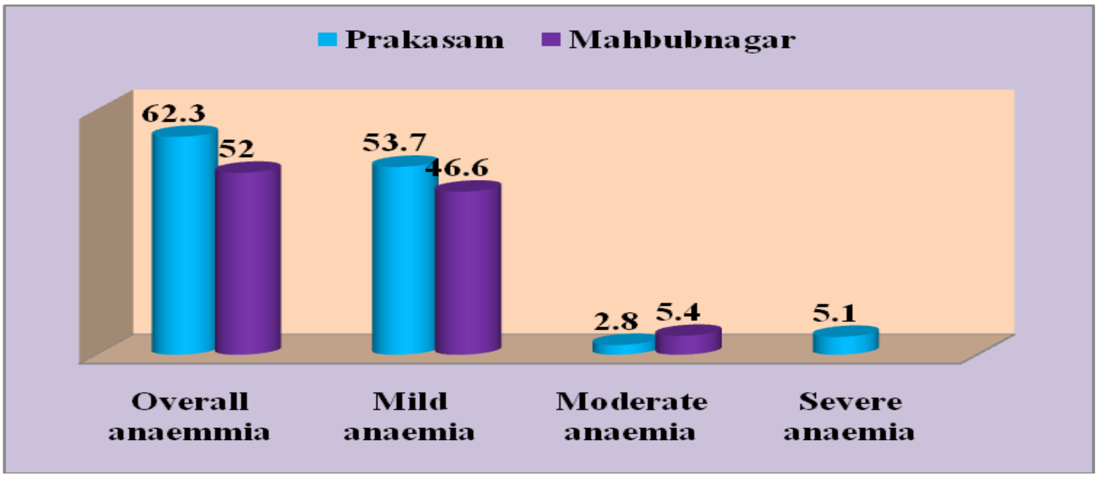

Figure.4.3. 1. Prevalence of anaemia in Prakasam and Mahbubnagar districts during NFHS-2

4.3.3. Andhra Pradesh (AP) 1998/99 (NFHS-2)

4.3.3.1. Profile of children below five years in Andhra Pradesh during (NFHS-2).

In Andhra Pradesh state (pre-divided)**,** data on 1881 children below five years was included in the study. Out of the children included in the study, 75.8 percent were residing in rural AP and 24.2 percent in urban AP. (24.2 %). Majority of the children were Hindus (84.4 %), in the age bracket >23-≤ 35 months old, born with an average weight (71.5 %) and were currently breastfeeding (84.7 %). The population had an almost equal number of girls and boys (Table.4.3.7) most of whom belonged to OBC (43.8 %).

Most of the children had mothers who were not educated (53.6 %) and were not working (53 %). Among the children with working mothers, most of them were employed in the agricultural sector and lived in households with no toilet facilities thus practicing open defecation in the bushes (73.0 %).

Results presented in Table.4.3.8 revealed majority of the children did not suffer from cough (63.7 %) or fever (71.4 %) two weeks prior to the survey. Anthropometric measurements revealed majority of the children were mildly stunted (32.3 %), mildly underweight (35.1 %) and were not wasted (normal).

4.3.3.2. Prevalence of anaemia among children below five in Andhra Pradesh state during NFHS-2.

The overall prevalence of anaemia among children below five years in this state based on selected variables was 67.3 percent of which 56.6 percent were mildly anaemic, 9.9 percent were moderately anaemic and 0.7 percent were severely anaemic (Figure.4.3.2).

Table.4.3.7. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Andhra Pradesh state during 1998/99

Background characteristic	% of children with any Anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Child characteristics								
Residence								
Urban	67.0	57.9	8.2	0.8	455(24.2)	DF=3	-0.183	0.344(-)
Rural	68.0	56.9	10.7	0.4	1426(75.8)	X^2=3.2873	RC	
						P=0.3494(NS)		
Religion								
Hindu	68.0	57.2	10.1	0.6	1585(83.4)	DF=9	-0.100	0.651(-)
Muslim	66.6	61.6	5.0	0.0	157(8.4)	X^2=17.248	-0.021	0.943(-)
Christian	67.3	50.7	16.6	0.0	134(7.1)	P=0.045*	RC	
Others	0.0	0.0	0.0	0.0	2(0.1)		NC	NC
Sex								
Male	67.7	55.2	11.7	0.8	943(50.1)	DF=9	-0.166	0.211(-)
Female	67.9	59.1	8.5	0.2	938(49.9)	X^2=17.248	RC	
						P=0.045*		
Age								
0-6	49.4	46.8	2.6	0.0	369(19.6)	DF=15	**0.596**	**0.021(0.55)**
>6 - ≤ 8	66.7	62.3	4.4	0.0	177(9.4)	X^2=118.2229	-0.016	0.955(-)
>8 - ≤ 11	68.9	57.3	11.7	0.0	136(7.2)	P<.0001**	-0.181	0.521(-)
>11 - ≤ 17	77.0	62.4	14.6	0.0	388(20.6)2		**-0.419**	**0.033(1.52)**
>17 - ≤ 23	72.6	57.2	14.7	0.7	276(14.7)		-0.199	0.349(-)
>23 - ≤ 35	71.4	58.7	11.3	1.5	534(28.4)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=9	0.670	0.428(-)
Larger than AV	70.4	59.9	9.8	0.7	312(16.6)	X^2=13.8866	0.821	0.323(-)
Average (AV)	67.0	57.0	9.7	0.3	1342(71.5)	P=0.1264(NS)	0.702	0.409(-)
Smaller than	70.2	55.2	13.2	1.8	210(1.2)		RC	
AV	57.1	41.8	15.3	0.0	14(0.8)			
Very small	NA	NA	NA	NA	NA			
Currently breastfeeding								
No	71.4	57.0	13.1	1.4	288(15.3)	DF=3	-0.193	0.348(-)
Yes	67.1	57.2	9.6	0.4	1593(84.7)	X^2=8.9488	RC	
						P=0.03*		
Caste								
SC	72.6	54.9	16.2	1.5	39(21.1)	DF=9	-0.20	0.337(-)
ST	61.3	47.2	12.4	1.7	117(6.2)	X^2=42.4537	0.172	0.594(-)
OBC	66.6	58.3	8.1	0.2	821(43.8)	P<.0001**	0.0044	0.803(-)
NONE	67.6	59.1	8.4	0.0	542(28.9)		RC	
Maternal characteristics								
Education of mother								
No education	67.1	55.1	11.6	0.4	1007(53.6)	DF=9	-0.414	0.079(-)
Primary	72.4	65.1	6.5	0.8	451(23.9)	X^2=43.5882	-0.289	0.214(-)
Secondary	73.7	53.6	20.1	0.0	130(6.9)	P<.0001**	**-0.736**	**0.015(2.09)**
Higher	60.4	53.6	6.1	0.7	292(15.6)		RC	
Occupation								
Not working	67.7	58.6	8.7	0.4	1014(53.9)	DF=9	-0.432	0.170(-)
Professional	69.8	61.9	7.9	0.0	26(1.4)	X^2=77.6736	-1.337	0.27(-)
Sales	65.3	50.7	14.6	0.0	28(1.5)	P<.0001**	-0.540	0.422(-)
Agric S-E	65.0	56.7	8.3	0.0	200(10.6)		-0.112	0.754(-)
Agric E	69.4	53.6	14.9	0.9	426(22.6)		-0.239	0.458(-)
Household	65.1	48.9	0.0	16.2	11(0.6)		-1.406	0.098(-)
Service	100.0	100.0	0.0	0.0	2(0.1)		-0.639	0.753(-)
Skilled-M	69.1	61.5	7.5	0.0	78(4.1)		-0.267	0.537(-)
Unskilled -M	66.3	55.8	10.6	0.0	97(5.1)		RC	
Toilet facility								
Flush	62.5	55.7	6.3	0.5	367(19.5)	DF=18	0.161	0.283(-)
Pit-latrine	67.8	59.7	8.1	0.0	141(7.5)	X^2=42.8817	0.270	0.197(-)
Bush	69.2	57.2	11.4	0.6	1371(73.0)	P=0.0008**	RC	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available								

Source: NFHS-2

A similar prevalence of total anaemia was reported during NFHS-2 in Indian states like Meghalaya (67.6 %), Tamil Nadu (69.0 %) and Delhi (69.0 %) but it was lower than estimated national prevalence for India as a whole (74.3 %) and Andhra Pradesh (72.3 %). A similar prevalence of severe anaemia was also reported in Arunachal Pradesh and Kerala ((0.7 % and 0.5 %) respectively (IIPS & ORC Macro, 2000). Studies elsewhere have reported similar findings. A prevalence of 66.6 percent was reported among Ethiopian children (Woldie *et al*., 2014) and 69 percent among Nepalese children (MOHP, 2012).

4.3.3.3. Association of anaemia and selected variables.

Analysis of data in this Table, did not find a significant association of anaemia prevalence with residence, size at birth and number of children below five years but found religion, sex, age, breastfeeding, caste, mothers education, occupation and toilet facility to be currently associated with anaemia prevalence in children.

4.3.3.3.1. Children characteristics

Results presented in Table.4.3.9 reveal that Hindu children had higher prevalence of overall anaemia and were the only ones found with severe anaemia in comparison to their counterparts from other religious affiliations. Ramesh and Lopamudra (2010) reported similar findings as the current study. However (IIPS & ORC Macro, 2000) found that children who belonged to other religions were more anaemic than the Hindu children during NFHS-2. The cause of higher anaemia in Hindu children could be a result of being breastfed by anaemic mothers and feeding on complementary diet that has very little bio-available iron which is common in the vegetarianism practiced by Hindus.

Male children had a higher prevalence of moderate (11.7 %) and severe (0.8 %) anaemia compared to the female children (8.5 % and 0.2 %). Ramesh and Lopamudra (2010) and IIPS & ORC Macro (2000) reported severe anaemia to be higher in male children than female children with (3.0 % vs 2.9 %) and (5.9 % vs 4.8 %) respectively. This could be because they are more active than female children.

Overall, anaemia was highest among children >11-≤17 months (77.0 %) but the highest association of severe anaemia was with children >23-≤35 (1.5 %) months compared to children in other age brackets (Figure.4.3.3). This could be a result of consumption of complementary foods that have low bio-available iron for example cow's milk which contains less iron than other foods and makes it difficult for the body to absorb iron from food (Glader, 2007) and the common vegetarian diet in Indians.

Results also revealed higher anaemia prevalence among children who were not breastfeeding by the time of the survey with 71.4 percent overall anaemia of which 1.4 percent severely anaemic. Studies have shown infants who drink milk in the first year of their lives are more at a risk of developing anaemia as cow's milk does not have enough of the iron needed by the children to grow and develop (Glader, 2007).

4.3.3.2. Maternal factors.

Anaemia prevalence was significantly associated with education, occupation of the mother and presence of a toilet facility in the household

Anaemia prevalence was higher among children whose mothers attained some sort of formal education in comparison to the children whose mothers had no education. The differences were significant (Table.4.3.7). Several studies in developing countries have reported a similar finding (Mamiro *et al*., 2005 and Woldie *et al*., 2014) in Ghanaian and Ethiopian children respectively.

Different from the perceived protective effect of employment status of a woman on her family and self, results in Table.4.3.7 revealed that anaemia was higher among the children of employed mothers as compared to those whose mothers were not working. This is because employment reduces the time a woman has to care for her children well. Due to the busy schedule at work, most women have no time to prepare healthy meals for the children hence they end up feeding them street food, most of which is not prepared and served in hygienic conditions, thereby increasing the rate of infections. Similar findings were reported in NFHS-2 among Indian children (IIPS and ORC Macro, 2000) and by (Sinha *et al*., 2008) in rural Wardha children.

Toilet facility was significant in influencing anaemia. Anaemia was higher in children living in households with no toilet facility. Poor disposal of waste results in spread of communicable diseases like diarrhoea, typhoid, dysentery etc. With recurrent infections in children, anaemia occurs due to low consumption of food because of loss of appetite and low absorption of iron, as most is lost during diarrhoea etc (IIPS and Macro, 2007).

4.3.3.3. Morbidity

Results presented in Table.4.3.8 revealed that anaemia prevalence was significantly associated with presence of fever but not cough in AP children below five years of age. However anaemia was highest in children who suffered from fever (74.6 %) and cough (70.4 %) two weeks prior to the survey. Stoltzfus *et al*. (2000) reported an association between anaemia and fever in children <30 months old which was seen to decrease in older children. Stoltzfus, (unpublished data), also found similar observation in older preschool children. It can be speculated that certain immunologic responses (e.g., secretion of tumor necrosis factor-a) underlie the effect of fever on erythropoiesis and that these responses change with normal child development, creating a strong age modification of fever's effect.

Table.4.3 8. Association and determinants of anaemia in children below five years based on morbid conditions in Andhra Pradesh state during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate (SE)	Significance (RR)
Had fever								
No	65.0	54.9	9.7	0.4	1344(71.4)	DF=3	0.181	0.271(-)
Yes	74.6	62.7	11.2	0.8	537(28.6)	X^2=16.6235 P=0.0008**	RC	
Had cough								
No	66.3	55.9	9.9	0.5	1198(63.7)	DF=3	0.37	0.813(-)
Yes	70.4	59.2	10.6	0.6	683(36.3)	X^2=3.4077 P=0.3329 (NS)	RC	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia.								

Source: NFHS-2.

4.3.3.4. Nutritional status.

Table.4.3 9. Association and determinants of anaemia in children below five years based on morbid conditions in Andhra Pradesh state during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
STUNTING								
Normal	63.0	56.6	6.0	0.4	522(29.7)	DF=9	0.53	0.871(-)
Mild –S	70.5	58.4	12.1	0.0	567(33.3)	X^2=33.805	-0.343	0.224(-)
Mod –S	71.6	58.3	12.4	0.9	424(24.1)	P<.0001**	-0.220	0.395(-)
Sev- S	74.5	59.7	13.2	1.6	245(13.9)		RC	
WASTING								
Normal	63.3	56.3	9.4	0.6	1027(57.9)	DF=9	-1.333	**0.025(3.79)**
Mild –W	73.6	60.8	12.1	0.7	588(33.2)	X^2=17.584	-1.281	**0.027(3.60)**
Mod-W	69.0	54.5	14.5	0.0	128(7.2)	P=0.0403*	-1.025	0.87(-)
Sev-W	60.1	60.1	0.0	0.0	31(1.7)		RC	
UNDERWEIGHT								
Normal	64.3	55.9	8.1	0.4	492(28.0)	DF=9	0.656	0.110(-)
Mild-uw	64.7	55.2	9.3	0.3	616(35.1)	X^2=46.317	1.045	**0.004(0.35)**
Mod- uw	76.2	63.6	12.1	0.4	471(26.8)	P<.0001**	0.606	**0.042(0.55)**
Sev- uw	78.5	59.1	17.2	0.2	178(10.1)		RC	
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight.								

Source: NFHS-2.

Results show that anaemia was significantly associated with poor nutritional status in children as compared to children with a good nutritional status.

Table.4.3.9 revealed that anaemia prevalence in children was highest among severely stunted children (74.5 %), mildly wasted children and severely underweight children (78.5 %).This is because with poor nutritional status comes increased infections due to low immunity and hence reduced Hb levels.

4.3.3.5. Determinants of anaemia in children

Results of ordinal logistic regression presented in the Table.4.3.7- 9 revealed that age, mothers educational level, wasting and underweight were significantly correlated with severity of anaemia in children but not with any of the remaining factors examined.

Children who were between 0-6 months old had a RR of 0.55 times of being anaemic which increased to 1.52 times among children 11-17 months old. The low risk in 0-6 months, which is due to the protective effect of breastfeeding where exclusively breastfed child will have enough iron as iron in milk is 3 times absorbed, thus protecting against anaemia. The risk increases due to complementary foods that are introduced, which might contain low bio-available iron i.e children absorb only (10 %) for the iron from food (Glader, 2007). Also, the rate of infection is lower during breastfeeding as compared to bottle feeding (WHO, 2012).

Children with mothers who attained secondary education had a 2.09 times RR of being anaemic as compared to their counterparts with mothers that attained higher education. Ramesh and Lopamudra (2010) found mothers education to be significantly correlated to childhood anaemia as well as in the USA (de Benoist *et al.*, 2008). This is because education increases the mother’s ability to select healthy foods or even care for the child better.

Wasting was negatively correlated with severity of anaemia in children while underweight was positively correlated with the severity of anaemia in children. This infers that anaemia increased with increase in severity of underweight among children. The RR of being anaemic was 3.60 times among mildly wasted children in comparison to children who were severely wasted and it was 0.35 times and 0.55 times among mildly and moderately underweight children respectively. Sinha *et al* (2008) reported that moderately underweight and severely underweight children were at a greater risk of being anaemic as compared to their counterparts with normal anthropometric data.

Similar findings were reported in Brazil (Osorio *et al*., 2001) and Burma (Zhao *et al*, 2012). This is could be because undernourished children are often anaemic (Osorio *et al*., 2001) and low haemoglobin level has a compromising effect of the linear growth (Soliman *et al*., 2009), and coexisting of other micronutrient deficiencies may increase the development of anaemia by a synergistic association.

4.3.4. Andhra Pradesh 2005/06 (AP)

4.3.4.1. Profile of study population in 2005/06 (NFHS-3)

In Andhra Pradesh pre-divided**),** data on approximately 2247 children below five years of age was included in the study. Out of these children, majority were residing in rural part of the state (65.7 %), were of Hindu religion (85.7 %), male (54.3 %), were of average size at birth ((39.9), belonged to OBC (50.5 %) and were between age bracket >47-≤59 and >35-≤47.

Majority of the children had mothers with education (41.4 %), were not working (56.1 %) and lived in households with no proper toilet facilities so practiced open defecation as a form to dispose-off human waste (55.9%).

Results presented in Table.4.3.11 revealed that majority of the children did not suffer from either fever (90.8 %) or cough (85.3 %) two weeks prior to the survey. Majority of the children were neither stunted nor wasted but were mildly underweight (Table.4.3.12).

4.3.4.2. Prevalence of anaemia among children below five in Andhra Pradesh state 2005/06.

The overall prevalence of anaemia in children below five years in Andhra Pradesh during the survey was 66.0 percent of which 56.4 percent were mildly anaemic, 10.4 percent were moderately anaemic and 0.3 percent were severely anaemic (Figure.4.3.2). The prevalence is lower than the national estimate (69.5 %) and prevalence reported in AP (70.8 %) but similar to prevalence in Punjab (66.4 %), Orissa (65.0 %), prevalence of severe anaemia in Manipur (0.3 %) based on the latest NFHS-3 findings. However, the prevalence was lower than what was reported in other states like Chhattisgarh (71 %) and Haryana (72 %) (IIPS & Macro, 2007). Other studies have also reported similar prevalence like 65.3 percent in Palestine children (Alzain, 2012), 68.9 percent in lake Albert, Uganda (Green *et al*., 2011) and some lower prevalence like 20.6 percent in Mexican children (De la Cruz-Congora *et al*., 2012) in 2006-NHNS and 39 percent in

Table.4.3 10. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Andhra Pradesh state during 2005/06

Background characteristic	% of children with any Anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban Rural	66.1 72.5	56.5 62.2	9.4 9.9	0.3 0.3	772(34.4) 1475(65.7)	DF=3 X^2=9.959 P=0.0189*	**0.139** RC	**0.004(0.87)**
Religion								
Hindu Muslim Christian Others	70.8 60.0 86.1 0.0	60.4 55.5 70.7 0.0	10.1 4.5 15.4 0.0	0.4 0.0 0.0 0.0	192(85.7) 231(10.3) 91(4.0) 0	DF=12 X^2=30.879 P=0.0021**	-0.099 -0.075 -0.677 RC	0.879(-) 0.909(-) 0.319(-)
Sex								
Male Female	66.9 74.3	58.0 63.6	8.8 10.8	0.2 0.4	1219(54.3) 1027(45.7)	DF=3 X^2=15.7285 P=0.0013**	**0.263** RC	**0.001(0.77)**
Age								
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35 >35 - ≤ 47 >47 - ≤ 59	0.0 76.7 83.8 86.9 75.7 76.6 65.9 55.3	0.0 74.9 72.7 62.1 61.6 66.2 57.0 51.1	0.0 1.8 11.0 24.8 13.0 10.4 8.5 3.8	0.0 0.0 0.0 0.0 1.1 0.0 0.4 0.5	0.0 122(5.4) 109(4.9) 239(10.6) 228(10.1) 475(21.2) 535(23.8) 538(23.9)	DF=18 X^2=197.186 P<.0001**	NA **-0.997** **-0.789** **-0.902** **-0.707** **-0.475** **-0.362** RC	NA **<.0001(2.71)** **<.0001(2.20)** **<.0001(2.46)** **<.0001(2.02)** **<.0001(1.61)** **0.004(1.44)**
Size at birth								
Very large Larger than AV Average (AV) Smaller thanAV Very small DK	69.5 71.6 69.2 69.9 58.3 87.7	60.0 61.0 59.0 62.0 58.0 71.0	8.7 10.3 9.9 7.9 0.3 16.7	0.8 0.2 0.3 0.0 0.0 0.0	318(14.2) 837(37.3) 895(39.9) 145(6.5) 25(1.1) 22(1.0)	DF=15 X^2=12.999 P=0.6024 (NS)	-0.457 -0.501 -0.401 -0.445 0.757 RC	0.295(-) 0.240(-) 0.346(-) 0.331(-) 0.139(-)
Currently breastfeeding								
No Yes	66.2 73.5	58.9 61.4	69 11.9	0.5 0.2	982(43.7) 1264(56.3)	DF=3 X^2=26.169 P<.0001**	**0.386** RC	**<.0001(0.68)**
Caste								
SC ST OBC NONE	69.1 76.0 70.6 68.2	57.8 57.4 62.0 59.6	10.7 18.6 8.7 7.7	0.6 0.0 0.0 0.8	385(17.2) 210(9.4) 1133(50.5) 517(23.0)	DF=9 X^2=35.957 P<.0001**	-0.145 -0.192 -0.066 RC	0.284(-) 0.254(-) 0.520(-)
Maternal characteristics								
Education of mother								
No education Primary Secondary Higher	70.8 73.7 69.7 58.6	58.7 66.6 60.5 50.1	12.1 6.7 8.6 8.6	0.0 0.5 0.6 0.0	930(41.4) 399(17.8) 801(35.7) 116(5.2)	DF=9 X^2=28.519 P=0.0008**	-0.014 -0.021 0.148 RC	0.917(-) 0.896(-) 0.267(-)
Occupation								
Not working Professional Clerical Sales Agric S-E & Agric E Service Skilled & Unskilled -M	70.1 59.0 31.2 78.9 72.1 74.5 67.4	61.0 53.7 27.3 60.0 59.8 51.5 62.5	8.5 5.2 3.8 18.9 12.2 23.0 4.9	0.5 0.0 0.0 0.0 0.0 0.0 0.0	260(56.1) 52(2.3) 7(0.3) 26(1.2) 649(28.9) 60(2.7) 192(8.6)	DF=18 X^2=41.073 P=0.0015**	-0.267 -0.437 -0.474 0.087 -0.177 -0.308 RC	0.076(-) 0.102(-) 0.389(-) 0.816(-) 0.301(-) 0.242(-)
Toilet facility								
Flush Pit-latrine Bush Others Not dejure Res	65.1 81.7 74.2 80.0 59.7	59.0 72.7 61.6 53.2 54.1	5.4 9.1 12.5 26.8 5.6	0.7 0.0 0.2 0.0 0.0	75(33.5) 50(2.2) 1254(55.9) 28(1.3) 161(7.2)	DF=27 X^2=83.979 P<.0001**	0.957 0.623 0.720 RC	**<.0001(0.38)** **0.037(0.54)** **<.0001(0.49)**
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available								

Soure:NFHS-3

Ivory Coast (Asobayire, 2001). The difference can result from haemoglobin estimation method used in the different studies and difference in the cultures affecting feeding habits.

4.3.4.3. Association of anaemia and selected variables.

Results of this section are based on bivariate analysis and logistic regression analysis. Bivariate analysis based on chisquare (Table.4.3.10, 4.3.11 & 4.3.12) revealed that there was a significant association between anaemia in children and almost all the selected variables except for size at birth and presence of cough.

4.3.4.3.1. Children characteristics

Children from rural areas were more anaemic (72.5 %) than those from urban areas (66.1 %). Similar observation was reported in NFHS-3 (IIPS and Macro, 2007). This could be a result of lengthy breastfeeding which is common with rural mothers and yet the iron is in breast milk is not sufficient to support the rapid growth of the child past six months.

Christian children were more anaemic (86.1 %) followed by Hindu (70.8 %). This result is contradictory to most studies which have reported anaemia to be most associated with children from Hindu, Sikh and Muslim than Christian children (Ramesh and Lopamudra, 2010., IIPS and ORC Macro, 2000 and IIPS and Macro, 2007)

Female children also had the highest prevalence of anaemia (74.3 %) as compared to male children (66.9 %). Muoneke *et al*. (2012) reported similar findings between female and male Nigerian children (58.9 % vs 48.1 %) though the association was not significant like in the current study.

Figure.4.3.3 shows that anaemia was also highest among children >11-≤ 17 months followed by >8-≤11months with a prevalence of 86.9 percent and 83.8 percent. Similar result was reported in Indian children during NFHS-3 with a prevalence of 84.6 percent (IIPS and Macro, 2007).

4.3.4.3.2. Maternal factors.

Education of the mother, occupation, toilet facility were found significant to influence prevalence of anaemia in children

Anaemia prevalence in children decreased with increase in formal education of the child's mother from 73.7 percent among children whose mothers acquired primary education to 58.6 percent among children whose mothers attained higher education. Arnold *et al*. (2009) and Ramesh and Lopamudra (2010) reported similar result in Indian children. This shows the protective role education plays on health of a child.

4.3.4.3.3. Morbidity

Table.4.3.11. Association and determinants of anaemia in children below five years based on morbid conditions in Andhra Pradesh state during 2005/06

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Had fever								
No Yes DK	71.2 63.5 5.2	60.8 56.9 5.2	10.2 5.7 0.0	0.2 6.9 0.0	2029(90.3) 212(9.4) 5(0.2)	DF=6 X^2=21.3663) P=0.0016**	0.120 -0.036 RC	1.046(-) 0.973(-)
Had cough								
No Yes DK	71.0 66.8 2.6	60.6 59.1 2.6	10.1 7.7 0.0	0.4 0.0 0.0	1915(85.3) 328(14.6) 3(0.1)	DF=9 X^2=63.1506 P=0.1164(NS)	1.892 1.985 RC	0.084(-) 0.072(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=severe anaemia.								

Source: NFHS-3.

Results in Table.4.3.11 revealed that anaemia was highest among children who did not suffer from cough or fever two weeks prior to the survey. However, severe anaemia was mostly associated with children who suffered from cough before the survey with a prevalence of 6.9 percent. Mwanziva *et al*. (2010) reported an association between fever and anaemia in Masai children.

4.3.4.4. Nutritional status.

Table.4.3 12. Association and determinants of anaemia in children below five years based on morbid conditions in Andhra Pradesh state during 2005/06

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
STUNTING								
Normal Mild –S Mod –S Sev- S	63.6 66.4 75.1 80.5	57.1 57.7 60.6 68.2	6.4 8.7 13.5 11.7	0.0 0.0 1.0 0.6	694(32.1) 618(28.6) 515(23.8) 335(15.5)	DF=9 X^2=63.151 P<.0001**	**0.450** **0.593** 0.236 RC	**0.037(0.64)** **0.002(0.55)** 0.176(-)
WASTING								
Normal Mild –W Mod-W Sev-W	70.1 69.2 68.0 81.0	61.3 59.0 50.6 81.0	8.5 9.6 17.4 0.0	0.2 0.5 0.0 0.0	1114(51.5) 823(38.1) 190(8.8) 35(1.6)	DF=9 X^2=26.586 P=0.0016 **	0.588 **0.759** 0.597 RC	0.136(-) **0.043(0.47)** 0.124(-)
UNDERWEIGHT								
Normal Mild-uw Mod- uw Sev- uw	63.7 68.7 73.0 77.9	55.7 60.7 61.1 62.9	8.0 7.7 11.5 14.1	0.0 0.3 0.4 0.9	519(24.0) 769(35.6) 655(30.3) 217(10.1)	DF=9 X^2=31.153 P=0.0003 (**)	-0.332 0.042 0.019 RC	0.256(-) 0.866(-) 0.925(-)
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight.								

Source: NFHS-3.

Anaemia prevalence in children increased with severity of stunting and underweight hence children who were severely stunted, underweight and wasted had the highest association with anaemia and the association was significant ($p<0.05$) as seen in Table.4.3.12. Woldie *et al*. (2014) and Sinha *et al*. (2008) reported anaemia to be associated with under-nourishment.

4.3.4.5. Determinants of anaemia in children

Results of ordinal logistic regression revealed a significant correlation between severity of anaemia in children with residence, sex, age, breastfeeding status, toilet facility, stunting and wasting only but not with the rest of the variables (Table.4.3.10-12).

Children of urban residence had a 0.89 times RR of being anaemic as compared to their counterparts of rural residency. Similar findings were presented in reports by Ramesh and Lopamudra (2010) and Arnold *et al*. (2009) This can be result of dependence on cereal based complementary diets (porridges) which is very common and locally available in developing countries and rural communities in particular where variety is limited which is mostly found in urban areas with a wide spread of fortified formulas for children to choose from. These cereals are rich in phytates that inhibit iron absorption. Also the agricultural based employment in rural settings with low salaries limits the purchasing power for nutritious formulas.

Sex was positively correlated to severity of anaemia in children. Male children had a RR of 0.77 times of being anaemic compared to their female counterparts. The findings are similar to study reports from Ghana (GSS, GHS and ICF, 2013), Ethiopia (Woldie *et al*. 2014) and Bangladesh (Uddin *et al*., 2011). The possible explanation for this discrepancy could be due to sate of rapid growth of male children in the first months of life which increases their micronutrient requirement including iron (Onyango, 2003). If this physiological state is not compensated with appropriate and iron rich complementary foods at this critical stage, risk of iron deficiency anaemia will be higher among male children as compared to their counterparts.

Children who were not breastfed had RR of 0.68 times being anaemic as compared to the children who were still being breastfed. This is because breast milk contains easily absorbable iron enough to sustain the child’s rapid growth up to 6 months and must be complemented thereafter. So if complementary food is not introduced at the right time, if it does not contain bio-available iron like in meats and eggs, then the risk of anaemia in the child increases (Wharton, 1999, Muhe *et al*., 2000 and Alzain, 2012).

Toilet facility was positively correlated to severity of anaemia in children. In comparison to children who used other toilet facilities, the RR of being anaemic was 0.38 times, 0.54 times and 0.49 times among children who belonged to households with flush toilet, pit latrine and those who practiced open defecation. The result is contradictory to available literature for it is expected that children from households without toilet facilities should be more anaemic. This can be a result of poor hygiene in households with proper toilets for if not cleaned well and regularly, they can breed disease causing bacteria hence increasing infections in children. This indicates that the amount of water in a household for use is a very important factor in determining the hygiene in a home.

Stunting and wasting were positively correlated to severity of anaemia. Among mildly stunted children, anaemia increased by 59.3 percent with a RR of 0.55 times of being anaemic as compared to their counterparts. Among the mildly wasted children, anaemia increased by 79.5 percent with a RR of 0.47 times being anaemic as compared to their counterparts. Reports from Ethiopia (Woldie *et al*., 2014) and Burma (Zhao *et al*., 2012) are in support with the current finding. This is because under-nourishment interferes with linear growth in children.

4.3.2.4.6. Comparison between Andhra Pradesh state during 1998/99 and 2005/06.

Figure.4.3.3 below shows a slight decrease in anaemia prevalence over the years by 1.3 percent. Both mild and severe anaemia decreased but moderate anaemia increased. The continued high prevalence can be explained by the persistent poor sanitary conditions as seen even in NFHS-3, where three fourth of the households had no toilet facilities, and were therefore practicing in open defecation which is a rapid way of spreading communicable diseases as it contaminates the water systems and whole surrounding, putting children at a very high risk.

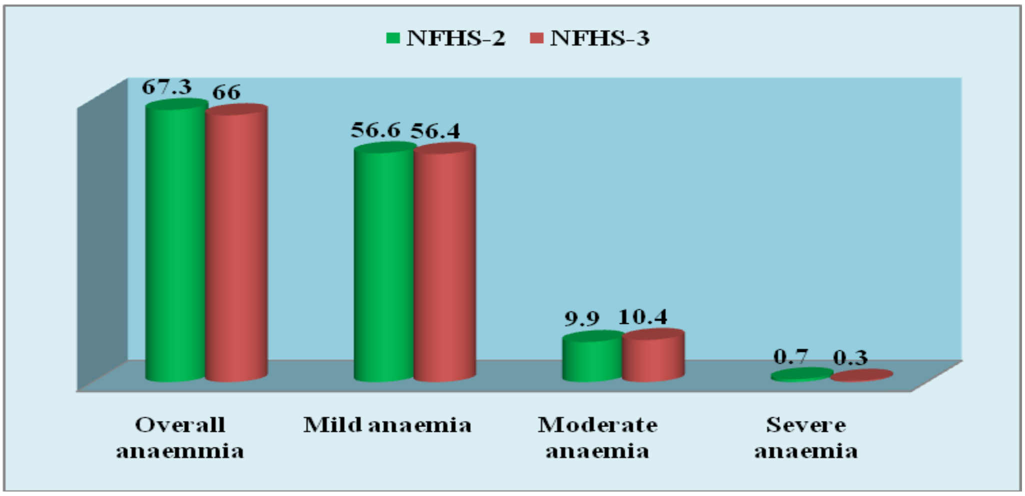

Figure.4.3. 2. Anaemia prevalence in Andhra pradesh districts and states.

Over the years, the consistent risk factors were age and wasting in children. This implies that acute malnutrition is a serious problem in this state**.**

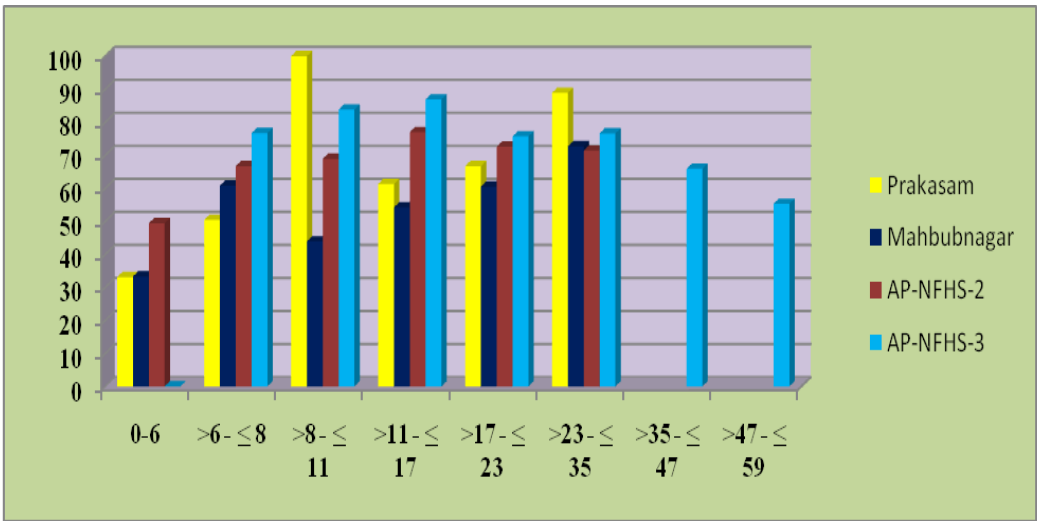

Figure.4.3. 3. Anaemia prevalence in Andhra pradesh districts and states by age groups.

4.3.2.4.7. Conclusion

In Andhra pradesh state, acute malnutrition is a risk factor which needs to be addressed urgently. This can be done by improving the feeding practices i.e., timely introduction of healthy fortified complementary foods low in phytates with more bio-available iron so as to sustain the rapid growth in children after 6 months of exclusive breastfeeding. Also breast feeding should not be prolonged as it hinders children's interest in other foods increasing starvation**.**

4.3.5. Akola

4.3.5.1. Profile of study population in Akola district 1998/99 (NFHS-2).

Data on approximately 46 children was included in the study. Majority of the children were living in rural Akola (72.6 %), of Hindu religion (95.3 %), in the age bracket >23-≤ 35 months (45.6 %), were of average size at birth (65.1 %) and were currently breastfeeding (81.0 %). There were more female children than male in this population (54.7 % vs 45.3 %).

Majority of children's mothers attained higher education (53.9 %) but were not working (59.6 %) and were living in households with no toilet facility (51.4 %). Results in Table.4.3.14 show that majority of the children had no fever (45.6 %) and 55.5 percent had cough by the time of the survey. When anthropometric measurement were analyzed, results presented in Table.4.3.15 show that majority of the children were mildly stunted (44.1 %), moderately underweight (45.7 %) and had a normal height for age (60.7 %).

4.3.5.2. Prevalence of anaemia among children in Akola district.

The overall prevalence of anaemia was 55.5 percent of which all were mildly anaemic. None of the children was found with moderate or severe anaemia. A similar overall prevalence of anaemia (55.3 %) was reported in Mizoram in north-east Indian Dey *et al*. (2013). NFHS-2 reported similar prevalence in Arunachal Pradesh (54.4 %) and Goa (53.4 %) and higher prevalence in Gujarat (74.5 %) and Bihar with a prevalence of 81.3 percent (IIPS and ORC Macro, 2000). Ayoya *et al*. (2013) reported a very low prevalence of 38.8 percent in Haitian children and Nguyen *et al.* (2006) reported a prevalence of 45.1 percent in children in Viet Nam. The differences in prevalence could be a result of different haemoglobin estimation methods, cultural diversity even within the same country.

4.3.5.3. Association of anaemia and selected variables.

Results in this section were based on bivariate analysis using chi-square test.

4.3.5.3.1. Children characteristics

Results presented in Table.4.3.13 show that there is a no significant association between residence, religion, sex, age of the child and breastfeeding but only size at birth and caste was found significantly associated with prevalence of anaemia**.** Leal *et al*. (2011) and Ewusie *et al*. (2014) did not find any association of anaemia and sex.

Table.4.3.13. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Akola district during 1998/99

Background characteristic	% of children with any Anaemia	Percentage of children with Mild-A	No. Of children (%)	Chi-square & p-value	Ordinal logistic regression Estimate	Significance (RR)
Child characteristics						
Residence						
Urban Rural	50.0 57.2	50.0 57.2	13(28.1) 33(72.0)	DF=1 X^2=0.195 P=0.6588(NS)	-1.872 RC	0.073(-)
Religion						
Hindu Muslim	53.0 100.0	53.0 100.0	43(95.3) 2(4.7)	DF=1 X^2=1.813 P=0.178(NS)	-21.990 RC	NC NC
Sex						
Male Female	55.2 55.3	55.2 55.3	21(45.3) 25(54.7)	DF=1 X^2=0 P=0.9951(NS)	-0.522 RC	0.998 (-)
Age						
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35	0 32.1 0.0 66.6 67.2 66.9	0 32.1 0.0 66.6 67.2 66.9	2(4.7) 7(14.6) 2(5.2) 7(14.9) 7(15.1) 21(45.6)	DF=5 X^2=8.883 P=0.1138(NS)	NC 2.907 NC 1.049 -2.047 RC	NC 0.270 (-) NC 0.539(-) 0.241(-)
Size at birth						
Very large Larger than AV Average (AV) Smaller than AV Very small	NA 76.4 45.6 100.0 0.0	NA 76.4 45.6 100.0 0.0	NA 14(11.4) 98(80.1) 10(8.5) NA	DF=4 X^2=5.5482 P=0.2355(NS)	NC NC NC NC NA	NC NC NC NC NA
Currently breastfeeding						
No Yes	75.4 50.5	75.4 50.5	9(5.2) 37(81.0)	DF=1 X^2=1.757 P=0.185(NS)	-0.945 RC	0.379(-)
Caste						
SC ST OBC NONE	100.0 0 100.0 41.8	100.0 0 100.0 41.8	2(5.2) 2(5.2) 9(22.5) 28(67.1)	DF=3 X^2=13.889 P=0.0031**	-21.659 NC -1.074 RC	0.998 NC 0.344(-)
Maternal characteristics						
Education of mother						
No education Primary Secondary Higher	100.0 67.2 66.1 35.7	100.0 67.2 66.1 35.7	7(15.6) 7(15.1) 7(15.4) 25(53.9)	DF=3 X^2=10.291 P=0.0162*	NC NC NC NC	NC NC NC NC
Occupation						
Not working Professional Agric S-E Agric E Unskilled -M	58.1 0.0 50.0 50.6 100.0	58.1 0.0 50.0 50.6 100.0	27(59.6) 2(4.7) 5(10.4) 9(20.1) 2(5.2)	DF=4 X^2=4.774 P=0.3113(NS)	-2.172 3.709 -0.636 -1.452 RC	0.360(-) 0.062(-) 0.836(-) 0.614(-)
Toilet facility						
Flush Pit-latrine Bush Others	60.5 NA 50.2 NA	60.5 NA 50.2 NA	22(48.6) NA 23(51.4) NA	DF=1 X^2=0.4805 P=0.4882(NS)	-0.755 RC	0.338(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available.						

Source: NFHS-2

Size at birth was significantly associated with prevalence of anaemia in children below five. Anaemia was highest among children who were smaller than average as compared to other children (Table.4.3.13). Smaller children below average size (2.5kgms) are prone to infection (WHO, 2012)

All children who belonged to SC and OBC were anaemic while those who belonged to none of the caste had a lower prevalence of anaemia (41.8 %). SC children live in the most disadvantaged communities with majority of their parents having no education or minimum education, are most likely to be ignorant about anaemia and its causes. NNMB (2003) reported that only 33.9 percent of children mothers were aware of anaemia which could be the possible causes for the persistent problem in children and women.

4.3.5.3.2. Maternal factors.

Anaemia in children was not significantly associated with occupation of the mother and toilet facility but was associated with education of the mother.

Anaemia in children decreased with increase in education level of the mother from 100 percent among children whose mothers had no education to 35.7 percent among children whose mothers attained higher education level. During the DLHS-RCH in 2002-2004, a similar trend in anaemia distribution based on mother's education was reported (IIPS and MoHFW, 2006).

4.3.5.3.3. Morbidity

When data on morbidity was analyzed, results revealed that anaemia was most prevalent among children who had fever (66.3 %) and cough (62.9 %) as compared to those who were not sick two weeks prior to the survey. However the association and difference between the two groups was not significant (Table.4.3.14). This is contradictory to findings from Stoltzfus *et al*. (2000) who reported fever to be strongly associated with anaemia in children <30 months of age.

Table.4.3 13.Association and determinants of anaemia in children below five years based on morbid conditions in Akola district during 1998/99

Background	Percentage of children with any anaemia	Percent of children with	Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild -A			Estimate (SE)	Significance (RR)
Had fever						
No Yes	45.9 66.3	45.9 66.3	25(54.4) 21(45.6)	DF=1 X^2=1,892 P=0.1689 (NS)	0.281(-) RC	0.806(-)
Had cough						
No Yes	45.6 62.9	45.6 62.9	20(44.5) 25(55.5)	DF=1 X^2=1.357 P=0.2441 (NS)	1.031 RC	0.341(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, RC=reference category.						

Source: NFHS-2.

4.3.5.3.4. Malnutrition.

Table.4.3 14.Association and determinants of anaemia in children below five years based on morbid conditions in Akola district during 1998/99

Background	Percentage of children with any anaemia	Percent of children with	Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild -A			Estimate (SE)	Significance (RR)
Stunting						
Normal Mild –S Mod –S Sev- S	25.4 75.0 50.7 100	25.4 75.0 50.7 100	9(21.8) 18(44.1) 9(22.4) 5(11.6)	DF=3 X^2=9.7374 P=0.0209*	2.809 2.195 0.500 RC	0.328(-) 0.340(-) 0.771(-)
Wasting						
Normal Mild –W Mod-W Sev-W	64.6 59.3 100.0 0.0	64.6 59.3 100.0 0.0	25(60.7) 11(27.9) 2(5.8) 2(5.5)	DF=3 X^2=5.2315 P=0.1556 (NS)	21.262 20.262 19.08 RC	0.997(-) NC NC
Underweight						
Normal Mild-uw Mod- uw Sev- uw	76.1 40.9 74.5 0.0	76.1 40.9 74.5 0.0	9(21.8) 11(27.0) 19(45.7) 2(5.5)	DF=3 X^2=7.7389 P=0.0517 (NS)	**-39.576** **-38.786** -37.785	**<.0001(1.54)** **<.0001(7.0)** -
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight, RC=reference category						

Source: NFHS-2

Data on child anthropometric measurements presented in Table.4.3.15 show there was a significant association between stunting and anaemia prevalence in children below five years but not with wasting and underweight in children. Anaemia was highest among severely stunted children (100 %), moderately wasted children (100 %) and those who were not underweight (76.1 %). Ayoya *et al*. (2013) similar result to the current study in which anaemia was significantly associated with only stunting but not wasting and underweight.

4.3.5.3.5. Determinants of anaemia in children

Results based on logistic regression did not find any significant association between anaemia in children and all examined variables except for underweight. Underweight was negatively correlated with anaemia prevalence in children. The RR of being anaemic was 7.0 times higher among children who were mildly under-weight as compared to their counterparts. However, Ayoya *et al*. (2013) did not find underweight to be significantly correlated with severity of anaemia in Haitian children but rather stunting which is contradictory to findings of the current study.

4.3.6. Solapur District

4.3.6.1. Profile of study population in Solapur district 1998/99 (NFHS-2).

Data on approximately 126 children below five years was included in the study. Out of these children, majority resided in rural Solapur (72.8 %) and the remaining in the urban part of the district (27.2 %). Results presented in Table.4.3.16 show that majority of the children were of Hindu religion (90.4 %), female (60.0 %), between the age bracket >17-≤35 months (37.6 %), currently breastfeeding (87.4 %) and were of average size at birth (56.4 %).

Majority of the children's mothers had no education (49.4 %), were not employed (59.1 %) and living in a household with no toilet facility hence practice open defecation in the bush (83.0 %).

Table.4.3.17 results show that two weeks before the survey, majority of the children had not suffered from fever (75.3 %) or cough (73.8 %). Also, majority of the children were not stunted (32.7 %), were mildly wasted (42.1 %) and moderately underweight (42.3 %).

4.3.6.2. Prevalence of anaemia among children in Solapur district.

The overall prevalence of anaemia is 69.0 percent of which 54.9 percent were mildly anaemic, 11.0 percent were moderately anaemic and 2.1 percent were severely anaemic. Similar prevalence was reported in Dehli (69.0 %), Tamil Nadu (69.0 %), severe anaemia in Himachal Pradesh (2.2 %), Mizoram (2.3 %) and in Goa a prevalence of 2.0 percent (IIPS and ORC Macro, 2000). In Nepal, a prevalence of 69 percent was reported (MOHP, 2011). This was lower than the DHS-2006 of Ugandan children in the same age bracket who were reported to have a prevalence of 72 percent (Menon and Yoon, 2015) and NNMB prevalence in Andhra Pradesh of 70.8 percent but higher than that of Maharashtra of 59.1 percent (NNMB, 2003).

4.3.6.3. Association of anaemia and selected variables.

These results are based on bivariate analysis and results are presented in Table.4.3.16, 4.3.17 and 4.3.18.

4.3.6.3.1. Children characteristics

Results in Table.4.3.16 show there was a significant association between age of the child and size at birth with anaemia prevalence in children below five years but not with residence, religion, sex, breastfeeding status and caste. Kikafunda *et al.* (2009) and

Cornet *et al*. (1998) found anaemia to be significantly associated with sex while Osóˊrio *et al.* (2001) and Sayyari *et al*. (2006) did not find sex to be significantly associated with anaemia in children just like in the current study.

Table.4.3 15. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Solapur district during 1998/99

Background characteristic	% of children with any Anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban	75.0	56.3	18.8	0.0	34(27.2)	DF=3	-0.561	0.337(-)
Rural	64.4	54.1	8.0	2.4	92(72.8)	X^2=4.3527	RC	
						P=0.2259(NS)		
Religion								
Hindu	65.9	54.1	9.9	19	114(90.4)	DF=6	0.666	0.736(-)
Muslim	75.0	0.0	25.0	0.0	10(7.7)	X^2=4.385	0.032	0.988(-)
Christian	NA	NA	NA	NA	NA	P=0.6248(NS)	NA	NA
Others	100.0	100.0	0.0	0.0	2(1.9)		RC	
Sex								
Male	68.9	55.6	13.3	0.0	50(40.0)	DF=3	-0.072	0.892(-)
Female	66.2	54.1	9.3	2.9	76(60.0)	X^2=1.981	RC	
						P=0.5765(NS)		
Age								
0-6	34.0	34.0	0.0	0.0	14(10.7)	DF=15	1.962	0.058(-)
>6 - ≤ 8	53.8	53.8	0.0	0.0	21(16.7)	X^2=42.353	1.126	0.190(-)
>8 - ≤ 11	100.0	100.0	0.0	0.0	11(8.7)	P=0.0002**	-0.282	0.790(-)
>11 - ≤ 17	33.3	1.7	15.6	0.0	14(10.9)		1.693	0.092(-)
>17 - ≤ 23	86.8	66.6	14.0	6.2	35(37.6)		-0.536	0.480(-)
>23 - ≤ 35	72.3	51.4	21.0	0.0	32(25.4)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=9	NA	NA
Larger than AV	49.4	39.8	9.6	0.0	22(17.7)	X^2=18.68	1.282	0.323(-)
Average (AV)	71.2	58.3	12.9	0.0	71(56.4)	P=0.0281*	0.498	0.675(-)
Smaller than AV	63.1	45.1	9.5	8.4	26(20.3)		0.561	0.661(-)
Very small	100.0	100.0	0.0	0.0	7(5.6)		RC	
Currently breastfeeding								
No	55.9	29.0	27.0	0.0	16(12.6)	DF=3	0.657	0.443(-)
Yes	68.9	58.4	8.6	2.0	110(87.4)	X^2=7.539	RC	
						P=0.0566(NS)		
Caste								
SC	72.2	59.2	13.0	0.0	16(13.0)	DF=9	-0.281	0.735(-)
ST	71.0	64.0	7.0	0.0	31(24.2)	X^2=7.901	-0.107	0.868(-)
OBC	66.7	43.6	23.1	0.0	21(16.7)	P=0.5442(NS)	-0.337	0.656(-)
NONE	64.2	52.6	7.9	3.7	58(46.1)		RC	
Maternal characteristics								
Education of mother								
No education	70.5	51.9	18.6	0.0	62(49.4)	DF=9	0.368	0.854(-)
Primary	67.0	59.0	0.0	8.0	27(21.4)	X^2=18.026	0.711	0.727(-)
Secondary	59.4	53.2	6.2	0.0	34(27.3)	P=0.0349*	1.000	0.621(-)
Higher	100.0	100.0	0.0	0.0	2(1.9)		RC	
Occupation								
Not working	66.1	57.4	8.6	0.0	75(59.1)	DF=6	0.532	0.448(-)
Agric S-E	51.9	51.9	0.0	0.0	14(11.2)	X^2=11.602	1.232	0.210(-)
Agric E	75.5	50.3	19.5	5.8	38(29.8)	P=0.0715(NS)	RC	
Toilet facility								
Flush	80.0	60.0	20.0	0.0	21(17.0)	DF=6	-0.722	0.297(-)
Pit-latrine	NA	NA	NA	NA	NA	X^2=5.679	NA	
Bush	64.7	53.6	9.0	2.1	105(83.0)	P=0.4604(NS)	RC	
Others	NA	NA	NA	NA	NA		NA	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available								

Source: NFHS-2

4.3.6.3.2. Maternal factors.

Results revealed that only education of the mother was associated with prevalence of anaemia in children below five years but not occupation and toilet facility (Table.4.3.16). In conformity to the current study, Ramesh and Lopamudra (2010) and Kikafunda *et al*. (2009) and IIPS and MoHFW, 2006 reported similar findings.

4.3.6.3.3. Morbidity.

Table.4.3.16. Association and determinants of anaemia in children below five years based on morbid conditions in Solapur district during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate (SE)	Significance (RR)
Had fever								
No Yes	61.1 86.2	51.1 65.6	10.0 13.7	0.0 6.9	95(75.3) 31(24.8)	DF=3 X^2=12.323 P=0.0064**	-0.014 RC	0.988(-)
Had cough								
No Yes	62.9 79.7	55.1 53.7	7.9 19.4	0.0 6.5	93(73.8) 33(26.2)	DF=9 X^2=11.2004 P=0.0107*	1.314 RC	0.165(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, RC=reference category								

Source: NFHS-2

Morbidity was significantly associated with anaemia prevalence in children. Results in Table.4.3.1 revealed that anaemia prevalence was highest among children who suffered from fever and cough two weeks prior to the survey represented by (86.2 % and 79.7 %) respectively (Table.4.17)**.**

4.3.6.3.4. Nutritional status.

Anaemia among children was found significantly associated with stunting and underweight but not wasting. Results in Table.4.3.18 revealed that anaemia was most prevalent among severely stunted children (79.9 %), moderately waste children (88.4 %) and severely underweight children (86.7 %).

Among stunted and underweight children, anaemia increased with increase in the degree of malnutrition and severely stunted and severely underweight children having the highest prevalence of overall anaemia and an association with severe anaemia as compared to other children (Table.4.3.18). The association between anaemia and Malnutrition, (wasting and underweight) in this study, is also supplemented by the work of Bhoite & Iyer (2011), which stated that the percentage of anaemic children amplified as the severity of underweight increased, (25 percent anaemia prevalence was seen in mild underweight children, whereas, 42 percent of anaemia was present in severely underweight category).

Table.4.3 17.Association and determinants of anaemia in children below five years based on morbid conditions in Solapur district 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
STUNTING								
Normal	52.8	52.8	0.0	0.0	39(32.7)	DF=9	1.824	0.217(-)
Mild –S	66.3	66.3	0.0	0.0	27(22.8)	X^2=41.334	1.641	0.157(-)
Mod –S	77.8	62.6	15.2	0.0	30(25.3)	P<.0001**	1.061	0.307(-)
Sev- S	79.9	30.5	40.0	9.5	23(19.2)		RC	
WASTING								
Normal	54.7	50.0	4.7	0.0	46(38.4)	DF=9	-19.211	<.0001(NC)
Mild –W	73.1	55.4	13.4	4.3	50(42.1)	X^2=15.279	-19.737	<.0001(NC)
Mod-W	88.4	62.2	26.2	0.0	19(15.6)	P=0.0835	-19.960	
Sev-W	47.0	47.0	0.0	0.0	5(3.9)	(NS)	RC	
UNDERWEIGHT								
Normal	54.4	54.4	0.0	0.0	25(20.8)	DF=9	1.179	0.594(-)
Mild-uw	54.4	54.8	0.0	0.0	26(21.5)	X^2=27.749	1.702	0.316(-)
Mod- uw	73.2	55.1	18.2	0.0	50(42.3)	P=0.0011	1.075	0.383(-)
Sev- uw	86.7	50.0	25.0	11.8	18(15.4)	**	RC	
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight, RC=reference category								

Source: NFHS-2

4.3.6.3.5. Determinants of anaemia in children

Results based on logistic regression did not find any of the examined factors to be statistically correlated with severity of anaemia in children. Similar findings were reported in two studies (Hussein and Mohammed, 2014 and Ong'echa *et al*., 2006).

4.3.6.3.6. Comparison between Akola and Solapur district.

Anaemia prevalence was higher in Solapur district by 13.5 percent and none of the children was moderately or severely anaemic in Akola district (Figure.4.3.4). This can be due to the fact that most of the mothers in Akola district attained higher education and yet were not working at the same time (Table.4.3.13) giving them the opportunity to care for their children well using the acquired knowledge as compared to mothers in Solapur district with almost half lacking an education, majority not working and with a high percentage lacking toilet facilities in their household hence poor hygiene (Table.4.3.16).

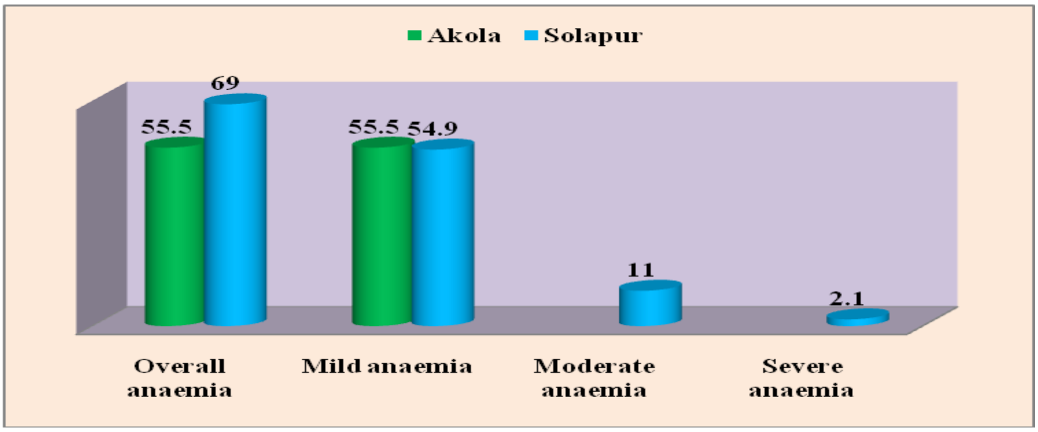

Figure.4.3. 4. Anaemia prevalence in children in Akola and Solapur districts during 1998/99

4.3.7. Maharashtra State (MH) 1998/99.

4.3.7.1. Profile of study population in Maharashtra state during 1998/99 (NFHS-2).

Data on approximately 2438 children below five years of age was included in the study. Out of these children, 62.4 percent were residing in rural Maharashtra and 37.6 percent in urban part of Maharashtra. Results in table.4.3.19 show that majority of the children are of Hindu religion (71.3 %), male (52.3 %), in the age bracket >23-≤35 months (31.9 %), were of average size at birth, currently breastfeeding (82.3 %) and neither from SC, ST nor OBC (53.6 %).

Majority of the children's mothers had no education (40.1 %), were unemployed (53.9 %) and lived in households with no toilet facility (61.7 %) hence practice open defecation in the bush. Data on morbidity presented in Table.4.3.19 revealed that majority of the children did not suffer from fever (63.0 %) or cough (59.1 %) two weeks prior to the survey. However data on anthropometric measurements showed that majority of the children were not stunted (32.3 %), neither wasted (40.2 %) but moderately underweight (32.1 %).

4.3.7.2. Prevalence of anaemia among children below five in Maharashtra state during 1998/99.

The overall prevalence of anaemia was 74.6 percent of which 64.3 percent, 9.3 percent and 0.5 percent were mildly, moderately and severely anaemic respectively. This prevalence is similar to the national estimate of NFHS-2 in Indian children with a prevalence of 74.3 percent but the difference was more in children who were moderately anaemic than mildly anaemic which is contradictory to severity of anaemia in the current study. However, NFHS-2 reported similar prevalence in other Indian

Table.4.3 18 Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Maharashtra state during 1998/99

Background characteristic	% of children with any Anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significanc e(RR)
Child characteristics								
Residence								
Urban	69.9	58.6	10.6	0.7	916(37.6)	DF=3	-0.161	0.074(-)
Rural	73.3	62.8	10.1	0.3	1522(62.4)	X^2=6.443 P=0.0919(NS)	RC	
Religion								
Hindu	71.9	61.6	10.4	0.5	1884(77.3)	DF=21	0.085	0.622(-)
Muslim	72.3	61.7	10.3	0.3	334(13.7)	X^2=23.068	-1.114	0.558(-)
Christian	61.9	48.0	13.8	0.0	35(1.4)	P=0.3404(NS)	0.411	0.264(-)
Others	71.8	65.0	6.4	0.3	172(7.1)		RC	
No religion	100.0	100.0	0.0	0.0	2(0.1)			
DK	100.0	60.3	39.7	0.0	12(0.5)			
Sex								
Male	75.5	63.2	11.7	0.5	1274(52.3)	DF=3	-0.202	0.024(1.22)
Female	68.2	59.1	8.8	0.4	1164(47.7)	X^2=18.6122 P=0.0003**	RC	
Age								
0-6	51.4	49.0	2.4	0.0	389(16.0)	DF=15	-0.666	<.0001(1.95)
>6 - ≤ 8	72.8	69.4	3.4	0.0	213(8.7)	X^2=151.404	-0.116	0.497(-)
>8 - ≤ 11	74.3	61.1	12.2	1.0	216(8.9)	P=<.0001**	0.038	0.825(-)
>11 - ≤ 17	77.7	64.2	12.9	0.6	358(14.7)		-0.023	0.875(-)
>17 - ≤ 23	84.7	64.1	16.5	4.1	486(20.0)		-0.251	0.054(-)
>23 - ≤ 35	73.0	62.0	10.6	0.4	777(31.9)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=9	NA	NA
Larger than AV	70.6	61.8	8.8	0.0	351(14.7)	X^2=10.406	0.781	<.0001(0.46)
Average (AV)	71.4	61.0	10.0	0.4	1549(635)	P=0.3187(NS)	0.648	<.0001(0.52)
Smaller than AV	73.2	61.2	11.5	0.6	378(15.5)		0.272	0.184(-)
Very small	77.9	63.1	13.4	1.4	154(6.3)		RC	
Currently breastfeeding								
No	73.0	61.7	10.3	1.0	43(17.7)	DF=	-0.486	<.0001(1.63)
Yes	71.8	61.1	10.3	0.3	2007(82.3)	X^2=4.156 P=0.2451(NS)	RC	
Caste								
SC	79.1	65.0	13.2	0.8	327(13.5)	DF=9	-0.083	0.551(-)
ST	77.0	64.6	12.4	0.0	298(12.3)	X^2=26.932	0.100	0.521(-)
OBC	67.5	58.6	8.6	1.0	499(20.6)	P=0.0014**	0.333	0.006(0.72)
NONE	71.0	60.8	9.9	0.3	1297(53.6)		RC	
Maternal characteristics								
Education of mother								
No education	74.5	63.0	11.0	0.5	977(40.1)	DF=9	-0.142	0.235(-)
Primary	75.1	62.8	11.8	0.5	651(26.7)	X^2=35.690	-0.190	0.139(-)
Secondary	68.9	55.8	12.3	0.7	360(14.8)	P<.0001**	0.045	0.764(-)
Higher	64.5	59.5	5.0	0.0	450(18.4)		RC	
Occupation								
Not working	68.7	58.9	9.6	0.2	1314(53.9)	DF=30	0.569	0.060(-)
Professional	56.6	55.3	1.3	0.0	45(1.8)	X^2=70.520	0.771	0.79(-)
clerical	68.7	68.7	0.0	0.0	2(0.1)	P<.0001**	-0.918	0.185(-)
Sales	77.6	63.0	14.5	0.0	15(0.6)		0.039	0.947(-)
Agric S-E	76.5	67.9	8.1	0.5	453(18.6)		0.727	0.025(0.48)
Agric E	75.3	61.1	13.2	1.0	420(17.2)		0.578	0.075(-)
Household	80.5	80.5	0.0	0.0	18(0.7)		0.341	0.500(-)
Service	85.9	85.9	0.0	0.0	4(0.2)		0.600	0.501(-)
Skilled -M	77.0	63.0	14.0	0.0	105(4.3)		0.401	0.282(-)
Unskilled –M	84.7	56.8	24.5	3.4	63(2.6)		RC	
DK	100.0	100.0	0.0	0.0	1(0.02)			
Toilet facility								
Flush	68.2	58.6	9.3	0.3	825(33.9)	DF=21	-0.168	0.900(-)
Pit-latrine	66.8	60.3	6.4	0.0	102(4.2)	X^2=44.5722	0.303	0.823(-)
Bush	74.4	62.7	11.1	0.6	1505(61.7)	P=0.002**	-0.043	0.974(-)
Others	100.0	100.0	0.10	0.0	5(0.2)		RC	

*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available

Source. NFHS-2

states like 74.5 percent (Gujarat), 75.0 percent (Madhya Pradesh) and slightly lower prevalence of 73.9 percent in Uttar Pradesh (IIPS and ORC Macro, 2000). Dey *et al*. (2013) also reported similar prevalence in Tripura with a prevalence of 74.2 percent and severe anaemia in Anurachal Pradesh and Manipur at 0.8 percent in each state. However, other reports have given higher prevalence of anaemia in the same state with a prevalence of 98.1 percent (IIPS/ MoHFW, 2006) and 76.0 percent (IIPS and ORC Macro, 2000).

4.3.7.3. Association of anaemia and selected variables.

4.3.7.3.1. Children characteristics

Anaemia in children was found to be significantly associated to age, sex and caste but not residence, religion, size at birth and breastfeeding (Table.4.3.19). Findings of Ramesh and Lopamudra (2010) complement the current findings.

4.3.7.3.2. Maternal factors.

Results presented in Table.4.3.19 show a significant association between anaemia prevalence in children and education of mother, occupation and toilet facility in the household in which they live.

Anaemia in children decreased with increase in educational level of the mother from 75.1 percent in children whose mothers attained only primary education to 64.5 percent among children whose mothers attained higher educational level. This is because with better education comes knowledge on proper child care practices like proper feeding to ensure balanced diet and maintain proper health which includes hygienic practices in child care. Kikafunda *et al*. (2009) found anaemia to be significantly associated with education of mother in Ugandan children with a similar trend as the current study.

Anaemia was highest in children living in households with no toilet facility (74.4 %). This is because with open defecation, comes easy spread of communicable diseases through contamination of water and food which the children drink and eat. WHO (2005) states that unsanitary conditions ca deprive a child of normal growth and are leading cause to spread of communicable diseases with anaemia being more prevalent after an episode of infection (WHO and UNICEF, 1998 and Jansson et al., 1986).

4.3.7.3.3. Morbidity

Results presented in Table.4.3.20 below revealed that anaemia was significantly higher among children who had fever (76.5 %) and those who suffered from cough (75.4 %) two weeks prior to the survey. This result indicates anaemia in children is associated to morbidity. Associations of morbidity and anaemia have been reported by Gahutu *et al*. (2011) and Kasdekar *et al*. (2015).

Table.4.3 19.Association and determinants of anaemia in children below five years based on morbid conditions in Maharashtra state during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Had fever								
No	69.3	59.2	9.7	0.4	1536(63.0)	DF=6	NC	NC
Yes	76.5	64.6	11.3	0.5	901(37.0)	X^2=15.2083	NC	NC
DK	100	100		0.0	1(0.02)	P=0.0187*	NC	NC
Had cough								
No	69.6	60.6	8.7	0.4	1440(59.1)	DF=6	**-1.756**	**0.037(5.79)**
Yes	75.4	62.2	12.7	0.5	997(40.9)	X^2=17.0571	**-1.744**	**0.039(5.72)**
DK	48.9	48.9	0.0	0.0	1(0.04)	P=0.0091**	**RC**	

*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, RC=reference category

Source: NFHS-2

4.3.7.3.4. Malnutrition.

Table.4.3.20.Association and determinants of anaemia in children below five years based on morbid conditions in Maharashtra state during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
STUNTING								
Normal	65.3	56.2	8.5	0.6	751(32.3)	DF=9	0.502	**0.002(0.61)**
Mild –S	70.4	61.9	8.5	0.0	633(27.2)	X^2=82.423	0.476	**0.004(0.62)**
Mod –S	78.9	68.0	10.4	0.5	601(25.8)	P<.0001**	0.165	0.331(-)
Sev- S	83.6	63.5	19.4	1.0	342(14.7)		**RC**	
WASTING								
Normal	68.1	60.8	7.3	0.1	942(40.2)	DF=9	0.348	0.289(-)
Mild –W	77.5	63.5	13.0	1.0	897(38.3)	X^2=43.024	0.018	0.955(-)
Mod-W	74.7	61.6	12.8	0.2	448(19.1)	P<.0001**	0.177	0.604(-)
Sev-W	73.1	63.3	9.8	0.0	57(2.4)		**RC**	
UNDERWEIGHT								
Normal	63.0	57.0	5.5	0.5	473(20.3)	DF=9	0.700	**<.0001(0.49)**
Mild-uw	70.7	62.0	8.4	0.3	684(29.4)	X^2=76.618	0.480	**0.002(0.62)**
Mod- uw	75.4	63.2	11.8	0.4	747(32.1)	P<.0001**	0.341	**0.027(0.71)**
Sev- uw	83.2	64.7	17.6	0.9	422(18.1)		**RC**	

*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight, RC=reference category

Source: NFHS-2

Malnutrition in form of stunting, wasting and underweight was analyzed and results presented in Table.4.3.21 below. Results revealed a significant association between anaemia and all indices of poor nutritional status.

According to the results of the study, anaemia was most prevalent among children who were severely stunted, severely underweight and mildly wasted represented by (83.6 %, 83.2 % and 77.5 %). Soares *et al.* (2011) reported anaemia to significantly increase with severity of under-nourishment which results due to increased infection as a result of poor immunity which is evident in severely malnourished children.

4.3.7.3.5. Determinant of anaemia in children

Results based on ordinal logistic regression presented in Table.4.3.19, Table.4.3.20 and Table.4.3.21 showed that severity of anaemia was correlated with caste, breastfeeding, sex, age, size at birth, occupation, presence of cough, stunting and underweight but not with residence, fever, religion, education of mother and toilet facility.

Caste was positively correlated with severity of anaemia and children who belonged to OBC were at 0.72 times RR of being anaemic as compared to children from other castes. This is contradictory to a report by Ramesh and Lopamudra (2010) in which children from SC/ST were at a higher RR of being severely anaemic than those from other castes. This could be a result of intervention government programmes which focus on SC/ST groups and giving little attention to other social classes yet all stand equally disadvantaged though not by wealth but probably ignorance and other environmental and biological factors.

Children who were not breastfeeding had a 1.63 times RR of being anaemic compared to their counterparts who were still breastfeeding. This is because non-breastfeeding children only draw their iron from the complementary food which is not readily bio-available as only 10 % is absorbed and yet a 8-10mg is needed on a daily basis increasing the risk of anaemia (Heird, 2007). Also, the Indian diet is rich in phytates which inhibit iron absorption due to vegetarianism.

Similar to findings of the current study, Magalha˜es and Clements (2011) reported male children to be at a higher risk of being anaemic than their female counterparts. The RR in the current study was 1.22 times higher for male children than the female ones.

Size at birth was positively correlated to anaemia prevalence in children. Severity of anaemia increased with decrease in body size at birth. The RR of being anaemic was 0.46 times and 0.52 times in children who were larger than average and average size at birth. This is because; the risk of infection is higher in low birth weight and hence higher prevalence of anaemic due to recurrent infections.

Age was negatively correlated to severity of anaemia. Anaemia prevalence in 0- 6 months old children decreased by 66.6 percent. The RR of being anaemic in children in this age bracket was 1.95 times as compared to older children. This is contradictory to findings by Cornet *et al*. (1998) who reported the highest prevalence of anaemia in children who were 6 months of age as compared to older children in Cameroon. This could be a result of timely and exclusive breastfeeding which improves the child's immunity and reduces rate of infections which are common in bottle feeding with nipple.

Results presented in Table.4.3.21 showed that both stunting and underweight were positively correlated with severity of anaemia among children. This infers that anaemia increased with increase in level of stunting and underweight in children below five years. The RR of being anaemic increased with increase in degree of stunting and underweight among children (Table.4.3.21). Soares *et al*. (2011) reported similar findings with anaemia being significantly correlated with severity of malnutrition and the risk of anaemia increasing with severity of malnutrition.

4.3.8. Maharashtra (MH) 2005/06

4.3.8.1. Profile of study population in Maharashtra state during 2005/06 (NFHS-3).

Approximately data on 2911 children was included in the study. Of these children, majority resided in rural part of the state (55.6 %), were Hindu (74.5 %), male (54.7 %), average in size at birth (53.8 %), still breastfeeding (58.7 %) and belonged to other caste (42.0 %).

Majority of the children's mothers had attained secondary education (58.3 %), were not working (60.2 % and lived in households with flush toilets (47.9 %). Data on morbidity revealed that majority of the children did not suffer from either cough or fever two weeks prior to the survey, were not stunted or wasted but mildly underweight (see Table.4.3.23 and Table.4.3.24).

4.3.8.2. Prevalence of anaemia among children below five in Maharashtra state.

The overall prevalence of anaemia was 62.3 percent of which 54.2 percent were mildly anaemic, 7.9 percent (moderately anaemic) and 0.3 percent (severely anaemic). Dey et al. (2013) reported a similar prevalence of 61.8 percent anaemia in Assam and

Table.4.3.21. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Maharashtra state during 2005/06

Background characteristic	% of children with any Anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban	58.4	51.9	6.4	0.2	129(44.4)	DF=3	0.032	0.656(-)
Rural	67.1	57.4	9.4	0.3	1619(55.6)	X^2=27.312 P=<.0001**	RC	
Religion								
Hindu	63.6	55.0	8.4	0.2	216(74.5)	DF=24	-0.240	0.034(1.27)
Muslim	53.4	52.7	0.1	0.6	391(13.4)	X^2=28.153	-0.681	<.0001(1.98)
Christian	40.6	40.6	0.0	0.0	18(0.6)	P=0.2536	-0.110	0.739(-)
Others	67.3	57.4	9.9	0.0	334(11.5)	(NS)	RC	
Sex								
Male	66.0	56.0	9.6	0.4	1592(54.7)	DF=3	-0.015	0.824(-)
Female	59.9	53.6	6.3	0.0	1319(45.3)	X^2=23.862 P<.0001**	RC	
Age								
>6 - ≤ 8	70.5	65.0	5.5	0.0	173(5.9)	DF=3	-1.007	<.0001(2.74)
>8 - ≤ 11	74.2	66.9	5.8	1.5	152(5.2)	X^2=311.649	-0.707	<.0001(2.03)
>11 - ≤ 17	82.1	59.8	22.4	0.0	353(12.1)	P=<.0001**	-1.021	<.0001(2.78)
>17 - ≤ 23	72.7	60.9	11.8	0.0	325(11.2)		-0.728	<.0001(2.07)
>23 - ≤ 35	65.0	55.5	9.5	0.4	637(21.9)		-0.538	<.0001(1.71)
>35 - ≤ 47	62.0	56.7	4.9	0.4	602(20.7)		0.518	<.0001(1.68)
>47 - ≤ 59	43.4	42.0	1.4	0.0	671(23.0)		RC	
Size at birth								
Very large	61.8	48.6	13.2	0.0	141(4.8)	DF=15	0.554	0.021(0.57)
Larger than AV	68.7	61.1	7.2	0.4	612(21.0)	X^2=57.999	0.445	0.015(064)
Average (AV)	61.4	53.6	7.7	0.0	1565(53.8)	P<.0001**	0.453	0.008(0.64)
Smaller than AV	63.5	55.3	7.6	0.6	349(12.0)		0.139	0.467(-)
Very small	48.3	38.3	10.0	0.0	113(3.9)		0.539	0.026(0.58)
DK	73.8	61.4	10.5	1.8	131(4.5)		RC	
Currently breastfeeding								
No	56.0	50.6	5.2	0.2	1203(41.3)	DF=3	0.610	<.0001(0.54)
Yes	68.3	58.0	10.1	0.3	1708(58.7)	X^2=57.796 P<.0001**	RC	
Caste								
SC	64.8	56.0	8.8	0.0	546(18.9)	DF=9	14.747	<.0001(3.94^{-7})
ST	67.4	55.2	12.2	0.0	359(12.4)	X^2=18.788	14.436	<.0001(5.38^{-7})
OBC	62.1	54.7	6.8	0.6	773(26.7)	P=0.0271*	14.586	<.0001(4.63^{-7})
NONE	62.1	54.5	7.5	0.2	1216(42.0)		RC	
Maternal characteristics								
Education of mother								
No education	66.2	55.1	10.7	0.3	703(24.2)	DF=9	-0.273	0.034(1.31)
Primary	63.2	54.1	9.1	0.0	281(9.6)	X^2=20.872	-0.377	0.009(1.46)
Secondary	62.6	55.6	6.9	0.1	1698(58.3)	P<.00132**	-0.084	0.446(-)
Higher	58.8	50.1	7.7	1.0	230(7.9)		RC	
Occupation								
Not working	61.8	54.1	7.4	0.3	1753(60.2)	DF=18	NC	NC
Professional	59.4	52.6	6.8	0.0	73(2.5)	X^2=32.849	NC	NC
clerical	52.5	52.5	0.0	0.0	4(0.1)	P<.00174**	NC	NC
Sales	76.0	68.9	7.0	0.0	46(1.6)		NC	NC
Agric S-E & E	65.6	55.5	10.1	0.0	827(28.4)		NC	NC
Service	62.5	58.8	3.7	0.0	86(2.9)		NC	NC
Skilled & Unskilled –M	66.4	56.1	8.3	2.0	123(4.2)		NC	NC
Toilet facility								
Flush	59.3	53.4	5.7	0.2	1393(47.9)	DF=30	0.938	<.0001(1.31)
Pit-latrine	90.1	80.3	9.9	0.0	23(0.8)	X^2=148.409	0.850	0.086(-)
Bush	66.3	56.7	9.3	0.3	1354(46.6)	P<.0001**	0.913	<.0001(0.40)
Others	100.0	100.0	0.0	0.0	1(0.03)		RC	
Not dejure resident	67.6	47.3	20.3	0.0	137(4.7)			
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available								

Source: NFHS-3

higher prevalence in Sikkim (70.9 %). A similar prevalence was reported during NFHS-3 in Maharashtra state (63.4 %) and Tripura (62.9 %) and 64.2 percent in Tamil Nadu (IIPS and Macro, 2007). In Sub-Saharan Africa, the prevalence was very high with 82 percent (Benin) and 83 percent in Mali (Ngnie-Teta *et al*. (2007). The difference in prevalence could be due to difference in study subjects in terms of culture which definitely affects feeding practices.

4.3.8.3. Association of anaemia and selected variables.

4.3.8.3.1. Children characteristics

Results in Table.4.3.22 revealed there was a significant association between anaemia prevalence and residence, sex, age, size at birth, breastfeeding and caste except for religion. This is contradictory to Dey *et al*. (2013) who reported religion to be significantly associated to anaemia prevalence in children.

Anaemia was significantly higher among rural children (67.1 %) as compared to urban children (58.4 %). In conformity to the current findings, IIPS and Macro, (2007) and Spinelli *et al*. (2005) indicated anaemia to be higher in rural children than urban children with (71.5 % vs 63.0 %) in NFHS-3 among Indian rural and urban children respectively.

Anaemia was significantly higher among male children (66.0 %) than female children (59.9 %) as was reported by Le Cessie *et al*. (2002) and Unsal *et al*. (2007). Dey *et al*. (2013) also reported a higher prevalence among male than female children (53.1 % vs 51.9 %) respectively.

Anaemia was highest in children between >11-≤ 17 months of age (82.1 %) compared to children in other age groups. Similar findings were reported in NFHS-3 with anaemia being highest in the age group >12-≤ 17 months with a prevalence of 84.5 percent (IIPS and Macro, 2007). However, Ong'echa *et al*. (2006) did not find anaemia to be significantly associated with age of the children below five years.

4.3.8.3.2. Maternal factors.

There was a significant association between education of mother, occupation and toilet facility in the household in which they lived (Table.4.3.22). Several reports have presented similar findings with anaemia decreasing with increase in education of the child's mother (NNMB, 2003 and IIPS and Macro, 2007) and to be significantly associated (Dey *et al*., 2013 and Arnold *et al*., 2009).

4.3.8.3.3. Morbidity

Table.4.3 22. Association and determinants of anaemia in children below five years based on morbid conditions in Maharashtra state during 2005/06

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Had fever								
No Yes DK	63.6 61.1 0.0	55.7 49.5 0.0	7.7 11.5 0.0	0.3 0.0 0.0	257(88.5) 329(11.3) 5(0.2)	DF=6 X^2=16.7539 P=0.0102**	**1.431** **1.492** **RC**	**0.021(0.24)** **0.017(0.22)**
Had cough								
No Yes DK	63.0 66.2 0.0	55.2 54.2 0.0	7.6 11.4 0.0	0.2 0.6 0.0	2492(85.9) 402(13.9) 7(0.2)	DF=6 X^2=21.003 P=0.0018**	**1.947** **2.118** **RC**	**0.008(0.14)** **0.004(0.12)**
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, RC=reference category								

Source: NFHS-3

There was a significant association between anaemia prevalence and morbid conditions in children (Table.4.3.23). Soares *et al*. (2011) reported anaemia to be associated significantly with morbid conditions.

4.3.8.3.4. Malnutrition.

Table.4.3 23.Association and determinants of anaemia in children below five years based on morbid conditions in Maharashtra state during 2005/06

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
STUNTING								
Normal Mild –S Mod –S Sev- S	55.0 62.1 67.2 72.4	49.7 53.2 59.7 59.7	5.4 8.6 7.6 12.2	0.3 0.3 0.0 0.5	795(29.3) 743(27.4) 710(26.2) 466(17.2)	DF=9 X^2=59.13 P<.0001**	**0.253** **0.275** **0.291** **RC**	**0.041(0.78)** **0.030(0.76)** **0.026(0.75)**
WASTING								
Normal Mild –W Mod-W Sev-W	67.8 59.8 55.6 69.2	57.9 53.5 45.9 63.3	9.3 6.3 9.7 5.9	0.6 0.0 0.0 0.0	1180(43.4) 1147(42.2) 311(11.5) 79(2.9)	DF=9 X^2=40.904 P<.0001**	0.035 0.425 0.519 RC	0.888(-) 0.086(-) 0.51(-)
UNDERWEIGHT								
Normal Mild-uw Mod- uw Sev- uw	61.5 62.0 62.3 71.2	52.9 54.0 56.5 56.0	8.2 7.7 5.6 15.2	0.4 0.2 0.3 0.0	511(18.8) 954(35.2) 925(34.1) 324(11.9)	DF=9 X^2=36.566 P<.0001**	0.164 0.238 **0.376** RC	0.264(-) 0.083(-) **0.007(0.69)**
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight, RC=reference category								

Source: NFHS-3

Results presented in Table.4.3.24 revealed that anaemia increased with severity of malnutrition in children. Severely stunted, wasted and underweight children had the highest prevalence of anaemia compared to their counterparts with other levels of under-nourishment and the association was significant. Soares *et al*. (2011) and Sinha *et* *al.* (2008) reported anaemia prevalence to significantly increase with severity of malnutrition similar to the current study.

4.3.8.3.5. Determinants of anaemia in children

Results based on ordinal logistic regression presented in Table.4.3.22, Table.4.3.23 and Table.4.3.24 showed that severity of anaemia was correlated with caste, breastfeeding, age, religion, size at birth, presence of cough, fever, stunting and underweight but not with residence, sex, education of mother and toilet facility, wasting.

Anaemia was negatively correlated to age of the child. The RR of being anaemic decreased with increase in age of the child. Anaemia was higher in children <24 months with prevalence ranging from (70 – 82) percent and it decreased to (43- 66) percent in children > 24 months. Ayoya *et al*. (2013) reported risk of developing anaemia to be 2.6 times higher in children <24 months as compared to children >24 months.

The RR of being severely anaemic was higher among Muslim children (1.98 times) and it was 1.27 times for the Hindu children in comparison to other religions. This can be attributed to religious norms which mothers of these children follow like fasting which would affect the nutritional value of breast milk on which the children are dependent for easily absorbable iron. This is contradictory to the findings of Dey *et al*. (2013) who reported anaemia risk to be highest among Hindu (OR=2.97 times) as compared to Muslim children (OR=1.41 times).

Education of the mother was negatively correlated to severity of anaemia. Anaemia prevalence in children decreased with increase in formal education of the mother. The RR of being anaemic was 1.31 times among children with mothers who had no education and it was 1.46 times among children with mothers who had primary education. However, Dey *et al.* (2013) reported that children born to literate mothers to be at a lesser risk of being anaemic as they would be more aware of causes and symptoms of anaemia than uneducated mothers.

Infection with fever and cough was positively correlated with prevalence of anaemia. Jansson *et al*. (1986) and Oso´rio *et al*. (2001) stated that there is a vast possibility of developing anaemia after an acute infection episode and these possibilities vary according to length and severity of the disease.

Chronic under-nourishment (stunting and underweight) was positively correlated to severity of anaemia in children (Table.4.3.24). Prevalence of anaemia is severely increased with severity of malnutrition. The RR of being anaemic was 0.75 times among moderately stunted children and it was 0.69 times among moderately underweight children. Ayoya *et al*. (2013) reported that stunted children were at a 2.2 times risk of being anaemic and Sinha *et al*. (2008) reported underweight children to be at a higher risk of being anaemic as compared to their healthy counterparts.

4.3.8.3.6. Comparison between Maharashtra state during 1998/99 and 2005/06.

As seen in figure.4.3.5 below, anaemia prevalence in children decreased over the years by 12.3 percent. The decrease can be attributed to government effort which advocates education of the girl child as seen in Table.4.3.19 and Table.4.3.22; there was a decrease in women with no education from 40.1 percent to 24.2 percent. There was also an improvement in sanitary conditions with more homes acquiring proper toilet facilities as portrayed by a decrease in household using bush method to disposed-off human waste from 61.7 percent to 46.6 percent. Despite the decrease in households without toilet facilities in NFHS-3 (2005/06), the percentage was still high which could explain why anaemia remains a public health problem in Maharashtra state

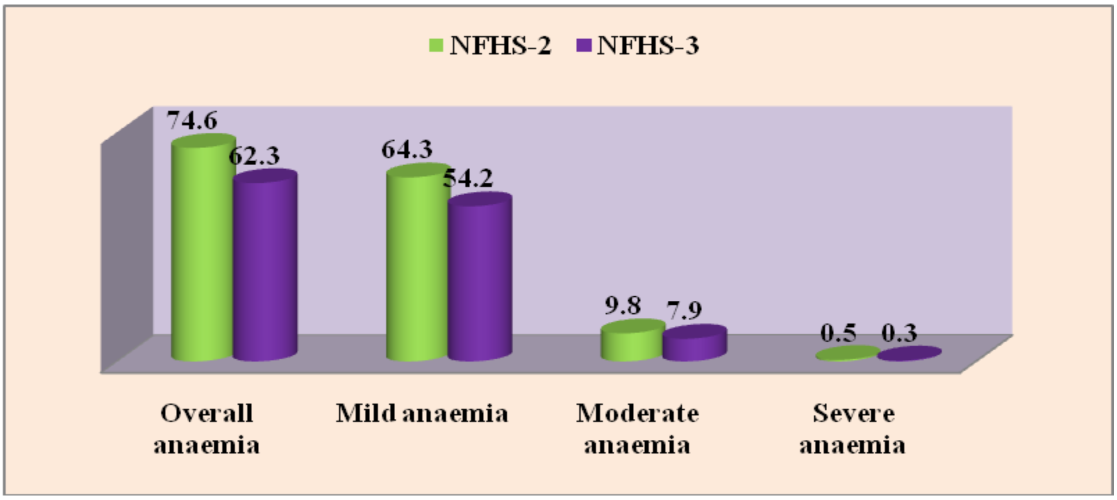

Figure.4.3. 5. Trends in anaemia prevalence during NFHS-2 and NFHS-3 in Maharashtra state.

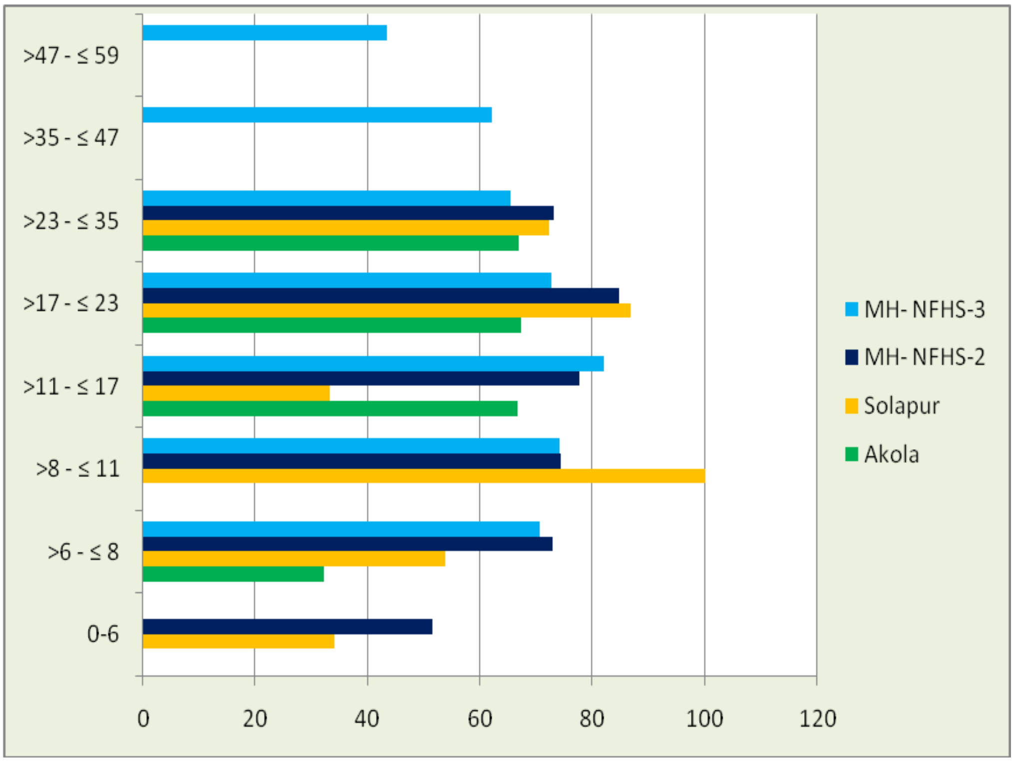

Figure.4.3. 6. Anaemia prevalence in Maharashtra state and its districts by age groups.

Based on Figure.4.3.6, anaemia in children rises from >6months and remains prevalent untill 24 months. This could be due to type and quality of complementary food provided to the children in this period. Kikafunda *et al*. (2009) stated that type, time and quality of complementary foods ontop of infections were significantly associated with high prevalence of anaemia in children < 24 months old. Children who had special meals prepared for them were at a lower risk of anaemia as compared to children who fed on staple family meals which contain very low bio-available iron but more of calories.

Conclusion

A very high prevalence was found in Maharashtra state and its districts, which indicates anaemia is a severe public health problem in children despite the tremendous decrease over the years.

4.3.9. Bijapur 1998/99

4.3.9.1. Profile of study population in Bijapur district 1998/99 (NFHS-2).

Data on approximately 77 children below five years of age was included in the study. Majority of these children were of rural residency (70.4 %), Hindu (77.4 %), male (51.5 %), in the age bracket >23-≤ 35 months old (27.3 %), of average size at birth

(41.1 %), breastfeeding (82.8 %) and belonged to other caste groups other than SC, ST or OBC (45.9 %).

Majority of the children's mothers had no education (61.5 %), were not working (59.9) and lived in households with no toilet facilities (72.9 %). Results presented in Table.4.3.26 and Table.4.3.27 show that majority of the children suffered from cough (68.3 %) and fever (68.1 %) two weeks prior to the survey and were undernourished.

4.3.9.2. Prevalence of anaemia among children below five in Bijapur district 1998/99

The overall prevalence of anaemia was 69.3 percent of which 48.8 percent were mildly anaemic, 11.9 percent were moderately anaemic and 8.7 percent were severely anaemic. Similar prevalence of 69.3 percent has been reported in Equatorial Guinea by Custodio *et al.* (2008), in lake Albert- Uganda (68.9 %) by Green *et al*. (2011), in India (69 %) by Arnold *et al*. (2009) and severe anaemia prevalence of 9.7 percent among Nigerian children (Muoneke *et al.* 2012). The prevalence of severe anaemia is higher than the average national prevalence of anaemia in India during NFHS-2 which is 5.4 percent (IIPS and ORC Macro, 2000). However, (IIPS and Macro, 2007) during NFHS-3 reported higher prevalence in Jammu & Kashmir (71.7 %), Andhra Pradesh (72.3 %), Orissa (72.3 %) and West Bengal (78.3 %). The similarity in prevalence elsewhere is a sign of how vast the problem of child anaemia is and differences can be a result of cultural, environment, socio-economical differences in the populations.

4.3.9.3. Association of anaemia and selected variables.

4.3.9.3.1. Children characteristics

Results presented in Table.4.2.25 show there is no significant association between residence, sex, age, size at birth, breastfeeding, and caste but only with religion. Ong'echa *et al*. (2006) and Leal *et al*. (2011) did not find anaemia to be associated with age and sex respectively.

Muslim children had the highest association of both overall anaemia (73.5 %) and severe anaemia (26.7 %). This could be due to early introduction of complementary food in the regime of the child prior to religious influences like fasting which the mother must participate in depending on the devotion to her faith. This complementary food being made from plant foods contains phytic acid which is a strong inhibitor to the absorption of iron which is likely non-haem iron. Non- haem iron is not readily bio-available for absorption. Dey *et al* (2013) reported anaemia to be higher in Muslim children while NFHS-2 reported all levels of anaemia to be higher among Hindu children (IIPS and ORC Macro, 2000).

Table.4.3 24. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Bijapur district 1998/99

Background characteristic	% of children with any Anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance(RR)
Child characteristics								
Residence								
Urban	71.4	42.9	9.5	19.0	23(29.6)	DF=3	-0.116	0.805(-)
Rural	65.6	49.4	14.2	2.0	54(70.4)	X^2=7.249	RC	
						P=0.0644(NS)		
Religion								
Hindu	65.0	50.3	12.9	1.8	60(77.4)	DF=6	-0.440	0.814(-)
Muslim	73.5	33.4	13.4	26.7	16(21.1)	X^2=13.583	-0.424	0.821(-)
Christian	NA	NA	NA	NA	NA	P=0.0347*	NA	NA
Others	100.0	100.0	0.0	0.0	1(1.5)		RC	
Sex								
Male	69.5	44.6	14.0	10.9	40(51.5)	DF=3	0.258	0.506(-)
Female	65.0	50.6	11.5	2.9	37(48.6)	X^2=2.114	RC	
						P=0.5491(NS)		
Age								
0-6	53.6	53.6	0.0	0.0	16(21.2)	DF=15	-0.949	0.071(-)
>6 - ≤ 8	62.1	49.9	0.0	12.2	9(11.6)	X^2=15.959	-0.047	0.947(-)
>8 - ≤ 11	67.3	34.3	16.7	16.3	7(8.7)	P=0.3848(NS)	0.175	0.836(-)
>11 - ≤ 17	63.1	25.5	37.6	0.0	9(11.4)		-0.039	0.957(-)
>17 - ≤ 23	86.0	64.6	14.3	7.1	15(19.9)		-0.007	0.991(-)
>23 - ≤ 35	68.3	42.6	15.4	10.3	21(27.3)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=9	NA	NA
Larger than AV	60.9	44.0	8.4	8.5	25(33.1)	X^2=4.2689	0.251	0.820(-)
Average (AV)	65.7	41.4	17.5	6.8	32(41.1)	P=0.8928(NS)	0.159	0.884(-)
Smaller than AV	81.3	62.9	12.3	6.1	18(23.0)		-0.579	0.602(-)
Very small	50.0	50.0	0.0	0.0	2(2.8)		RC	
Currently breastfeeding								
No	75.4	58.7	8.4	8.2	13(17.2)	DF=3	-1.057	0.088(-)
Yes	65.6	45.1	13.7	6.8	64(82.8)	X^2=1.015	RC	
						P=0.7976(NS)		
Caste								
SC	80.0	73.1	6.9	0.0	17(22.6)	DF=9	0.302	0.617(-)
ST	75.0	50.0	0.0	25.0	4(5.6)	X^2=14.945	-0.046	0.960(-)
OBC	50.4	39.3	11.1	0.0	20(25.9)	P=0.1243(NS)	0.506	0.337(-)
NONE	68.6	37.5	18.6	12.5	35(45.9)		RC	
Maternal characteristics								
Education of mother								
No education	67.5	47.0	16.0	4.5	47(61.5)	DF=9	-0.863	0.089(-)
Primary	75.7	50.0	13.4	12.3	9(11.4)	X^2=3.6831	-0.199	0.800(-)
Secondary	66.5	66.5	0.0	0.0	3(4.2)	P=0.931(NS)	0.349	0.765(-)
Higher	62.6	43.9	6.3	12.3	18(22.9)		RC	
Occupation								
Not working	74.0	52.5	12.1	9.4	46(59.9)	DF=21	0.090	0.943(-)
Professional	0.0	0.0	0.0	0.0	3(4.3)	X^2=24.432	0.164	0.871(-)
Sales	0.0	0.0	0.0	0.0	1(1.4)	P=0.2726(NS)	-1;356	0.172(-)
Agric S-Employ	83.3	50.0	33.3	0.0	6(8.3)		-0.279	0.843(-)
Agric Employ	50.9	39.1	0.0	11.8	9(11.7)		-0.064	0.960(-)
Service	100.0	0.0	100.0	0.0	1(1.4)		-0.452	0.838(-)
Skilled -M	66.6	50.1	16.4	0.0	6(8.4)		-0.279	0.842(-)
Unskilled –M	66.7	66.7	0.0	0.0	4(4.6)		RC	
Toilet facility								
Flush	25.3	25.3	0.0	0.0	4(5.7)	DF=9	2.324	0.052(-)
Pit-latrine	100.0	100.0	0.0	0.0	1(1.4)	X^2=5.56	-1.853	0.117(-)
Bush	69.4	48.0	13.8	7.6	72(92.9)	P=0.783(NS)	RC	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available, Employ= Employed, M=Manual								

Source: NFHS-2

4.3.9.3.2. Maternal factors.

None of the examined variables were found to be significantly associated with prevalence of anaemia, which is contradictory to Ong'echa *et al*. (2006) who found mothers education and occupation to be significantly associated with anaemia prevalence in their children.

4.3.9.3.3. Morbidity

Similar to reports of Menon and Yoon (2015) and Gahutu *et al.* (2011), morbid conditions were significantly associated with prevalence of anaemia with a very high prevalence of anaemia in children who suffered from cough and fever two weeks before the survey (82.1 % in each case) as compared to children who were free of morbidity. This is because morbid condition like high fever can cause red cell atrophy to be increased which is not replaced at the rate its destroyed hence increasing anaemia occurrence.

Table.4.3 25.Association and determinants of anaemia in children below five years based on morbid conditions in Bijapur district during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate (SE)	Significance (RR)
Had fever								
No Yes	60.4 82.1	39.8 63.9	14.4 9.3	6.2 8.8	52(68.1) 25(31.9)	DF=3 X^2=4.991 P=0.1725 (NS)	0.052 RC	0.928(-)
Had cough								
No Yes	60.4 82.1	43.8 55.4	14.6 9.0	2.1 17.7	53(68.3) 24(31.7)	DF=3 X^2=9.0619 P=0.0285*	0.660 RC	0.246(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia.								

Source.NFHS-2

4.3.9.3.4. Malnutrition.

Severe anaemia increased with severity of undernourishment in children (Table.4.3.27) and was significantly associated to acute undernourishment (wasting) only but not stunting and underweight.

Table.4.3 26.Association and determinants of anaemia in children below five years based on morbid conditions in Bijapur district during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
STUNTING								
Normal	73.7	56.5	12.8	4.3	25(37.9)	DF=9	0.624	0.313(-)
Mild –S	43.9	43.9	0.0	0.0	17(25.9)	X^2=9.8084	**1.363**	**0.043(0.26)**
Mod –S	77.8	56.0	11.0	10.8	10(15.1)	P=0.3662	-0.413	0.560(-)
Sev- S	69.7	39.1	15.3	15.3	14(21.1)	(NS)	RC	
WASTING								
Normal	45.7	33.3	12.4	0.0	26(36.8)	DF=9	2.820	0.202(-)
Mild –W	83.6	67.3	8.1	8.1	26(36.9)	X^2=27.954	1.879	0.361(-)
Mod-W	69.0	56.5	6.3	6.1	18(24.8)	P=0.001**	2.597	0.204(-)
Sev-W	100.0	0.0	0.0	100.0	1(1.5)		RC	
UNDERWEIGHT								
Normal	68.1	52.6	15.6	0.0	21(31.2)	DF=9	-0.012	0.993(-)
Mild-uw	54.2	54.2	0.0	0.0	14(21.2)	X^2=14.000	0.102	0.921(-)
Mod- uw	59.3	47.4	6.0	5.9	19(27.7)	P=0.1223	0.160	0.845(-)
Sev- uw	83.2	42.7	16.1	24.3	13(19.9)	(NS)	RC	

*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight.

Source: NFHS-2

4.3.9.3.5. Determinants of anaemia in children

Results based on logistic regression show that none of the examined variables were significantly correlated with anaemia prevalence in children except for stunting. This indicates chronic under-nourishment as a significant problem. Severe anaemia was highest among severely stunted children with a prevalence of 15.3 percent. Mildly stunted children had a 0.26 times RR of being severely anaemic as compared to other children with different degrees of stunting. Ayoya *et al*. (2013) reported stunted children to be at a 2.2 higher risk of being anaemic.

4.3.10. Tumkur 1998/99

4.3.10.1. Profile of study population in Tumkur district 1998/99 (NFHS-2).

Data on approximately 87 children below five years of age was included in the study. Out of these children, majority resided in rural Tumkur (94.9 %), were of Hindu religion (97.4 %), female (53.9 %), between >23-≤ 35 months of age (32.1 %), were larger than average at birth (43.6 %), were still breastfeeding (67.9 %), and belonged to OBC (42.3 %).

Most the children had mothers with no education (51.5 %), were not working (48.7 %) and belonged to households with no toilet facility (92.4 %). Majority of the children had suffered from cough and fever two weeks to the survey (Table.4.3.29), were neither stunted or wasted but mildly underweight (Table.4.3.30).

Table.4.3.27. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Tumkur district 1998/99

Background characteristic	% of children with any Anaemia	Percentage of children with		Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A			Estimate	Significance(RR)
Child characteristics							
Residence							
Urban Rural	100.0 55.5	75.0 47.5	25.0 8.0	4(5.1) 83(94.9)	DF=2 X^2=4.0278 P=0.1335(NS)	-1.829 RC	0.076(-)
Religion							
Hindu Muslim	56.7 100.0	48.9 50.0	7.8 50.0	85(97.4) 2(2.6)	DF=21 X^2=23.068 P=0.3404(NS)	1.527 RC	0.075(-)
Sex							
Male Female	58.4 57.3	50.1 47.8	8.3 9.5	40(46.1) 47(53.9)	DF=2 X^2=0.0659 P=0.9676(NS)	0.001 RC	0.997(-)
Age							
0-6 >6 - ≤ 8 >8 - ≤ 11 >11 - ≤ 17 >17 - ≤ 23 >23 - ≤ 35	35.4 74.9 62.8 85.7 69.3 52.2	35.4 62.3 62.8 57.6 61.8 40.2	0.0 12.6 0.0 28.1 7.6 12.0	19(21.7) 9(10.2) 9(10.2) 8(8.9) 15(16.7) 28(32.1)	DF=10 X^2=13.73 P=0.1857(NS)	0.604 -0434 0.025 0.913 -0.243 RC	0.116(-) 0.349(-) 0.957(-) 0.065(-) 0.535(-)
Size at birth							
Very large Larger than AV Average (AV) Smaller than AV Very small	NA 56.0 60.3 56.5 100.0	NA 44.2 60.3 43.6 100.0	NA 11.7 0.0 12.9 0.0	NA 38(43.6) 22(25.6) 26(29.5) 1(1.3)	DF=6 X^2=4.965 P=0.5483(NS)	NA 0.560 0.692 0.526 RC	NA 0.622(-) 0.548(-) 0.646(-)
Currently breastfeeding							
No Yes	56.2 58.6	48.2 49.2	8.0 9.4	28(32.1) 59(67.9)	DF=2 X^2=0.0703 P=0.9655(NS)	0.089 RC	0.772(-)
Caste							
SC ST OBC NONE	63.7 50.1 57.7 53.0	50.2 50.1 51.7 41.2	13.5 0.0 6.0 11.8	25(28.2) 7(7.8) 37(42.3) 19(21.6)	DF=6 X^2=2.411 P=0.8783(NS)	-0.227 0.272 0.015 RC	0.539(-) 0.626(-) 0.965(-)
Maternal characteristics							
Education of mother							
No education Primary Secondary Higher	67.6 49.5 85.7 34.8	60.2 37.2 71.6 26.1	7.5 12.3 14.1 8.7	45(51.5) 9(10.3) 8(8.9) 26(29.2)	DF=6 X^2=11.261 P=0.0806(NS)	-0.620 -0.387 -1.055 RC	0.048(1.86) 0.421(-) 0.035(2.87)
Occupation							
Not working Sales Agric Self-Emp Agric Emp Skilled -M Unskilled –M	50.1 50.0 76.8 55.1 67.0 100.0	42.3 50.0 61.6 50.2 33.5 100.0	7.8 0.0 15.2 4.9 33.5 0.0	43(48.7) 2(2.6) 15(16.8) 3(3.8) 2(2.6)	DF=10 X^2=8.9848 P=0.5335(NS)	0.833 1.782 -0.036 0.554 0.475 RC	0.378(-) 0.296(-) 0.971(-) 0.578(-) 0.669(-)
Toilet facility							
Flush Pit-latrine Bush Others	NA 49.9 58.5 NA	NA 33.3 50.2 NA	NA 16.5 8.3 NA	NA 7(7.6) 81(92.4) NA	DF=2 X^2=0.9367 P=0.626(NS)	NA -0.249 RC NA	NA 0.634(-) NA
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available, Emp= Employed, M=Manual							

Source: NFHS-2

4.3.10.2. Prevalence of anaemia among children below five in Tumkur district.

The overall prevalence of anaemia was 63.0 percent of which 52.5 percent were mildly anaemic and 10.6 percent were moderately anaemic. None of the children were found to be severely anaemic in this district. IIPS and ORC Macro (2000) reported a similar prevalence in Assam (63.2 %). Other studies also reported closer prevalence with 65.3 percent in Palestine children (Alzain, 2012) and 61.8 percent in Assam children in India (Dey *et al*., 2013).

4.3.10.3. Association of anaemia and selected variables.

4.3.10.3.1. Children characteristics

Results in Table.4.3.28 show there is no association between child anaemia with any of the selected variables that is residence, religion, age, sex, size at birth, breastfeeding and caste. Similar findings were reported by Hussein and Mohammed (2014) among Sudanese children of the same age.

4.3.10.3.2. Maternal factors.

Results in Table.4.3.28 also revealed that maternal factors were not associated with prevalence of anaemia in children.

4.3.10.3.3. Morbidity

Results in Table.4.3.29 show there is no significant association between anaemia in children and morbidity. However, children who suffered from cough and fever were found to be more anaemic than their counterparts. Hussein and Mohammed (2014) also reported similar findings with malaria morbid conditions in Sudanese children who had a prevalence of 34.4 percent anaemia. This is contradictory to Kasdeka *et al*. (2015) who found anaemia to be significantly associated with morbid conditions in children.

Table.4.3 28. Association and determinants of anaemia in children below five years based on morbid conditions in Tumkur district during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with		Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A			Estimate (SE)	Significance (RR)
Had fever							
No Yes	55.5 69.5	47.8 54.1	7.6 15.4	73(83.3) 15(16.7)	DF=2 X^2=1.4774 P=0.4777	0.333 RC	0.378(-)
Had cough							
No Yes	57.5 59.9	50.2 40.0	7.3 19.9	76(87.2) 11(12.8)	DF=2 X^2=1.969 P=0.3736(NS)	0.228 RC	0.589(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia.							

Source: NFHS-2

4.3.10.3.4. Nutritional status.

Results in Table.4.3.30 revealed that stunting and underweight were associated with anaemia prevalence in children but not wasting. This result means that chronic under-nourishment precipitates the occurrence of malnutrition as compared to acute under-nourishment. This is evident with the increase in anaemia prevalence with severity of under-nourishment.

Table.4.3.29. Association and determinants of anaemia in children below five years based on morbid conditions in Tumkur district during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with		Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A			Estimate	Significance (RR)
STUNTING							
Normal	36.1	36.1	0.0	28(33.7)	DF=6	1.428	0.059(-)
Mild –S	61.1	50.0	11.1	20(24.4)	X^2=12.6977	0.372	0.524(-)
Mod –S	67.0	50.4	16.5	20(24.4)	P-0.0481*	0.194	0.703(-)
Sev- S	84.8	69.6	15.2	15(17.6)		RC	
WASTING							
Normal	62.2	51.5	10.7	41(49.3)	DF=6	1.381	0.122(-)
Mild –W	62.2	52.7	9.5	24(28.1)	X^2=7.2678	1.221	0.137(-)
Mod-W	35.8	28.7	7.1	16(18.7)	P=0.2968 (NS)	**2.064**	**0.026(0.13)**
Sev-W	100.0	100.0	0.0	3(4.0)		RC	
UNDERWEIGHT							
Normal	47.0	47.0	0.0	19(22.9)	DF=6	-0.096	0.914(-)
Mild-uw	41.2	36.7	4.5	25(29.7)	X^2=13.038	0.484	0.507(-)
Mod- uw	84.1	63.2	20.8	21(25.8)	P=0.0424*	-0316	0.605(-)
Sev- uw	62.6	50.2	12.4	18(21.6)		RC	

*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight.

Source: NFHS-2

4.3.10.3.5. Determinant of anaemia in children.

Results based on logistic regression as presented in Table.4.3.28, Table.4.3.29 and Table.4.3.30 revealed that none of the examined factors was statistically correlated to severity of anaemia except for mothers' education and wasting

Education of a mother was negatively correlated to severity of anaemia. This infers severity of anaemia in children would decrease with increase in education of the mother. Children with mothers who had no education had a RR of 1.86 times of being anaemic and RR was 2.87 times for children with mothers who attained secondary education. This result is similar to finding by Ong'echa *et al.* (2006) who indicated mother's education greater than primary level was not protective of anaemia prevalence in children.

Wasting was positively correlated to severity of anaemia and moderately wasted children had a 0.13 times RR of being anaemic in comparison to their counterparts who were severely wasted.

4.3.10.3.6. Comparison between Bijapur and Tumkur districts during 1998/99 survey.

Anaemia prevalence was higher in Bijapur district by 6.3 percent and none of the children in Tumkur district was found to be severely anaemic as against the high prevalence of severe anaemia in Bijapur district (Figure.4.3.7). The higher prevalence of anaemia in children in Bijapur can be attributed to the higher number of uneducated and unemployed mothers which would reduce their ability to access money for quality food and health care. In both districts, undernourishment is a determinant of anaemia in children.

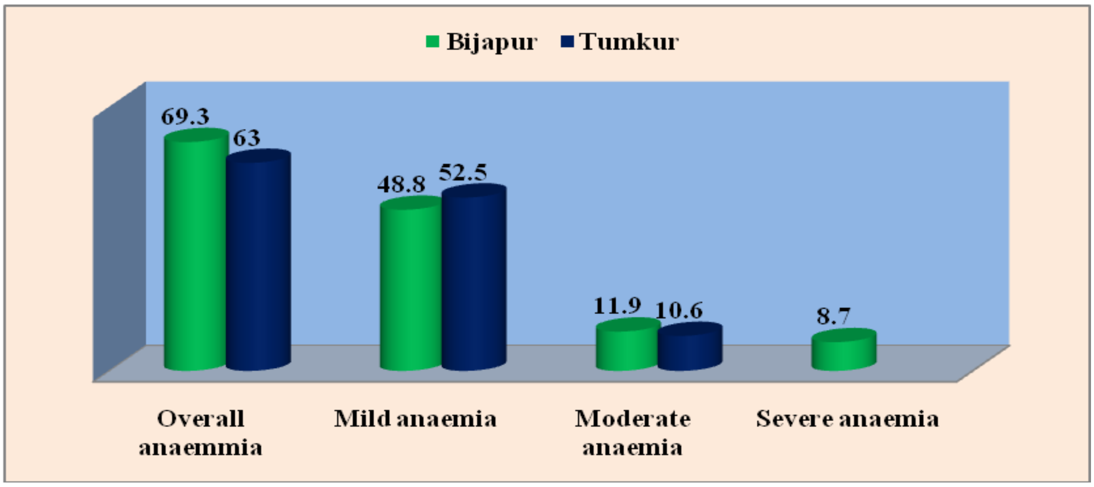

Figure.4.3. 7. Anaemia prevalence in children in Bijapur and Tumkur districts during 1998/99

4.3.11. Karnataka State (KA) 1998/99

4.3.11.1. Profile of study population in Karnataka State 1998/99 (NFHS-2)

Data on approximately 1123 children below five years was included in the study. Out of these children, majority lived in rural part of the state (67.7 %), were of Hindu religion (81.1%), male (51.0 %), between >23-≤ 35 months old, average in size at birth and still breastfeeding (73.3 %).

Majority of the children mothers had no education (49.6 %), not working (61.3 %) and had no toilet facility in the house (66.5 %). Data on morbidity revealed that majority of the children suffered from fever (71.8 %) and cough (69.9 %) weeks prior to the survey. Also most of the children were not stunted or wasted but mildly underweight.

Table.4.3.30. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Karnataka state during 1998/99

Background characteristic	% of children with any -A	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Child characteristics								
Residence								
Urban	62.4	48.8	10.8	2.7	363(32.3)	DF=3	0.252	0.023(0.78)
Rural	67.4	51.9	12.8	2.7	760(67.7)	X^2=3.0012	RC	
						P=0.391(NS)		
Religion								
Hindu	65.5	52.0	11.8	1.7	910(81.1)	DF=12	0.775	0.261(-)
Muslim	69.1	45.3	15.6	8.2	186(16.5)	X^2=34.6891	0.532	0.446(-)
Christian	49.8	49.8	0.0	0.0	22(2.0)	P=0.0005**	1.565	0.048(0.21)
Others	64.1	64.1	0.0	0.0	3(0.3)		RC	
DK	100.0	100.0	0.0	0.0	1(0.1)			
Sex								
Male	68.0	50.3	13.7	4.0	573(51.0)	DF=3	-0.353	0.004(1.42)
Female	63.5	51.6	10.5	1.4	550(49.0)	X^2=11.214	RC	
						P=0.0106*		
Age								
0-6	40.2	38.3	0.6	1.2	175(15.6)	DF=15	0.601	0.007(0.55)
>6 - ≤ 8	67.4	58.8	7.6	0.9	117(10.4)	X^2=123.591	0.119	0.607(-)
>8 - ≤ 11	74.9	63.5	7.6	3.8	89(7.9)	P=<.0001**	-0.290	0.243(-)
>11 - ≤ 17	77.8	53.4	22.2	2.2	205(18.3)		-0.520	0.004(1.68)
>17 - ≤ 23	74.4	56.3	19.3	1.7	195(17.4)		-0.363	0.047(1.44)
>23 - ≤ 35	62.2	46.8	10.6	4.8	342(30.4)		RC	
Size at birth								
Very large	NA	NA	NA	NA	NA	DF=9	NA	NA
Larger than AV	61.7	48.4	10.0	3.3	294(26.2)	X^2=18.736	0.249	0.396(-)
Average (AV)	63.9	50.9	10.9	2.1	480(42.7)	P=0.0275*	0.373	0.195(-)
Smaller than AV	72.0	54.2	15.4	2.5	311(27.7)		0.086	0.768(-)
Very small	70.1	43.9	17.4	8.9	38(3.4)		RC	
Currently breastfeeding								
No	64.2	51.3	11.4	1.5	299(26.7)	DF=3	0.120	0.291(-)
Yes	66.4	50.8	12.4	3.2	823(73.3)	X^2=2.781	RC	
						P=0.4266(NS)		
Caste								
SC	73.2	55.6	13.5	4.0	220(19.8)	DF=9	-0.070	0.730(-)
ST	65.3	49.0	14.8	1.6	68(6.1)	X^2=26.7	0.236	0.410(-)
OBC	62.3	52.3	9.8	0.3	398(35.8)	P=0.0016**	0.380	0.027(0.68)
NONE	64.6	46.6	13.3	4.6	425(38.2)		RC	
Maternal characteristics								
Education of mother								
No education	73.3	53.1	16.1	4.1	557(49.6)	DF=9	-0.830	<.0001(2.29)
Primary	61.5	50.8	9.0	1.7	197(17.5)	X^2=46.629	-0.167	0.318(-)
Secondary	63.2	55.5	7.7	0.0	100(8.9)	P<.0001**	-0.241	0.244(-)
Higher	54.3	44.7	7.9	1.7	269(23.9)		RC	
Occupation								
Not working	63.3	49.7	11.0	2.6	688(61.3)	DF=21	-0.166	0.783(-)
Professional	28.1	28.1	0.0	0.0	16(1.4)	X^2=45.641	0.513	0.044(0.59)
clerical	0.0	0.0	0.0	0.0	1(0.1)	P<.0014**	0.029	0.936(-)
Sales	59.3	46.2	6.6	6.5	16(1.5)		0.464	0.057(-)
Agric Self-Emp	71.8	53.2	15.8	2.8	118(10.5)		-0.141	0.465(-)
Agric Emp	71.8	53.9	13.7	4.2	203(18.1)		0.335	0.343(-)
Household	83.9	66.8	17.1	0.0	7(0.6)		0.30	0.883(-)
Service	67.5	48.6	18.9	0.0	47(4.2)		RC	
Skilled -M	76.3	71.7	4.6	0.0	24(2.1)			
Unskilled –M	100.0	52.3	47.7	0.0	2(0.2)			
Toilet facility								
Flush	54.7	47.0	7.0	0.6	193(17.2)	DF=18	0.478	0.001(0.62)
Pit-latrine	60.6	47.3	10.3	3.0	184(16.4)	X^2=35.8476	0.267	0.061(-)
Bush	69.9	52.8	13.9	3.2	747(66.5)	P=0.0974(NS)	RC	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available Emp= Employed, M=Manual								

Source: NFHS-2

4.3.11.2. Prevalence of anaemia among children below five in Karnataka state.

The overall prevalence of anaemia was 66.4 percent of which 52.4 were mildly anaemic, 11.5 percent were moderately anaemic and 2.6 were severely anaemic. Similar prevalence of 66.4 percent was reported in Karnataka on a survey conducted on micronutrient deficiencies (NNMB, 2003). Other studies have reported similar prevalence like 66.6 percent among Ethiopian children (Woldie *et al*. 2015), Alzain (2012) among Palestine children with a 65.3 percent prevalence. This prevalence was lower than the national estimate (74.3 %). Lower prevalence of 59.2 percent was reported by Arlappa *et al.* (2012) in children in Maharashtra state.

4.3.11.3. Association of anaemia and selected variables.

4.3.11.3.1. Children characteristics

Anaemia prevalence in children was significantly associated with religion, sex, age, size at birth and caste.

Male children had a higher prevalence of severe anaemia and this is contradictory to Kikafunda *et al* (2009) who reported higher prevalence of severe anaemia among female children but in agreement with Muoneke *et al.* (2012) who reported severe anaemia to be higher in male children.

4.3.11.3.2. Maternal factors.

Education of mother and presence of toilet facility was significantly associated with prevalence of anaemia but not to the occupation of the mother. Similar results have been reported in NFHS-3 (IIPS and Macro, 2007), Arnold *et al*. (2009) and Semedo *et al*. (2014).

4.3.11.3.3. Morbidity

Table.4.3.31. Association and determinants of anaemia in children below five years based on morbid conditions in Karnataka state during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Had fever								
No	63.6	50.7	10.7	2.2	827(73.7)	DF=6	**16.305**	**<.0001(8.29)**
Yes	71.8	51.3	16.3	4.2	293(26.1)	X^2=14.8947	**16.206**	**<.0001(9.16)**
DK	100.0	100.0	0.0	0.0	2(0.2)	P=0.0211*	RC	
Had cough								
No	64.6	51.0	11.4	2.1	861(76.7)	DF=9	0.167	0.897(-)
Yes	69.9	50.5	14.7	4.7	258(23.0)	X^2=8.79	0.205	0.874(-)
DK	66.5	66.5	0.0	0.0	3(0.3)	P=0.1857 (NS)	RC	
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia.								

Source: NFHS-2

Severe anaemia was mostly associated with children who suffered from fever and cough two weeks prior to the survey but was only significant in children with fever (Table.4.3.32). Mwanziva *et al*. (2010) reported similar results in which fever was significantly associated to childhood anaemia.

4.3.11.3.4. Nutritional status.

Anaemia increased with increase in the degree of under nutrition. Results in Table.4.3.33 below revealed that overall and severe anaemia was highest among severely undernourished children as compared to other levels of undernourishment. Children with normal anthropometric results had the least association with anaemia and this was significant ($p<0.05$). Similar findings were reported in DLHS-RCH 2002-2004 in which severe anaemia increased with severity of undernourishment (IIPS and MoHFW, 2006).

Table.4.3.32. Association and determinants of anaemia in children below five years based on morbid conditions in Karnataka state during 1998/99

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
STUNTING								
Normal	57.3	47.8	7.4	2.1	419(39.1)	DF=9	**0.778**	**<.0001(0.46)**
Mild –S	62.8	51.4	10.2	1.2	262(24.5)	X^2=52.448	**0.687**	**<.0001(0.50)**
Mod –S	74.7	53.7	18.6	2.5	220(20.5)	P<.0001**	0.093	0.630(-)
Sev- S	77.2	52.6	19.3	5.3	170(15.9)		RC	
WASTING								
Normal	60.8	50.2	9.4	1.3	446(41.4)	DF=9	0.550	0.070(-)
Mild –W	65.4	49.4	13.3	2.6	416(38.4)	X^2=43.593	0.457	0.134(-)
Mod-W	74.0	55.2	16.4	2.5	176(16.3)	P<.0001**	0.152	0.638(-)
Sev-W	80.8	54.3	12.3	14.3	45(4.1)		RC	
UNDERWEIGHT								
Normal	52.3	46.9	5.0	0.4	284(26.5)	DF=9	**0.862**	**<.0001(0.42)**
Mild-uw	63.5	49.8	11.2	2.5	310(28.9)	X^2=65.815	**0.497**	**0.005(0.61)**
Mod- uw	72.2	53.8	16.1	2.3	296(27.6)	P<.0001**	0.204	0.255(-)
Sev- uw	78.1	52.8	19.3	5.9	183(17.1)		RC	
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight.								

Source: NFHS-2

4.3.11.3.5. Determinant of anaemia in children.

Results based on ordinal logistic regression are presented in Table.4.3.31, Table.4.3.32 and Table.4.3.33, which showed anaemia in children was significantly correlated with residence, religion, sex, toilet facility, caste, age, fever, education of mother, occupation, underweight and stunting but not wasting, cough, size at birth and religion.

Sex was negatively correlated with severity of anaemia in children. The RR of being anaemic was 1.42 times higher in male children than the female counterparts.

Woldie *et al.* (2015) reported that Ethiopian male children below five years were 3.1 times more likely to be anaemic than their female counterparts. Dey *et al*. (2013) found male children to be at a 1.49 times higher irk of being anaemic than the female children.

Fever was positively correlated with severity of anaemia. The RR of being anaemic was higher in children who suffered from fever (9.16 times) as compared to those who did not suffer from fever (8.29 times). This is because fever is normally a symptom of acute infection from bacteria, virus or malaria. Kasdekar *et al.* (2015) reported fever to be significantly correlated to anaemia but Ong'echa *et al*. (2006) did not find fever to be significantly correlated with anaemia.

Education of mother was negatively correlated with anaemia in children. Children with uneducated mother have a 2.29 times higher RR of being anaemic as compared to their counterparts with mothers who had attained some level of formal education. Dey *et al*. (2013) and Kikafunda *et al*. (2009) reported anaemia to be lower in children whose mothers had formal education as compared to uneducated mothers. Uneducated mothers might not be in position to select nutritious healthy food to give their children as they cannot read or write and lack basic nutritional knowledge.

4.3.12. Karnataka State (KA) 2005/06

4.3.12.1. Profile of study population in Karnataka State 2005/06 (NFHS-3).

Data on approximately 1604 children below the age of five was included in the study. Out of these children, the larger majority resided in rural part of the state (66.6 %), were of Hindu religion (83.6 %), male (54.0 %), between >23-≤ 59 months, average size at birth (44.7 %), breastfeeding (55.1 %) and belonged to OBC (58.3 %).

Majority of the mothers had attained secondary education (46.4 %), were unemployed (61.7 %) and living in households that use bush method to dispose-off human waste (54.4 %). Majority of the children did not suffer from cough or fever two weeks prior t the survey (Table.4.3.35). Also the larger majority were not stunted (32.5 %), wasted (43.0) but were mildly underweight (34.2 %).

4.3.12.2. Prevalence of anaemia among children below five in Karnataka state.

The overall prevalence of anaemia among children in Karnataka state below five years was 68.7 percent of which 58.9 percent were mildly anaemic, 9.2 percent were moderately anaemic and 0.6 percent were severely anaemic. A similar prevalence of

Table.4.3 33. Percentage association and determinants of anaemia in children below five years based on selected socio-economic and demographic factors in Karnataka state during 2005/06

Background characteristic	% of children with any -A	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Child characteristics								
Residence								
Urban	64.9	58.5	6.4	0.0	535(33.4)	DF=3	-0.208	0.013(1.23)
Rural	70.9	60.7	10.0	0.2	1069(66.6)	X^2=10.956	RC	
						P=0.012*		
Religion								
Hindu	69.0	60.0	8.9	0.2	1340(83.6)	DF=12	-0.146	0.761(-)
Muslim	68.9	60.0	8.9	0.0	225(14.0)	X^2=3.5044	-0.176	0.721(-)
Christian	61.9	53.0	8.9	0.0	27(1.7)	P=0.9908	-0.509	0.361(-)
Others	73.7	73.7	0.0	0.0	5(0.3)	(NS)	RC	
DK	83.3	83.3	0.0	0.0	7(0.4)		NC	
Sex								
Male	69.7	61.0	8.7	0.0	867(54.0)	DF=3	0.139	0.079(-)
Female	67.9	58.7	8.9	0.3	738(45.0)	X^2=3.5621	RC	
						P=0.3128		
Age								
0-6	NA	NA	NA	NA	NA	DF=18	NA	NA
>6 - ≤ 8	78.3	74.2	4.1	0.0	86(5.4)	X^2=251.139	-1.121	<.0001(3.07)
>8 - ≤ 11	86.4	77.1	9.3	0.0	89(5.6)	P<.0001**	0.938	<.0001(0.39)
>11 - ≤ 17	91.7	72.5	19.2	0.0	179(11.1)		-1.058	<.0001(2.88)
>17 - ≤ 23	82.2	65.5	16.8	0.0	174(10.8)		-0.748	<.0001(2.11)
>23 - ≤ 35	78.3	65.2	12.7	0.3	364(22.7)		-0.655	<.0001(1.93)
>35 - ≤ 47	59.1	54.4	4.4	0.3	362(22.6)		-0.355	<.0001(1.43)
>47 - ≤ 59	44.4	43.3	1.1	0.0	351(21.9)		RC	
Size at birth								
Very large	71.6	64.8	6.8	0.0	127(7.9)	DF=15	-0.143	0.742(-)
Larger than AV	69.0	60.8	8.1	0.0	377(23.6)	X^2=29.6231	-0.252	0.546(-)
Average (AV)	67.0	60.1	6.6	0.3	715(44.7)	P=0.0134*	-0.254	0.540(-)
Smaller than AV	72.3	60.0	12.3	0.0	256(16.0)		-0.311	0.460(-)
Very small	71.5	53.5	18.0	0.0	107(6.7)		-0.581	0.182(-)
DK	63.6	41.9	21.7	0.0	17(1.1)		RC	
Currently breastfeeding								
No	62.2	54.3	8.0	0.0	720(44.9)	DF=3	0.353	<.0001(0.70)
Yes	74.3	64.6	9.5	0.3	884(55.1)	X^2=28.6533	RC	
						P<.0001**		
Caste								
SC	74.2	61.9	12.3	0.0	274(17.1)	DF=12	-0.144	0.489(-)
ST	78.4	68.3	9.1	1.1	108(6.7)	X^2=23.8949	-0.462	0.049(1.59)
OBC	67.4	59.6	7.6	0.1	935(58.3)	P=0.021*	0.048	0.803(-)
NONE	63.4	54.4	9.1	0.0	211(13.2)		-0.024	0.910(-)
DK	71.2	61.8	9.3	0.0	76(4.8)		RC	
Maternal characteristics								
Education of mother								
No education	69.7	59.1	10.2	0.4	537(33.5)	DF=9	0.072	0.668(-)
Primary	69.7	58.1	11.7	0.0	227(14.2)	X^2=28.2581	0.344	0.069(-)
Secondary	70.5	62.8	7.7	0.0	744(46.4)	P=0.0009*	0.012	0.943(-)
Higher	50.3	47.8	2.6	0.0	96(6.0)	*	RC	
Occupation								
Not working	70.9	61.2	9.7	0.0	990(61.7)	DF=21	-0.980	0.593(-)
Professional	57.0	57.0	0.0	0.0	26(1.6)	X^2=34.6617	-1.431	0.441(-)
clerical	28.4	21.6	6.7	0.0	18(1.1)	P=0.0307*	0.137	0.942(-)
Sales	43.5	43.5	0.0	0.0	11(0.7)		-0.901	0.633(-)
Agric Self-Emp & Em	66.3	58.1	7.6	0.6	393(24.5)		-0.564	0.759(-)
Service	78.7	68.5	10.1	0.0	23(1.5)		-0.705	0.706(-)
Skilled &Unskilled-M	69.4	61.6	7.8	0.0	141(8.8)		-0.687	0.709(-)
Toilet facility								
Flush	66.4	59.9	6.5	0.0	498(31.1)	DF=27	0.716	<.0001(0.49)
Pit-latrine	62.7	57.8	4.9	0.0	99(6.2)	X^2=24.8087	0.702	<.0001(0.50)
Bush	71.7	60.4	10.5	0.3	871(54.4)	P=0.5852	0.704	<.0001(0.49)
Others	100.0	100.0	0.0	0.0	5(0.3)	(NS)	RC	
Not dejure resident	66.3	56.5	9.7	0.1	127(8.0)			

*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Emp= Employed, M=Manual Mod-A= moderate anaemia, Sev-A=Severe anaemia, NC=Not computed, NA=Not available .

Source:NFHS-3

anaemia was reported in Uganda in Lake Albert area with a prevalence of 68.9 percent (Green *et al.* 2011). Reported similar prevalence in Gujarat (69.7 %), Rajasthan (69.7 %) and average national estimate (69.5 %) but was lower than the estimate for Karnataka (70.4 %), Andhra Pradesh (70.8 %) and Chhattisgarh (71.2 %). However, there were lower estimates than the current findings in Delhi (57.0 %) and Himachal Pradesh 54.7 percent (IIPS and Macro, 2007), whereas higher prevalence has been reported elsewhere with 82.percent prevalence in Benin (Ngnie- Teta *et al*. (2007). Similar prevalence could be due to the tropical weather in the southern states which makes the area endemic to parasitemia/ malaria hence increasing the risk of anaemia from infection.

4.3.12.3. Association of anaemia and selected variables.

4.3.12.3.1. Children characteristics

Results presented in Table.4.3.34 show there was a significant association with residence, age, size at birth, breastfeeding and caste but not with sex and religion.

Anaemia was highest in the age group >11-≤ 17 months (91.7 %) and it decreased with increase in age of the child to 44.4 percent in children >47-≤ 59 months of age. This result is contradictory to Gupta (2015) who reported anaemia to be significantly higher in older children 3-5 years than children 2- 3 years of age.

4.3.12.3.2. Maternal factors.

Mother's education and occupation were found significantly associated to the prevalence of anaemia but not toilet facilities.

Anaemia was highest in children with unemployed mothers (70.9 %) as compared to their counterparts with employed mothers. This could possibly be due to lack of autonomy in non-working women. Women lacking a source of income are hardly consulted on food purchases and expenditure of money in the home. Due to this, their contribution to the family is to only cook the meals presented to them which increases the risk of anaemia in both the mothers and the whole family especially children who are at rapid growth. This is because many studies have found maternal anaemia to be significantly associated with anaemia in children (Leite *et al.,* 2013 and Kikafunda *et al.*, 2009).

4.3.12.3.3. Morbidity

Results presented in Table.4.3.35 showed that anaemia was highest among children who suffered from cough and fever two weeks prior to the survey and this association was significant.

Table.4.3 34. Association and determinants of anaemia in children below five years based on morbid conditions in Karnataka state during 2005/06

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
Had fever								
No Yes	68.1 73.9	59.1 65.1	8.8 8.7	0.2 0.0	1368(85.4) 234(14.6)	DF=3 X^2=12.323 P=0.0064**	12.016 RC	0.968(-)
Had cough								
No Yes	62.9 79.7	55.1 53.7	7.9 19.4	0.0 6.5	93(73.8) 33(26.2)	DF=9 X^2=11.2004 P=0.0107*	11.955 RC	0.967(-)
*= significant at 5%, **= significant at 1%, NS- Not significant, S.E= Standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia.								

Source: NFHS-3

4.3.12.3.4. Nutritional status.

Results presented in Table.4.3.36 revealed child anaemia to increase with severity (degree) of chronic under-nourishment in both stunting and underweight and the association was significant (p<0.05). Leite *et al.* (2013) reported similar findings.

Table.4.3.35. Association and determinants of anaemia in children below five years based on morbid conditions in Karnataka state during 2005/06

Background	Percentage of children with any anaemia	Percentage of children with			Number of children (%)	Chi-square & p-value	Ordinal logistic regression	
		Mild-A	Mod-A	Sev-A			Estimate	Significance (RR)
STUNTING								
Normal Mild –S Mod –S Sev- S	52.8 66.3 77.8 79.9	52.8 66.3 62.6 30.5	0.0 0.0 15.2 40.0	0.0 0.0 0.0 9.5	39(32.7) 27(22.8) 30(25.3) 23(19.2)	DF=9 X^2=41.334 P<.0001**	0.406 **0.386** **0.524** RC	0.076(-) **0.050(0.68)** **0.003(0.59)**
WASTING								
Normal Mild –W Mod-W Sev-W	54.7 73.1 88.4 47.0	50.0 55.4 62.2 47.0	4.7 13.4 26.2 0.0	0.0 4.3 0.0 0.0	46(38.4) 50(42.1) 19(15.6) 5(3.9)	DF=9 X^2=15.279 P=0.0835 (NS)	0.080 0.335 0.054 R C	0.807(-) 0.257(-) 0.856(-)
UNDERWEIGHT								
Normal Mild-uw Mod- uw Sev- uw	54.4 54.4 73.2 86.7	54.4 54.8 55.1 50.0	0.0 0.0 18.2 25.0	0.0 0.0 0.0 11.8	25(20.8) 26(21.5) 50(42.3) 18(15.4)	DF=9 X^2=27.749 P=0.0011**	-0.198 0.266 0.224 RC	0.515(-) 0.278(-) 0.244(-)
*=significant at 5%, **= significant at 1%, SE= standard error, RR= relative risk, Mild-A= mild anaemia, Mod-A= moderate anaemia, Mild-S= mild stunting, Sev-S= severe stunting, Mil-W= mild wasting, Mod-W=moderate wasting, Sev-W= severe wasting, Mil-uw= Mild underweight, Mod-uw= moderate underweight, Sev-uw= severe underweight.								

Source: NFHS-3

4.3.12.3.5. Determinant of anaemia in children.

Results based on ordinal logistic regression were presented in Table.4.3.34, Table.4.3.35 and Table.4.3.36 which revealed that anaemia in children was significantly correlated with residence, toilet facility, breastfeeding, caste, age and stunting but not wasting, underweight, education of mother, fever, cough, size at birth, sex, occupation and religion.

Children in urban residence had a 1.23 times RR of being anaemic as compared to their rural counterparts. This could be a result of eating street food which is readily available in urban areas and is inferior in micronutrients like iron and vitamin necessary for haemoglobin production. These findings are contradictory to findings of Spinelli *et al.* (2005) who found anaemia risk to be higher in rural children.

Children who belonged to ST were 1.59 times at a higher risk of being anaemic as compared to children who belonged to other social groups (caste). Ramesh and Lopamudra (2010) and Dey *et al*. (2013) reported anaemia to be higher among ST/SC groups as they are underprivileged. With limited access to quality health care, sanitary conditions like clean water and toilet facilities hence at a higher risk of morbidity with poor medical attention.

Age was negatively correlated with severity of anaemia in children. The RR of being anaemic was highest in younger age that is 3.07 times in children >6-≤ 8 months which reduced with increasing age to 1.43 times in children >35-≤47 months. This could be due acquired immunity against infection in older children reducing the rate of recurrent infections which are very common in children <1 year of age and between ninth and twelve month of their life and are associated with low Hb concentrations (Reeves *et al*., 1984).

Stunting was also positively correlated with anaemia in children. In children, anaemia increased with severity of stunting. The RR of being anaemic was 0.68 times and 0.59 times among children who were mildly and moderated stunted. Leite *et al.* (2013) reported similar findings in Brazilian children with risk of anaemia in children increasing 1.12 times to 1.36 times with increase in severity of stunting. This is because Protein Energy Malnutrition favours the development of anaemia in a synergistic relationship and low haemoglobin has been implicated in compromising linear growth (Angeles *et al*., 1993 and Soliman *et al*., 2009).

4.3.12.3.6. Comparison between Karnataka state during NFHS-2 and NFHS-3.

Figure.4.3.8 shows that anaemia prevalence increased by 2.5 percent and the increment was due to mild anaemia but other degrees of anaemia decreased over the years. This can be attributed to the fact that much as the percent of illiterate mothers decreased, there was decrease in mothers who attained higher level of education which could be due to cultural responsibilities like marriage hence the women still lacked sufficient knowledge to care for their children because nutritional knowledge is optional at lower level of education.

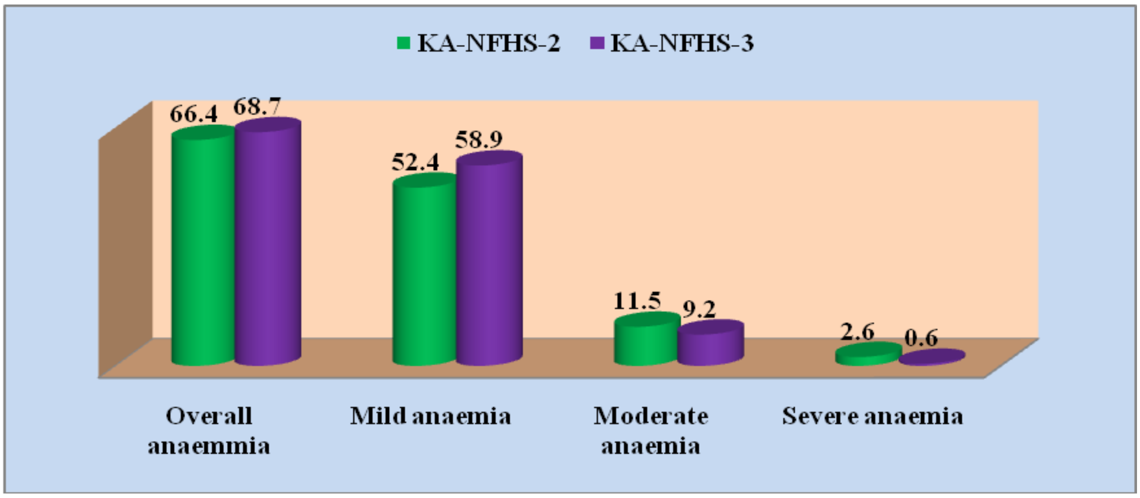

Figure.4.3.8. Trends in anaemia prevalence during NFHS-2 AND NFHS in Karnataka statebamong children below five years

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4.3.12.3.7. Conclusion.

In all the study population, anaemia was a severe public health problem and prevalence ranged between 55 – 75 percent. In all states, anaemia decreased except for Karnataka where anaemia prevalence increased.

In all study areas, poor sanitary conditions and low education of the mother were prominent features and this definitely affects the feeding practices of the child. In all study population, anaemia increased drastically between > 6-≤ 8 months age group which is the time in which complementary foods are introduced. Due to this, intervention programmes should focus on educating the mothers on” **when, how** and with **what**” to feed the child to avert this problem in this age group and children as a whole as supplementation of the children is not a remedy if their diet remains poor, because timely introduction of quality complementary food is a key to maintain the haemoglobin levels of a breastfeeding child.

4.4. Anaemia in adolescent girls.

This section will cover the results and discussion of anaemia in adolescent girls between the ages 15-19 years only, since repeated community based studies have reported higher association of late adolescence with anaemia in girls (Rajanatman *et al*., 2000; Shilpa *et al*., 2012 and Sebale *et al.,* 2013). The results will first be presented at district level and then state level in which the districts are found discussed concurrently for 1998/99 first, followed by 2005/06.

They will be discussed under the following headings:

A) Profile of study population

B) Overall prevalence of anaemia

C) Association of anaemia and background characteristics in adolescent girls.

- Socio-economic factors (residence, religion, caste, education, wealth and occupation).
- Demographic factors (age and age at first birth).
- Nutritional factors (BMI)

D) Determinants of Anaemia in Adolescent girls.

Ordinal logistic regression was conducted to ascertain the factors that significantly contributed to the level of anaemia among adolescent girls in the study areas during the 1998/99 and 2005/06 surveys. The categories of anaemia with non-anaemic girls as the reference group was regressed on residence, religion, age, age at first birth, BMI, caste, educational level of the woman, wealth and occupation across all states and districts and results presented under "**determinants of anaemia in adolescent girls**".

E) Comparison between territories (districts in same state and state level comparison over the years).

4.4.1. Prakasam

4.4.1.1. Profile of adolescent girls (15-19 years) in Prakasam district during NFHS-2

Data on 35 adolescent girls between 15-19 years was included in the study. In this study population, all the girls were found to live in rural Prakasam. Majority of the girls (53.1 %) were of Hindu religion, belonged to SC (41 %), attained primary education (58.8 %), belonged to poorer households (52.9 %), were employed with majority working in the agricultural sector (47.2 %) and 35.2 percent were not working.

Table.4.4. 1.Percent Association of anaemia in adolescent girls (15-19 years) with selected socio-economic and demographic variables in Prakasam district during 1998/99

Variables	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls (%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	NA	NA	NA	NA	NA	NA
Rural	6 4.7	41.2	17.7	5.8	35(100)	
Religion						
Hindu	66.8	44.5	22.3	0.0	19(53.1)	X²=5.3432 P=0.5006 NS
Muslim	50.0	50.0	0.0	0.0	4(11.8)	
Christian	66.6	33.1	16.9	16.6	12(35.1)	
Others						
Caste						
SC	71.5	28.5	28.8	14.1	14(41.1)	X²=17.397 P=0.0428 *
ST	100.0	100.0	0.0	0.0	2(6.0)	
OBC	33.2	33.2	0.0	0.0	12(35.3)	
None	100.0	66.7	0.0	0.0	6(17.7)	
Others	NA	NA	NA	NA	NA	
Education level						
No education	28.7	14.4	14.4	0.0	14(41.2)	X²=14.911 P-0.0019 **
Primary	89 .9	60.0	20.1	9.9	21(58.8)	
Secondary	NA	NA	NA	NA	NA	
Higher	NA	NA	NA	NA	NA	
Wealth index						
Poorest	100.0	100.0	0.0	0.0	2(5.8)	X²=9.7956 P=0.3673 NS
Poorer	77.8	44.5	22.4	11.0	19(52.9)	
Middle	40.0	20.0	20.0	0.0	10(29.6)	
Richer	50.4	50.4	0.0	0.0	4(11.7)	
Richest	NA	NA	NA	NA	NA	
Occupation						
Not working	100.0	83.5	0.0	16.5	12(35.2)	X²=31.4583 P<.0001 **
Professional	NA	NA	NA	NA	NA	
Clerical	NA	NA	NA	NA	NA	
Sales	NA	NA	NA	NA	NA	
Agricultural	37.6	25.1	12.5	0.0	17(47.2)	
Services	NA	NA	NA	NA	NA	
Skilled & unskilled manual	67.1	0.0	67.1	0.0	6(17.6)	
Age of woman(in years)						
15	NA	NA	NA	NA	NA	X²=19.014 P=0.0251 *
16	25.1	0.0	25.1	0.0	8(23.6)	
17	59.9	39.8	20.1	0.0	10(29.5)	
18	67.1	67.1	0.0	0.0	6(17.6)	
19	100.0	60.1	20.1	19.8	10(29.4)	
Age of woman at first birth(in years)						
10 -13	NA	NA	NA	NA	NA	X²=6.019 P=0.1107 NS
14 – 16	100.0	33.3	66.7	0.0	6(60.2)	
17 – 19	100.0	100.0	0.0	0.0	4(39.8)	
BMI status						
Moderate thinness	39 .9	0.0	20.1	19.8	10(29.4)	X²=23.689 P=0.0006. **
Mild thinness	100.0	50.0	50.0	0.0	8(23.7)	
Normal	62.5	62.5	0.0	0.0	16(47.0)	
Overweight	NA	NA	NA	NA	NA	
Obese class 1	NA	NA	NA	NA	NA	
Total	**69.1**	**46.5**	**17.1**	**4.4**		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant, NA= Not available.						

Source. NFHS-2

Distribution of the girls according to age was almost equal as represented by 29.5 %, 29.4 %, 23.6 % and 17.6 % for ages 17, 19, 16 and 18 years respectively. No girls of 15 years of age were found in the study. Among the girls included in the study, 60.2

percent had their first child between the age14-16 years none reported having their first child at an earlier age (10 –13 years). Table.4.4.1 also shows that more than 45 percent of the girls had normal BMI while the rest had BMI below normal (18.5kg/m²). This indicates the absence of overweight or obesity among the girls in the study area during the study period. Similar results were found by Roshina (2013) where all the adolescent girls who were either anaemic or normal, had a BMI less than normal (18.5kg/m²).

4.4.1.2. Prevalence of anaemia among adolescent girls (15-19 years) in Prakasam district during NFHS-2

The overall prevalence of anaemia among the study population was 69.1 percent of which 46.4 percent were mildly anaemic, 17.1 percent were moderately anaemic and 4.4 percent were severely anaemic in Prakasam district. This prevalence is high and very much above the WHO definition of anaemia tolerable level in a population (<40%), which indicates the existence of a public health problem in this population (WHO/UNICEF, 1996). Findings of the present study are almost in accordance with findings from Nepal, a neighbouring country where adolescent girls were reported with a (68.8 %) prevalence of anaemia (Shah and Gupta, 2002). During NFHS-3, adolescent girls in the same age bracket (15-19 years) in Jharkhand had a prevalence of (67.2 %) of which 48.6 %, 17.8 % and 0.8 %) were mildly, moderately and severely anaemic respectively (VISTAAR, 2010). However, Premalatha *et al*. (2012) reported a higher prevalence (78.75 %) among adolescent girls in Chennai while Kurniawan *et al.* (2006) and Sidhu *et al.* (2005) reported lower prevalence's (21.8 % and 12.8 %) respectively.

4.4.1.3. Association of anaemia and background characteristics in adolescent girls

Results of the study (Table.4.4.1) show that there is no significant association between residence, religion, age at first birth and wealth index, but caste, education, occupation, age and BMI showed a significant association ($p<0.05$).

4.4.1.3.1. Socio-economic variables

Results from (Table 4.4.1) show that there is a significant association between anaemia prevalence and socio-economic variables apart from residence, religion and Wealth index.

All adolescent girls were of rural residence and among them 64.7 percent were anaemic with (41.2 %, 17.7 % and 5.8 %) mild, moderate and severe anaemia respectively. Yasutake *et al*. (2013) reported similar prevalence of anaemia among rural adolescent girls (64.1 %) in Mali-2006 DHS and a similar prevalence of moderate to severe anaemia (24.1 %) in Guinea-2005 DHS. The high percentage of anaemic adolescent girls might be because in rural setting, norms and traditions have a strong hold, i.e., women might be the last to eat after everyone else leaving them with little to consume and replenish their iron stores. Also, in rural setting, majority of the girls are likely to be married off at an early age as seen in (Table.4.4.1) where primary education was the highest level of formal education achieved with a majority giving birth to their first child in mid adolescence.

The highest association of anaemia with caste was among the adolescent girls who belonged to the scheduled tribe (100 %). All the girls in ST were mildly anaemic and in scheduled caste girls (71.5 %) were anaemic and the severity of anaemia varied with mild (28.5 %), moderate (28.8 %) and severe anaemia (14.1 %). Similar results were reported by Sachan *et al.* (*2012*) with an overall prevalence of anaemia higher among those adolescent girls belonging to the scheduled caste/ scheduled tribe which was also statistically significant as in the present study. This is because these two caste groups are under privileged when it comes to access to resources like quality food, education and media.

Education has an impact on the prevalence of anaemia. Anaemia decreases with an increase in educational level (Ramesh and Lopamudra, 2010). This study however, found contradicting results, with anaemia prevalence higher among the adolescent girls who had attained primary education (89.9 %) as compared to those without any formal education (28.7 %) as seen in figure.4.4.3. These results are not in line with those of Ramesh and Lopamudra (2010) who reported anaemia among adolescents to decline with increase in educational level from 32.8 percent among illiterate to 22.6 percent among adolescent girls with 11 years and above. Gupta *et al*. (2012) also reported anaemia to be highest among illiterate adolescent girls (62.5 %) and lowest among adolescent girls who achieved higher education (23.68 %). This could be attributed to government programmes which target uneducated adolescent girls and ignore, or give minimal attention to adolescent girls enrolled in primary school, with the assumption that formal education will provide the required necessary knowledge. This is not true for primary education as the formal education system is designed to provide knowledge gradually, basing on the stage of brain development in the individual.

Even though household wealth was statistically not significant, there was a decrease in anaemia of any degree with increase in the wealth of household (figure.4.4.2). Similar findings were reported by Roshina (2013) who found the maximum number of adolescent girls with higher percentage of anaemia belonging to the low (poorest) or lower middle (poorer) group. Vasanthi *et al*. (1994) and Sachan *et al*. (2012) also reported similar results which revealed a rising trend in mean haemoglobin with improved socio-economic status and most of the adolescent girls belonging to lower socio-economic status being anaemic. This may be due to better availability of high quality food for adolescent girls with better socio-economic status.

Occupation of women allows them better access to resources like quality food and health care. In Prakasam district, all the adolescent girls who were not working (100 %) were reported anaemic with varying degrees of mild and severe anaemia respectively (83.5 % and 16.5 %). 67.1 and 37.6 percent moderate anaemia was found in unskilled manual labour and agricultural workers, respectively, among the adolescent girls with no cases of severe anaemia. This association was significant ($p<0.0001$).

4.4.1.3.2. Demographic and Nutritional factors

Demographic variables like age of the adolescent and age when they had the first child were included in the study to assess their impact on anaemia in the girls.

Table 4.4.1 indicates a steady increase in anaemia with progression of adolescence (increase in age) from 25.1 percent among 16 year old girls to 100 percent among 19 year old girls and the association was found to be significant ($p<0.05$). Being 19 years of age showed the strongest association with severe anaemia (19.8%) among all other age groups where no association was found. Premalatha *et al*. (2012) reported similar findings where anaemia prevalence increased with age and was significantly associated to anaemia just like in the present study. However, this is in contrary to the reports of study done by Rajini (2010), Kaur *et al*. (2006)., Singh (2008) and Kotecha *et al*. (2000) which stated that age was not a correlated factor. This could be so because by the age of 19 years, the adolescent girl is a mother with atleast one child or more which depletes their iron stores. Data from the sample registration system (SRS) 2005 indicated the mean age for effective marriage in Andhra Pradesh was 19 years compared to India as a whole which was 20 years (Sachan *et al.*, 2012).

Though majority of the girls were found with a normal BMI (47.0 %), anaemia among them was still above 60 percent (62.5 %) which is very high. All the girls who were mildly thin were found to be anaemic. However, severe anaemia increased with the decrease in BMI below normal. That is the moderately thin adolescent girls showed the strongest association with severe anaemia occurring in 19.8 percent of the girls, compared to mild thinness and normal BMI. Keikhaei *et al*. (2012) and Miah *et al*. (2014) reported similar findings in Iran and Bangladesh where anaemia was highest among adolescent girls with a BMI below normal compared to the girls with normal or higher BMI, which was statistically significant as in the present study.

4.4.1.4. Determinants of Anaemia in Adolescent girls (15-19 years) in Prakasam district during NFHS-2

All the selected variables were subjected to regression analysis to determine the net influence of each variable on the severity of anaemia among the adolescent girls in Prakasam district, and results of the findings are presented below (Table. 4.4.3). The bivariate analysis (using chi-square) showed a significant association with all selected variables (age of adolescent girl, age at first birth, BMI, caste, education and occupation) apart from wealth and residence. Multivariate analysis also found wealth and all other significant variables in bivariate analysis to have a significant net effect on severity of anaemia apart from age at first birth and education.

Anaemia prevalence increased with progression of adolescence. Results of the study indicated that as the age of the adolescent girl increased, anaemia increased by (40.3 %). The girls in late adolescent had RR of 0.67 times of being anaemic as compared to girls who were 15 years of age. Punia *et al*. (2011) reported a positive correlation with anaemia increasing with age as in the current study, but Chavada *et al*., (2013) did not find anaemia to be correlated with adolescent girls' age in Ahmadabad. This is could because in late adolescence, the menstruation cycle is regular with no skipped months and by the age of 19 years, most of these adolescent girls have a child or two if married, with higher responsibilities accorded to older adolescent girls (Ramesh and Lopamudra, 2010).

Nutritional status was significant in determining the severity of anaemia among this group of adolescent girls. The adolescent girls who were moderately thin had a RR of 1.09 times of being anaemic, as compared to their counterparts with a normal BM1 (RR=0.92 times). This is because underweight adolescent girls are susceptible to illnesses like malaria, helminths due to lowered immunity resulting in low work out put which causes a decrease their income, thus aggravating the vicious cycle of poverty and malnutrition**.** Miah *et al*. (2014**)** reported similar findings as the present study, with the lowest percentage of anaemic group i.e. 9.21 percent belonging to the ideal weight category and highest percentage i.e. 35.9 percent belonged to underweight category.

Being a part of the SC sect placed the adolescent girls at a 1.34 times of being anaemic as compared to adolescent girls who belonged to other groups, whose RR of being anaemic was less (RR=0.75). This is because adolescent girls in the SC category come from the less privileged households which have limited resources to wealth thus preventing them from access to quality food (animal sources of iron) to meet the demands of adolescence**.** Balarajan *et al.* (2013) reported similar findings among adolescent girls from SC group.

Wealth of the household in which the adolescent girls lived was found to significantly influence the severity of anaemia negatively. This result indicates that as wealth of the household increased, severity of anaemia decreased (figure.4.4.3). Adolescent girls who belonged to poorer households had 1.09 times RR of being anaemic as compared to their counterparts from the richer households who had a less RR of being anaemic (RR= 0.92 times). Ramesh and Lopamudra (2010) reported similar findings where standard of living was correlated with anaemia in adolescent girls and severity decreased with increase in wealth/standard of living. Findings of the present study are contradictory to Rawat *et al.* (2001) and Chaudhary and Dhage (2008) who found no association. This is because wealth of the household determines availability and allocation of money towards purchase and preparation of quality food (balanced meal) which is not available for poorer households.

Occupation of a woman increases her chances of having control of money, and some studies have reported that malnutrition in any form decreases in households in which a woman played a significant role in decision making. Adolescent girls who were not working were all anaemic with the highest significance of severe anaemia compared to their counterparts who were employed in different fields (Table.4.4.1). Results presented in Table.4.4.3 revealed that unemployment among adolescent girls increased the severity of anaemia by 15.3 percent. The adolescent girls who were not working had a RR of 0.86 times of being anaemic compared to their counterparts who were employed. This result is contradictory to Gupta *et al*. (2012) who reported highest prevalence among employed adolescent girls (88.89 %) as compared to the unemployed adolescent girls (66.67 %). The findings of our study could be a result of dependence syndrome which comes due to unemployment.

4.4.2. Mahbubnagar (1998/99)

4.4.2.1. Profile of adolescent girls (15-19 years) in Mahbubnagar district during NFHS-2

Approximately data on 85 adolescent girls were included in the study. In this study population, majority of the girls were found to live in rural Mahbubnagar (95.6 %) and the remaining 4.4 percent in urban area of the district. All the girls (100 %) were of Hindu religion. No other religions were found among these girls. Majority (64.3 %) belonged to OBC, had no formal level of education (78.9 %), belonged to poorer class (38.4 %), were employed mainly in the agricultural sector (62.3 %) and only (18.7 %) were not working.

Since focus is on late adolescence, the distribution of the girls according to age was 31.1, 30.6, 14.5, 12.0 and 11.8 percent for ages 18, 19, 16, 17 and 15 years respectively. Among the girls included in the study, only 41 of them gave information on when they had their first child. Results show that 54.4 percent had their first child between the age 17-19 years, 35.7 %percent between 14-16 years of age and only 10 percent between the ages of 10-13 years.

From Table 4.4.2, it is evident that more than 68 percent of the girls had normal BMI while the rest had BMI below normal ($<18.5 kg/m^2$) representing 14.4 percent for moderate thinness and mild thinness each. Only 2.4 % had a BMI above normal and were all overweight. No cases of obesity were found in this study population.

4.4.2.2. Prevalence of anaemia among adolescent girls (15-19 years) in Mahbubnagardistrict during NFHS-2

The overall prevalence of anaemia among the study population was 60.2 percent of which 47.9 percent were mildly anaemic, 10.9 percent were moderately anaemic and 1.3 percent were severely anaemic. Several studies have reported prevalence of > 60.0 percent. Findings of the present study are almost in accordance with Dutt *et al*. (2009), Deshpande *et al*. (2013) and Verma *et al*. (2014) who reported a prevalence of (61 %, 60 % and 60.96 %) respectively. However, Premalatha *et al*. (2012) and Swati *et al*. (2011) reported a higher prevalence of 78.7 and 83.3 percent respectively while Agarwal (1998) reported a lower prevalence of 47.6 percent.

Table.4.4. 2.Percentage association of anaemia in adolescent girls (15-19years) with selected socio-economic and demographic variables in Mahbubnagar district during 1998/99

Background characteristics	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls (%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	50.0	50.0	0.0	0.0	4(4.4)	X^2=0.664 P=0.8817 NS
Rural	57.3	42.4	12.5	2.5	82(95.6)	
Religion						
Hindu	57.0	42.7	11.9	2.3	86(100)	NA
Muslim	NA	NA	NA	NA	NA	
Christian	NA	NA	NA	NA	NA	
Others	NA	NA	NA	NA	NA	
Caste						
SC	85.7	71.3	14.3	0.0	14(16.6)	X^2=14.531 P=0.1047 NS
ST	50.0	50.0	0.0	0.0	8(9.8)	
OBC	55.2	40.4	11.1	3.7	55(64.3)	
None	25.5	0.0	25.5	0.0	8(9.4)	
Others	NA	NA	NA	NA	NA	
Education level						
No education	57.3	42.2	12.1	3.0	68(78.9)	X^2=6.207 P=0.719 NS
Primary	66.1	33.1	33.1	0.0	6(7.2)	
Secondary	66.0	66.0	0.0	0.0	6(7.0)	
Higher	34.8	34.8	0.0	0.0	6(7.0)	
Wealth index						
Poorest	79.9	50.1	29.8	0.0	20(23.7)	X^2=21.2329 P=0.0471 *
Poorer	43.4	24.7	12.6	6.1	33(38.4)	
Middle	55.3	55.3	0.0	0.0	19(21.6)	
Richer	50.0	50.0	0.0	0.0	8(9.5)	
Richest	67.7	67.7	0.0	0.0	6(7.0)	
Occupation						
Not working	75.5	62.7	12.8	0.0	16(18.7)	X^2=28.0578 P=0.0054 **
Professional	NA	NA	NA	NA	NA	
clerical	NA	NA	NA	NA	NA	
Sales	NA	NA	NA	NA	NA	
Agricultural	100.0	69.3	30.7	0.0	27(62.3)	
services	NA	NA	NA	NA	NA	
unskilled manual	62.0	49.7	0.0	12.3	16(19.1)	
Age of woman(in years)						
15	60.1	60.1	0.0	0.0	10(11.8)	X^2=13.225 P=0.3531 NS
16	33.3	16.5	16.9	0.0	12(14.5)	
17	59.7	59.7	0.0	0.0	10(12.0)	
18	60.9	38.3	15.1	7.6	27(31.1)	
19	61.8	46.2	15.6	0.0	26(30.6)	
Age of woman at first birth(in years)						
10 -13	100	100	0.0	0.0	4(10.0)	X^2=25.4652 P=0.0128 *
14 – 16	42.3	42.3	0.0	0.0	15(35.7)	
17 – 19	63.7	36.2	27.6	0.0	22(54.4)	
BMI status						
Moderate thinness	16.5	16.5	0.0	0.0	12(14.4)	X^2=31.6929 P=0.0002 **
Mild thinness	66.2	16.5	49.7	0.0	12(14.4)	
Normal	62.0	51.7	6.9	3.4	59(68.8)	
Overweight	100.0	100.0	0.0	0.0	2(2.4)	
Total	**60.2**	**47.9**	**10.9**	**1.3**		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant, NA= Not available.						

Source. NFHS-2

4.4.2.3. Association of anaemia and background characteristics in adolescent girls

This section covers the results based on bivariate analysis from Table.4.4.2.

4.4.2.3.1. Socio-economic factors

Residence of the adolescent girls was found not significant in influencing anaemia prevalence in Mahbubnagar district. However anaemia was highest in rural adolescent girls (57.3 %) with 42.4, 12.5 and 2.5 percent representing mild, moderate and severe anaemia respectively as compared to urban adolescent girls (50.0 %) who were all mildly anaemic. Similar results were reported by Swati *et al*. (2011) where anaemia was highest among rural adolescent girls (100 %) compared to urban adolescent girls who were anaemic at (66 %). The urban –rural difference might be due to availability of information and exposure to knowledge on proper feeding and also quality of education which is better in the urban areas as compared to rural areas, thus empowering the adolescent girls with knowledge and skills to take care of themselves better. Lower levels of anaemia are observed in urban adolescent girls, though the percentage still remains high (>40 %) as per WHO/UNICEF definition of anaemia as a public health problem. This indicates a severe public health problem in adolescent girls of rural Mahbubnagar district. A similar trend was reported in India-2005/06 DHS and Burkina Faso-2003 DHS between rural and urban prevalence of anaemia among adolescent girls (58.1 % vs 51.9 % and 54.6 % vs 50.4 %) respectively (Yasutake *et al.*, 2013).

Both caste and educational level were found to be statistically not significant in influencing anaemia prevalence (Table.4.4.2). The highest level of association between anaemia and caste was with SC (85.7 %) followed by OBC (55.2 %), of which 3.7 percent were severely anaemic. Similar findings were reported by Ramesh and Lopamudra (2010) where anaemia was highest among adolescent girls from SC/ST caste (98.3%) with highest prevalence of 30.0 percent severe anaemia in comparison to girls under castes. The highest association with SC adolescent girls could be due to poor implementation and supervision of government programmes intended to reach out to this sector of individuals. It could also be due to rigid mind - set of adolescent girls from these communities who hold cultural ties and strong beliefs and would not accept any new information or practice that is against their cultural beliefs, irrespective of its benefits.

Among the adolescent girls without any formal education, 57.3 percent were anaemic and among them, 3.0 percent were severely anaemic compared to adolescent girls with atleast formal education, in whom severe anaemia was absent. This signifies that with attainment of any form of formal education, severe anaemia decreased from 3.0 to 0.0 percent. Similar findings were reported by Simhachalalam *et al*. (2014) with higher anaemia prevalence among the illiterate adolescent girls in Hyderabad compared to the literate (90.0 % vs. 77.3 %).

Wealth of the households in which the adolescent girls belonged was significantly associated with anaemia prevalence. The strongest association between anaemia and wealth was found in the poorest households (79.9 %). However the girls belonging to the richest households also indicated a high prevalence of mild anaemia (67.7 %). Though the poorer households showed the least prevalence of anaemia, they alone had an association with severe anaemia (6.1 %) compared to the other categories. Similar findings were reported by Rajaratnam *et al.* (2000) and Basu *et al*. (2005) where anaemia decreased significantly with increase in social economic status.

Different from most studies, results presented here showed the highest association of anaemia of any kind with agricultural workers (100 %) as compared to the adolescents who are not working (75.5 %). Gupta *et al*. (2012) reported similar findings with employed adolescent girls being more anaemic than the unemployed girls. This could be due to the strenuous work involved in agricultural work, depleting the meagre iron reserves of the adolescent girls, thus lowering their haemoglobin levels further, also in addition to lack of sufficient food required to replenish the nutrients required for the synthesis of haemoglobin. On the other hand, the lower levels in the non-working girls could be because they atleast have sufficient time to prepare and eat all meals as well as take rest or could be enrolled in formal education.

4.4.2.3.2. Demographic and Nutritional factors

In the adolescence group (15-19) years, anaemia prevalence was about (>60 %). The prevalence of 60 percent and above was reported in several studies.

Child bearing at a tender age (10-13years) has shown several risks to the child and mother, including maternal mortality, neonatal mortality, fistula, caesarean and anaemia (Scholl and Reilly, 2000 and Black *et al*., 2008). In Mahbubnagar district, 100 percent of the adolescent girls who gave birth between the ages 10-13 years were anaemic. Anaemia prevalence decreased in those who had a child in mid- adolescence (42.3 %) and later increased to 63.7 % among those who had a child in late adolescence (17-19years). This association was found significant (p0.0128). The increase in anaemia during child birth in late adolescence, which varies from mid-adolescence, could be due to stable and consistent menstruation periods, which is common in earlier years, successive births i.e more than one child, depleting the iron stores in the girl's body and also excessive work assigned to older adolescent girls, as they are assumed to be adults, leaving the girl with little time to eat well and have adequate rest.

4.4.2.4.Determinants of Anaemia in Adolescent girls (15-19 years) in Mahbubnagar district during NFHS-2

Results presented in Table.4.4.3 show the findings of the ordinal logistic regression. They indicate that almost all variables had a net influence on severity of anaemia apart from residence and religion during this year among the study population. Table 4.4.2 shows that there was no significant association between caste, education and age of the adolescent girls in bivariate analysis but multivariate analysis found a significant effect of those variables with severity of anaemia.

Anaemia among the adolescent girls increased with progression of adolescence (increase in age) and results indicate that an increase in the age of the adolescent girls increased severity of anaemia by 63.9 percent with a RR of 0.53 times of being anaemic among the older adolescent girls. Ramesh and Lopamudra (2010) reported a positive significant effect of age on severity of anaemia among adolescent girls in India similar to our study. This could be due to increased responsibilities of child bearing and home care during early marriage, which strain their vulnerable bodies while they are still at an age where they need to be cared for.

Nutritional status of the adolescent girl was significant in affecting the severity of anaemia negatively. Under nutrition was found to be significantly influencing the severity of malnutrition with a higher RR of being anaemic with below normal nutritional status. The RR of being anaemic was 2.25 times among adolescent girls who were moderately thin and 1.24 times among adolescent girls who were mildly thin as compared to their counterparts with a normal BMI. This could be due to lowered immunity that comes with under-nutrition.

Adolescent girls from the SC category were 2.63 times at a risk of being anaemic as compared to their counterparts. This is due to the fact that girls with from this caste are less privileged with limited access to quality resources like schools, health care, proper housing and lack affordability to eat balanced meals on a daily basis**.** Ramesh and Lopamudra (2010) reported similar results among SC/ST adolescent girls who had higher odds of being anaemic as compared to other caste girls.

Education of the adolescent girls was significant in determining the severity of anaemia. As formal education increased, the RR of being anaemic decreased among the adolescent girls with RR= 1.85 times among the adolescent girls with no education, to 1.11 times among the adolescent girls who achieved primary education and 1.08 times among the adolescent girls who had attained secondary education level in comparison to their counterparts who attained higher educational level. These results explain the major role that education plays in providing the knowledge (nutritional knowledge) required for the girls to suitably care for themselves. Kulkarni *et al.* (2012) reported a similar finding in adolescent girls residing in Maharashtra.

Table.4.4.3. Results of ordinal logistic regression on prevalence of anaemia among adolescent girls in Prakasam and Mahbubnagar districts during 1998/99 survey.

Variable	Prakasam				Mahbubnagar			
	1998-1999				1998-1999			
	Estimates	S.E	Significance	RR	Estimates	S.E	Significance	RR
Residence								
Urban	NA	NA	NA	NA	-0.668	0.105	0.545	-
Rural	NA	NA	NA	NA	RC			
Age of woman	0.403	0.045	0.003**	0.67	0.639	0.053	0.0005**	0.53
Age at first birth	0.217	0.321	0.500	-	-0.390	0.043	0.0027**	1.47
BMI								
Moderate- T	-0.084	0.202	0.004**	1.09	-0.813	0.064	0.0003**	2.25
Mild- T	0.734	0.611	0.230	-	-0.220	0.129	<0.0001**	1.24
Normal	RC				RC			
Caste								
SC	-0.295	0.015	<0.0001**	1.34	-0.968	0.12	<0.0001**	2.63
ST	0.133	0.918	0.092	-	0.846	0.52	0.598	-
OBC	1.186	0.816	0.146	-	0.459	0.37	0.724	-
Others	RC				RC			
Educational level of woman.								
No education	1.020	0.565	0.071	-	-0.619	0.103	0.014*	1.85
Primary	RC				-0.108	0.013	0.004**	1.11
Secondary	NA	NA	NA	NA	0.841	0.012	0.008**	1.08
Higher	NA	NA	NA	NA	RC			
Wealth								
Poorest	-0.263	0.920	0.775	-	-0.911	0.1139	0.0046**	2.48
Poorer	-0.084	0.014	0.0014*	1.09	-0.337	0.037	0.003**	1.40
Middle	0.438	0.786	0.577	-	-0.813	0.063	0.0003**	2.25
Richer	RC				-0.850	0.121	0.008	2.34
Richest					RC			
Occupation								
Not working	0.153	0.025	0.0013**	0.86	0.799	0.114	0.0082**	2.22
Agricultural self-employed	NA	NA	NA	NA	0.380	0.095	0.045*	0.68
Agricultural employed	1.045	0.679	0.124	-	0.561	0.031	<0.0001**	0.57
Unskilled manual	RC				RC			
*= significant at 5%, **= significant at 1%,S.E= Standard Error, RC= Reference category, Moderate-T= Moderate thinness, Mild-T =Mild thinness, (-)=not applicable, na=not available, RR= relative risk								

Source. NFHS-2

Similar to education, wealth of the household in which the girl lived was significant in influencing severity of anaemia negatively. This indicates that increase in quintiles of wealth of the household in which the adolescent girl lived, decreased the severity of anaemia considerably. Increase in wealth among the poorest households decreased anaemia among the adolescent girls by 91.1 percent and decreased anaemia by 33.7 percent among the poorer households. The RR of anaemic girls among the adolescent girls from the poorest households was 2.48 times and among the adolescent girls from the poorer households1.40 times. This is due to the fact that as wealth increases, resources like money allotted to quality food, proper sanitary conditions and health care are improved, resulting in better haemoglobin levels with reduced illness and better quality feeding. Bharati *et al.* (2009) noted that the odds of being anaemic among adolescent girls decreased with improvement in standard of living of the adolescent girls, with girls having high standard of living recording the lowest odds of being anaemic.

Occupation was also significant in influencing the severity of anaemia positively. Increase in the number of adolescent girls not working could increase anaemia by 79.9 percent. Among those who were employed, anaemia increased by 38.0 percent among adolescent girls who were self employed in agriculture and increased by 56.1 percent among the adolescent girls who were employed in agricultural sector. The RR of being anaemic was 2.22 times among adolescent girls who were not working compared to their counterparts with employment in different fields. This is because lack of employment makes the girls dependent on another individual for necessities like food and deters their ability to make independent decisions concerning what to eat, cook, how much of it and where and when to go to hospital.

4.4.2.5. Comparison between Prakasam and Mahbubnagar

Generally anaemia prevalence was higher among adolescent girls in Prakasam district by 9.0 percent as compared to the adolescent girls in Mahbubnagar district with differences in severity (Figure.4.4.1). This could be due to a higher prevalence of severe anaemia in older adolescent girls in Prakasam district as compared to those in Mahbubnagar (figure.4.4.2) and a higher percentage of girls who gave birth in mid adolescence were in Prakasam district (figure.4.4.4).

Based on the wealth index, wealth of the household was found to be statistically not significant in influencing the prevalence of anaemia in Prakasam while it was significant in Mahbubnagar (p=0.05). Figure.4.4.3 shows that the prevalence of anaemia in both districts was highest in the poorest class. However, among the richest class in Mahbubnagar, anaemia prevalence was very high (67.7 %).

Results from Table 4.4.3 revealed that certain factors were significant determinants in the prevalence of anaemia among adolescent girls in both districts (age, moderate thinness, SC registration, poorer households and girls who were not working).

Anaemia among the adolescent girls increased with age with a 0.14 times higher risk among adolescent girls in Prakasam district as compared to Mahbubnagar district as adolescence progressed. Moderately thin adolescent girls in Mahbubnagar district were 1.29 times at a higher risk of being anaemic as compared to those from Prakasam district. Adolescent girls from poorer households in Mahbubnagar district were at a 0.31times higher risk of being anaemic as compared to those in Prakasam district and among the adolescent girls not working, the risk was 1.36 times higher among the girls from Mahbubnagar district as compared to those from Prakasam district.

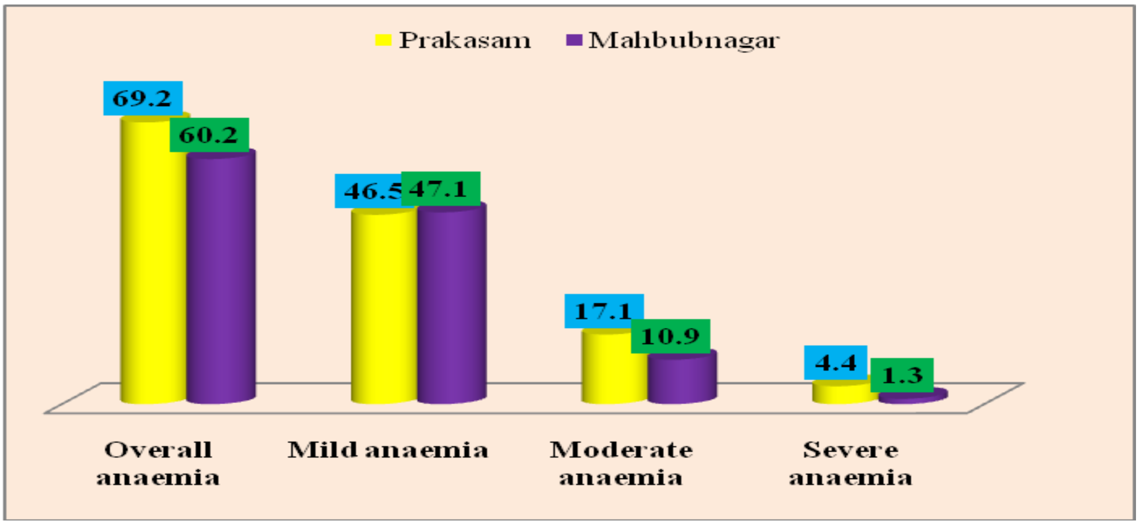


Figure.4.4.1.Prevalence of anaemia among adolescent girls (15-19 years) in Prakasam and Mahbubnagar district during 1998/99

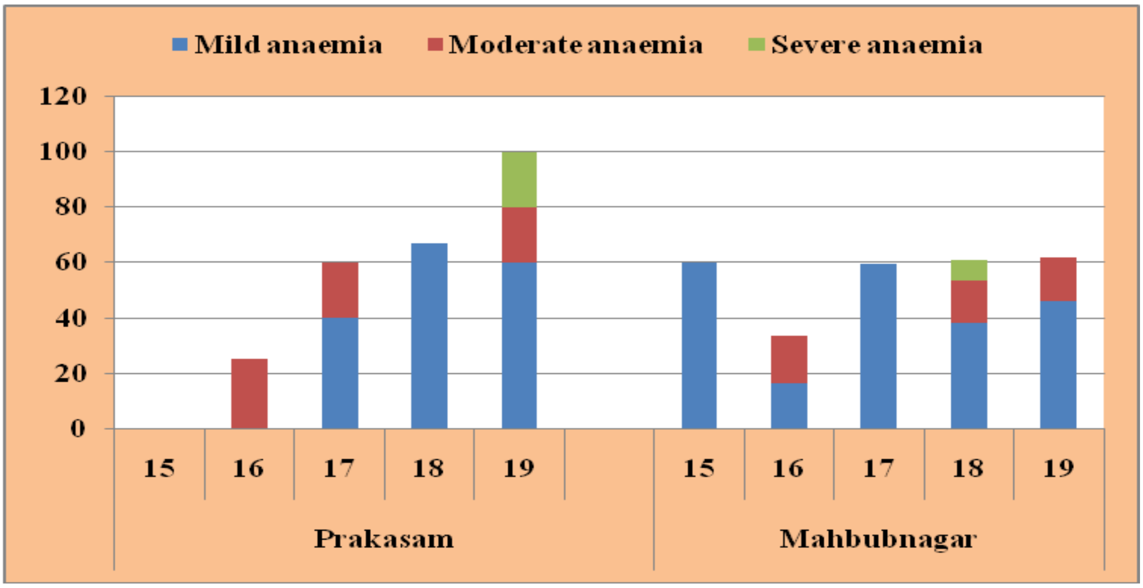


Figure.4.4.2.Severity of anaemia prevalence among adolescent girls (15-19 years) according to age in Prakasam and Mahbubnagar districts during 1998/99

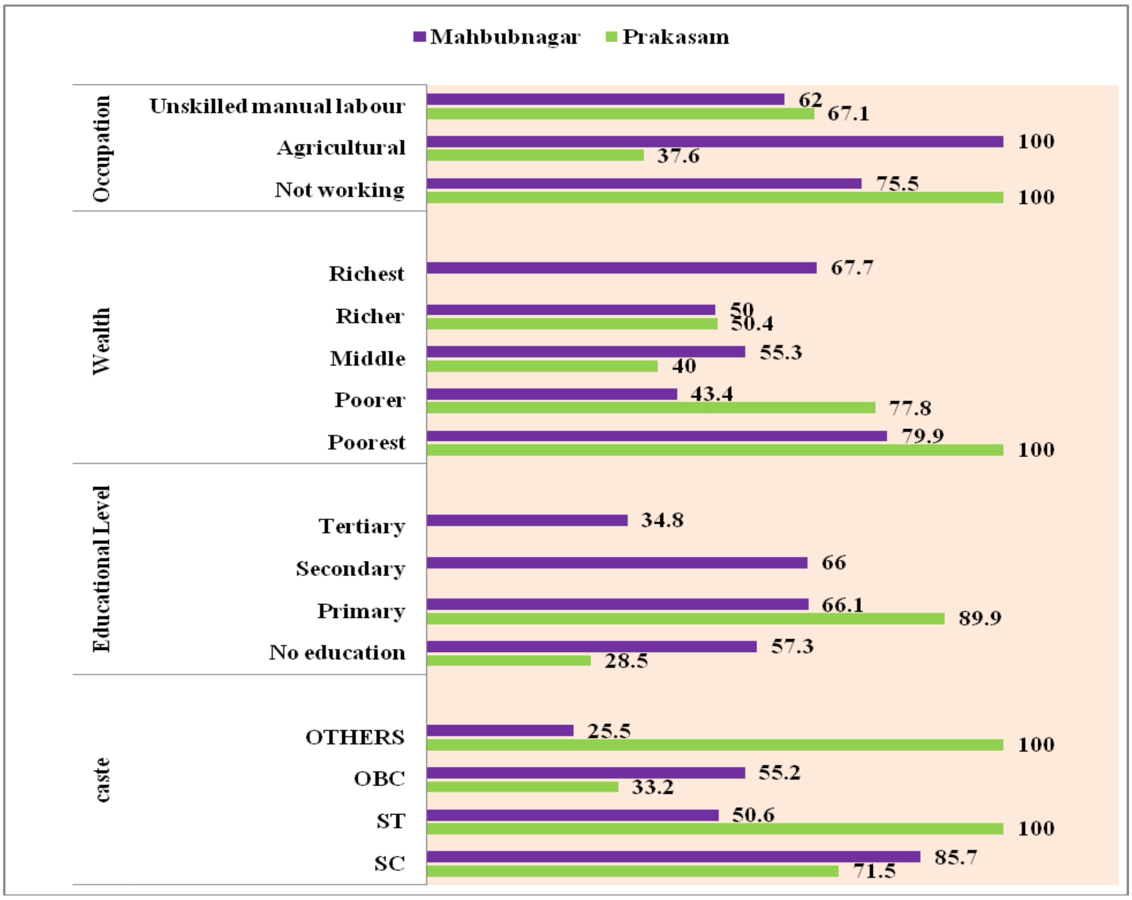


Figure.4.4. 3.Percentage of anaemia among adolescent girls (15-19 years) by occupation, wealth, education and caste in Mahbubnagar and Prakasam districts during 1998/99

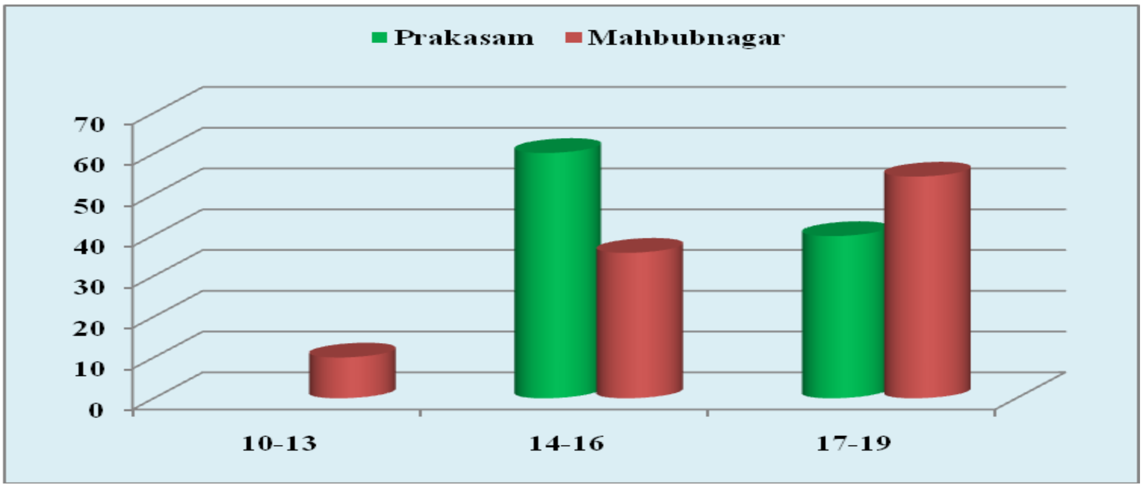


Figure.4.4. 4.Distribution of adolescent girls (15-19 years) according to age at first birth in Prakasam and Mahbubnagar district during 1998/99

4.4.2.6. Conclusion

In general, the risk of being anaemic was higher among adolescent girls from Mahbubnagar district as compared to those from Prakasam district despite overall anaemia being higher in Prakasam adolescent girls. This can be attributed to higher percentage of non-working adolescent girls and lower enrolment and retention in formal education system inspite of better wealth situation in Prakasam as compared to Mahbubnagar.

4.4.3. Andhra Pradesh State (1998/99)

4.4.3.1. Profile of adolescent girls (15-19 years) in Andhra Pradesh state during NFHS-2

From the state of Andhra Pradesh (pre-divided), data of 816 adolescent girls aged 15-19 was included in the study. Of these girls, 85 percent and 15 percent were in rural and urban area of Andhra Pradesh state respectively. Majority of the girls (87.2 %) were of Hindu religion, belonged to OBC (51.2 %), with atleast half having no formal education (50.0 %) and the other half had attained some formal education at different levels that is, primary (24.7 %), secondary (23.6 %) and (2.0 %) higher education levels. Distribution of the girls according to wealth index of households in which they live was middle (26.6 %), poorer (26.5 %), richer (20.7 %), poorest (19.3 %) and richest (7.0 %). Majority of the adolescent girls were involved in agricultural work as their source of income (45.2 %) and a good percentage of the girls (41.8 %) were not working, increasing their risk towards poor nutritional status.

Age wise distribution was done on single years and in this study population, majority of the girls were in the ages of 18 and 19 years, represented by 31.2 percent and 30.3 percent respectively, and the rest belonged to the remaining ages (Table 4.4.4). Majority of the girls in this state gave birth to their first child between the age of 14-16 years (48.7 %), followed by 17-19 (45.3 %) and very few of them gave birth to their first child in early adolescence between 10-13 years of age (6.0 %).

More than half of the adolescent girls had a normal BMI (55.0 %). The remaining girls were either underweight with moderate thinness (21.6%) and mild thinness (22.7 %) or overweight (0.7 %). This indicates that the problem of underweight is more common among the adolescent girls at 44.3 percent compared to overweight. No adolescent girls were found to be obese at any level.

4.4.3.2. Prevalence of anaemia among adolescent girls (15-19 years) in Andhra Pradesh state during NFHS-2

The overall prevalence of anaemia was 59.4 percent with 42.9, 12.5 and 4.0 percent representing mild, moderate and severe anaemia respectively. These findings were almost in accordance with findings from Sachan *et al*. (2012) who reported a prevalence of anaemia at 56.3 percent among adolescent girls. A similar prevalence of severe anaemia as the present study (3.58 %) was reported by Verma *et al*. (2013). Using DHS data from 34 countries, Yasutake *et al*. (2013) reported similar prevalence of 59.2 and 59.9% percent in Benin-2006 and Mali-2006 respectively. However, Shilpa *et al.* (2012) reported a lower prevalence of 41.1 percent. Findings from the DLHS-2002-04 on reproductive health reported higher prevalence (98.2 %) of anaemia among adolescent girls in Andhra Pradesh (IIPS and MoHFW, 2006).

Table.4.4.4. Percentage association of anaemia among adolescent girls (15-19) years with socio-economic and demographic variables in Andhra Pradesh state during 1998/99

Background characteristic	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls (%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	63.0	41.3	17.1	4.6	122(15.0)	X^2=1.1057 0.7757 NS
Rural	59.1	40.0	14.1	5.0	694(85.0)	
Religion						
Hindu	60.0	41.0	13.9	5.1	712(87.2)	X^2=33.0186 P<.0001 **
Muslim	37.2	37.2	0.0	0.0	44(5.4)	
Christian	73.3	33.3	33.3	6.7	60(7.4)	
Others	NA	NA	NA	NA	NA	
Caste						
SC	66.7	38.4	22.2	6.0	200(24.5)	X^2=29.733 P=0.0005 **
ST	46.0	37.7	4.1	4.2	49(6.0)	
OBC	61.7	41.5	15.0	5.3	418(51.2)	
None	49.2	39.7	6.7	2.8	149(18.2)	
Others	NA	NA	NA	NA	NA	
Education level						
No education	62.4	42.5	14.4	5.6	407(50.0)	X^2=25.5423 P=0.0024 **
Primary	63.3	35.3	22.0	6.0	201(24.7)	
Secondary	50.9	39.4	8.5	3.0	192(23.6)	
Higher	52.3	52.3	0.0	0.0	16(2.0)	
Wealth index						
Poorest	67.8	44.5	16.7	6.7	158(19.3)	X^2=35.0822 P=0.0005 **
Poorer	65.9	36.8	21.7	7.5	216(26.5)	
Middle	51.1	37.2	10.2	3.7	216(26.6)	
Richer	57.9	42.7	12.9	2.3	169(20.7)	
Richest	52.1	45.3	3.4	3.3	57(7.0)	
Occupation						
Not working	64.0	45.1	14.1	4.7	341(41.8)	X^2=38.0454 P=0.0038 **
Professional	NA	NA	NA	NA	NA	
clerical	NA	NA	NA	NA	NA	
Sales	100.0	100.0	0.0	0.0	2(0.2)	
Agricultural	55.1	34.7	16.0	4.5	369(45.2)	
services	0.0	0.0	0.0	0.0	2(0.3)	
Skilled & unskilled manual	62.6	43.2	11.7	7.8	103(12.6)	
Age of woman(in years)						
15	55.4	48.6	6.8	0.0	60(7.3)	X^2=32.4383 P=0.0012 **
16	47.3	34.2	13.1	0.0	107(13.1)	
17	55.1	35.8	10.9	8.3	148(18.1)	
18	62.5	40.3	15.2	7.0	254(31.2)	
19	66.1	43.3	18.7	4.2	247(30.3)	
Age of woman at first birth(in years)						
10 -13	67.0	49.7	17.4	0.0	25(6.0)	X^2=42.7373 P=0.0034 **
14 – 16	63.4	40.4	19.0	4.0	200(48.7)	
17 – 19	62.1	45.6	12.1	4.4	186(45.3)	
BMI status						
Moderate thinness	50.4	26.3	13.7	10.3	176(21.6)	X^2=48.7643 P<.0001 **
Mild thinness	67.6	43.3	22.1	2.2	185(22.7)	
Normal	59.6	43.5	12.0	4.1	449(55.0)	
Overweight	100.0	100.0	0.0	0.0	6(0.7)	
Total	**59.4**	**42.9**	**12.5**	**4.0**		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant, NA= Not available.						

Source. NFHS-2

4.4.3.3. Association of anaemia and background characteristics in adolescent girls

Results from Table 4.4.4 show a significant association between anaemia prevalence with all socio-economic and demographic variables in Andhra Pradesh state apart from residence ($p<0.05$).

4.4.3.3.1. Socio-economic factors

Although residence was not significant to influence the prevalence of anaemia among adolescent girls in this state, a higher prevalence of anaemia was found among the urban adolescents (63.0 %) as compared to the rural adolescent girls (59.1 %). Similar findings were reported from analysis of national representative data from countries like Peru, El Salvador and Haiti in Latin America and the Caribbean, with anaemia prevalence in urban adolescent being either higher or equivalent to anaemia in rural adolescents (PAHO/WHO, 2010). This could be due to urbanization leading to nutrition transition, where the western life style is overshadowing the traditional behaviour. For example, busy life style which has resulted in dependence on over processed food high in preservatives plus other toxins, and minimum consumption of natural foods that enhance the digestive system ability to absorb and utilize nutrients from food, in addition to high pollution in urban centres which increases oxidative stress that depletes iron reserves greatly.

Results of this study also show highest association of anaemia with the Christian religion (73.3 %) followed by the Hindu religion (60.0 %) and least among the Muslim (37.2 %). These results contradict findings from IIPS and MoHFW (2006) in India where highest prevalence of anaemia was reported among Hindu adolescent girls (98.2 %) followed by Muslims (96.7 %) and then Christians (90.6 %). This could be due to religious norms like fasting among most Christians where in due course, there is no consumption of red meat which contains the most easily absorbable iron as compared to the plant proteins. Hindus also face the same problem due to the vegetarianism among most of them, leaving them with plant sources of iron which contain inhibitors of iron absorption, especially phytates and polyphenols, thus accelerating the problem of anaemia occurrence due to depleted iron stores. Trivedi and Pasrija (2007) reported no significant relation between religion and anaemia among adolescent girls in Raipur city.

In this state, results show an inverse relation between education of the adolescent girl and anaemia prevalence. As the level of education increases, prevalence of anaemia decreases from 63.3 percent among those who attained primary education to 52.3

percent in higher and 50.9 percent in girls who attained secondary education (Table 4.4.4). Similar findings were reported by Kulkarni *et al* (2012). This is due to the fact that with attainment of higher education, adolescent girls become more knowledgeable on foods and practices to avoid occurrence of anaemia.

Similar to what has been previously documented, the present study showed a steady decrease in anaemia prevalence in adolescent girls (15-19) years with increase in wealth of the households in which they live from (67.8 %) among the poorest households to (52.1 %) among the richest households. Almost similar results were reported by Yasutake *et al*. (2013) in countries like Benin during 2006 DHS (64.1% and 59.9%) in poorest and richest families. Other countries like Mali-2006 and Guinea-2005 followed a similar trend based on household wealth and anaemia distribution. Pattnaika *et al* (2013) also reported anaemia to be highest among adolescent girls from low socio-economic class and least among the girls from high socio-economic class.

However, the adolescent girls from the richest households also portrayed a high prevalence of anaemia (>40%) as per WHO guidelines. This high prevalence among girls from the richest households could be due to other co-founding factors not included in the study like menarche, faulty eating habits, especially where the rich tend to rely on junk food which is calorie dense, but poor in other nutrients required for the production of haemoglobin and skipping meals in order to maintain a slim body structure, leaving the body in starvation. Yasutake *et al*. (2013) reported a similar trend as the present study in Guinea-2005 DHS and Madagascar-2008/09 DHS between anaemia in adolescent girls and wealth of the households in which they lived, with adolescent girls having a high prevalence despite living among the richest households.

All the adolescent girls involved in sales as an occupation were reported to be anaemic. This prevalence is higher than in girls who were not working, inspite of the fact that earnings from occupation are meant to elevate the lives of the girls by giving them autonomy and a voice in decision making (FAO, 2010). However, this study did not find a similar trend. Non-working adolescent girls had a lower prevalence than some of those who were working. This difference was significant (p=0.0038). This could be due the nature of the sales job. Chances are high that the girls never have time to eat proper meals and therefore end up skipping meals due to their busy schedule and the tireless movements from one place to another, as most of the sales persons move from door to door selling their products. The earnings are low from these kind of jobs, so they are unable to cover the excessive demand of nutrients that come with adolescence leading to complete exhaustion of the body and its nutrients. Excessive stress can lead to atrophy of the red cells before their 120 day life span. On the other hand, the non-working adolescent girls do not have to struggle much, as most of the food to be cooked is brought to them, and they have enough time to rest. Gupta *et al.* (2012) reported similar results with higher anaemia prevalence among employed adolescent girls (88.89 %) compared to the unemployed (66.67 %) in Maharashtra.

4.4.3.3.2. Demographic and nutritional factors

Anaemia prevalence was also found highest among the adolescent girls in ages 18 and 19 years (>60 %) representing 62.5 percent and 66.1 percent respectively. Anaemia increased with increase in age of the girls. Also, age of 17 years showed the strongest association with severe anaemia (8.3 %) but it decreased with increase in age as well. This result is contradictory to Kapoor *et al*.(1992**)** who reported anaemia prevalence to decrease with increase in age (57.8 percent among younger adolescent girls and 31.32 percent among older adolescent girls). Rajaratnam *et al*. (2000) reported similar findings as Kapoor *et al*. (1992). This result could be due to higher responsibilities assigned to older adolescent girls, for example child bearing and care, and adjustment to living away from their parents might hinder proper consumption of food when newly married.

Age of first delivery partly signifies age of marriage as the culture in India does not permit bearing children outside marriage. Anaemia was highest (67.0 %) in adolescent girls who had their first child in early adolescence (10-13) years and steadily decreased with increase in age at birth of first child. Those who had their first children between 14-16 years had a prevalence of 63.4 % and 17-19 years had a prevalence of 62.1 %. This indicates that older age at first delivery plays a protective role on the adolescent girls in preventing occurrence of anaemia. However, the high prevalence (>60 %) across all age groups is a complication of adolescent pregnancy and even in late adolescence, the girl’s body is not mature enough for child birth and the responsibility that comes with it.

BMI impacts strongly on anaemia prevalence among this population group with overweight being (100 %) associated with anaemia prevalence in the adolescent girls in Andhra Pradesh state. Mildly thin adolescents were found with 67.6 percent anaemia and moderately thin adolescents with 50.4 percent anaemia. However, moderate thinness showed the strongest association with severe anaemia (10.3 %) and it was significant (p<.0001). However, Verma *et al* (2004) reported that adolescent girls with a lower BMI (<18.5kg/m$^{2)}$ were more anaemic (82.4 % and 97.4 %) as compared to adolescent girls having BMI more than (18.5kg/m^2) whose anaemia prevalence was lower (79.7 % and 40.0 %) respectively.

4.4.3.4. Determinants of anaemia in adolescent girls (15-19 years) in Andhra Pradesh state during NFHS-2

All variables were subjected to ordinal logistic regression and results presented below (Table.4.4.5). All the selected variables showed a significant effect on severity of anaemia in multivariate analysis using ordinal logistic regression except for residence.

Religion significantly increased anaemia prevalence. In comparison to the Christian adolescent girls, the RR of being anaemic was 0.66 times among the Hindu girls and 0.34 times among the Muslim adolescent girls. The variations in RR of being anaemic are due to the different religious practices in each religious denomination. Trivedi and Pasrija (2007) did not find religion to significantly affect anaemia in adolescent girls while Kappala *et al*. (2014) found Hindu adolescent girls to have higher odds of being anaemic as compared to girls of other religions.

Severity of anaemia decreased with increase in age of the adolescent girls (Table 4.4.4). Increase in age of the adolescent girls decreased severe anaemia by 9.3 percent. The RR of being anaemic among the adolescent girls was 1.09 times with progression of adolescence. This could be due to stable menstrual cycle, improved experience in caring for their health as well as maturation of the reproductive system to suit child birth and intervention programmes which normally target older adolescent girls as part of the reproductive women age group (15-49).

In comparison to the overweight in adolescent girls, underweight as a factor, was significant in affecting severity of anaemia positively. This indicates that increase in BMI above normal among the adolescent girls who were moderately thin, increased anaemia prevalence by 82.8 % and among the mildly thin adolescent girls it increased by 53.0 %. The RR of being anaemic was 0.44 times among moderately thin adolescent girls and 0.59 times among the mildly thin adolescent girls compared to their counterparts with a normal BMI.

Severe anaemia was highest among adolescent girls with an SC registration followed by OBC. The RR of being anaemic was 1.79 times and 1.05 times among the adolescent girls with SC and OBC registration respectively, in comparison with their counterparts with registration in other castes. Bondevik *et al.* (2000) reported a higher risk of being anaemic among the special ethnic groups such as Lama, Tamangs and Sherpa in Nepal.

Severity of anaemia decreased with increase in educational level of the adolescent girls. The RR of being anaemic was 1.23 times, 1.26 times and 0.89 times among the adolescent girls with no education, primary education and secondary educational respectively. The higher RR among the girls who had attained primary education in comparison with the girls with no education could be due to the focus of government programmes on the adolescent girls with no education. The assumption that formal education should provide all necessary knowledge is not the case in primary education where only minimal knowledge is provided and as such, the girls at this educational level lack the relevant skills to search and source for in-depth knowledge.

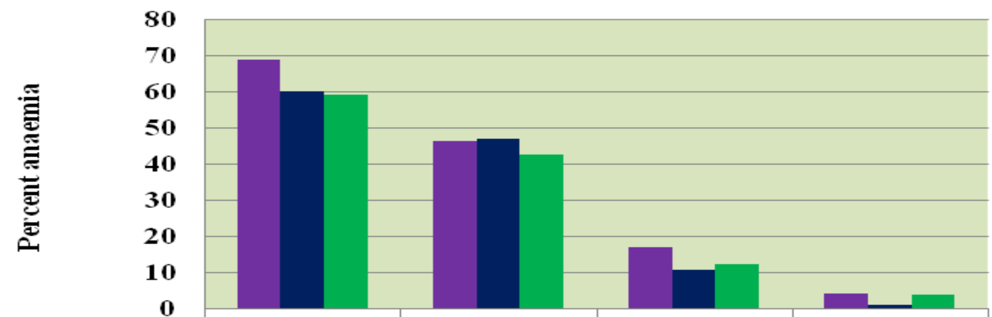
Wealth was significant in decreasing severity of anaemia with improvement in the quintiles of wealth of the households in which the adolescent girls lived. Improvement in wealth of the poorest and poorer households decreased severity of anaemia by 49.8 and 54.5 percent respectively. The RR of being anaemic was higher among adolescent girls from the poorest (RR=1.65 times) and poorer (RR=1.73 times) households and was 1.09 times among adolescent girls from middle wealth households as compared to girls from the richest households. This is because girls from poorest and poorer households are likely to attend low quality schools with low educational standards and are normally married off at an early age.

Among the adolescent girls who were not working, severity of anaemia increased by 27.9 percent with an RR of 0.76 times of being anaemic in comparison with their counterparts who were employed in unskilled manual labour (1.32 times). This result indicates that as much as employment of the girl would improve her nutritional status, the type of employment matters, as strenuous work depletes iron stores further due to excessive stress, with limited resting time, and limited time to cook and eat all meals each day.

4.4.3.5. Comparison between Prakasam, Mahbubnagar and Andhra Pradesh

Figures.4.4.5 and 4.4.6 show the nutritional status of the adolescent girls based on the overall percentage of anaemia and the distribution of the girls based on their BMI status. The nutritional status of the adolescent girls in this age bracket is poor as they all show a high prevalence of anaemia (>40%) as per WHO guidelines. However, in Prakasam district, the situation is worst among the three as it has the highest prevalence of overall anaemia (69.1%) and severe anaemia (4.4%). It also had the least number of girls with normal BMI (18.5Kg/m^2) representing only 47 percent with more than half being underweight. This could be due to the low education status in the district with only primary education being the highest level of formal education. Low education incapacitates the adolescent girls as they are not equipped with enough knowledge on how to take care of themselves or how to source for information from workshops, newspapers or seminars, which are areas of updated information in the field of health and nutrition. Due to the low educational level, a large number of these girls were not working and those who were working, were employed in low paid jobs (agricultural and unskilled manual labour as seen in Table.4.4.1.

Adolescent girls in Mahbubnagar showed a better nutritional status in terms of having girls with better BMI (68.8%) and lowest levels of those with BMI below normal. However, 2.4 percent of the girls were overweight, which indicates a dual burden of malnutrition with overweight being on the rise and this could have considerably contributed to the high prevalence of anaemia in these girls (60.2 %).



	Overall anaemia	Mild anaemia	Moderate anaemia	Severe anaemia
Prakasam	69.2	46.5	17.1	4.4
Mahbubnagar	60.2	47.1	10.9	1.3
Andhra Pradesh	59.4	42.9	12.5	4

Figure.4.4. 5.Comparison in anaemia prevalence among adolescent girls (15-19 years) in Andhra Pradesh State, Prakasam and Mahbubnagar districts during 1998/99

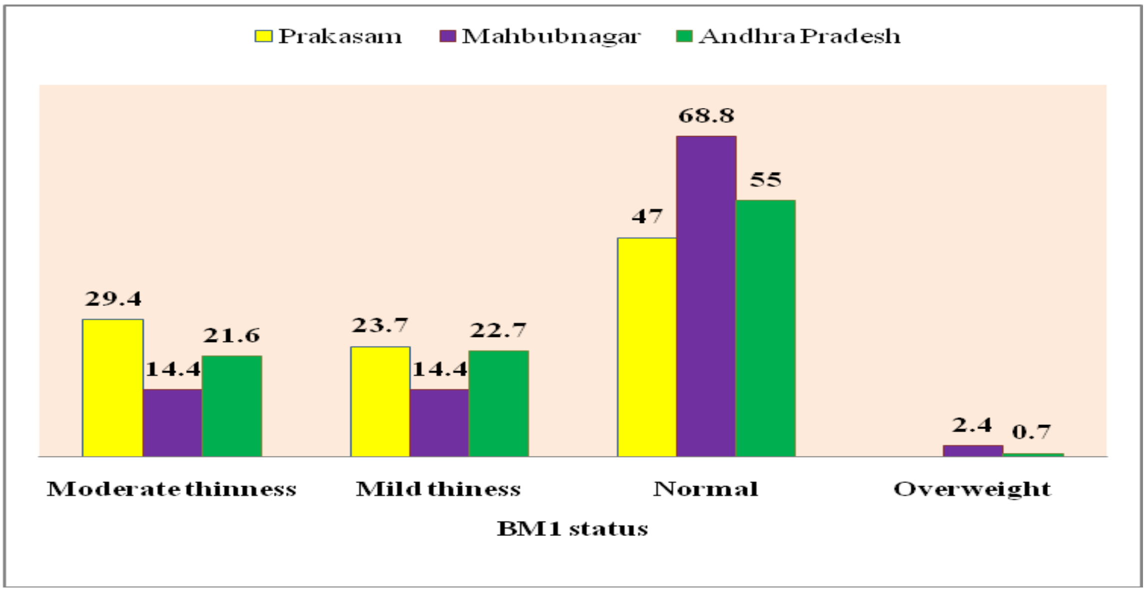


Figure.4.4. 6.Distribution of adolescent girls (15-19 years) based on their BMI status between Prakasam, Mahbubnagar and Andhra Pradesh during 1998/99.

Among the variables included in the ordinal regression to ascertain the net effect on anaemia prevalence among the adolescent girls during the study period, factors like age of the girl, moderate thinness, registration with SC, belonging to poorer households and not working, were significant in determining severity of anaemia across all the three study areas (Prakasam district, Mahbubnagar district and Andhra Pradesh state). However, there were with differences in RR of each variable on occurrence of anaemia among the girls despite being located in the same region and state in which similarities exist in the way of life and other cultural practices.

4.4.4. Andhra Pradesh (2005/06)

4.4.4.1. Profile of adolescent girls (15-19 years) in Andhra Pradesh state during NFHS-3

In Andhra Pradesh (pre-divided), approximately data on 1565 adolescent girls was included in the study. Results presented in Table.4.4.5 showed that majority of the girls (61.0 %) were occupying rural AP of Hindu religion (80.5 %), belonged to OBC sect (50.1 %), attained secondary education (61.7 %), belonged to richer/ richest households (44.3 %), were unemployed (62.3 %) and among the girls working, most were employed in agricultural sector (22.7 %).

More than one-quarter of the girls were 18 years of age and rest were 15, 16, 17 or 19 years old (Table 4.4 6). Of the adolescent girls included in the study, only 198 gave a response to the query on when they had their first child. More than 47.0 percent of the girls gave birth to their first child between the ages 14-16 years. More than half of the girls had a normal BMI while 43.0 percent had a BMI below normal (<18.5kg/m^2) and 2.8 percent had a BMI above normal (>22.5kg/ m^2).

4.4.4.2. Prevalence of anaemia adolescent girls (15-19 years) in Andhra Pradesh state during NFHS-3

The overall prevalence of anaemia in adolescent girls aged 15-19 years was 69.4 percent of which 41.4 percent were mildly anaemic, 20.3 percent moderately anaemic and 6.4 percent severely anaemic. These findings are in line with findings from a survey on micronutrient deficiency by NNMB (2003) which revealed prevalence (70 %) among Indian adolescent girls. A similar prevalence of severe anaemia (7.1 %) among 16 districts and 11 states from northern and eastern parts of India was reported by Toteja *et al*. (2006). However Bharati *et al*. (2009) reported very high prevalence of anaemia (99.9 %) in Jharkhand adolescent girls when DLHS-RCH data was analyzed and Toteja *et al*. (2006) reported an overall prevalence of 90.1 percent among adolescent girls in 16 districts and 1 state of northern and eastern India.

4.4.4.3. Association of anaemia and background characteristics in adolescent girls

4.4.4.3.1. Socio-economic factors

Residence was found to be statistically not significant in influencing the prevalence of anaemia in girls but rural residence showed a stronger association with anaemia prevalence (71.0 %) compared to urban residence (66.4 %). Studies using DHS data reported similar findings in Bolivia-2003 DHS and Honduras-2005 DHS (PAHO/WHO, 2010). Yasutake *et al*. (2013) reported a similar result in Ghana-2008 DHS (63.8 % vs 59.3 %) and Mali- 2006 DHS (64.1 % vs 55.3 %) for rural and urban residency respectively.

Religion was found significant in influencing anaemia prevalence with the highest prevalence being among the Christian girls (75.7 %) followed by Hindu (68.9 %) and Muslims (67.0 %). All religions showed high prevalence of anaemia which could be due to religious beliefs (fasting) and food taboos (avoidance of red meat during lent in Christians, non- consumption of beef among Hindu religion and dependence on vegetables and lengthy fasting among Muslims etc. Bharati *et al*. (2009) in analysis of DLHS-RCH 2002-2004 data reported opposite results with anaemia being highest among Hindu (90. 0 %), followed by Muslims (88.5 %) and Christians (60.6 %)

Table.4.4.5. Percentage association of anaemia among adolescent girls aged (15-19) years with socio-economic and demographic variables in Andhra Pradesh state during 2005/06.

Background characteristics	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls (%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	66.4	39.5	19.3	7.6	610(39.0)	X²=5.0564 P=0.1677 NS
Rural	71.0	44.6	18.4	8.0	955(61.0)	
Religion						
Hindu	68.9	42.2	18.4	8.3	1260(80.5)	X²=21.120 P=0.0121 *
Muslim	67.0	46.7	13.2	7.1	193(12.4)	
Christian	75.7	39.0	32.9	3.9	111(7.1)	
Others	0	0	0	0	0	
Caste						
SC	72.4	42.3	22.9	7.1	303(19.4)	X²=11.741 P=0.2283 NS
ST	78.4	50.1	20.9	7.4	99(6.4)	
OBC	68.5	43.0	17.4	8.1	783(50.1)	
None	65.8	39.9	17.7	8.1	379(24.2)	
Education level						
No education	78.2	53.2	18.9	6.1	276(17.6)	X²=31.268 P=0.0003 **
Primary	75.2	42.5	23.1	9.6	214(13.7)	
Secondary	65.3	39.6	17.5	8.2	1013(64.7)	
Higher	72.0	44.9	23.1	3.9	62(3.9)	
Wealth index						
Poorest	81.0	57.0	19.4	4.6	147(9.4)	X²=39.866 P<.0001 **
Poorer	76.7	43.2	20.2	13.3	237(15.2)	
Middle	67.7	40.7	18.8	8.2	488(31.2)	
Richer	67.9	42.2	19.0	6.7	414(26.5)	
Richest	61.2	38.2	16.8	6.2	279(7.8)	
Occupation						
Not working	66.5	41.7	16.6	8.2	957(62.3)	X²=46.391 P=0.0003 **
Professional	67.0	64.5	2.1	0.4	16(1.1)	
clerical	93.5	0.0	93.5	0.0	2(0.1)	
Sales	74.8	19.6	4.1	1.1	12(0.7)	
Agricultural	74.6	45.7	22.0	6.9	355(22.7)	
services	74.7	25.7	29.8	19.3	36(2.3)	
Skilled & unskilled manual	72.1	44.7	20.3	7.1	169(10.8)	
Age of woman(in years)						
15	68.2	43.2	18.6	6.4	254(16.3)	X²=27.183 P=0.0073 **
16	65.2	39.2	18.9	7.1	364(23.3)	
17	69.1	36.1	22.9	10.0	286(18.3)	
18	70.7	44.4	16.0	10.3	412(26.3)	
19	73.7	51.3	18.4	4.0	249(15.9)	
Age of woman at first birth(in years)						
10 -13	75.0	25.0	50.0	0.0	10(5.0)	X²=63.195 P<.0001 **
14 – 16	81.7	59.2	22.4	0.1	94(47.6)	
17 – 19	80.0	61.8	11.4	6.9	94(47.5)	
BMI status						
Moderate thinness	66.2	37.2	22.7	6.3	326(20.8)	X²=23.389 P=0.0762 NS
Mild thinness	71.9	43.0	18.1	10.7	347(22.2)	
Normal	68.8	43.3	18.0	7.5	848(54.2)	
Overweight	79.3	65.8	9.1	4.4	43(2.7)	
Obese class I	33.3	33.3	0.0	0.0	2(0.1)	
Total	**69.4**	**41.4**	**20.3**	**6.4**		

**=Significant at 0.01, *= Significant at 0.05, NS=Not significant, NA= Not Available.

Source. NFHS-3

This study results also found a decrease in anaemia prevalence with acquisition of education from (78.2 %) among girls with no education to (65.3 %) among girls with secondary education. These findings were also statistically significant (p=0.0003). Similar trend was observed in DLHS-RCH conducted in 548 districts with highest prevalence being among illiterate adolescent girls (98.3 %), 0-9 years of schooling (97.9

%) and 10 years and above (97.0 %) with a similar trend for severe anaemia as well (IIPS and MoHFW, 2006).

The study also found an elevated prevalence of anaemia among girls who acquired higher education (72.0 %) as compared to secondary education (65.3 %). These results are different from what most studies have reported but are in line with the results of Bharati *et al*. (2009) who reported a slightly higher prevalence of anaemia of 89.9 percent among adolescent girls with 10 years and above of schooling, as compared to adolescent girls with 9 years of schooling (89.7 %).

However this study also recorded the least prevalence of severe anaemia (3.9 %) among those with higher education as compared to those with primary education (9.6 %) which indicates that higher education plays a role in reducing the severity of anaemia in adolescent girls. This is because educated girls are more aware of how to care for their health better as regards nutrition in terms of ideal foods to maintain iron levels. Similar findings have been reported by (IIPS and MoHFW, 2006, Bharati *et al*., 2009, Kulkarni *et al*., 2012).

As regards wealth of the households, the study results revealed a gradual decrease in anaemia prevalence with increase in household wealth from 81.0 percent among the girls from the poorest households to 61.2 percent among girls from the richest households, though this prevalence is still very high. This association was significant ($p<0.05$).

4.4.4.3.2. Demographic and nutritional factors

Ages 18 and 19 years showed a stronger association with anaemia prevalence (70.7 % and 73.7 %) respectively. However age of 19 years showed the least prevalence of severe anaemia (4.0 %) which could be due to maturity of the girl’s body into womanhood stage, where she is capable of nurturing a pregnancy with less complications compared to earlier stages in adolescence. At this age, the girl is more mature and capable to properly taking care of herself in terms of meals, hence the decrease in severe anaemia. The highest prevalence of total anaemia could be due to stable menstrual cycle, repeated pregnancy, especially with those having more than one child. Bharati *et al.* (2009) reported contradicting results with a slightly lower overall prevalence in 18 and 19 years olds as compared to 15 and 16 years old girls. However, these older girls had higher levels of severe anaemia (11.3 % each) as compared to the younger ones in this age bracket (10.7 %).

BMI was found not significant in influencing anaemia prevalence but a higher prevalence of anaemia was found among the overweight adolescent girls (79.3 %) and those who were mildly thin (71.9 %) which indicates malnutrition as risk factor to anaemia prevalence.

4.4.4.4. Determinants of anaemia in adolescent girls

All the variables were regressed using ordinal logistic regression. Though bivariate analysis found a significant association between age and occupation with anaemia prevalence, results in multivariate analysis using ordinal logistic regression did not find the two variables to have a net effect but found residence to have a net effect on severity of anaemia despite not having a significant association in bivariate analysis.

Anaemia was higher among rural adolescent girls and residence was significant in affecting severity of anaemia positively. Adolescent girls who were residing in urban A.P. had a 0.86 times RR of being anaemic as compared to their counterparts in the rural areas of AP state (RR=1.17 times). Bharati *et al*. (2009) also reported that girls residing in the urban area had significantly lower odds of being anaemic (OR=0.940) as compared to their rural counterparts after controlling for age, caste, religion and marital status in DHLS-RCH 2002-2004 survey.

Nutritional status of the adolescent girls had a bearing on severity of anaemia. Severity of anaemia decreased with improvement in nutritional status towards normal. In comparison to overweight adolescent girls, the RR of being anaemic was 2.37 times among the girls who were moderately thin, 1.99 times among the girls who were mildly thin and 1.41 times among the girls with a normal BMI. Kappala *et al*. (2014**)** reported thin adolescent girls to have higher odds of being anaemic (OR= 25.07) when compared to the girls with a normal BMI (OR=5.48).

Caste is also used in India to categories social status in society. Results revealed that caste affects severity of anaemia among the adolescent girls negatively. The RR of being anaemic was 1.23 times among adolescent girls with SC registration and 1.41 times among adolescent girls with ST registration in comparison to their counterparts who belonged to other castes.

Improvement in the educational level of adolescent girls with no formal education was found to decrease severity of anaemia by 43.2 percent. The adolescent girls with no

Table.4.4. 6.Results of ordinal logistic regression on prevalence of anaemia among adolescent girls in Andhra Pradesh during 1998 and 2005/06

Variable	Andhra Pradesh							
	1998-1999				2005-2006			
	Estimates	S.E	Significance	RR	Estimates	S.E	Significance	RR
Residence								
Urban	-0.046	0.172	0.789	-	**0.156**	**0.074**	**0.035***	**0.86**
Rural	**RC**				**RC**			
Religion								
Hindu	**0.414**	**0.20**	**0.01***	**0.66**	1.071	0.771	0.165	-
Muslim	**1.074**	**0.392**	**0.006****	**0.34**	1.334	0.773	0.135	-
Christian	**RC**				1.056	0.784	0.363	-
None					**RC**			
Age of woman	**-0.093**	**0.008**	**0.0006****	**1.09**	-0.033	0.026	0.202	-
Age at first birth	-0.003	0.052	0.954	-	-0.055	0.065	0.403	-
BMI								
Moderate- T	**0.828**	**0.111**	**0.006****	**0.44**	**-0.863**	**0.193**	**<0.0001****	**2.37**
Mild- T	**0.530**	**0.12**	**0.03***	**0.59**	**-0.690**	**0.197**	**<0.0001****	**1.99**
Normal	0.758	0.511	0.138	-	**0.484**	**0.189**	**0.010***	**1.62**
Overweight	**RC**				**RC**			
Caste								
SC	**-0.584**	**0.207**	**0.005****	**1.79**	**-0.206**	**0.101**	**0.041***	**1.23**
ST	0.062	0.344	0.857	-	**-0.350**	**0.165**	**0.034***	**1.41**
OBC	**-0.0465**	**0.188**	**0.013***	**1.05**	-0.120	0.079	0.131	-
None	**RC**				**RC**			
Educational level of woman.								
No education	**-0.205**	**0.023**	**0.003****	**1.23**	**-0.432**	**0.181**	**0.017***	**1.54**
Primary	**-0.231**	**0.02**	**0.001****	**1.26**	-0.278	0.186	0.135	-
Secondary	**0.111**	**0.015**	**0.008****	**0.89**	-0.146	0.160	0.363	-
Higher	**RC**				**RC**			
Wealth								
Poorest	**-0.498**	**0.025**	**<0.0001****	**1.65**	**-0.504**	**0.153**	**0.001****	**1.66**
Poorer	**-0.545**	**0.068**	**0.004****	**1.73**	**-0.421**	**0.129**	**0.001****	**1.52**
Middle	**-0.087**	**0.010**	**0.003****	**1.091**	**0.213**	**0.098**	**0.030***	**1.24**
Richer	-0.236	0.296	0.426	-	0.141	0.088	0.111	-
Richest	**RC**				**RC**			
Occupation								
Not working	**0.279**	**0.031**	**0.002****	**0.76**	0.224	0.125	0.073	-
Professional	NA	NA	NA	NA	0.260	0.273	0.341	-
Clerical	NA	NA	NA	NA-	0.726	0.674	0.281	-
Sales.	-0.443	0.680	0.515	-	0.064	0.336	0.848	-
Agricultural self employed	0.701	0.290	0.16	-	NA	NA	NA	
Agricultural employed	0.333	0.241	0.167	-	-0.070	0.151	0.646	-
Services	-0.038	0.715	0.958	-	-0.062	0.217	0.774	-
Skilled manual	0.527	0.351	0.133		**RC**			
Unskilled manual	**RC**							
*= significant at 5%, **= significant at 1%,S.E= Standard Error, RC= Reference category, Moderate-T= Moderate thinness, Mild-T=Mild thinness, (-)=not applicable, NA=not available, RR= relative risk								

Source. NFHS-2 &3

formal education had a RR of 1.54 times being anaemic in comparison to their counterparts who attained higher education level (RR= 0.65).

Improvement in the wealth of the poorest and poorer households, in which the adolescent girls lived, would decrease severity of anaemia by 50.4 and 42.1 percent respectively. The RR of being anaemic decreased with improvement in wealth status of the household in which the girls lived. In comparison to adolescent girls from the richest households, the RR of being anaemic was 1.66 times, 1.52 times and 1.24 times among adolescent girls from poorest, poorer and middle income households respectively. Bharati *et al*. (2009**)** found standard of living as an important determinant of anaemia. Adolescent girls having a high standard of living index had lower odds of being anaemic (OR=0.896) which increased to (OR=0.974) among girls with a medium standard of living index in comparison to their counterparts who had low standard of living whose odds of being anaemic were the highest among the three categories.

4.4.4.5. Trends of anaemia prevalence among adolescent girls in Andhra Pradesh state during 1998-2006.

Figure.4.4.7 below shows an increase of 10 percent in the overall total anaemia prevalence from (59.4 % in 1998/99 to 69.4 % in 2005/06). The differential in anaemia prevalence between the two surveys was because of moderate and severe anaemia. There was slight decrease in mild anaemia over the years but moderate anaemia increased from 12.5 % to 20.5 % and severe anaemia also increased from 4.0 % in 1998/99 survey (NFHS-2) to 6.4 % in 2005/06 survey (NFHS-3). Similar results were reported by Balarajan *et al*. (2013) on analysis of data between 34 states in India where anaemia in adolescent girls (15-19 years) increased from 55.6 percent in NFHS-2 to 62.9 percent in NFHS-3.

In both age groups, education level, wealth and occupation were found significant to influence anaemia prevalence. This increase in anaemia prevalence could have been due to the increased number of adolescent girls who were not working from 41.8 % in NFHS-2 to 62.3 % in NFHS-3 despite the increase in formal education attainment across the years which is indicated by the reduced number of adolescent girls who are illiterate (no formal education) from (50.0 %) in NFHS-2 to (17.6 %) in NFHS-3. Lack of a source of income for the girls reduces their access to quality and enough food plus health services as their autonomy is reduced.

Figure.4.4.8 shows a substantial increase in anaemia prevalence in adolescent girls over the years based on residence, with rural residency revealing a remarkably higher increase in anaemia prevalence among adolescent girls in rural Andhra Pradesh state

(11.9 %) as compared to their urban counterparts where anaemia increased by 3.4 percent despite not being a significant determinant. This result calls for more emphasis of government programmes to help adolescent girls in rural areas of Andhra Pradesh fight against anaemia by offering health, hygiene and nutrition education at household level including all family members who are atleast above 10 years of age in both genders.

Over the years, some factors remained determinants of anaemia among the adolescent girls in this state like under-nutrition (underweight), registration with SC, lack of education and lower wealth status of the household with differences between the two surveys.

Adolescent girls who were under-nourished (BMI below normal) in 2005/06 survey had a 3.33 times higher RR of being anaemic as compared to those girls in the 1998/99 survey. This could be due to infiltration of the western culture into the traditional culture and changing food habits leading to increased abdominal obesity and hence, dependence on famous fat loss/weight loss diets which necessitate consumption of small amount of food, and in some cases starvation in an attempt to lose weight drastically (for example, the high fibre diets which in-turn bind iron and limit its absorption from food despite consumption of iron rich foods). There was an increment of (20.5%) more adolescent girls not working in 2005/06 survey as compared to 1998/99 survey. Adolescent girls with SC registration in 1998/99 survey had a 0.56 times higher RR of being anaemic as compared to the girls in 2005/06 survey which could have been due to increment in severe anaemia among girls in this SC caste during the 2005/06.

The adolescent girls with no education in 2005/06 survey were at 0.31 times higher risk of being anaemic than the girls in the 1998/99 survey. This could be due to the increment in severity of anaemia in 2005/06 survey. The risk of being anaemic was higher among the poorer households in 1998.

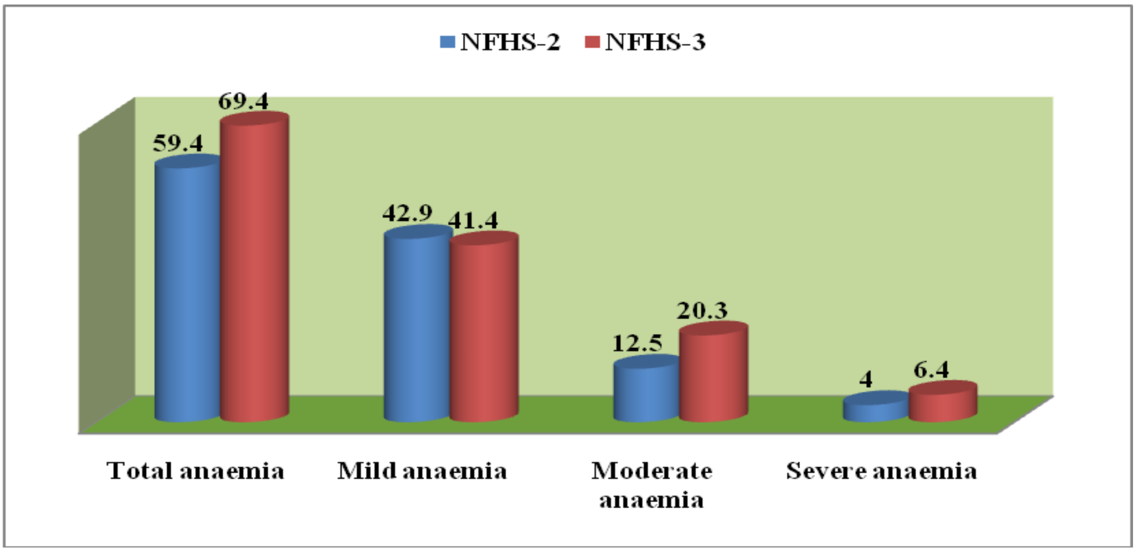


Figure.4.4. 7.Trends in anaemia prevalence among adolescent girls (15-19 years) in Andhra Pradesh during 1998-2006

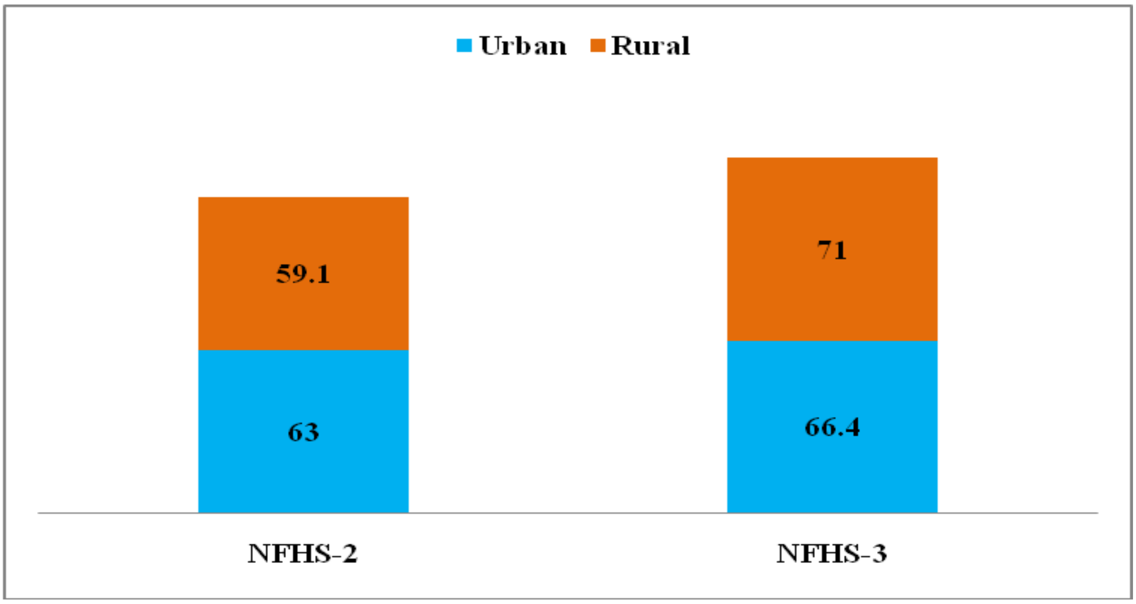


Figure.4.4. 8.Trends in anaemia prevalence among adolescent girls based on residence between NFHS-2 and NFHS-3 surveys in Andhra Pradesh state.

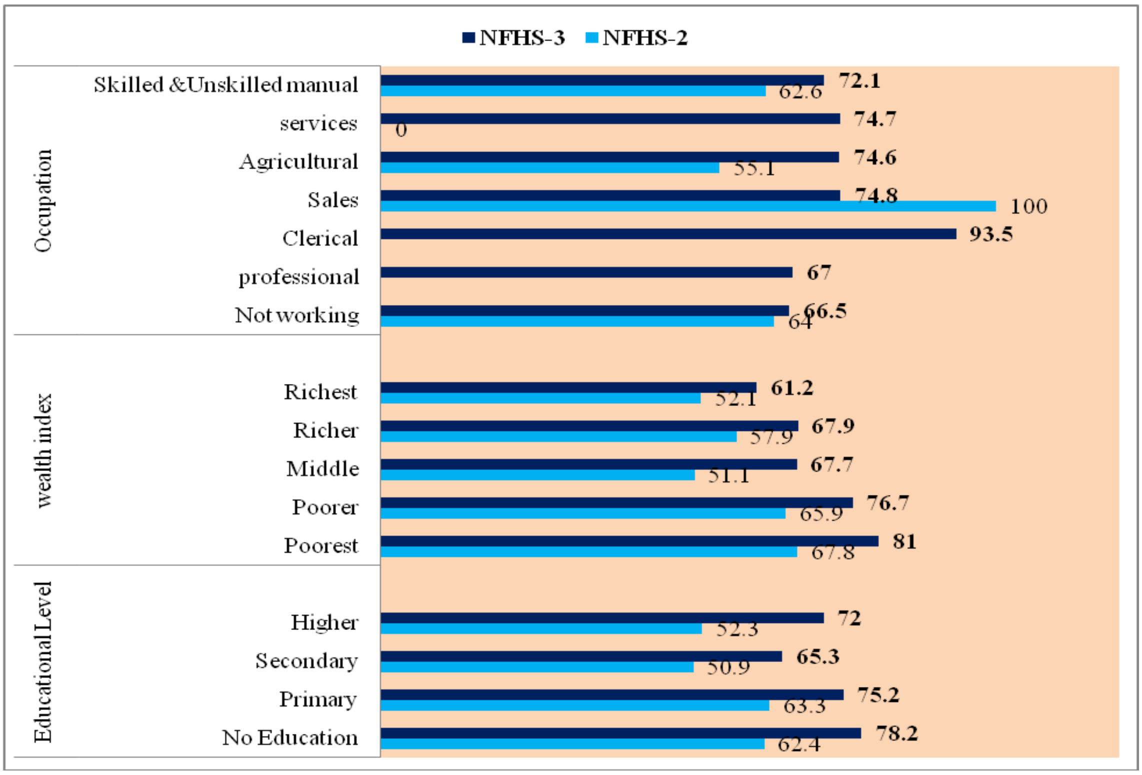


Figure.4.4.9.Trends in anaemia prevalence by occupation, wealth and educational level of adolescent girls in Andhra Pradesh during NFHS-2 and NFHS-3.

4.4.4.6. Conclusion

The above study results indicate that socio-economic status of the girls and the households in which they live remained a strong contributor in influencing the prevalence of anaemia.

4.4.5. Solapur District

4.4.5.1. Profile of adolescent girls (15-49 years)in Solapur district during NFHS-2

Results presented in Table.4.4.7 showed that approximately data on 67 adolescent girls between the ages 15-19 years was included in the study. Majority of these girls occupied rural Solapur (87.1 %), were of Hindu religion (87.1 %), belonged to other castes (38.1 %), attained up to secondary level of education (47.7 %), were from poorest households (40.5 %), were not working (55.4 %) and the remaining 44.6 percent were employed in the agricultural sector.. This could mean that they probably ended up as house wives.

Majority of the adolescent girls in this study were 18 years of age (41.7 %) and no girls beyond that age were found (Table.4.4.7). Of these girls, only 32 girls gave a

Table.4.4.7. Percentage association of anaemia among adolescent girls aged (15-19years) with socio-economic and demographic variables in Solapur district during 1998/99

Background characteristics	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls (%)	Chi-square & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	25.0	0.0	25.0	0.0	9(13.0)	X²=5.458 P=0.1412 NS
Rural	44.1	28.2	8.4	7.5	58(87.1)	
Religion						
Hindu	39.4	21.6	11.0	6.8	64(96.3)	X²=7.7815 P=0.0507 *
Muslim	100.0	100.0	0.0	0.0	2(3.7)	
Christian	NA	NA	NA	NA	NA	
Others	NA	NA	NA	NA	NA	
Caste						
SC	52.8	0.0	52.8	0.0	5(6.9)	X²=29.903 P=0.0005 **
ST	12.1	0.0	12.1	0.0	18(26.8)	
OBC	37.7	37.7	0.0	0.0	19(28.2)	
None	63.4	36.6	9.7	17.2	25(38.1)	
Others						
Education level						
No education	39.6	10.5	10.5	18.6	23(35.2)	X²=15.303 P=0.0829 NS
Primary	27.3	27.3	0.0	0.0	9(13.5)	
Secondary	50.5	36.0	14.5	0.0	32(47.7)	
Higher	0.0	0.0	0.0	0.0	2(3.7)	
Wealth index						
Poorest	41.4	25.3	0.0	16.2	27(40.5)	X²=39.153 P<.0001 **
Poorer	43.6	14.6	29.0	0.0	17(25.3)	
Middle	20.9	20.9	0.0	0.0	12(17.5)	
Richer	51.8	51.8	0.0	0.0	9(13.4)	
Richest	100.0	0.0	100.0	0.0	2(3.2)	
Occupation						
Not working	31.6	13.3	12.4	5.9	37(55.4)	X²=13.749 P=0.0326 *
Professional	NA	NA	NA	NA	NA	
Clerical	NA	NA	NA	NA	NA	
Sales	NA	NA	NA	NA	NA	
Agricultural	54.2	38.6	8.3	7.3	29(44.6)	
services	NA	NA	NA	NA	NA	
Skilled & unskilled manual	NA	NA	NA	NA	NA	
Age of woman(in years)						
15	11.9	11.9	0.0	0.0	18(27.4)	X²=28.371 P=0.0008 **
16	0.0	0.0	0.0	0.0	2(3.7)	
17	50.9	50.9	0.0	0.0	18(27.3)	
18	58.8	17.7	25.4	15.7	28(41.7)	
19	NA	NA	NA	NA	NA	
Age of woman at first birth(in years)						
10 -13	100.0	0.0	100.0	0.0	2(7.6)	X²=41.616 P=0.0003 **
14 – 16	30.6	20.1	10.6	0.0	23(71.4)	
17 – 19	68.2	36.1	0.0	32.1	7(21.0)	
BMI status						
Moderate thinness	25.0	0.0	0.0	25.0	9(13.1)	X²=12.255 P=0.0565 *
Mild thinness	40.1	20.1	10.6	9.4	23(34.7)	
Normal	46.8	33.6	13.2	0.0	35(52.2)	
Overweight	NA	NA	NA	NA		
Total	43.7	22.5	15.6	5.6		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant, NA=not available.						

Source. NFHS-2

response on when they had their first child. Among these adolescent girls, majority (71.4 %) gave birth to their first child between the ages 14-16 years, which indicates that adolescent marriages are high in this district. Results of anthropometry data showed that more than half of the girls had a normal BMI (52.2%) and the rest were either mildly thin (34.7%) or moderately thin (13.1%). None of them were overweight or obese. This result indicates that under-nutrition is the major problem among these adolescent girls in this study district.

4.4.5.2. Prevalence of anaemia adolescent girls (15-49 years) in Solapur district during NFHS-2

The overall prevalence of anaemia among the adolescent girls in this district was 43.7 percent of which 22.5, 15.6 and 5.6 percent were mildly, moderately and severely anaemic, respectively. Similar findings were reported in Egypt-2005 DHS (44.9 %) and Tanzania -2010 DHS (42.2 %) by Yasutake *et al*., (2013). Bharati *et al*., (2009**)** reported higher prevalence in Sikkim (76.2 %), Kerala (85.7 %) and lower prevalence (31.6 %) in Manipur adolescent girls.

4.4.5.3. Association of anaemia and background characteristics in adolescent girl

Table.4.4.7 shows a significant association (p<0.05) of anaemia prevalence with almost all socio-economic and demographic variables included in the study except for residence and education.

4.4.5.3.1. Socio-economic factors

Though residence was not significant in influencing anaemia prevalence among this population, a higher prevalence was found in rural adolescent girls (44.1 %) as compared to urban adolescent girls (25.0 %). Just like in most studies, the present study shows variations in prevalence based on residence with rural adolescent girls being more anaemic than their urban counterparts. However, IIPS and MoHFW (2006) which was conducted in 2002-2004 showed equal prevalence of any type of anaemia in both urban and rural adolescent girls in India (97.8 %) which was higher than our current study. In the same survey, it was reported that rural adolescent girls had a stronger association with severe anaemia compared to their urban counterparts (27.9% Vs 25.6%) which is similar to our present study (7.5 % Vs 0 **%).** Sudha-Rani and Suryaprabha (2013**)** reported contradicting results with urban adolescent girls having a higher association with severe anaemia (8.4 %) as compared to their counterparts in the rural areas (3.4 %).

All the girls of Muslim faith were found to be mildly anaemic (100 %) and though the Hindu girls showed a lower prevalence of anaemia (39.4 %), there was a stronger association with severe anaemia (6.8 %) which was not found among the Muslim girls and the difference was significant (p=0.0507). Sudha-Rani and Suryaprabha (2013) found no significant association between religion and anaemia among adolescent girls.

The results of this study showed a higher prevalence of anaemia among adolescent girls who attained secondary level of education as compared to those who attained primary education level (27.3 %) or without any formal education (39.6 %). Bharati *et al*. (2009) reported similar findings with a slightly higher prevalence of anaemia among adolescent girls with 10 years and above of schooling (89.9 %) as compared to those with 9 years of schooling (89.7 %), and the least prevalence was among the illiterate adolescent girls (89.2 %). This result could be due to other socio-factors like acceptance and practice of the acquired knowledge which is very necessary if education is to have an impact in preventing or lowering anaemia prevalence. This result is contradicting most studies which report anaemia prevalence to decrease with increase in educational level (IIPS and Macro, 2007, Sudha-Rani and Suryarabha, 2013 and Miah *et al*., 2014).

This study also found anaemia prevalence highest among the well to do households, i.e. richest (100 %) who were all moderately anaemic and richer (51.8 %) who were all mildly anaemic and this association was significant (p<0.0001). Similar results were reported in Nepal- 2011 DHS and Haiti-2005-06 DHS where the girls from the well do families had higher prevalence of anaemia as compared to the girls from the poorer and poorest households (Yasutake *et al*., 2013).

However adolescent girls from the poorest households in this study had the strongest association with severe anaemia (16.2 %) where none of the girls from the other households were found to be severely anaemic. Bharati *et al.* (2009) reported that adolescent girls with low standard of living index had the highest association with severe anaemia (10.8 %), just as the current study.

Agricultural work showed a higher association with anaemia among the adolescent girls (54.2 %) as compared to the girls who were not working (31.6 %) and this association was found to be statistically significant. Gupta *et al* (2012) reported a higher prevalence among the adolescent girls who were employed as compared to the unemployed.

4.4.5.3.2. Demographic and nutritional factors

Anaemia prevalence was also found to increase with increase in age of the girl from 11.9 percent among girls who were 15 years of age to 58.8 percent among 18 year old girls who also showed a strong association with severe anaemia with a prevalence of 15.7 percent. Similar findings of anaemia increase with increase in age were reported by Bharati *et al.* (2009) in northern and eastern districts and states in India with an increase from 10.7 percent severe anaemia among 15 year old adolescent girls to 11.3 percent among 19 year old adolescent girls. Rajaratnam *et al*. (2000) in Tamil Nadu and Verma *et al.* (2014) in Haryana reported similar results for adolescent girls.

All the girls who gave birth in early adolescence were moderately anaemic and 68.2 percent of the adolescent girls who gave birth between the age 17-19 years showed a stronger association with severe anaemia (32.1 %) and the association was significant (p=0.0003).

Results from this study also show that the least prevalence of anaemia was with girls who were moderately thin (25.0 %) as compared to those who had a normal BMI (46.8 %). This result is contradictory to Kappala *et al*. (2014) where thin adolescent girls were more anaemic as compared to girls with a normal BMI. This result indicates that having a normal BMI did not protect the girls from anaemia, hence, other factors like the quality of food consumed are very vital in maintaining Haemoglobin levels. However, thin adolescent girls showed an association with severe anaemia where as none of the girls with a normal BMI were severely anaemic (Figure.4.4.11).

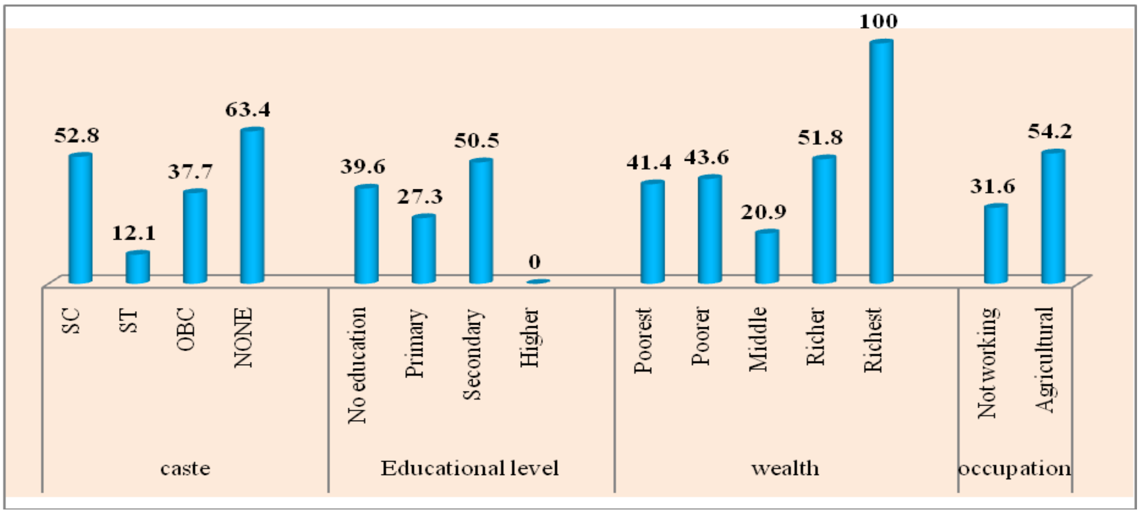


Figure.4.4. 10.Percentage of anaemia among adolescent girls in Solapur district by caste, educational level, wealth and occupation during 1998/99.

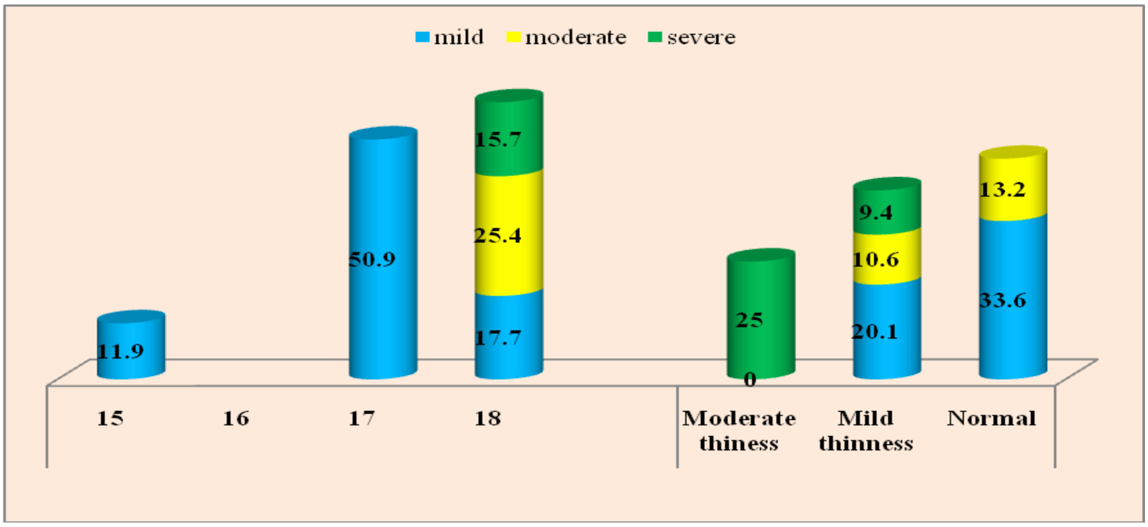


Figure.4.4. 11.Percentage severity of anaemia among adolescent girls (15-19 years) in Solapur district based on age and BMI during 1998/99.

4.4.5.4. Determinants of anaemia among adolescent girls in Solapur district during NFHS-2

All socio-economic and demographic variables were regressed and results of the findings presented below. Though bivariate analysis found a significant association between anaemia prevalence and religion, age at first birth and occupation, multivariate analysis did not find those mentioned variables to have any influence on severity of anaemia but found age, BMI, caste and wealth to have a significant net effect in determining anaemia among adolescent girls in Solapur district during 1998/99 survey.

Anaemia increased with increase in age. Decrease in age of the girl decreased severity of anaemia by 68.7 percent. Older adolescent girls (18 years) had RR of 1.99 times of being severely anaemic (15.7 %) as compared to the younger adolescent girls where none were found to be severely anaemic. Bharati *et al* (2009) and Kappala *et al.* (2014) indicated that older adolescent girls had higher odds of being severely anaemic as compared to younger adolescent girls.

BMI status of the girl was positively correlated with severity of anaemia. Figure.4.4.11 shows severe anaemia was highest among moderately thin adolescent girls (25.0%) and decreased with improvement in BMI status toward normal where none of the girls with a normal BMI was found to be severely anaemic. Severe anaemia increased by 60.2 percent among moderately thin adolescent girls and increased by 12.6 percent among mildly thin adolescent girls as compared to their counterparts with a normal BMI. Moderately thin girls were at 0.55 times RR of being anaemic while the mildly thin adolescent girls were at a 0.88 times RR of being anaemic as compared to their counterparts with a normal BMI. This could be due to poor food habits and ignorance on proper nutrition which can result in “Hidden hunger” with iron, vitamin B_{12} and vitamin C deficiency, thus causing anaemia among the adolescent girls with a normal BMI.

Table.4.4. 8.Results of ordinal logistic regression on prevalence of anaemia among adolescent girls in Solapur district during 1998/99

Solapur				
Variable	1998-1999			
	Estimates	S.E	Significance	(RR)
Residence				
Urban Rural	0.0619 RC	1.018	0.543	-
Religion				
Hindu Muslim Christian None	1.167 RC	1.185	0.324	-
Age of woman	**-0.687**	**0.328**	**0.036***	**1.99**
Age at first birth	0.043	0.267	0.872	-
BMI				
Moderate- T Mild- T Normal	**0.602** **0.126** **RC**	**0.133** **0.014**	**0.038**** **0.003****	**0.55** **0.88**
Caste				
SC ST OBC None	0.223 **1.999** 0.861 **RC**	1.027 **0.899** 0.711	0.828 **0.045*** 0.226	- **0.14** -
Wealth				
Poorest Poorer Middle Richer Richest	**2.260** **2.191** **3.208** 2.160 **RC**	**1.03** **0.995** **1.550** 1.377	**0.017*** **0.010*** **0.038*** 0.117	**0.10** **0.11** **0.04** -
Occupation				
Not working Professional Clerical Sales. Agricultural self-employed Agricultural employed	0.826 NA NA NA 0.547 RC	0.642 NA NA NA 0.847	0198 NA NA NA 0.519	- -
*= significant at 5%, **= significant at 1%,S.E= Standard Error, RC= Reference category, Moderate-T=Moderate thinness, Mild-T=Mild thinness, (-)=not applicable, NA=not available, RR= relative risk				

Source. NFHS-2.

Caste was positively correlated with severity of anaemia among adolescent girls. Girls from ST caste had the least prevalence of anaemia (12.1 %) with none being severely anaemic. They had a 0.14 times RR of being anaemic in comparison to their counterparts who did not belong to any of the disadvantaged castes where severe anaemia was highest (17.2 %). This can be accountable to government programmes with a mission to uplift status of adolescent girls from low castes which have successfully provided awareness through knowledge sharing and encouraging school enrolment and retention. This result is contradictory to studies where anaemia was highest among the ST and SC caste groups as they are the most disadvantaged in terms of access to quality resources (IIPS and MoHFW, 2006, Bharati *et al.*, 2009 and Ramesh and Lopamudra, 2010).

Wealth was found to be positively correlated with anaemia. Severe anaemia decreased with increase in household wealth from which the adolescent girl lived. The relative risk of being anaemic was 0.10 times, 0.11 times and 0.04 times among adolescent girls from poorest, poorer and middle class households. This finding indicates that belonging to poorer and poorer households increases the risk of severe anaemia among adolescent girls. UNFPA (2013) also reported girls from disadvantaged (poorest and poorer) households are married off at an early age.

4.4.6 Akola district

In this district, the sample size of the girls in this age bracket (15-19) was too small so analysis was not performed as it is not a statistically acceptable number (<10) since conclusions cannot be made from it.

4.4.7. Maharashtra State (1998/99)

4.4.7.1. Profile of adolescent girls in Maharashtra State during NFHS-2

In this state, data on 759 adolescent girls was included in the analysis. Among these, 73.8 percent of the adolescent girls were occupying rural Maharashtra and the remaining 26.2 percent urban part of the state. Most of the girls (84.2 %) were of Hindu religion, Table.4.4.9 shows that 19.0, 14.4 and 13.5 percent belonged to OBC, ST and SC, respectively. More than 50 percent of the girls belonged to none of the above castes. The study also shows that (37.8 %) of the girls did not have any formal education and the remaining had formal education at different levels (20.8 %, 39.0 % and 2.4 %) representing primary, secondary and higher education level. Among girls included in the study, (30 %) were from the middle class family, (35.2 %) belonged to the poorer or poorest class and (34 %) belonged to the richer or richest class (Table.4.4.9). A high number of the girls were not working (45.2 %) and among those who were working, almost half of the girls were involved in agricultural work (49.1%).

Table.4.4. 9.Percentage association of anaemia among adolescent girls aged (15-19 years) with socio-economic and demographic variables in Maharashtra state during 1998/99

Background characteristics	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls (%)	Chi-square & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	53.2	36.1	15.2	1.9	199(26.2)	X²=6.4813 P=0.0904 NS
Rural	57.0	35.8	14.6	6.5	560(73.8)	
Religion						
Hindu	57.5	37.1	15.3	5.1	640(84.2)	X²=36.820 P=0.0055 **
Muslim	47.6	34.9	11.3	1.4	78(10.2)	
Christian	39.1	19.6	19.5	0.0	3(0.4)	
Others	48.6	18.3	13.3	17.0	39(5.2)	
Caste						
SC	55.4	32.2	18.8	4.4	102(13.5)	X²=20.303 P=0.0161 *
ST	70.7	40.2	24.5	6.0	110(14.4)	
OBC	52.4	36.5	12.8	3.1	144(19.0)	
None	53.4	35.4	11.9	6.2	403(53.1)	
Others						
Education level						
No education	57.7	31.6	18.2	8.0	287(37.8)	X²=16.256 P=0.0617 NS
Primary	58.6	38.9	13.7	6.1	158(20.8)	
Secondary	53.2	38.5	12.1	2.6	296(39.0)	
Higher	49.7	34.3	15.4	0.0	18(2.4)	
Wealth index						
Poorest	67.9	39.2	17.4	11.3	137(18.0)	X²=40.553 P<.0001 **
Poorer	64.4	36.9	20.1	7.4	130(17.2)	
Middle	47.8	33.8	9.7	4.3	229(30.2)	
Richer	50.5	31.3	17.9	1.2	173(22.7)	
Richest	56.9	43.1	10.2	3.6	91(11.9)	
Occupation						
Not working	52.1	32.2	16.3	3.6	342(45.2)	X²=44.984 P=0.0017 **
Professional	0.0	0.0	0.0	0.0		
clerical	NA	NA	NA	NA	NA	
Sales	NA	NA	NA	NA	NA	
Agricultural	57.8	37.7	14.6	5.5	372(49.1)	
services	100.0	0.0	100.0	0.0	1(100)	
Domestic	55.2	55.2	0.0	0.0	4(0.5)	
Skilled & unskilled manual	69.8	46.5	4.2	19.1	39(5.1)	
Age of woman(in years)						
15	50.2	27.0	12.9	10.3	88(11.5)	X²=24.384 P=0.018 *
16	52.4	36.7	11.2	4.4	104(13.7)	
17	50.8	31.9	18.4	0.4	126(16.6)	
18	64.4	43.1	15.0	6.3	227(29.8)	
19	54.1	33.7	14.9	5.5	215(28.3)	
Age of woman at first birth(in years)						
10 -13	62.8	37.2	25.6	0.0	18(4.5)	X²=35.030 P=0.0094 **
14 – 16	60.8	31.9	20.9	8.0	241(58.6)	
17 – 19	59.8	44.5	10.7	4.6	152(37.0)	
BMI status						
Moderate thinness	51.9	39.2	8.0	4.7	144(19.0)	X²=11.664 P=0.2329 NS
Mild thinness	61.4	38.5	16.6	6.3	220(29.0)	
Normal	54.8	33.5	16.4	4.9	389(51.3)	
Overweight	32.7	16.1	8.3	8.3	6(0.9)	
Total	**54.9**	**33.5**	**16.4**	**5.1**		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant, NA=Not Available.						

Source. NFHS-2

The remaining girls were involved in skilled/unskilled manual labour (5.1 %), household/domestic (0.5 %) and service sector. None of the girls had professional employment.

Majority of the girls were between the ages 18 and 19 years represented by (29.8 % and 28.3 %) respectively. Among these girls, only 411 adolescent girls responded to the query regarding when they had their first child. Majority of the girls had their first child between the ages 14-16 years (mid-adolescence), 37.0 percent during 17-19 years and only 4.5 percent in early adolescence (10-13 years). Majority of the girls also had a normal BMI (51.3 %) and the remaining were malnourished (Table.4.4.9).

4.4.7.2. Prevalence of anaemia adolescent girls in Maharashtra State during NFHS-2

The overall prevalence of anaemia in Maharashtra state among adolescent girls (15-19) years during 1998/99 survey was 54.9 percent of which 33.5 percent were mildly anaemic, 16.4 percent were moderately anaemic and 5.1 percent were severely anaemic. The findings were in accordance with Verma *et al*. (2014) who reported a prevalence of 55.8 percent among girls of the same age bracket. Vankundre (2011) and Purnia *et al*. (2011) reported lower prevalence of 43.5 percent and 40 percent respectively. However Kakkar *et al.* (2011) and Santanu *et al*. (2012) reported a higher prevalence of anaemia among adolescent girls (58.4 percent and 71.5 percent).

4.4.7.3. Association of anaemia and background characteristics in adolescent girls

Results from Table.4.4.9 show a significant association (P<0.05) of prevalence of anaemia in adolescent girls (15-19) years in Maharashtra state during 1998/99 survey with most of the socio-economic and demographic variables except for residence, education and BMI.

4.4.7.3.1. Socio- economic factors

Though residence was found not significant in influencing prevalence of anaemia, a higher prevalence of (57.0 %) was found among adolescent girls in rural Maharashtra as compared to (53.2 %) among those in urban Maharashtra. Similar prevalence of anaemia in rural adolescents was reported in Dharwad taluka (57.8 %) which was higher than prevalence among urban adolescents (31.3 %) as reported by Akkamahadevi *et al*. (1998).

Religion was found to significantly influence the prevalence of anaemia in this study population with the highest prevalence being among Hindu girls (57.5 %) and this could be due to their vegetarian culture coupled with other biological and physiological conditions like menstruation and pregnancy. The lowest prevalence of anaemia was observed among Christian girls (39.1 %) indicating that among these girls, anaemia is not a severe threat as it is below 40 percent as per WHO definition of public health problems. Similar result was reported by Bharati *et al*. (2006) with a lower prevalence of anaemia among Christian girls in the northern and eastern state using DLHS-RCH of 2002-2004. This could be because the survey might have been conducted in a period when the Christians were not on religious fast, hence they would be consuming all meats which are good sources of easily absorbable iron

Anaemia prevalence was significantly with ST sect, Hindu religion, poorer and poorest households. Bharati *et al*. (2009) also reported the lowest prevalence among Christian adolescent girls just like the current study. This could be because the survey might have been conducted when the Christians were not a religious fast hence allowed to consume all sorts of meat which is a good source of easily absorbable iron.

Similar to education, increased wealth of a household has been associated with improved access to facilities like food and medical facilities which in turn should reduce the prevalence of anaemia. The study results showed a positive direction with improved wealth; however the least prevalence of anaemia was in girls who belonged to the middle class (47.8 %) as compared to those from the richer (50.5 %) and richest (56.9 %) classes. This indicates that wealth alone is not enough to curb the problem of anaemia prevalence. Other factors like number of children, age at first birth, length of menarche, occupation, feeding habits like (time of eating, number of meals a day, quality of food) and lack of balanced meals on top of genetic factors can be a reason for the high prevalence of anaemia despite increased wealth. Deshpande *et al*. (2013) reported similar findings with the least prevalence of anaemia among adolescent girls from socio-economic class II with a prevalence of 43.3 percent and 1 percent severe anaemia and the highest prevalence was in socio-economic classes IV and V with a prevalence of 83.3 percent of which 2 percent were severely anaemic.

A higher prevalence (>60 %) was seen among those involved in service jobs (100 %), skilled and unskilled manual work (69.8 %), as compared to the girls who were not working (52.1 %) which was the lowest prevalence among all occupations. This result can be attributed to the fact that non-working adolescent girls have time to attend the educational programme trainings in which knowledge to benefit adolescent health is disseminated. The timing of these programmes is always during the day when adolescent girls with occupations are busy with work hence do not have a chance to attend.

4.4.7.3.2. Demographic and nutritional factors

Age 18 years showed the strongest association with anaemia prevalence with prevalence of 64.4 percent at any degree but age 15 years showed a strongest association with severe anaemia (10.3 %) compared to all other ages. This association was found significant ($p<0.05$). This result is in-line with findings from Sidhu *et al*. (2005) who reported a prevalence of 12.83 percent severe anaemia being highest among adolescent girls in the age of 15 years. This is because at this time, growth is rapid which slows down as adolescence progresses. With the increased body size, comes an increase in blood volume.

Age at first delivery is very crucial and a big contributing factor to anaemia prevalence in a woman's life. First delivery during adolescence (<20 years) showed a strong association with high prevalence of anaemia (>59.0 %) which was also significant ($p<0.0094$). However, the age group of 10-13 years showed a higher prevalence of 62.8 percent compared to other age brackets and it is because at this stage in adolescence, the body of the girl is at its initial stages of maturity and demand of nutrients with heightened hormones due to pregnancy taxes the body with a great demand for iron resulting in anaemia. The slightly lower levels of anaemia during 17-19 years are due to a more maturely developed reproductive system and also greater responsibility as the girls are older and better prepared to care for themselves than in early adolescence.

Anaemia prevalence was also highest among the girls who were mildly thin (61.4 %) as compared to those who were moderately thin (51.9 %). Results also show the least prevalence of anaemia in overweight girls (32.7 %) compared to the normal girls (54.8 %).

4.4.7.3.4. Determinants of anaemia in adolescent girls in Maharashtra State during NFHS-2

All the socio-economic and demographic variables were regressed. Though multivariate analysis found BMI and caste not significantly associated with anaemia prevalence, multivariate analysis found the two to have a net influence on anaemia severity including all other variables except for residence, education of the girl.

Religion was negatively associated with severity of anaemia. Anaemia increased by 40.0 percent and 23.2 percent among the Hindu and Muslim girls respectively. In comparison to adolescent girls who belonged to other religions (other than the three mention in Table 4.4.11), the RR of being anaemic was highest among the Hindu girls (RR=1.49 times) and (RR=1.26 times) among the Muslim girls. This difference could be due to variations in religious beliefs which include intense fasting among Muslims, vegetarianism among the Hindus and early marriages in both religions.

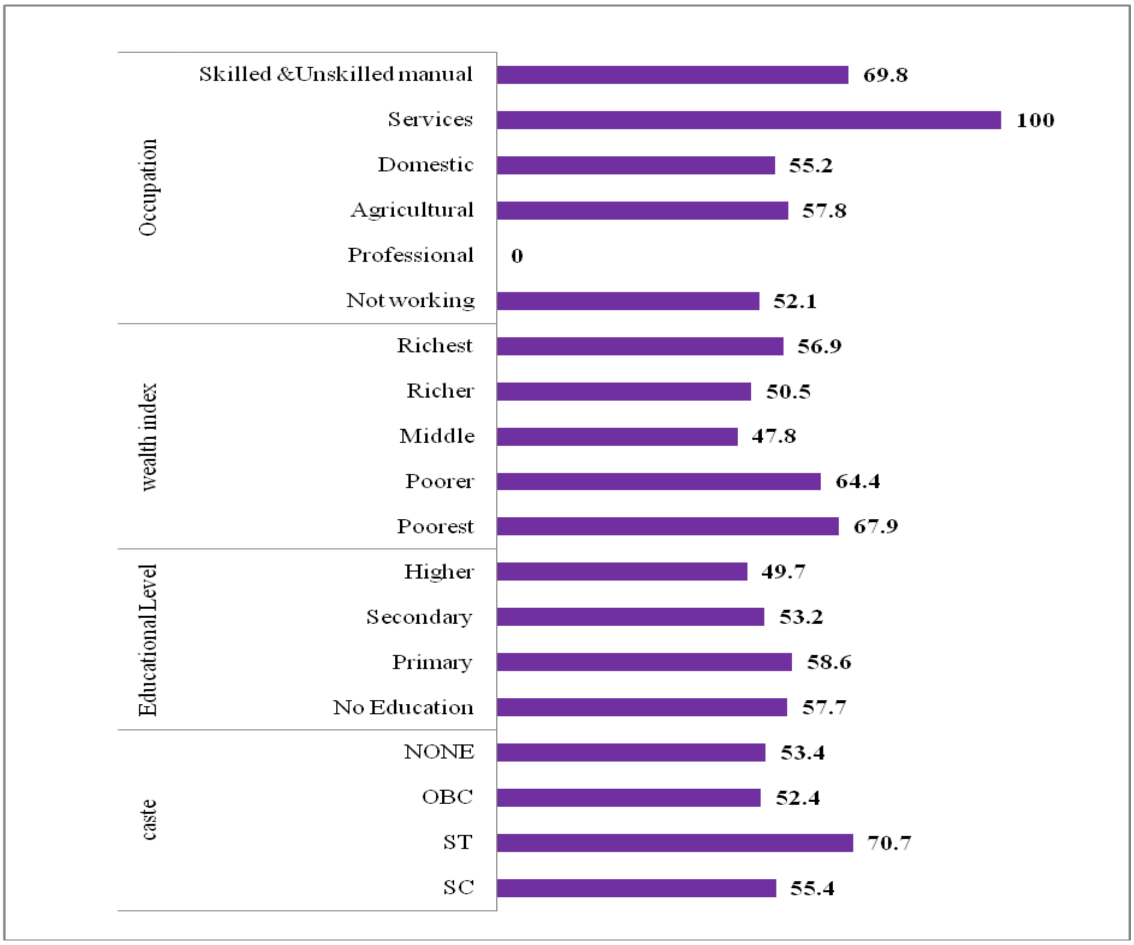


Figure.4.4. 12.Anaemia prevalence i adolescent girls (15-19 years) in Maharashtra state by caste, educational level, wealth and occupation during 1998/99

Age of the adolescent girl was negatively associated with severity of anaemia. Severe anaemia decreased with increase in age of the girl by 2.1 percent. The relative risk of being severely anaemic among these adolescent girls was 1.02 times.

Age at first birth was positively correlated with severity of anaemia. An inverse relationship was found with age at first childbirth and anaemia, where decrease in age at first birth increased severity of anaemia by 48.0 percent among the adolescent girls. Adolescent girls who gave birth at an earlier age were 0.62 times at a risk of being anaemic as compared to those who gave birth at an older age when the body has matured more to prepare to reproduction. Adolescent girls with normal BMI had a 0.78 times RR of being severely anaemic compared to their counterparts who were overweight (RR=1.28 times).

Registration with SC and ST caste was significant in determining severity of anaemia. Adolescent girls from ST had a higher RR of 1.55 times of being anaemic and the girls with SC registration had a 0.82 times relative risk of being anaemic as compared to their counterparts from other castes. This is because these two sectors are among the most disadvantaged groups socially, with limited access to resources despite the government's effort to uplift their status, implementation of the programmes meant to achieve this are poorly managed, resulting in a failure to achieve the objectives of most of these programmes. Ramesh and Lopamudra (2010**)** reported similar finding in DHLS-RCH. 2002-2004.

Result of Table.4.4.11 shows that wealth was negatively correlated with severity of anaemia. In comparison to the adolescent girls from the richest households, adolescent girls from the poorest and poorer households had a relative risk of 1.71 times and 1.55 times being anaemic respectively. This is because with limited resources comes limited allocation of money to feeding and education. Also, poverty can force these girls into early marriage so that the burden of their care is shifted to another family irrespective of their age. In this state, more than half (58.6 %) of the girls had their first child between 14-16 years which could have been due to poverty forcing them into early marriage.

Lack of an occupation among the adolescent girls (not working) was negatively correlated with anaemia prevalence. The adolescent girls who were not working had a 1.78 times RR of being anaemic in comparison to the adolescent girls who were employed in the unskilled manual sector (RR=0.56 times). This result indicates the protective role that employment plays in uplifting the situation of adolescent girls and protecting against malnutrition in any form as they are in position to make decisions on food consumption and other aspects like medical care directly related to their lives.

4.4.7.5. Comparison between Solapur and Maharashtra during 1998/99 survey

Figure.4.4.13 shows anaemia prevalence was 11.2 percent higher in Maharashtra state as compared to Solapur district but severe anaemia was 0.5 percent higher in Solapur in comparison to Maharashtra state.

Some factors were found to be determinants of anaemia in both Solapur district and Maharashtra state. These factors are caste and wealth of the household in which the girls lived. The RR of being anaemic among adolescent girls with an ST registration was 1.41 times higher among adolescent girls in maharashtra state as compared to their counterparts in solapur district. Among the girls from poorest households, the relative risk of being anaemic was 1.61 times higher in Maharshtra state as compared to the girls from the same type of household in solapur district. This could be due to lower standards of education and a higher number of girls who gave birth in late adolescence in Maharashtra state as seen figure.4.4.14.

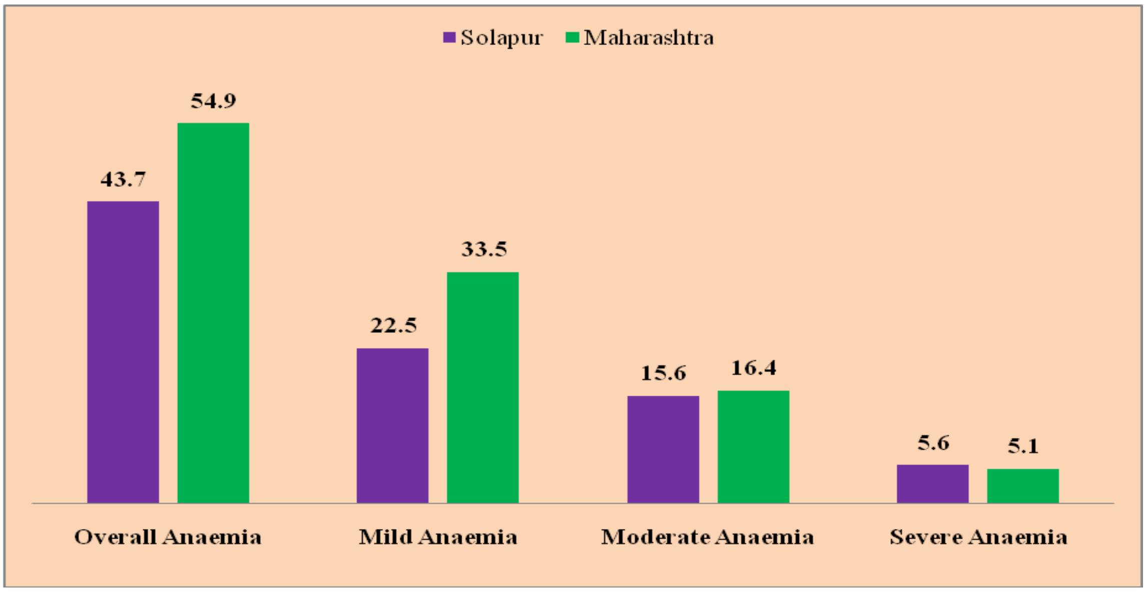


Figure.4.4. 13.Percentage prevalence of anaemia among adolescent girls (1519 years) in Solapur district and Maharashtra state during 1998/99.

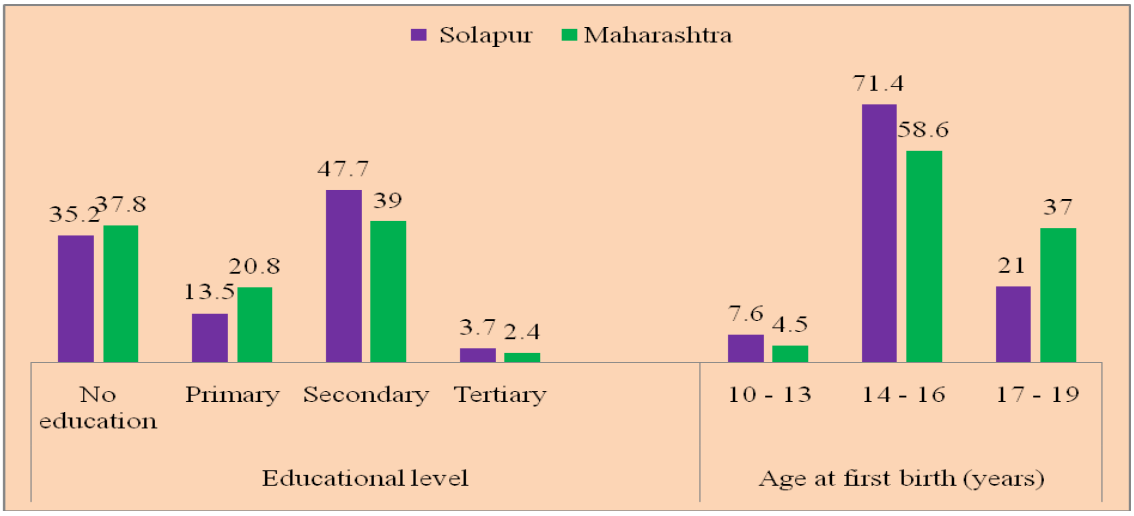


Figure.4.4. 14.Distribution of adolescent girls (15-19 years) in Solapur district and Maharashtra state by education and age at first birth during 1998/99.

4.4.8. Maharashtra State (2005/06)

4.4.8.1. Profile of adolescent girls in Maharashtra state during NFHS-3

In this survey, data on 2013 adolescent girls between the ages 15-19 years was included in the analysis. Majority of these girls (53.1 %) resided in rural part of the state and the remaining (47.0 %) resided in the urban part of the state. Majority of the girls were Hindu (76.8 %) and almost half (42.1 %) did not belong to either SC. ST or OBC.

Majority of the adolescent girls were educated at different levels (93.6 %) with most having acquired secondary education and only (6.4 %) had no formal education. Among the girls, 55.5 percent belonged to the richest and richer households while (24.3 %) belonged to poorest and poorer households. Majority of the girls were not working. Among those working, majority were employed in the agricultural sector.

Age-wise distribution was almost equal for all ages apart from 19 years who were slightly fewer (Table4.4.10). Out of adolescent girls included in the study, only 221 gave a response to the query on when they had their first child. Results in Table.4.4.10 show that majority of the girls had their first child between the ages 17-19 years (55.1 %). Majority of the girls had a normal BMI (46.2 %) while the remaining were malnourished where (50.6 %) had a BMI below normal and (2.6 %) had a BMI above normal.

4.4.8.2. Prevalence of anaemia among adolescent girls in Maharashtra state during NFHS-3

The overall prevalence of anaemia among these adolescent girls was 55.2 percent with 33.4 percent being mildly anaemic, 12.1 percent moderately anaemic and 9.3 percent severely anaemic. Ministry of health survey, Maldives reported 57 percent prevalence of anaemia among adolescent girls 15 -19 years of age in 2001 (WHO/SEAR, 2011) and Singh (2007) reported a similar prevalence of 52 percent in Indian adolescent girls. Slightly higher prevalence was reported by Kokiwar (2007) in Ranga Reddy district (83 %) and NNMB (2006) in Rajasthan (73.3%).

4.4.8.3. Association of anaemia and background characteristics in adolescent girls

Bivariate analysis using chi-square showed a significant association between anaemia prevalence and all the selected socio-economic and demographic factors except for residence and BMI status.

Table.4.4.10.Percentage association of anaemia among adolescent girls aged (15-19 years) with socio-economic and demographic variables in Maharashtra State during 2005/06

Background characteristic	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls(%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	51.4	36.2	12.0	3.2	945(47.0)	X²=5.7816 P=0.1227 NS
Rural	53.7	35.6	12.8	5.3	1068(53.1)	
Religion						
Hindu	54.4	37.3	13.0	4.1	1545(76.8)	X²=79.216 P<.0001 **
Muslim	46.2	29.9	11.0	5.4	262(13.0)	
Christian	36.7	22.8	3.4	10.5	9(0.4)	
	47.1	33.7	10.6	2.8	195(9.7)	
No religion	100.0	0.0	0.0	100.0	2(0.1)	
Caste						
SC	54.1	34.6	15.5	3.9	386(18.3)	X²=57.478 P<.0001 **
ST	72.1	46.9	16.3	9.0	231(11.5)	
OBC	48.1	35.7	10.2	2.3	565(28.1)	
None	49.7	33.6	11.5	4.6	846(42.1)	
Others						
Education level						
No education	60.5	34.9	15.0	10.6	129(6.4)	X²=31.902 P=0.0002 **
Primary	52.2	30.8	13.6	7.8	206(10.2)	
Secondary	52.0	36.0	12.3	3.6	1582(78.6)	
Higher	53.5	45.3	8.2	0.0	97(4.8)	
Wealth index						
Poorest	59.6	33.3	19.2	7.0	223(11.1)	X²=43.408 P<.0001 **
Poorer	60.2	38.7	15.5	6.0	266(13.2)	
Middle	51.8	33.4	13.7	4.7	406(20.2)	
Richer	54.2	39.5	10.6	4.1	522(25.9)	
Richest	45.7	34.0	9.3	2.5	596(29.6)	
Occupation						
Not working	49.5	34.5	11.4	3.6	126(62.7)	X²=42.186 P<.0001 **
Professional	62.8	26.4	16.3	20.2	19(10)	
clerical	100.0	53.2	30.4	0.0	10(0.5)	
Sales	62.6	45.2	17.4	0.0	13(0.7)	
Agricultural	57.3	36.5	14.5	6.2	542(26.9)	
services	49.2	34.1	14.6	0.4	36(1.8)	
Skilled & unskilled manual	58.9	45.9	10.2	2.8	131(6.5)	
Age of woman(in years)						
15	44.1	35.0	7.7	1.3	411(20.4)	X²=53.644 P<.0001 **
16	50.0	34.5	9.8	5.7	408(20.3)	
17	54.8	36.6	13.3	5.0	420(20.9)	
18	54.9	31.4	17.4	6.1	419(20.8)	
19	60.1	42.8	14.1	3.2	355(17.7)	
Age of woman at first birth(in years)						
10 -13	100.0	0.0	0.0	100.0	2(1.0)	X²=61.770 P<.0001 **
14 – 16	70.0	47.7	17.4	4.9	97(43.9)	
17 – 19	63.0	34.7	20.9	7.5	122(55.1)	
BMI status						
Moderate thinness	48.4	29.6	13.4	5.3	509(25.3)	X²=19.912 P=0.1753 NS
Mild thinness	54.9	38.6	11.2	5.1	525(25.3)	
Normal	54.1	38.0	12.8	3.4	930(46.2)	
Overweight	47.4	34.0	11.3	2.1	45(2.2)	
Obese class 1	18.7	18.7	0.0	0.0	5(0.3)	
Obese class II	0.0	0.0	0.0	0.0	1(0.1)	
Total	55.2	33.4	12.1	9.3		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant, NA=not available.						

Source. NFHS-3

4.4.8.3.1. Socio-economic factors

Results from Table.4.4.10 revealed minor differences in anaemia prevalence between adolescent girls in rural (53.7 %) and urban (51.4 %) settings though it was higher in the rural setting and was mostly due to severe anaemia (5.3 %).

Results presented in Table.4.4.10 also showed a significantly higher association of anaemia in adolescent girls of Hindu religion, ST sect, who lacked education and from poorest and poorer households (severe anaemia). National reports have reported similar findings (NMMB, 2006 and IIPS and MoHFW. 2006).

Results also showed that adolescent girls who were not working were less anaemic (49.5 %) as compared to their counterparts who were employed in different fields. These results indicate that despite the ability to earn, the adolescent girls were anaemic which could be due to low salary which is not enough to compensate for their increased needs, unpaid work and lack of enough time to prepare and eat all meals. For example, this study also found the highest association of severe anaemia with professional adolescent girls (20.2 %).

4.4.8.3.2. Demographic and nutritional factors

An inverse relation was found between age of the adolescent girl and anaemia prevalence. Anaemia prevalence increased with age from 44.1 percent among 15 year old adolescent girls to 60.1 among 19 year old adolescent girls. Sudha Rani and Suryaprabha (2013) revealed that anaemia increased with increase in age. The authors reported a high prevalence of anaemia in rural (83.3 %) and in urban adolescent girls (100 %) between 18-19 years of age in a south Indian city as compared to their younger counterparts.

Age at first birth was also significant in influencing the prevalence of anaemia among adolescent girls. Results from Table.4.4.10 revealed that anaemia prevalence was highest among adolescent girls who had their first child in early adolescence (100 %) where all were severely anaemic and decreased to 63.0 percent among adolescent girls who had their first child between 17- 19 years. The high prevalence even in late adolescence is a confirmation of anaemia as a complication which arises with adolescent pregnancy.

The same table also shows that under-nourishment had the strongest association with severe anaemia represented by (5.3 % and 5.1 %) prevalence among adolescent girls who were moderately thin and mildly thin respectively.

Under-nourishment (low BMI) had the strongest association with severe anaemia (5.3 % and 5.1 %) which continued to decrease with increase in BMI thought the association was not significant. This result indicates low BMI as a risk factor for severe anaemia among adolescent girls.

4.4.8.4. Determinants of Anaemia in Adolescent girls

All the selected variables for bivariate analysis were included in the regression model and results are presented in Table.4.4.11. Results of ordinal logistic regression show that age, age at first birth, wealth and occupation though significant in bivariate analysis, were not found significant to affect degree of anaemia.

Religion was significant and had a negative correlation with degree of anaemia among the adolescent girls. In comparison to adolescent girls who belonged to other religions, the RR of being severely anaemic was 1.59 times among Muslim adolescent girls and 1.26 times among Hindu adolescent girls. The difference in risk of anaemia could be due to the different religious norms in each religion.

BMI of the adolescent girl had a negative net effect on severity of anaemia. Adolescent girls who were moderately thin had the highest association with severe anaemia. In comparison to adolescent girls who were overweight, the RR of being severely anaemic was 2.25 times among moderately thin adolescent girls. This result is an indication that underweight (low BMI) is a risk to anaemia.

Caste was also significant in influencing severity of anaemia. Anaemia prevalence was highest among adolescent girls with ST registration who also had the highest prevalence of severe anaemia (Table.4.4.10). Results of ordinal logistic regression revealed the relative risk of being anaemic among adolescent girls with ST registration was 1.31 times and 0.79 times for adolescent girls in OBC as compared to their counterparts who belonged to other castes.

Educational level had an inverse relationship with severity of anaemia. Improvement in the educational level of adolescent girls with no formal education would decrease severity of anaemia by 42.4 percent among them. The relative risk of

Table.4.4. 11.Results of ordinal logistic regression on prevalence of anaemia among Adolescent girls in Maharashtra state during 1998 and 2005/06

Variable	1998-1999				2005-2006			
	Estimates	S.E	Significance	RR	Estimates	S.E	Significance	RR
Residence								
Urban	0.066	0.132	0.617	-	0.109	0.071	0.125	-
Rural	**RC**				**RC**			
Religion								
Hindu	-0.400	0.02	<0.0001**	1.49	-0.232	0.110	0.034*	1.26
Muslim	-0.232	0.033	0.008**	1.26	-0.466	0.127	<0.0001**	1.59
Christian	0.362	0.519	0.486	-	-0.461	0.289	0.111	-
None	**RC**				**RC**			
Age of woman	-0.21	0.049	0.66	-	-0.042	0.023	0.069	-
Age at first birth	0.03	0.057	0.563	-	0.126	0.071	0.079	-
BMI								
Moderate- T	-0.496	0.512	0.333	-	-0.812	0.217	<0.0001**	2.25
Mild- T	-0.465	0.510	0.362	-	-0.325	0.221	0.142	-
Normal	0.245	0.045	0.01*	1.28	-0.308	0.217	0.155	-
Overweight	**RC**				**RC**			
Caste								
SC	0.198	0.016	0.003**	0.82	0.096	0.091	0.290	-
ST	-0.441	0.187	0.018*	1.55	-0.271	0.110	0.014*	1.31
OBC	0.092	0.184	0.617	-	0.240	0.080	0.003**	0.79
None	**RC**				**RC**			
Educational level of woman.								
No education	0.090	0.377	0.812	-	-0.424	0.198	0.032*	1.53
Primary	0.055	0.385	0.887	-	-0.196	0.175	0.264	-
Secondary	0.370	0.377	0.327	-	-0.154	0.142	0.278	-
Higher	**RC**				**RC**			
Wealth								
Poorest	-0.537	0.230	0.020*	1.71	-0.172	0.128	0.180	-
Poorer	-0.438	0.237	0.064	-	-0.0882	0.118	0.486	-
Middle	-0.052	0.215	0.807	-	0.009	0.096	0.924	-
Richer	-0.202	0.213	0.344	-	0.014	0.081	0.863	-
Richest	**RC**				**RC**			
Occupation								
Not working	-0.095	0.821	0.908	-	-0.012	0.120	0.919	-
Professional	0.350	0.885	0.692	-	-0.150	0.274	0.583	-
Clerical	-0.361	0.801	0.652	-	-0.314	0.384	0.414	-
Sales.	NA	NA	NA	NA	-0.071	0.326	0.828	-
Agricultural self employed	0.629	0.042	0.03*	0.53	NA	NA	NA	NA
Agricultural employed	0.393	0.416	0.344	-	-0.046	0.140	0.774	-
Household	0.025	0.800	0.200	-	-0.227	0.216	0.294	-
Services	-0.278	0.806	0.730	-	**RC**			
Skilled manual	0.064	0.019	0.045*	0.94				
Unskilled manual	**RC**							
*= significant at 5%, **= significant at 1%,S.E= Standard Error, RC= Reference category, Moderate-T= Moderate thinness, Mild-T=Mild thinness, (-)=not applicable, NA=not available, RR= relative risk								

Source. NFHS-2 &3

being anaemic was 1.53 times among adolescent girls with no education as compared to their counterparts who had attained higher education level (RR=0.65 times). The higher risk of being anaemic among the adolescent girls with no education is because they lack necessary information to take better care of themselves, which is seen among adolescent girls with higher education who had a lower prevalence of anaemia, with none of the girls being severely anaemic (Table.4.4.10).

4.4.8.5. Trends in anaemia prevalence among adolescent girls between 1998 – 2006 surveys

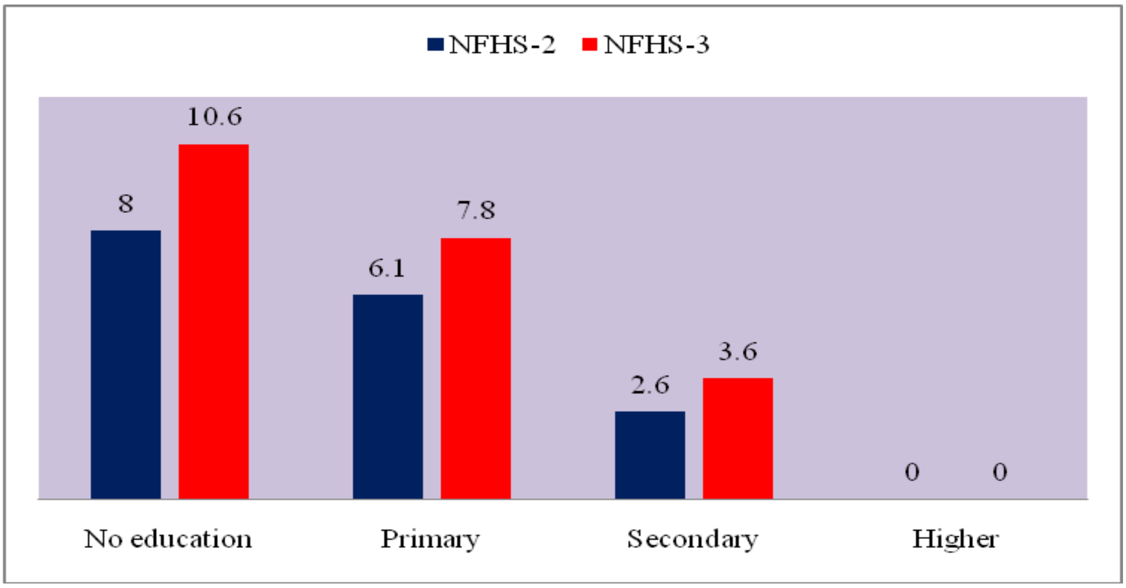


Figure.4.4. 15. Trends in prevalence of severe anaemia among adolescent girls (15-19 years) in Maharashtra state during 1998-2006 by level of education.

Figure.4.4.15 shows that severe anaemia increased among adolescent girls irrespective of educational level with an exception among adolescent girls who attained higher education in which none were severely anaemic across the years. Hence the result indicates higher education to play a protective role among the girls which could be due to more knowledge acquired which equips them to better care for themselves.

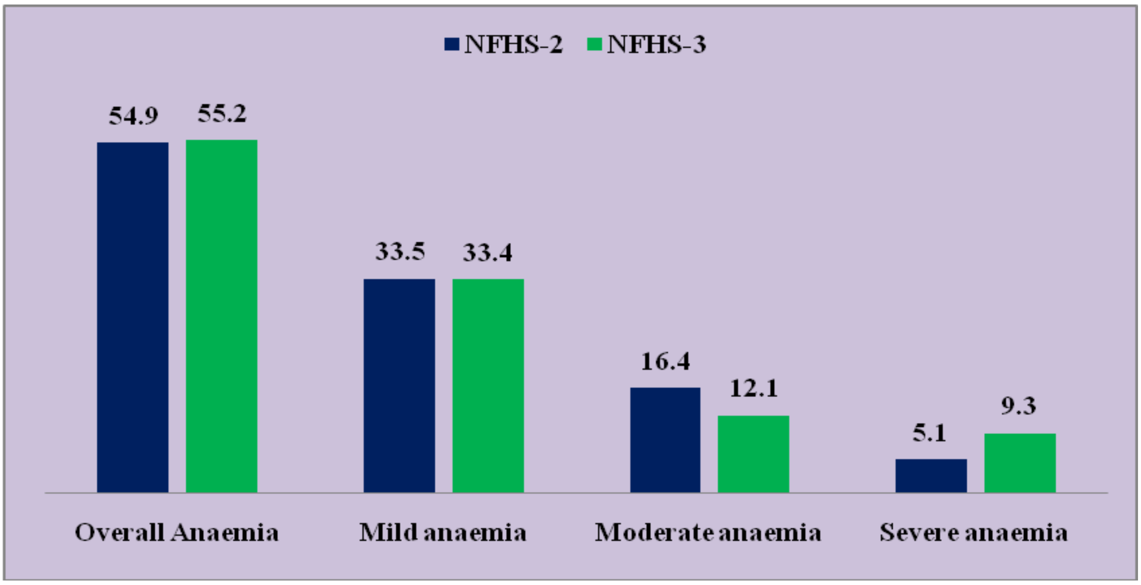


Figure.4.4. 16Trends in anaemia prevalence among adolescent girls (15-19 years) in Maharashtra state during 1998-2006.

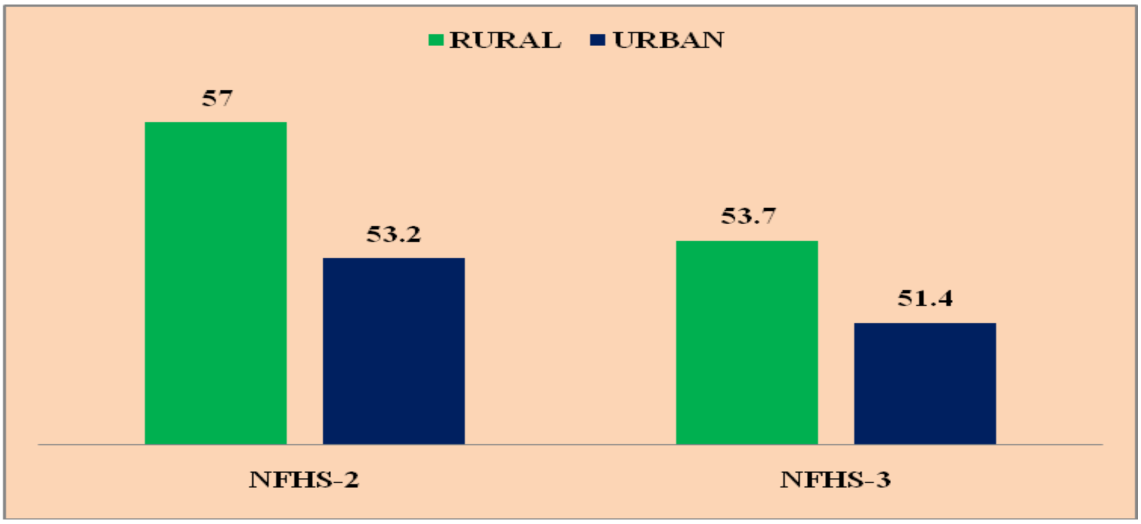


Figure.4.4. 17.Trends in anaemia prevalence by residence among adolescent girls in Maharashtra state between 1998-2006.

Figure.4.4.16 below shows a 0.3 percent increment in overall anaemia over the years. This increment was due to severe anaemia which increased by 4.2 percent in NFHS-3 between the two surveys but there a noticeable decrease in moderate anaemia by 4.3 percent in NFHS-3. The general increment could be a result of increment in adolescent girls who were not working and increment in girls who had their first child between 17-19 years of age which clearly shows that the problem of adolescent pregnancy remains a significant problem in the state with girls being married off at an early stage. However the increment of 0.3 percent is low and can be attributed to improvement in education level of the girls with better retention of girls in formal education system as seen in Table.4.4.9 and Table.4.4.10.

Figure.4.4.17 shows anaemia prevalence decreased in both urban and rural adolescent girls over the years though it remained above WHO definition of public health problem (> 40).

Across the years, some factors remained determinants of anaemia in adolescent girls in this state but with varying risks between the years. These factors include religion, ST caste. The hindu girls had a 0.23 times higher RR of being anaemic during 1998/99 survey and the muslim girls had a 0.3 times higher RR of being anaemic in 2005/06 survey. Among the adolescent girls with ST registration, there was a 0.24 times higher RR of being anaemic in the 1998/99 survey as compared to their counterparts in the 2005/06 survey.

4.4.9. Tumkur district (1998/99)

4.4.9.1. Profile of adolescent girls (15-49 years) in Tumkur district during NFHS-2

Data on 53 adolescent girls between the ages 15-19 years was included in the study. In this district, majority of the girls occupied rural Tumkur (93.7 %) and only (6.3 %) urban Tumkur. Almost all the girls were of Hindu religion (97.9 %) and the remaining few Muslim (2.1 %) with no other religions found in this population. Majority of the girls (41.8 %) had a registration with OBC, did not attain any formal education (39.7 %) but a good number of the girls had attained up to secondary education (31.2 %). In terms of wealth of the households, majority of the girls came from poorer households (35.4%) and the remaining (12.4 %, 29.3 %, 18.8 % and 4.1 %) came from the poorest, middle, richer and richest household respectively. Half of the girls in this study population were not working (50.0 %). For those employed, majority were involved in agricultural work (37.5%), the remaining (8.4 % and 4.2 %) were in sales and skilled manual labour. These differences in occupation were not significant in influencing the prevalence of anaemia.

Most of the girls were in the ages 18 and 19 years (35.4 % and 31.2 %) respectively. Out of the studied adolescent girls, only 28 girls gave information on when they had their first child. Results revealed that majority of the girls (59.7 %) gave birth to their first child in the age bracket of 17-19 years and 36.3 percent between 14-16 years. Only 4 percent gave birth in early adolescence.

Out of the adolescent girls under study, 52.2 percent had a normal BMI. The remaining girls were malnourished with mild thinness, moderate thinness or overweight (27.1 %, 16.5 % and 4.2 %) respectively. This difference in BMI status was significant in anaemia prevalence.

4.4.9.2. Prevalence of anaemia in adolescent girls in Tumkur district during NFHS-2

The overall prevalence of anaemia was 51.1 percent irrespective of severity. Mild anaemia was 22.2 percent, moderate anaemia 16.6 percent and severe anaemia 11.4 percent (figure.4.4.21). A similar prevalence of severe anaemia (10.9 percent) was reported by Bharati *et al.* (2009) among adolescent girls of the 35 selected districts in northern and eastern states of India. Yasutake *et al.* (2013) reported a similar prevalence between girls of ages 15-19 years in Guinea-2008 DHS (51.0 percent), Burkina Faso-2003 DHS (51.9 percent) and Sierra Leone- 2008 DHS (50.6 %) but Niger-2006 DHS recorded a lower prevalence than our current study (46.7 %) despite having one of the highest rates of adolescent marriages. WHO/SEARO (2011) report noted a lower prevalence of 46 percent in 2006 DHS among Nepalese adolescent girls.

Table.4.4. 12.Percentage association of anaemia among adolescent girls (15-19 years) with socio-economic and demographic variables in Tumkur district during 1998/99

Background characteristic	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls (%)	Chisquare & p-value
		Mild anaemia	Mode-rate anaemia	Severe anaemia		
Residence						
Urban	66.7	33.3	0.0	33.3	3(6.3)	X^2=3.7078 P=0.2948 NS
Rural	46.5	22.1	17.7	6.7	50(93.7)	
Religion						
Hindu	46.6	23.3	16.9	6.4	53(97.9)	X^2=12.6081 P=0.0056 **
Muslim	100.0	0.0	0.0	100.0	1(2.1)	
Christian	NA	NA	NA	NA	NA	
Others	NA	NA	NA	NA	NA	
Caste						
SC	63.1	17.9	17.9	27.3	12(22.9)	X^2=9.6772 P=0.3772 NS
ST	49.7	24.8	24.9	0.0	9(16.7)	
OBC	40.0	25.1	14.9	0.0	22(41.8)	
None	44.3	22.0	11.1	11.2	10(18.6)	
Others						
Education level						
No education	41.8	10.5	20.8	10.5	21(39.7)	X^2=10.2868 P=0.3278 NS
Primary	55.2	33.0	22.2	0.0	10(18.8)	
Secondary	60.0	40.1	13.2	6.7	17(31.2)	
Higher	20.2	0.0	0.0	20.2	6(10.4)	
Wealth index						
Poorest	49.6	0.0	33.2	16.5	7(12.4)	X^2=6.3463 P=0.8976 NS
Poorer	52.5	29.0	17.5	5.9	19(35.4)	
Middle	49.9	28.5	14.2	7.2	16(29.3)	
Richer	44.6	22.5	11.0	11.1	10(18.8)	
Richest	0.0	0.0	0.0	0.0	2(4.1)	
Occupation						
Not working	45.7	20.8	16.6	8.4	27(50.0)	X^2=9.6598 P=0.6458 NS
Professional	NA	NA	NA	NA	NA	
clerical	NA	NA	NA	NA	NA	
Sales	24.5	0.0	24.5	0.0	5(8.4)	
Agricultural	49.7	27.7	10.9	11.1	20(37.5)	
services	NA	NA	NA	NA	NA	
Skilled & unskilled manual	100.0	49.3	50.7	0.0	2(4.2)	
Age of woman(in years)						
15	33.0	0.0	33.0	0.0	3(6.2)	X^2=12.024 P=0.4438 NS
16	62.0	12.5	36.9	12.6	9(16.7)	
17	19.6	19.6	0.0	0.0	6(10.5)	
18	58.7	29.4	11.7	17.6	19(35.4)	
19	39.9	26.5	13.4	0.0	17(31.2)	
Age of woman at first birth(in years)						
10 -13	100.0	100.0	0.0	0.0	1(4.0)	X^2=26.8578 P=0.0817 NS
14 – 16	44.1	0.0	32.9	11.2	10(36.3)	
17 – 19	53.4	39.9	6.8	6.7	17(59.7)	
BMI status						
Moderate thinness	87.6	25.2	50.0	12.4	9(16.5)	X^2=18.4044 P=0.0308 *
Mild thinness	53.8	30.6	15.4	7.8	15(27.1)	
Normal	31.8	19.9	7.9	4.0	28(52.2)	
Overweight	50.4	0.0	0.0	50.4	2(4.2)	
Total	**51.1**	**22.2**	**16.6**	**11.4**		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant, NA= Not available.						

Source. NFHS-2

4.4.9.3. Association of anaemia and background characteristics in adolescent girls

In this district, most of the socio-economic and demographic variables were found not significant in influencing the prevalence of anaemia among the adolescent girls under study except for religion and BMI status of the girls.

4.4.9.3. Socio-economic factors

Much as residence was not significant in influencing anaemia prevalence among these girls, urban residence showed a higher association with anaemia (66.7 percent) as compared to rural residency in the girls (46.5 percent). Similarly, a study conducted among school girls aged 14-17 years in Kathmandu valley in Nepal confirmed that anaemia was a severe nutritional problem in adolescent girls even in urban areas where 64% of the girls are reported to be anaemic (Rikimaru *et al*., 2003). In a study undertaken by Shah and Gupta (2002) in the semi-urban setting in adolescent girls aged 11-18 years, the overall prevalence of anaemia was found to be 68.8%, with hematocrit level less than 36, as per the WHO cut off.

This could definitely be caused by dependence on junk food and influence of the western culture in the urban adolescent girls as they are available and easily accessible compared to the village setting.

As per results presented in Table.4.4.12, education, wealth and employment of the adolescent girl were found not significant in influencing anaemia prevalence.

Anaemia was found to be highest among girls with some form of employment i.e. skilled labour (100.0%) and agricultural (49.7%) as compared to unemployed adolescent girls (45.7%). This could be because these kind of employment pay less and do not allow enough time for the girls to eat their meals so they end up skipping meals to meet up with the demands of the jobs and by day break, they are too tired to cook so end up eating junk foods like bread, ‘pani-puri’ or rice and pickle which are easy to cook/ prepare. Gupta *et al*. (2012) reported similar findings.

4.4.9.3. Demographic and nutritional factors

Anaemia prevalence showed the strongest association with malnutrition (>50%). Adolescent girls with normal BMI portrayed low levels of anaemia prevalence (31.8%). Those who were moderately thin showed a higher prevalence of anaemia (87.6%) than mildly thin (53.8%) and overweight girls (50.4%). This association was significant (p=0.0308) indicating that poor nutritional status in-terms of anthropometric measures strongly influences the occurrence of anaemia in this study population. Similar results were reported by Miah *et al*. (2014) among Bangladesh adolescent girls. Simachalam *et* *al*. (2014) reported similar results in two urban slums of Hyderabad. Among the girls with < 38 kg weight, anaemia prevalence was 46.6 %, while in girls with > 38 kg it was 39.33 % and in girls with BMI > 18.5 kg/m2 it was 21%. This is because poor nutritional status especially under-nutrition predisposes the body to a series of infections due to lowered immunity.

4.4.9.4. Determinants of anaemia among adolescent girls in Tumkur district during NFHS-2

All the socio-economic and demographic variables were regressed and results of logistic regression revealed religion and BMI as the only factors found to be significant in determining the degree of anaemia among adolescent girls in Tumkur district during this study period.

Majority of the adolescent girls were Hindus. The RR of the Hindu adolescent girls being anaemic was 0.37 times as compared to the Muslim adolescent girls who were at a higher risk of being anaemic (RR= 2.73 times). This difference is attributed to the differences in religious norms and practices for each religion.

Nutritional status expressed as BMI of the adolescent girl had a positive influence on degree of anaemia among the adolescent girls. Anaemia was highest among the malnourished adolescent girls (over and under nourishment) as compared to adolescent girls with a normal BMI. Under-nourishment increased degree of anaemia by 62.3 percent among moderately thin adolescent girls and by 55.6 percent among mildly thin adolescent girls. In comparison to overweight adolescent girls, the relative risk of being anaemic was 0.54 times and 0.57 times among moderately thin and mildly thin adolescent girls respectively. Kurniawan *et al.* (2006) reported that the proportion of thinness was significantly higher among subjects who suffered from iron deficiency anaemia, with thin subjects having a 5 fold higher risk of suffering from iron deficiency anaemia than non-thin subjects.

4.4.10. Bijapur district.

4.4.10.1. Profile of the study population in 1998/99

In Bijapur district, data on 32 adolescent girls between 15-19 years was included in the study. Most of the girls were of rural residence (86.5%) and the remaining (13.5 %) lived in the urban part of the district. Majority of the girls (79.8%) were of Hindu religion, (16.9 %) Muslims and (3.3%) were Jain. No other religions were found in this group of adolescent girls.

Majority of the girls in this district did not belong to any of the discussed castes (42.5 %). The rest were either from OBC (35.8 %), SC (11.0 %) and ST (10.7 %) and the difference in these castes was not significant in affecting the prevalence of anaemia.

Table.4.4.13.Percentage association of anaemia in Adolescent girls (15-19 years) with selected Socio-economic and Demographic variables in Bijapur district during 1998/99

Variable	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with		No. of Adolescent girls (%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia		
Residence					
Urban	75.0	75.0	0.0	4(13.5)	X^2=3.2078 P=0.2011 NS
Rural	51.8	31.6	20.2	28(86.5)	
Religion					
Hindu	52.1	34.4	17.7	26(79.8)	X^2=6.8627 P=0.1433 NS
Muslim	59.7	59.7	0.0	5(16.9)	
Christian	NA	NA	NA	NA	
Others	100.0	0.0	100.0	1(3.3)	
Caste					
SC	34.4	0.0	34.4	3(11.0)	X^2=5.6561 P=0.4628 NS
ST	35.5	35.5	0.0	3(10.7)	
OBC	69.2	59.1	10.0	11(35.8)	
None	57.8	32.7	25.1	13(42.5)	
Others	NA	NA	NA	NA	
Education level					
No education	53.2	35.0	18.2	19(58.7)	X^2=3.3516 P=0.7636 NS
Primary	100.0	100.0	0.0	1(3.5)	
Secondary	59.0	39.2	19.7	11(34.4)	
Higher	0.0	0.0	0.0	1(3.5)	
Wealth index					
Poorest	0.0	0.0	0.0	3(10.2)	X^2=14.1595 P=0.0279 *
Poorer	58.7	50.6	8.2	13(40.6)	
Middle	74.1	61.5	12.6	9(27.6)	
Richer	49.2	0.0	49.2	7(21.6)	
Richest	NA	NA	NA	NA	
Occupation					
Not working	66.1	49.3	16.8	20(62.3)	X^2=8.7396 P=0.557 NS
Professional	0.0	0.0	0.0	1(3.5)	
clerical	NA	NA	NA	NA	
Sales	NA	NA	NA	NA	
Agricultural	42.3	28.4	13.9	8(23.9)	
services	0.0	0.0	0.0	1(3.3)	
Skilled & unskilled manual	52.0	0.0	52.0	2(7.0)	
Age of woman(in years)					
15	50.0	50.0	0.0	2(6.7)	X^2=4.482 P=0.8112 NS
16	100.0	66.7	33.3	3(10.4)	
17	49.0	24.7	24.3	4(14.0)	
18	45.1	27.0	18.1	12(38.7)	
19	55.8	43.9	12.0	10(30.6)	
Age of woman at first birth(in years)					
10 -13	100.0	0.0	100.0	1(8.2)	X^2=19.530 P=0.0765 NS
14 – 16	24.9	24.9	0.0	4(30.0)	
17 – 19	36.8	36.8	0.0	9(61.9)	
BMI status					
Moderate thinness	39.0	39.0	0.0	6(17.4)	X^2=1.6614 P=0.7977 NS
Mild thinness	55.9	33.6	22.3	10(30.5)	
Normal	59.8	39.3	20.4	17(52.1)	
Overweight	NA	NA	NA	NA	
Obese class 1	NA	NA	NA	NA	
total	51.7	32.7	19.0		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant, NA= Not available.					

Source. NFHS-2

More than half of the girls in this district did not have any formal education (58.7%) and the rest had some formal education at different levels that is, 34.4, 3.5 and 3.5 percent representing secondary, higher and primary education respectively.

Majority of the adolescent (40 %) girls belonged to poorer households and the rest belonged to middle and richer classes and the minority to the poorest representing 27, 21 and 10. 2 percent respectively. None of the girls belonged to the richest households.

Majority of the adolescent girls (62.3 %) were not working and 23.9% were in involved in agricultural work. Only 3.5 percent of the girls were involved in professional jobs which could be attributed to the fact that only 3.5 percent of the girls attained higher education level.

The highest percentage of girls was in the age bracket 18 and 19 years (> 30 %) and majority of the girls (61.9 %) gave birth to their first child when they were between the ages 17-19 years. More than half of the girls in this district had a normal BMI (52.1 %) and the remaining were under nourished, that is, either mildly thin (30.5 %) or moderately thin (17.4 %), but the difference in BMI was not significant in influencing the prevalence of anaemia despite the variations. None of the girls were found to be overweight or obese which indicates chronic energy deficiency as a major problem in Bijapur district.

44.10.2. Prevalence of anaemia among adolescent girls in Bijapur district during NFHS-2

The overall prevalence of anaemia was 51.7 percent at any level of which 32.7 percent were mildly anaemic and 19.0 percent were moderately anaemic. None of the girls were severely anaemic in the current study. These findings were almost in accordance with Gupta *et al.* (2012) with a prevalence of 52.8 percent among adolescent girls in Multannagar, India, and Priti *et al*. (2013) with a prevalence of 52 percent among adolescents in Nepal. Naidu *et al*. (2014) reported a very high prevalence of (85.29 percent) among adolescent girls in two urban slums in Hyderabad.

4.4.10.3. Association of anaemia and background characteristics in adolescent girls

In this study group, almost all the selected socio-economic and demographic variables were found not significant in influencing anaemia prevalence apart from wealth of the household in which the girl lived ($p<0.05$).

4.4.10.3.1. Socio-economic factors

With regard to residence, though it was found not significant in influencing anaemia prevalence. A higher prevalence of anaemia was seen in the urban adolescent girls (75.0%) as compared to the rural adolescent girls (51.8%). Kulkarni *et al*. (2012) reported a higher prevalence of 90.1 percent among urban adolescent girls with 88.6 percent being mildly anaemic.

Muslim religion showed a higher association with anaemia prevalence (59.7%) as compared to the Hindu religion (52.1%) but the difference was not significant. Vankudre *et al*. (2011) and Gupta *et al*. (2012) did not find religion significantly associated with anaemia prevalence like in the present study.

Being part of the OBC showed a higher association with anaemia prevalence (69.2%). Anaemia however was found to be lowest in the girls who belonged to the SC/ST (<40%) which indicated that anaemia is not a public health problem in the girls from this caste group. These results are unique and different from what most studies have reported with anaemia prevalence being higher among girls who belonged to the SC/ST castes as they are the less privileged (Ramesh and Lopamudra, 2010). This can be a result of implementation of some programmes meant to benefit the adolescent girls from these low castes. Therefore, it is better if all adolescent girls are treated as the same with an almost equal risk of being anaemic except for the elite class.

It is expected for anaemia prevalence to be higher in the girls without any education as they would be lacking information in taking better care of themselves. The current study however found the lower prevalence of anaemia in adolescent girls without any formal education (53.2%) as compared to those with some formal education. It was 59.0 percent among those who attended up to secondary level and 100% among those who attained only up to primary level of education. These findings are contradictory to Gupta *et al*. (2012) and Kappala *et al*. (2014) who reported highest prevalence of anaemia among the illiterate adolescent girls as compared to their counterparts with formal education, in studies carried out in other parts of India.

However, similar to this study Ramesh and Lopamudra (2010) found anaemia level to decrease with increase in formal educational level from 100% in the primary school dropouts to zero percent among those who attained higher education implicating formal education as a platform for knowledge which assists in fighting anaemia by making information on diet sources of iron, feeding habits, causes of anaemia and ways to prevent it available, understandable and more practical for the girls to take up and practice.

Table 4.4.12 also shows that anaemia was absent in girls who belonged to the poorest households as compared to richer households and the association was significant. This result is contradictory with findings from Deshpande *et al*. (2013) who found the least prevalence of anaemia among the richer and richest households and the highest prevalence among the poorest and poorer households. Findings of the current study clearly indicate that other than socio-economic factors, there are other factors like length and start of menstruation, Haemoglobinopathies, infections and illnesses like malaria not included in the analysis which could have contributed to higher anaemia prevalence among adolescent girls from households with improved wealth compared to those from the poorest households.

Although all girls had a prevalence of anaemia (>40), the highest prevalence of anaemia was among the adolescent girls who were not working (66.1 %) though nature of the girl's occupation was found not significant in influencing the prevalence of anaemia (Table 4.4.12). Gupta *et al*. (2012) reported a similar prevalence (66.67 %) as the current study among non-working adolescent girls. This could be due to lowered autonomy among these girls on what to eat as they must depend on another person to provide them with food to cook and eat since they lack money of their own and most likely do not contribute to the decisions on food purchase.

4.4.10.3.2. Demographic and nutritional factors

No significant correlation was found between age of the adolescent girl and anaemia prevalence in this study similar to Mehta *et al*. (2004) and Kotecha *et al*. (2009) in studies in other parts of India.

BMI was not significant in influencing prevalence of anaemia among the adolescent girls. Anaemia prevalence decreased with decrease in BMI. This result is contradictory to that of several studies where anaemia prevalence was reported to increase with decrease in the BMI (Roshina, 2013, Deshpande *et al*., 2013 and Kirniawan *et al*., 2013). This could be an outcome of government programmes which target under-nutrition and the incentives given to boost the growth of the adolescent girls like mid day meal in those going to school, as well as deworming to lower the infection rate.

4.4.10.4. Determinants of anaemia among adolescent girls in Bijapur district during NFHS-2

Although bivariate analysis did not find an association between anaemia and residence, multivariate analysis found a positive correlation between the two. Urban residency increased anaemia prevalence by 60.9 percent among the adolescent girls in this district. The RR of being severely anaemic was 0.54 times among urban adolescent girls in comparison to their rural counterparts (1.84 times).

In Bijapur district, wealth of the household in which the adolescent girl lived was significant in influencing anaemia prevalence. Severity of anaemia increased with increase in household wealth in which the adolescent girl lived. In comparison to the adolescent girls from the richer households, the RR of being anaemic was 0.57 times for (poorest), 0.88 times (poorer) and 1.31 times for (middle class) households. This result is contradictory to what most studies have reported and this can be attributed to lack of nutritional knowledge even among the richer households which is a big hindrance in proper feeding habits to avert the situation of anaemia among the adolescent girls.

Improvement in the employment status of the adolescent girls who are not working would decrease anaemia by (19.6 %). In comparison to the adolescent girls employed in the unskilled manual sector, adolescent girls who were not working had a 1.22 times relative risk of being anaemic. These results indicated that any form of employment would uplift the status of the girl and enable her to make decisions on what to cook and seek immediate medical attention for her ill health as she will have some money to pay for the services which is not the case with the adolescent girls who are not working

Table.4.4. 14. Results of ordinal logistic regression on prevalence of anaemia among Adolescent girls in Bijapur and Tumkur districts during 1998 and 2005/06.

Variable	**Bijapur**				**Tumkur**			
	1998-1999				**1998-1999**			
	Estimates	S.E	Significance	RR	Estimates	S.E	Significance	RR
Residence								
Urban	**0.609**	**0.36**	**0.003****	**0.54**	-0.972	0.571	0.088	-
Rural	**RC**							
Religion								
Hindu	0.220	0.552	0.691	-	**1.006**	**0.029**	**<0.0001****	**0.37**
Muslim	RC				**RC**			
Age of woman	0.102	0.170	0.504	-	0.057	0.147	0.701	-
Age at first birth	0.043	0.140	0.760	-	0.098	0.109	0.369	-
BMI								
Moderate- T	0.508	0.655	0.437	-	**0.623**	**0.241**	**0.045***	**0.54**
Mild- T	0.271	0.520	0.602	-	**0.556**	**0.111**	**0.023***	**0.57**
Normal	**RC**				1.242	0.773	0.108	-
Overweight					**RC**			
Caste								
SC	0.331	0.763	0.664	-	-0.675	0.613	0.271	-
ST	0.408	0.779	0.601	-	-0.334	0.672	0.619	-
OBC	-0.048	0.499	0.924	-	0.077	0.604	0.898	-
None	**RC**				**RC**			
Educational level of woman.								
No education	0.081	0.852	0.924	-	-0.497	0.754	0.510	-
Primary	-0.430	1.08	0.691	-	-0.625	0.816	0.444	-
Secondary	0.105	0.895	0.906	-	-0.682	0.764	0.372	-
Higher	**RC**				**RC**			
Wealth								
Poorest	**0.563**	**0.038**	**0.0001****	**0.57**	-0.435	0.943	0.644	-
Poorer	**0.127**	**0.041**	**0.045***	**0.88**	-0.299	0.86	0.730	-
Middle	**-0.271**	**0.061**	**0.035***	**1.31**	-0.123	0.891	0.891	-
Richer	**RC**				-0.210	0.918	0.819	-
Richest					**RC**			
Occupation								
Not working	**-0.196**	**0.027**	**0.007****	**1.22**	0.896	0.717	0.211	-
Professional	0.214	1.057	0.840	-	NA	NA	NA	NA
Clerical	NA	NA	NA	NA	NA	NA	NA	NA
Sales.	NA	NA	NA	NA	1.106	0.956	0.247	-
Agricultural self-employed	0.879	0.986	0.373	-	0.752	0.799	0.347	-
Agricultural employed	-0.478	0.852	0.575	-	0.724	0.773	0.349	-
Services	0.214	1.057	0.840	-				
Skilled manual					**RC**			
Unskilled manual	**RC**							
*= significant at 5%, **= significant at 1%,S.E= Standard Error, RC= Reference category, Moderate-T= Moderate thinness, Mild-T =Mild thinness, (-)=not applicable, NA=not available, RR= relative risk								

Source.NFHS-2

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4.4.10.5. Comparison between Tumkur and Bijapur districts during 1998/99 surveys

Figure.4.4.18 shows that the difference in anaemia prevalence was negligible. It was 0.6 percent higher in Bijapur district adolescent girl as compared to their counterparts in Tumkur district. Mild and moderate anaemia was higher in Bijapur adolescent girls as compared to Tumkur adolescent girls. However none of the girls in Bijapur was found with severe anaemia where as it was 11.4 percent among adolescent girls in Tumkur district.

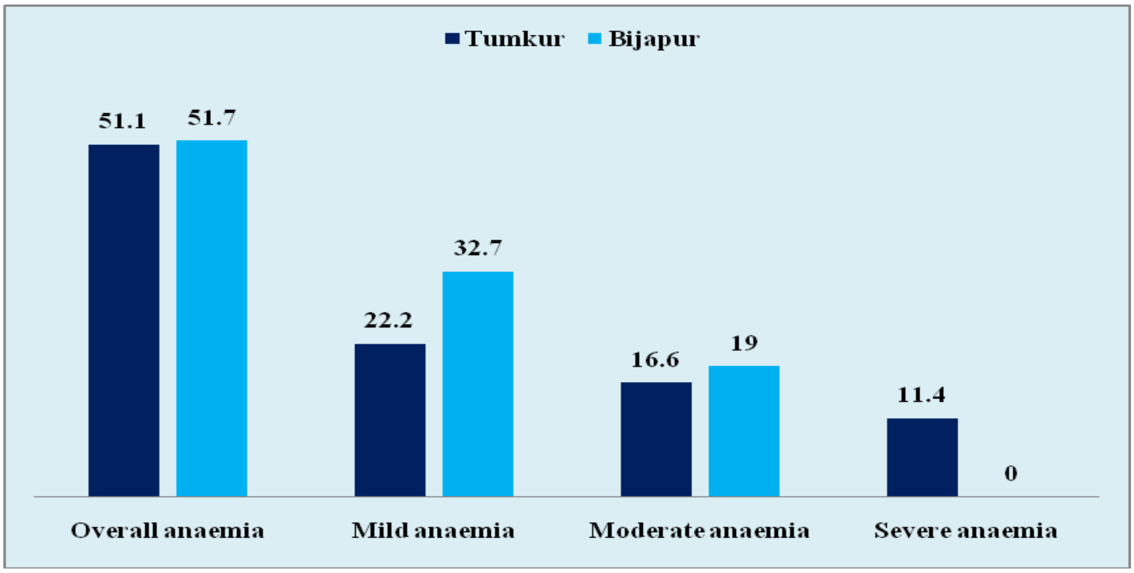

Figure.4.4. 18.Comparison in percentage of anaemia among adolescent girls (15-19 years) in Tumkur and Bijapur districts during 1998/99

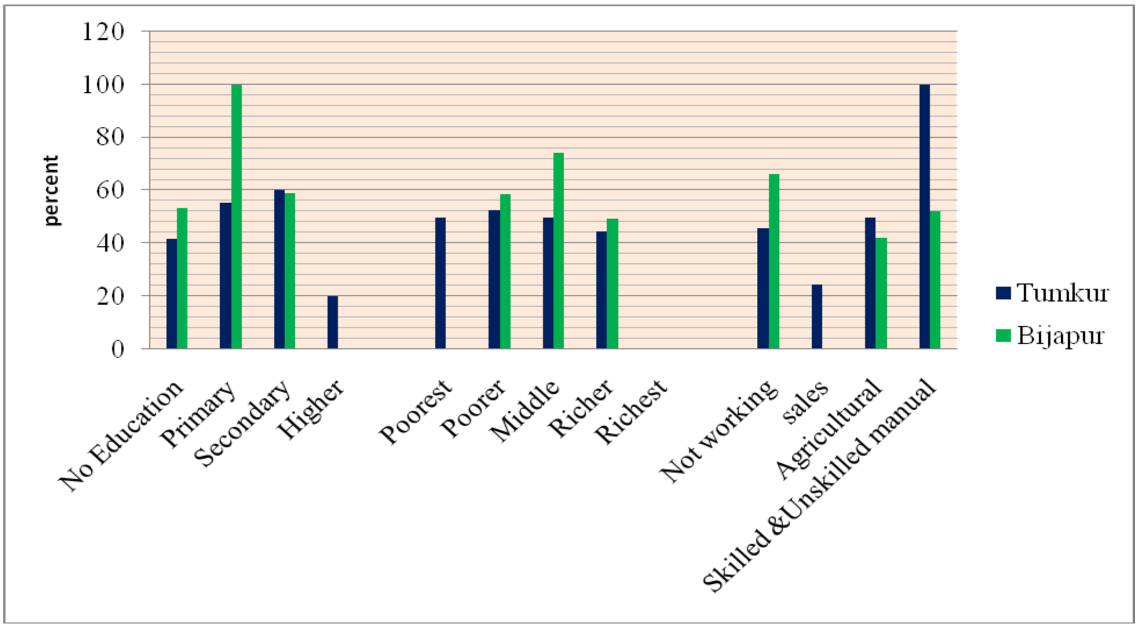

Figure.4.4.19.Comparison in prevalence of anaemia among adolescent girls (15-19 years) in Tumkur and Bijapur district during 1998/99.

Figure.4.4.19 shows the comparison between the two districts, of anaemia prevalence basing on socio-economic factors. These factors like education, wealth and occupation contributed to anaemia more in Bijapur district. However among the poorest households in Bijapur, none of the adolescent girls was found anaemic as compared to their counterparts in Tumkur district.

Between the two districts, no factors were found common in determining severity of anaemia which could be attributed to the fact that none of the girls in Bijapur district was found with severe anaemia.

4.4.11. Karnataka State

4.4.11.1. Profile of the study population in 1998/99

Data on 452 adolescent girls aged 15-19 years in Karnataka state was included in the study. Majority of these girls (77.9 %) were found living rural Karnataka and the remaining (22.1 %) were living in urban Karnataka. Majority of the girls were of Hindu religion (84.8 %) and (14.0 %) were of Muslim religion, (0.2 %) Christians and the rest were from other religions (0.1 %). Most of the girls (38.5 %) belonged to OBC, 19.7 percent were from SC and 9.0 percent were of ST caste.

Table.4.4.15 shows that 46.1 percent of the girls had no formal education and only 3.2 percent attained higher level of formal education and the rest attained primary or secondary level of the education. Most of the girls (30.8 %) belonged to households who were in the middle class according to wealth classification. The rest were from poorest, poorer, richer and richest households represented by 14.3, 26.7, 19.3 and 9.0 percent. More than half of the adolescent girls were not working (58.3 %). Of the adolescent girls working, 35.2 percent were involved in agricultural work and only 0.5

percent were in professional work which could be due to the fact that very few of the girls attained higher education level.

Age wise distribution showed that most of the girls were in the ages of 18 and 19 years represented by 29.1 and 28.4 percent, respectively (Table.4.4.15). Out of the adolescent girls included in the study, only 241 girls gave information on when they had their first child. Results of this study show that majority of the girls gave birth for the first time in mid adolescence between 14-16 years (54.9 %) followed by 17-19 years (37.8 %) and the remaining few in early adolescence between the ages 10-13 years (7.3

%). This study also found that more than half of the girls (54.3 %) had a normal BMI while (44.0 %) were suffering from chronic energy deficiency/ underweight and remaining were overweight (1.7 %).

Table.4.4. 15.Percentage association of anaemia among adolescent girls aged (15-19 years) with socio-economic and demographic variables in Karnataka state during 1998/99

Background characteristic	Percentage of Adolescent girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls (%)	Chi-square & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	55.0	41.5	11.3	2.2	100(22.1)	X^2=8.6886 P=0.0337 *
Rural	58.3	31.5	19.9	6.9	352(77.9)	
Religion						
Hindu	58.4	33.7	18.4	6.4	383(84.8)	X^2=10.779 P=0.2911 NS
Muslim	50.5	34.8	12.2	3.5	63(14.0)	
Christian	100.0	0.0	100.0	0.0	1(0.2)	
Others	75.0	25.5	49.5	0.0	4(1.0)	
Caste						
SC	65.7	35.3	16.5	14.0	87(19.7)	X^2=15.263 P=0.0839 NS
ST	50.4	25.5	19.2	5.7	40(9.0)	
OBC	56.6	34.1	18.0	4.5	171(38.5)	
None	55.1	34.0	18.1	3.0	146(32.8)	
Education level						
No education	61.3	32.8	21.2	7.4	208(46.1)	X^2=13.134 P=0.1567 NS
Primary	59.1	41.1	18.0	0.0	72(16.0)	
Secondary	53.0	31.0	15.6	6.4	157(34.7)	
Higher	46.0	38.2	0.0	7.8	14(3.2)	
Wealth index						
Poorest	61.0	32.3	23.7	5.0	64(14.3)	X^2=14.886 P=0.2477 NS
Poorer	68.1	41.7	19.9	6.5	121(26.7)	
Middle	53.1	31.7	14.3	7.1	139(30.8)	
Richer	55.0	29.4	20.4	5.1	87(19.3)	
Richest	41.9	27.8	11.4	2.7	40(9.0)	
Occupation						
Not working	54.9	32.6	15.9	6.3	26(58.3)	X^2=20.407 P=0.8133 NS
Professional	51.2	0.0	51.2	0.0	2(0.5)	
Clerical	NA	NA	NA	NA	NA	
Sales	56.2	28.3	27.9	0.0	8(1.7)	
Agricultural	63.5	38.0	19.2	6.2	159(35.2)	
services	0.0	0.0	0.0	0.0	1(0.2)	
Skilled & unskilled manual	57.4	21.9	35.6	0.0	16(3.5)	
DK	0.0	0.0	0.0	0.0	1(0.2)	
Age of woman(in years)						
15	52.0	29.5	16.0	6.5	34(7.5)	X^2=14.009 P=0.3001 NS
16	66.4	37.1	21.1	8.1	69(15.2)	
17	53.9	25.6	17.2	11.1	89(19.7)	
18	59.5	36.8	17.6	5.1	131(29.1)	
19	55.0	35.3	18.0	1.7	128(28.4)	
Age of woman at first birth(in years)						
10 -13	50.8	37.5	13.3	0.0	18(7.3)	X^2=21.189 P=0.4475 NS
14 – 16	61.6	29.9	21.7	10.0	132(54.9)	
17 – 19	49.7	31.5	14.6	3.6	91(37.8	
BMI status						
Moderate thinness	55.4	32.4	13.5	9.4	82(18.1)	X^2=7.4992 P=0.5853 NS
Mild thinness	57.5	33.0	17.9	6.6	117(25.9)	
Normal	58.4	34.1	20.2	4.1	245(54.3)	
Overweight	57.2	42.7	0.0	14.5	8(1.7)	
Obese class 1						
Total	**54.8**	**29.7**	**20.2**	**4.9**		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant.						

Source. NFHS-2

4.4.11.2. Prevalence of anaemia among adolescent girls in Karnataka state during NFHS-2

The overall prevalence of anaemia of any degree was 54.8 percent of which 29.7 percent were mildly anaemic, 20.2 percent were moderately anaemic and 4.9 percent were severely anaemic in this state during this year (figure.4.4.21). Almost similar prevalence (55.8 %) was reported among adolescent girls in the same age bracket (15-19 years) in India by IIPS and Macro (2007). Also a similar prevalence (55.5 %) was reported in Senegal using 2010-2011 DHS data (Yasutake *et al*., 2013). The same study also reported lower prevalence in Nepal-2011 DHS (38.6 %) and Uganda-2006 DHS (36.9 %) adolescent girls. Miah *et al.* (2014) also reported a low prevalence of anaemia among Bangladesh adolescent girls (17.5 %). The variations in prevalence could be a result of different study areas whose life style is deeply affected by environmental socio-factors like religious and traditional norms plus altitude.

4.4.11.3. Association of anaemia and background characteristics in adolescent girls

Table.4.4.15 shows there was almost no significant association between anaemia prevalence with the selected socio-economic and demographic variables apart from residence which was significant ($p<0.05$).

4.4.11.3.1. Socio-economic factors

In this study, anaemia prevalence was higher among rural adolescent girls (58.3%) as compared to urban adolescent girls (55.0%) and the association was significant. Yasutake *et al*. (2013) reported similar results in Congo DRC-2007 DHS (51.2 % Vs 48.0%) and Ghana-2008 DHS (63.8 % Vs 59.3 %) respectively. A similar trend of anaemia distribution was observed in Latin America and Caribbean countries like Bolvia-2003 DHS and Honduras 2005 DHS between rural and urban adolescent girls (PAHO/WHO, 2010). The rural-urban difference could be a result of limited access to quality resources like education, medical facilities, balanced meals as and strict attachment to culture, leaving little or no room for acceptance and rejection of cultural practices that contribute to increased prevalence of anaemia

Basing on caste, anaemia showed the highest association with girls from SC (65.7%) and least prevalence with girls from ST (50.4%). Severe anaemia was also highest among adolescent girls with SC registration (14.0 %). Ramesh and Lopamudra (2010) reported a similar result with severe anaemia being highest among adolescent girls of SC/ST caste (30.0 %) in India as these are the most deprived social groups in

India with limited access to quality resources like education and medical care compared to their counterparts of the same age bracket. Due to poverty, most of these girls drop out of school and indulge in the labour market at an early age to help raise income for feeding and other basic necessities in the household. This arrests their future opportunities which could be improved with a better paying job if they attain a better education.

Table.4.4.15 revealed anaemia prevalence among adolescent girls in this state decreased steadily with an increase in formal educational level. However, severe anaemia was most associated with adolescent girls who attained higher education. Analysis of DHS data from Latin America and Caribbean countries revealed a similar result. In Bolivia-2003 DHS, El Salvador-2003 DHS and Honduras-2005 DHS, anaemia decreased with increase in education which was the opposite in Haiti-2005 DHS and Peru-2004 DHS (PAHO/WHO, 2010). Kaur *et al*.(2011) in a follow-up study on the impact of nutritional education on Haemoglobin levels in adolescent medical student girls revealed an increase of 5.34 % in mean haemoglobin after education on nutrition and good eating habits, with increased meals containing vitamin C. This is partly due to higher acceptance levels and easy practice of knowledge acquired with minimal supervision among girls who have attained higher education as compared to those with no or low level of education. Hence school enrolment and retention in formal education needs to be monitored in order to fight this persistent problem.

Anaemia prevalence was also highest among adolescent girls from the poorer (68.1%) and the poorest (61.0%) households and it decreased with increase in wealth from 53.1% among the middle class to 41.9% among the richest class though the association was not significant. Also, the richest class had the lowest level of severe anaemia among all classes (Table.4.4.15). Similar trend was reported in Niger-2006 DHS (Yasutake *et al*., 2013) with anaemia prevalence of 46.7, 48.5, 52.8, 43.3 and 39.0 percent among adolescent girls from poorest, poorer, middle, richer and richest households respectively. Siddharam *et al*. (2011), similar to the current study, reported socio-economic class not to be significantly correlated with anaemia but with higher prevalence of anaemia among adolescent girls from class V (33%) and class V (32.4 %) compared to the girls from class III and class II (26 % and 8.4 %) respectively. This is affiliated to the increased purchasing power of quality food and frequency of meals that comes with improved wealth, as iron rich animal food sources are expensive and unaffordable in low wealth households on a daily basis. They then resort to plant sources of iron that are rich in inhibitors like phytates to prevent complete absorption and utilisation (Kishore, 2006). Dutt *et al*. (2009) did not find wealth to be significantly associated with anaemia prevalence among adolescent girls just like in the present study.

Occupation is a source of income and any source of income would help increase the purchasing power and access to better quality food and health services. This study however found a lower prevalence of anaemia among girls who were not working (54.9 %) as compared to the girls who were involved in agricultural work as an occupation (63.5 %) though the girls who were not working also showed the highest prevalence of severe anaemia (6.3 %) and agricultural (6.2 %). Of the few girls involved in professional work, prevalence stood at 51.2% where all were mildly anaemic. This study indicates that having a source of income does not necessarily exempt the adolescent girl from risk of anaemia but protects the girl from severe cases of anaemia which have detrimental side consequences.

4.4.11.3.2. Demographic and nutritional factors

Though age of the adolescent girls was found not significant in influencing anaemia prevalence among the adolescent girls in this state, all girls at all ages had a high prevalence (>50.0%) which indicates that ages 15-19 are a risk to prevalence of anaemia in the lives of girls due to the increased demand of nutrients which comes with adolescence, menstruation and other social habits. Kim *et al*. (2014) also reported anaemia as higher among older adolescent girls. This is in line with global prevalence of anaemia among adolescent girls

This study also found a higher prevalence of anaemia among adolescent girls who gave birth in the middle adolescence (14-16) years. This could be due to the fact that in this age bracket, growth is rapid and the demand of nutrient on the body is high so pregnancy at this stage only depletes the body more of its iron stores, making the girl more vulnerable to anaemia (UNFPA, 2013). These findings are similar to a study by Frost (2001) who reported that USA has the highest number of girls who had a child by the age 15 and 18 years. Early child birth is caused by the limited knowledge on contraceptive use in Indian adolescent girls.

Anaemia prevalence increased with increase in BMI of the girl (Table.4.4.15). Kim *et al*. (2014) in analysis of the Korean data over four year survey indicated anaemia to be prevalent among adolescent girls with a higher BMI just as findings of the present study.

4.4.11.4. Determinants of Anaemia in Adolescent girls

The selected socio-demographic characteristics were subjected to ordinal regression to assess the net effect of each independent variable on degree of anaemia prevalence anaemia prevalence among the adolescent girls in Karnataka state during this study period. Results in Table.4.4.17 show a significant effect with all socio-economic factors (education, wealth and occupation), residence, age of the girl, age at first birth and BMI except for caste and religion.

Urban residency had a positive correlation with severity of anaemia. Among urban resident girls, anaemia increased by 32.2 % with a 0.73 times RR of being anaemic in comparison to their rural counterparts.

Age was negatively correlated with severity of anaemia. Severe anaemia decreased with increase in age. Study results revealed that severity of anaemia among the adolescent girls in this state during this study period decreased by 61.0 percent with increase in age. The older adolescent girls had a 1.84 RR of being anaemic. This is in line with findings of Kakkar *et al.* (2011) who reported anaemia prevalence to be higher in younger adolescents and decreased with increase in age

Caste was negatively correlated with severity of anaemia. The RR of being severely anaemic was 1.39 times, 1.33 times and 1.32 times among adolescent girls belonging to SC, ST and OBC caste in comparison to their counterpart who belonged to other castes. Ramesh and Lopamudra (2010) reported similar findings with anaemia being correlated negatively to adolescent girls from SC/ST caste.

Education of the adolescent girl had a negative influence on degree of anaemia among adolescent girls. Anaemia level decreased with increase in educational level of the adolescent girl with the highest levels among adolescent girls with no education and the least among the adolescent girls with higher educational level. Severe anaemia was highest among adolescent girls with higher educational level (7.8 %) followed by the girls with no education (7.4%). Among adolescent girls with no education, severity of anaemia decreased by 12.5 percent with a 1.13 times RR of being anaemic and it decreased by 90.0 percent with a 2.45 times RR of being anaemic among adolescent girls with secondary education in comparison to adolescent girls with higher educational level. These findings are backed up Kakkar *et al*. (2011) and IIPS and Macro (2007).

Similarly, wealth of the household in which the adolescent girl lived was significant in reducing anaemia with increase in wealth. Among the adolescent girls from the poorest households, anaemia reduced by 57.7 percent and 63.3 percent among the adolescent girls from the poorer households. The RR of being anaemic among adolescent girls from poorest households was 1.78 times and 1.88 times among the girls from the poorer households. Miah *et al.* (2014) also found a significant association of anaemia with adolescent girls with a low family income. This is because low income/wealth limits purchasing power and access to quality resources.

Results presented in Table.4.4.17 revealed a positive correlation between severity of anaemia and occupation of the girl. Among adolescent girls not working, anaemia increased by 23.9 percent with a 1.26 RR of being anaemic and anaemia increased by 12.3 percent among adolescent girls who were self-employed in the agricultural sector with a 1.13 times RR of being anaemic in comparison to their counterparts employed in unskilled manual labour sector. The lower risk with self employed agricultural girls as compared to the non-working girls is an indication that occupation plays a protective role in reducing severity of anaemia as autonomy of the girl is increased with an income. FAO (2010) stated that there was an improvement in nutritional status of family members in households where a woman played a role in decisions on meals and health care of the family members.

4.4.11.5. Comparison between Tumkur, Bijapur districts and Maharashtra state during 1998/99.

Figure.4.4.20. shows a comparison between the three study areas. Anaemia was highest in Karnataka state as compared to the individual districts found in this state which was mostly due to moderate anaemia where it was higher than in the districts. However, it is observed that severe anaemia was higher in Tumkur district by 6.5 percent than in Maharashtra. Similar differences in anaemia prevalence was observed in Nepal according to ecological zones despite being in the same country with the highest level of anaemia in Terrain region followed by the mountainous regions using NMSS data in 1998 (WHO/SEARO, 2011).

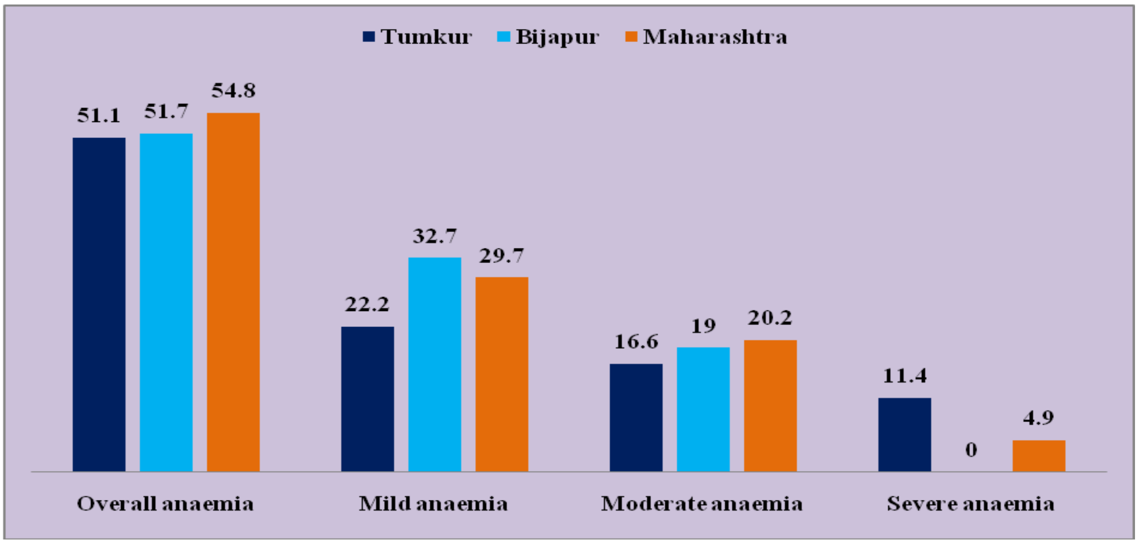

Figure.4.4. 20. Comparison in anaemia prevalence among adolescent girls (15-19 years) in Tumkur, Bijapur and Karnataka during 1998/99.

4.4.12. Karnataka state 2005/06 (NFHS-3)

4.4.12.1. Profile of adolescent girls (15-19 years) in Karnataka state during NFHS-3

Data on 1251 adolescent girls aged 15 -19 years was included in the study during this survey. The data analyzed shows majority of the adolescent girls (60.0 %) lived in rural Karnataka and the remaining (40.0 %) in urban Karnataka. The most famous religion among these adolescent girls was Hindu (84.4 %) followed by Islam (12.0 %), Christianity (2.7 %). Minority of the adolescent girls worshiped other religions (0.9 %) like Jain.

Caste is taken as a determinant of family socio-economic status. In this population, 58.6 percent of the adolescent girls belonged to OBC, the rest belong to SC, ST and some belonged to neither (OBC, SC nor ST) representing 16.3, 7.7 and 12.4 percent respectively. A small percentage of the girls belonged to other castes (Table.4.4.16).

Majority of the girls were found to have attained secondary education (74.5 %) and only 13.4 percent had no formal education. The rest attained primary or higher education level.

Table.4.4. 16.Percentage association of anaemia among adolescent girls aged (15-19 years) with socio-economic and demographic variables in Karnataka state during 2005/06.

Background characteristics	Percentage of Adolescen-t girls with any Anaemia	Percentage of adolescent girls with			Number of Adolescent girls(%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	44.5	30.3	10.8	3.4	500(40.0)	X²=12.492 P=0.0059 **
Rural	54.3	35.4	15.0	4.0	751(60.0)	
Religion						
Hindu	49.9	33.2	13.1	3.6	1054(84.4)	X²=16.806 P=0.1571 NS
Muslim	56.6	36.7	14.9	5.0	150(12.0)	
Christian	34.4	26.6	7.7	0.0	34(2.7)	
Others	54.1	21.2	22.4	10.6	11(0.9)	
Caste						
SC	46.9	28.2	15.6	3.1	202(16.3)	X²=15.266 P=0.2272 NS
ST	56.4	35.7	13.0	7.6	95(7.7)	
OBC	51.8	34.4	14.2	3.2	728(58.6)	
None	46.3	35.1	7.2	4.0	154(12.4)	
Others	44.6	29.3	11.5	3.8	63(5.1)	
Education level						
No education	59.0	34.2	18.1	6.7	167(13.4)	X²=22.140 P=0.0084 *
Primary	52.8	33.6	15.8	3.4	108(8.6)	
Secondary	49.8	33.8	12.5	3.4	931(74.5)	
Higher	25.9	20.3	5.6	0.0	45(3.6)	
Wealth index						
Poorest	61.9	35.8	17.8	8.3	101(8.1)	X²=34.128P=0.0006 **
Poorer	56.2	37.0	14.2	4.9	269(21.5)	
Middle	51.6	34.4	13.0	4.2	329(26.3)	
Richer	48.7	30.2	16.0	2.4	305(24.4)	
Richest	39.9	30.8	7.6	1.5	247(19.7)	
Occupation						
Not working	48.1	33.1	11.9	3.1	870(70.0)	X²=31.790 P=0.0233 *
Professional	80.8	59.6	0.0	21.3	6(0.5)	
clerical	57.5	57.5	0.0	0.0	6(0.5)	
Sales	62.3	26.0	36.4	0.0	10(0.8)	
Agricultural	53.7	32.4	17.0	4.3	225(18.0)	
services	34.1	22.7	0.0	11.4	12(0.93)	
Skilled & unskilled manual	59.3	35.6	17.4	6.3	122(9.7)	
Age of woman(in years)						
15	52.9	36.8	13.6	2.5	91(7.3)	X²=25.521 P=0.0125 *
16	48.4	38.4	7.5	2.5	127(19.8)	
17	51.9	35.7	11.9	4.3	262(20.9)	
18	49.3	30.5	13.9	4.9	301(24.0)	
19	50.3	26.5	19.7	4.0	123(9.8)	
Age of woman at first birth(in years)						
10 -13	67.5	33.7	10.8	22.9	11(6.8)	X²=19.942 P=0.5249 NS
14 – 16	56.5	29.7	19.4	7.4	82(50.9)	
17 – 19	56.8	28.1	23.1	5.6	68(42.3)	
BMI status						
Moderate thinness	51.1	35.0	14.2	2.0	323(25.8)	X²=16.521 P=0.5563 NS
Mild thinness	54.1	34.1	15.5	4.5	299(23.9)	
Normal	49.5	32.8	12.1	4.6	584(46.7)	
Overweight	33.0	23.0	10.0	0.0	39(3.2)	
Obese class 1	50.0	50.0	0.0	0.0	3(0.2)	
Obese class II	0.0	0.0	0.0	0.0	1(0.1)	
Obese class III	0.0	0.0	0.0	0.0	1(0.1)	
Total	**48.9**	**31.8**	**12.4**	**4.6**		
**=Significant at 0.01, *= Significant at 0.05, NS=Not significant.						

Source. NFHS-3

Distribution of the girls according to wealth differed slightly between the poorer, middle and richer class represented by 21.3, 26.3 and 24.4) respectively. A few of the adolescent girls belonged to the poorest households (8.1 %) and atleast 19.7 percent belonged to the richest households. Majority of the girls (70.0 %) were not working and the remaining were involved in either agricultural work, skilled and unskilled manual labour, services, sales, and the least number of girls were involved in professional and clerical work (0.5 %) each.

Most of the girls were in the age of 18 years (24.0 %). Out of these adolescent girls, only 161 gave information on when they had their first child. Results reveal majority had their first child between the ages 14-16 years (50.9 %). This study population showed a dual existence of malnutrition with both under-nutrition (49.7 %) and over-nutrition (3.6 %). However, 46.7 percent of the girls had a normal BMI (Table.4.4.16).

4.4.12.2. Prevalence of anaemia among adolescent girls (15-19 years) in Karnataka state during NFFHS-3

The overall prevalence of anaemia was 48.9 percent of which 31.8 percent were mildly anaemic, 12.4 percent were moderately anaemic and 4.6 percent were severely anaemic (figure.4.4.21). This prevalence is slightly lower than what most studies have reported among adolescent girls (Trivedi and Pasrija, 2007, Sudha-Rani and Suryaprabha, 2013) with prevalence of 82 percent and 82.6 percent in adolescent girls in Raipur and Patancheru respectively. Sinha *et al*. (2012) reported a similar prevalence of severe anaemia (4.1 percent) among adolescent girls in Birtanagar in Nepal. However Kim *et al*. (2014) reported a very low prevalence (5.3 %) of anaemia among Korean adolescent girls using national health and nutrition survey over a four year period (2008-2011). The variations are expected due to difference in study population.

4.4.12.3. Association of anaemia and background characteristics in adolescent girls

4.4.12.3.1. Socio-economic factors.

Among adolescent girls, a higher prevalence (54.3 %) was found among rural adolescent girls as compared to (44.5 %) among the urban adolescent girls in Karnataka state. Analysis of DHS data from other countries revealed similar prevalence as the current study for example, in Cambodia-2010 DHS, prevalence was (47.8 %) and in Haiti-2005/06 and Democratic Republic of Congo- 2007 DHS prevalence was (48.7 %) among adolescent girls of the same age Bracket (Yasutake *et al*., 2013). The same study reported lower prevalence in other countries using DHS data. Countries like Leotho-2009 DHS, Timo-leste-2009/10 DHS and Rwanda-2010 DHS with low prevalence of

21.3, 21.5 and 15.0 percent respectively among adolescent girls of the same age bracket (15- 19 years).

Similar prevalence of moderate to severe anaemia as in the current study (17.0 %) was reported in Benin-2006 DHS (16.7 %). The variations between the countries are due to different geographical locations and cultures, which affect food habits greatly.

Though caste was found not significant in influencing anaemia prevalence among adolescent girls, a higher prevalence was found among girls who belonged to ST caste (56.4 %) followed by OBC (51.8 %). This result is consistent to other findings in Indian studies which consistently reveal adolescent girls from SC and ST caste as the most deprived socially. Hence, they are more vulnerable to malnutrition in all forms as compared to their counterparts from other social sectors (Ramesh and Lopamudra, 2010, IIPS and ORC Macro, 2000 and IIPS and Macro, 2007)

Similar to reports from most studies, anaemia prevalence was found to decrease with acquisition of formal education from (59.0 %) among girls with no education to a low prevalence (25.9 %) among girls who attained higher education and it was found to be significant. Similar findings were reported by other studies (Rajaratnam *et al*., 2000, Kaur *et al.,* 2006 and Kulkarni *et al*., 2012).

Wealth was found to significantly influence anaemia prevalence with the highest prevalence (61.9 %) among adolescent girls and the poorest households to (39.9 %) among the girls from the richest households. The poorest households also showed the strongest association with severe anaemia (8.3 %). Basu *et al*. (2005) and Chaudhary and Dhage (2008) reported similar findings as our current study but Kulkarni *et al*. (2012) found no significant association between anaemia and wealth.

Similar to education and wealth, occupation of the girls was found significant to influence the prevalence of anaemia. However, the study results were contradicting to most research findings. Adolescent girls with professional jobs had the highest prevalence of anaemia (80.8 %) compared to other occupations and among adolescent girls who were not working (Table.4.4.16).

4.4.12.3.1. Demographic and nutritional factors

Anaemia prevalence among all ages was high (>40.0%) but the differentials were minor as it ranged between 48.4 % and 52.9 percent. In this study, girls who were 15 years had the highest prevalence among all ages.

The girls who gave birth in early adolescence had the highest prevalence of anaemia (67.5 %) which could have been caused by complications in child delivery which are common in early adolescence. For example, excess bleeding due to immature reproductive system, lack of proper care due to immaturity are some of the causes. This association however, was not significant in influencing the prevalence of anaemia and that is the reason for anaemia prevalence to be reduced with increase in age (Table.4.4.16).

4.4.12.4. Determinants of anaemia among adolescent girls in Karnataka state during NFHS-2

All the socio-economic and demographic variables were regressed and results of ordinal logistic regression show that socio-economic variables had a net influence on anaemia prevalence among the adolescent girls in Karnataka during 2005/06 except for caste. However, socio-demographic variables and BMI had no net influence on degree of anaemia despite bivariate analysis having found an association with residence and age of the adolescent girl.

Level of education was negatively correlated to the severity of anaemia in adolescent girls during this study period. Hence, the severity of anaemia decreased with increase in educational level. with reference to adolescent girls who attained higher educational level, the RR of being anaemic among adolescent girls with no level of education was 2.82 times while it was 2.58 times and 2.03 times among adolescent girls with primary and secondary education respectively. Rajaratnam *et al.* (2000), Kaur *et al.* (2006) and Kulkarni *et al*. (2012) reported similar findings as the current study.

Similar to education, wealth had a negative influence on the degree of anaemia among adolescent girls in this state during the study period, hence the severity of anaemia decreased with increase in wealth of the household in which the adolescent girl lived. In reference to adolescent girls from the richest households, the RR of being anaemic among adolescent girls from the poorest households was 1.81 times and 1.45 times among adolescent girls from the poorer households. This is because improved wealth provides a platform for allocation of more resources towards quality food, education and health and hygiene services. Kim *et al*. (2014) reported a similar result in Korea using National health and nutrition survey data from 2008- 2011 among adolescent girls with a decreasing trend in anaemia prevalence with increase in household income. Basu *et al*. (2005) and Chaudhary and Dhage (2008).

Table.4.4. 17.Results of ordinal logistic regression on prevalence of anaemia among Adolescent girls in Karnataka state during 1998 and 2005/06

Variable	Karnataka state							
	1998-1999				2005-2006			
	Estimates	**S.E**	**Significance**	RR	**Estimates**	**S.E**	**Significance**	RR
Residence								
Urban	**0.322**	**0.0161**	**<0.0001****	0.73	0.002	0.065	0.972	-
Rural	**RC**							
Religion								
Hindu	1.297	1.262	0.304	-	0.516	1.129	0.648	-
Muslim	1.088	1.270	0.392	-	0.233	0.403	0.563	-
Christian	**RC**				0.007	0.415	0.987	-
None					**RC**			
Age of woman	**-0.61**	**0.076**	**0.0046****	**1.84**	-0.064	0.099	0.523	-
Age at first birth	**0.58**	**0.0161**	**<0.0001****	**0.73**	0.002	0.065	0.972	-
BMI								
Moderate- T	**-0.222**	**0.032**	**0.0084****	**0.80**	-	-	-	-
Mild- T	**0.311**	**0.078**	**0.0455***	**0.73**	-	-	-	-
Normal	**0.342**	**0.093**	**0.045***	**1.41**	-	-	-	-
Overweight	**RC**							
Caste								
SC	**-0.331**	**0.0662**	**0.025***	**1.392**	-0.123	0.230	0.593	-
ST	**-0.82**	**0.047**	**0.0143***	**1.325**	-0.341	0.249	0.171	-
OBC	**-0.276**	**0.039**	**0.0081****	**1.317**	-0.323	0.210	0.124	-
None	**RC**				**RC**			
Educational level of woman.								
No education	**-0.125**	**0.025**	**0.0253***	**1.13**	**-1.035**	**0.305**	**0.001****	**2.82**
Primary	0.091	0.846	0.914	-	**-0.948**	**0.313**	**0.002****	**2.58**
Secondary	**-0.900**	**0.225**	**0.0455***	**2.45**	**-0.708**	**0.292**	**0.015***	**2.03**
Higher	**RC**				**RC**			
Wealth								
Poorest	**-0.577**	**0.290**	**0.047***	**1.78**	**-0.596**	**0.158**	**<0.0001****	**1.81**
Poorer	**-0.633**	**0.272**	**0.020***	**1.88**	**-0.374**	**0.129**	**0.004****	**1.45**
Middle	-0.297	0.265	0.264	-	-0.236	0.127	0.062	-
Richer	-0.405	0.280	0.148	-	-0.173	0.123	0.185	-
Richest	**RC**				**RC**			
Occupation								
Not working	**0.239**	**0.040**	**0.0145***	**1.26**	**0.404**	**0.126**	**0.001****	**0.67**
Professional	-0.472	0.656	0.471	-	-0.124	0.548	0.822	-
Clerical	NA	NA	NA		0.389	0.628	0.536	-
Sales.	0.135	0.509	0.709	-	-0.050	0.422	0.905	-
Agricultural self-employed	**0.123**	**0.009**	**0.0002****	**1.130**	NA	NA	NA	NA
Agricultural employed	0.034	0.381	0.929	-	0.179	0.145	0.217	-
Household	-0.056	0.883	0.949	-	NA	NA	NA	NA
Services	0.280	0.882	0.751	-	0.520	0.450	0.248	-
Skilled manual	-0.175	0.516	0.734	-	**RC**			
Unskilled manual	**RC**							
*= significant at 5%, **= significant at 1%,S.E= Standard Error, RC= Reference category, Moderate-T= Moderate thinness, Mild-T=Mild thinness, (-)=not applicable, na=not available, RR= relative risk								

Source. NFHS-2&3

Occupation was also significant with a positive correlation on degree of anaemia among adolescent girls who were not working. Unemployment among adolescent girls increased anaemia prevalence by 40.4 percent. In comparison to adolescent girls employed in unskilled manual jobs, the RR of being anaemic among adolescent girls who were not working was 0.67 times. This is due to lack of an income which diminishes the already scanty chances of her autonomy in family affairs which happens to girls who are working.

4.4.12.5. Trends of anaemia prevalence among adolescent girls in Karnataka state during 1998-2006

Figure.4.4.21 below shows a decrease in overall prevalence of anaemia over the years. Anaemia decreased by 5.9 percent. Moderate and severe anaemia decreased over the years but there was an increase in mild anaemia among the adolescent girls over the years.

The decrease in anaemia prevalence could be attributed to the fact that there was an improvement with education among the girls over the years. This is seen with a decrease in the percentage of girls with no education (from 46.1 % to 13.4 %) and an increase in the girls who acquired secondary education (from 34.7 % to 74.5 %) in NFHS-2 and NFHS-3 respectively which also reflects in the prevalence of anaemia

Figure.4.4.22 also shows a decrease in anaemia prevalence in adolescent girls by residency. Anaemia decreased most in urban adolescent girls by 10.5 % and only by 3.7 % among the rural adolescent girls. This indicates that the situation in rural areas is still worse; hence more effort and resources are required in terms of education awareness which needs to be improved just like in urban areas. In Urban areas, access to internet facilities makes it easier for the girls to access latest information which is not the case in the rural areas.

Over the years, socio-economic factors were significant in determining the prevalence of anaemia except for caste. Anaemia level decreased with increase in educational level. The RR of being anaemic was 1.69 times higher among adolescent girls with no level of education in NFHS-3 as compared to NFHS-2 and among adolescent girls with secondary education, the RR of being anaemic was 0.42 times higher in NFH-2 as compared to adolescent girls in NFHS-3 which can be attributed to the fact that lesser number of adolescent girls had attained secondary education by the time NFHS-2 was conducted and the percentage increased in NFHS-3 (34.7 % vs 74.5 %) respectively. In general, between the two surveys, NFHS-3 showed a reduction in risk of being anaemic among the adolescent girls because more girls enrolled and were retained in education system which is evident in results as expressed in Tables. 4.4.15 - 17.

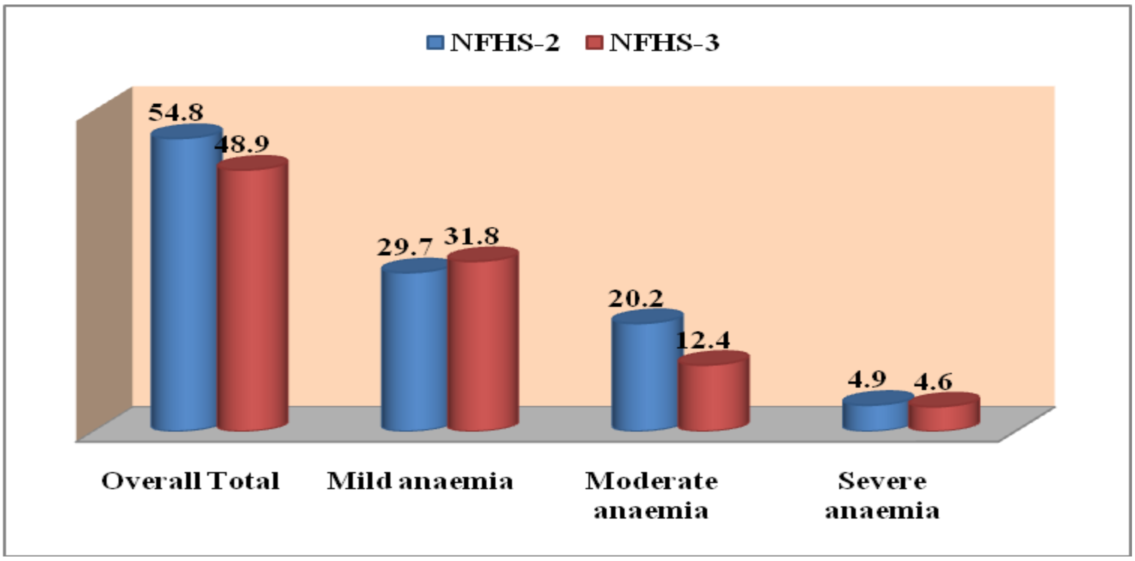

Figure.4.4. 21. Trends in anaemia prevalence among adolescent girls (15-19 years) in Karnataka State during 1998-2006

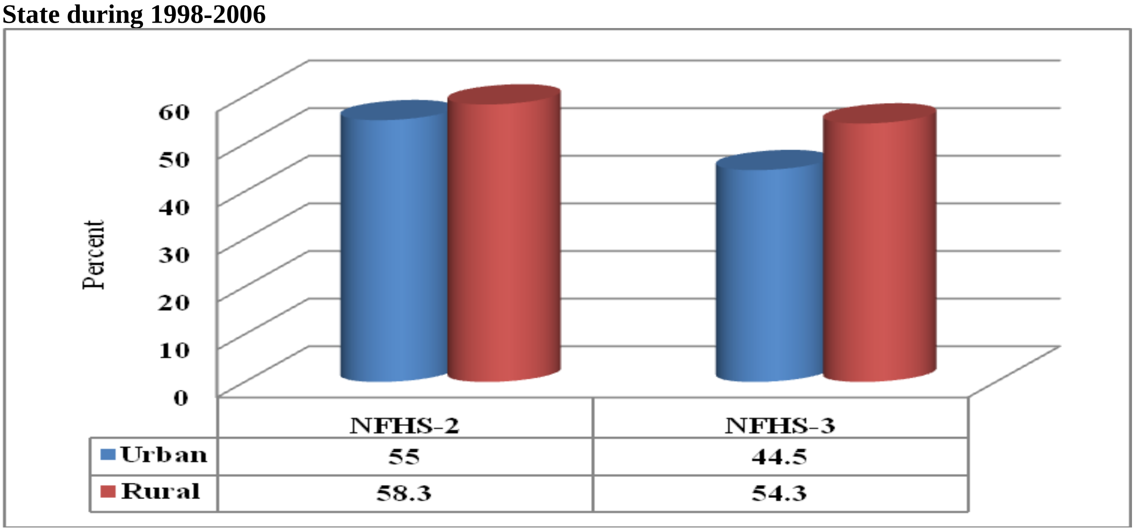

Figure.4.4. 22. Percentage prevalence of anaemia among adolescent girls over the years by residence Karnataka state

Table.4.4.17 shows a systematic reduction in risk of being anaemic among adolescent girls during NFHS-3 survey with improvement in wealth between poorest and poorer households in which the girls lived in comparison to NFHS-2. This can be attributed to proper implementation of government poverty alleviation schemes meant to uplift the status of the poor families/households.

Over the years the percentage of adolescent girls not working increased from (58.3 %) in NFHS-2 to (70.0 %) in NFHS-3 and the RR of being anaemic decreased from 1.26 times to 0.67 times between the two surveys. The reduced RR of being anaemic can be attributed to higher enrolment and retention in formal education which provided substantive knowledge to girls to take better care of their health. The increased enrolment in formal education also reduced pregnancies in early and mid –adolescence which protects against anaemia.

4.4.12.6. Comparison across all states and districts included in the study

There were variations in anaemia prevalence across the study areas. In all the study population across the years, mild anaemia was the most prevalent type of anaemia among the adolescent girls across the years in all districts and states. However, Chitra *et al*. (2014) reported severe anaemia as the most prevalent degree of anaemia (54.36 %) in Coimbatore, Tamil Nadu, where as Bharati et al. (2009) and IIPS and MoHFW (2006) reported moderate anaemia as the most prevalent degree of anaemia among adolescent girls in India. This difference is clearly due to difference in study area, methods of data collection and analysis used.

Across all the years, anaemia was highest in Andhra Pradesh state and districts. This could be due to the rice-based diet consumed in Andhra Pradesh which lack bio-available iron. However, Tumkur district had the highest prevalence of severe anaemia. IIPS and MoHFW, (2006) reported variations among the three states. Maharashtra state had the highest prevalence of anaemia among adolescent girls (99.2 %), followed by Andhra Pradesh (98.0 %) and lastly Karnataka (96.4 %). NMSS (1998) and WHO/SEARO (2011) noted that from region to region, the prevalence of anaemia varies in severity despite being in the same country, which could be a result of multiple factors like altitude, biological, genetic and cultural differences as observed in Nepal surveys. Bharati *et al*. (2009) also reported variations of anaemia similar to the present study. They found anaemia to be highest in northern region (93.6 %), followed by western region (91.8 %) and was least prevalent in the north-eastern region (59.9 %)

Socio-economic factors like education, wealth, occupation and BMI have proved to be the most common determinants of anaemia prevalence among adolescent girls between 15-19 years of age. Makinson (1985) noted that for mothers between 15 -19 years of age, the risk associated with anaemia was more with socio-economic factors than with biological effects of age.

Hence anaemia remains a severe public health problem with need to improve the awareness among the adolescent girls which should probably be started at an earlier age (10 years) to empower every girl with the ability to watch over her diet at an earlier age. It has been documented that the side effects of anaemia start at an early age and are permanent if not corrected early (UNFPA, 2013 and UNICEF, 2011). Hence early nutrition is necessary.

This will be achieved by encouraging school retention to enable the girls study up to higher education where they will be in position to understand the nutritional facts better. Irrespective of field of study, nutritional education should be incorporated in the school curriculum to equip all with basic information on signs and symptoms of common nutritional deficiencies and appropriate food preparation methods, so as to minimize side effects of poor nutrition even with availability of food as seen among girls from rich households.

4.5. Anaemia in pregnant women

Pregnancy as a physiological condition different from normal and is characterized by an increased demand of nutrients to support the child. This set of study population was analyzed at state level only in both 1998 as well 2005/06. This is because in 1998/99 at district level, the sample size was very small (< 30). The results and discussion are therefore presented at state-level as well under the following headings:

a) Profile of pregnant women
b) Prevalence of anaemia among pregnant women
c) Association of anaemia and selected socio-economic and demographic variables
    1. Socio-Economic factors
    2. Demographic factors
    3. Nutritional factors
d) Determinants of anaemia among pregnant women
e) Trends in anaemia prevalence

4.5.1. Andhra Pradesh (AP) state

4.5.1.1. Profile of pregnant women in Andhra Pradesh during 1998/99

A total of 338 pregnant women were included in the study in Andhra Pradesh state (pre-divided) of which 70.0 percent were living in rural AP and 30.0 percent in urban AP. Results presented in Table.4.5.1 revealed that majority of the pregnant women were of Hindu religion (84.4 %), belonged to OBC (42.0 %), had no education (50.4 %) and were not working (47.7 %). Among the working pregnant women, (36.2 %) were involved in agricultural work. As far as social economic class using wealth index is concerned, only 14.0 percent of the women belonged to the poorest class, 23.7 percent in the middle class and 21.6 percent in the richest category.

Among the pregnant women, 39.9 percent, 38.6 percent and 0.6 percent were between the age bracket of 20-24, 15-19 and 35-39 years respectively. Out of these, only 194 gave information on when they had their first child. Table.4.5.1 shows that 64.8 percent of these women had their first baby between the ages 15-19 years. Majority (43.0 %) of the pregnant women were found with no child at the time of the survey, 39.4 percent had one child and 17.6 percent had two or more children. Majority (> 60 percent) of the pregnant women had a normal BMI.

Table.4.5.1.Percentage association of Anaemia in pregnant women with selected socio-economic and demographic variables in Andhra Pradesh state during 1998/99.

Background characteristic	Percent pregnant women with any Anaemia	Percentage of pregnant women with		Number of pregnant women (%)	Chi-square & p-value
		Mild anaemia	Moderate anaemia		
Residence					
Urban	33.3	27.8	5.6	101(30.0)	X^2=4.855 P=0.0883 (NS)
Rural	45.5	40.8	5.1	237(70.0)	
Religion					
Hindu	42.1	36.6	5.6	284(84.0)	X^2=9.6585 P=0.0466 *
Muslim	23.8	23.8	0.0	32(10.0)	
Christian	64.5	55.5	9.0	22(6.4)	
Caste					
SC	53.4	47.2	6.2	64(19.0)	X^2=9.4357 P=0.1505 (NS)
ST	45.9	38.4	7.6	27(7.9)	
OBC	43.1	39.1	4.1	142(42.0)	
None	32.0	26.2	5.7	105(31.1)	
Education level					
No education	41.1	36.5	4.7	171(50.4)	X^2=17.621 P=0.0073 **
Primary	55.6	48.1	7.6	54(16.0)	
Secondary	46.3	39.1	7.2	80(23.8)	
Higher	12.0	12.0	0.0	33(9.8)	
Wealth index					
Poorest	34.4	25.9	8.5	47(14.0)	X^2=23.117 P=0.0032 **
Poorer	59.3	52.9	6.3	65(19.2)	
Middle	37.6	32.6	5.0	80(23.7)	
Richer	46.2	46.2	0.0	72(21.4)	
Richest	31.5	23.8	7.7	73(21.6)	
Occupation					
Not working	42.4	36.4	6.0	161(47.7)	X^2=25.868 P=0.0112 *
Professional	16.8	0.0	16.8	12(3.5)	
Sales	0.0	0.0	0.0	6(1.8)	
Agricultural	49.8	46.5	3.2	12(36.2)	
Skilled & unskilled manual	27.7	21.9	21.9	36(10.8)	
Age of woman(in years)					
15 -19	46.1	44.7	1.4	131(38.6)	X^2=73.129 P=0.0002 **
20 -24	41.3	35.5	5.8	135(39.9)	
25 -29	41.2	30.4	10.8	57(16.9)	
Table.4.5.1. Continued					
30- 34	14.7	0.0	14.7	14(4.1)	
35-39	0.0	0.0	0.0	2(0.6)	
Age of woman at first birth(in years)					
10 -14	49.3	25.0	24.3	8(4.3)	X^2=63.556 P<.0001 **
15- 19	44.4	41.2	3.2	126(64.8)	
20 -24	56.2	40.7	15.5	52(27.0)	
25 -29	0.0	0.0	0.0	8(4.0)	
BMI status					
Moderate thinness	20.3	6.8	13.6	30(8.9)	X^2=23.143 P=0.0032 **
Mild thinness	49.8	40.6	9.3	44(13.1)	
Normal	43.6	40.2	3.3	233(69.0)	
Overweight	33.6	26.8	6.8	29(8.5)	
Obese class 1	100	100	0.0	2(0.6)	
Number of children under five					
0	40.8	35.6	5.3	145(43.0)	X^2=4.581 P=0.8013 (NS)
1	42.3	36.1	6.2	133(39.4)	
2+	43.2	39.9	3.3	60(17.6)	
Total	**38.8**	**32.5**	**6.7**		

**= significant at 0.01, *= significant at 0.05, NS= Not significant.

Source. NFHS-2

4.5.1.2. Prevalence of anaemia among pregnant women in Andhra Pradesh during NFHS-2.

The overall prevalence of anaemia among pregnant women during NFHS-2 in Andhra Pradesh state was 38.8 percent of which 32.5 percent were mildly anaemic and

6.7 percent were moderately anaemic. No cases of severe anaemia were found in this state during this survey (figure.4.5.1). The prevalence in this state was not a public health problem as per WHO categorisation since it was below 40 percent (Seshadri, 2001). A similar prevalence of anaemia of 40 percent was reported by Dim and Onah (2007) in pregnant women in Enungu, south-east Nigeria. Mulambalah *et al.* (2014) reported a similar prevalence of anaemia (38.78 percent) in Kakamega, Kenyan pregnant women while 33.1 percent prevalence was reported among Ethiopian pregnant women using 2005 DHS data (Gebremedhin and Enquselassie, 2011). Some studies however, reported higher prevalence than the present study. Bagachi (2004) reported 45 percent prevalence of anaemia among Pakistani pregnant women and Toteja *et al.* (2006) reported a much higher prevalence of anaemia (84.9 percent) among pregnant women from 16 districts of 11 states in India while Hassan *et al*. (2014) reported a much lower prevalence (12.2 percent) among pregnant women in Zaria district in Nigeria. The lower prevalence in this study could be due to the effective administration of folic acid tablets to pregnant women in the state which is helpful in combating anaemia in pregnancy. Among these women, as seen in Table.4.5.1, more than half of the women belonged to average, richer and richest households and were employed thus contributing to increasing purchasing power of quality food and access to timely and quality medical care.

4.5.1.3. Association of anaemia and selected socio-economic and demographic variables

Bivariate analysis was conducted using chi-square to find association of anaemia prevalence with the selected variables and results presented in Table.4.5.1. Results revealed that factors like residence, caste and number of children were not significant in influencing prevalence of anaemia among pregnant women in AP during this survey. However, religion, educational level, wealth, occupation, age, age at first birth and BMI were significantly associated to the prevalence of anaemia among these women.

4.5.1.3.1. Socio-economic factors

Religion was found significant in influencing anaemia prevalence (p=0.0466) with the highest prevalence among the Christian pregnant women (64.5 %) followed by the Hindu (42.1 %) and then Muslims (23.8 %). Gogoi and Prusty (2013) found similar results in Assam, with Christians having the highest prevalence of anaemia (87.0 %) followed by Hindu (73.2 %) and Muslims (67.3 %) though it was higher than the current study. However, the result is contradictory to the studies of Ramesh and

Lopamundra (2010) and IIPS and MoHFW (2006) who reported the highest prevalence of anaemia among Hindu pregnant women. These differences among the religious groups could be due to different religious norms attached to food and pregnancy.

Results of the current study found the least prevalence of anaemia among pregnant women who attained higher education (12.0 %). Similar prevalence was reported by Mulambalah *et al.* (2014) with only 2.3 percent and 15.6 percent prevalence among pregnant women who attained university and tertiary education respectively in Kakamega, Kenya. IIPS and MoHFW (2006) reported a decrease in severe anaemia with increase in education from 3.8 percent among non-literate to 1.2 percent among those with 10 years and above of schooling. This result infers that higher education better prepares the women on how to care for themselves and also eases their ability to follow information given during antenatal care with minimal supervision compared to the women with no education who require constant monitoring.

Pregnant women from poorer households had the highest prevalence of anaemia (59.3 %) followed by the richer households (46.2 %). The households under the remaining categories based on wealth had a prevalence <40.0 percent though it was still high. Mulambala *et al.* (2014) also reported a significant association of anaemia with socio-economic class. The highest prevalence being among pregnant women from socio-economic class IV (50 %) and the least among socio-economic class I (3.1 %) similar to the current study. IIPS and MoHFW (2006) reported highest prevalence (99.6 %) among the pregnant women from low standard of living which decreased (92.1 %) among those from high standard of living. Socioeconomic class/ wealth also partly determine a woman's access to information which helps protect her from anaemia. Those from low socio-economic class might not even have access to television or radio and are less educated and unable to read and write well hindering their access to current information that they require to limit anaemia.

Occupation is an important factor in women empowerment with a significant influence on anaemia prevalence in pregnant women in AP. However the highest Anaemia prevalence (49.8 %) was among women employed in the agricultural sector followed by those women who were not working (42.4 %) as seen in Figure 4.5.3. Maskey *et al*. (2014) reported similar findings with anaemia among the pregnant employed women being higher than among the pregnant women who were housewives in Nepal (47.7 % vs 45.0 %) respectively. This study is contradictory to findings from

Okunade and Adegbesan-Omilabu (2014), who reported unemployed pregnant women in Nigeria to be more anaemic than the employed pregnant women (37.0 % vs 34.8 %) respectively. These findings could be a result of limited time that employed women have to prepare and eat all meals of the day in balanced form. The busy schedule with some types of employment, rob the pregnant women of the time they require to care for their health as well as rest.

However, results of this study also found professional women with the least prevalence of 16.8 percent. Okunade and Adegbesan-Omilabu (2014) also reported the least prevalence of anaemia among civil servants (12.1 %). This could be a result of properly designed policies. In professional employment or civil service, women are granted a sick-paid leave from work hence they do not have to work even when they are sick. This allows them to access timely medical attention unlike agricultural workers where payment is based on availability at work in most cases coupled with little pay.

4.5.1.3.2. Demographic factors.

Age of the woman is also an important aspect in anaemia prevalence among the pregnant women. This study result found anaemia prevalence to decrease with increase in age of the pregnant woman from 46.1 percent among women in the age bracket 15-19 years to 0 percent among women in the age bracket 35-39 years. Okunade and Adegbesan-Omilabu (2014) reported similar findings with anaemia being most prevalent among 15-19 year old pregnant women in Nigeria (42.9 %) which was significant similar to the current study. Hence anaemia was highest in pregnant women below 29 years with prevalence above WHO cut-off. Zehra *et al.* (2014) reported similar findings with higher prevalence (68 percent) among pregnant women between 18-29 years as compared to (32 percent) which was also significant. The higher prevalence among adolescent mothers is due to the fact that their body is over tasked as there is an increase in demand for iron with the rapid growth in adolescence and addition of pregnancy in adolescence makes the demand even higher hence increasing their vulnerability to anaemia.

Age at first delivery of the baby also was found significant to influence anaemia prevalence. The current study found a prevalence (>40.0 percent) among women who gave birth to their first baby before 24 years of age. The women who had their first child above 25 years of age had a normal Hb level. This result indicates that pregnancy in young age is a risk factor in prevalence of anaemia among the pregnant women.

UNFPA (2013) stated that anaemia is a high risk factor among adolescent pregnant women which if not corrected translates into later life of a woman as a persistent problem throughout her reproductive cycle.

This study also found anaemia prevalence to increase with increase in the number of children with the highest prevalence being among women who had two or more children (43.2 percent). This is because there is increase in iron depletion with each index pregnancy. Alem *et al*. (2013) reported the least prevalence of anaemia among Ethiopian pregnant women who had no child (9.2 percent) which increased with number of children. Pregnant women with two children had an anaemia prevalence of 30.6 percent and it was highest in those who had more than three children (51.7 percent).

4.5.1.3.3. Nutritional factor

All the pregnant women who were obese were found to be anaemic (100 percent) which could have been due to small numbers. However anaemia prevalence among under-nourished pregnant women was 49.8 percent which was higher than in pregnant women with a normal BMI (43.6 %). Maskey *et al.* (2014) reported the highest prevalence of anaemia among pregnant women with a low BMI ($<18.5kg/m^2$) as compared to those with a normal BMI and a BMI > $25kg/m^2$ (75.0 % vs 46.5 % and 36.6 %) respectively among Nepalese pregnant women. This is because under-nourished women have lowered immunity and are susceptible to recurrent infections from hookworms, malaria among others which can result in reduced Hb levels as reported by several studies (Kaur, 2014).

4.5.1.4. Determinants of anaemia in pregnant women during NFHS-2

The preceding discussion was based primarily on differentials. Multivariate analyses using ordinal logistic regression analysis allows us to assess net influences of various factors on the degree of anaemia after other factors are controlled. Results of ordinal logistic regression revealed that socio-economic variables (caste, educational level, partner’s educational level and wealth) have a net influence on severity of anaemia among the pregnant women in Andhra Pradesh during 1998/99 except occupation. However, residence, religion, age, age at first birth, parity and BMI were not significantly associated with severity of anaemia.

Caste was negatively correlated with anaemia prevalence in pregnant women. Pregnant women from SC had a 1.91 times higher RR of being anaemic in comparison to their counterparts who belonged to other social classes. Ramesh and Lopamudra

(2010) reported similar findings with SC/ST women having higher odds of being anaemic as compared to the women who belonged to other caste. This is due to the fact that women in SC have limited access to quality health care. They are most likely to attend antenatal care in their third trimester or less than five times throughout pregnancy.

Education was negatively correlated to anaemia prevalence among pregnant women. Severity of anaemia among the educated pregnant women decreased with increase in formal education. In comparison to the pregnant women who attained higher education, the RR of being anaemic was 3.22 times , 5.16 times and 4.06 times among pregnant women with no education, primary education and secondary education respectively. This result indicates that women with no education had a lower risk of being anaemic and anaemia prevalence among them was lower (41.1 %) compared to the pregnant women who attained primary (55.6 %) and secondary (46.3 %) education. Ramesh and Lopamudra (2010) reported similar findings in Indian pregnant women as the current study with regards to their education. This can be attributed to government programmes which normally target the uneducated pregnant women with the assumption that they are at a higher risk as compared to educated women assumed to be more knowledgeable and yet the component of nutrition education is an option in formal education system which makes even the educated pregnant women vulnerable to anaemia.

Partner's education was also negatively correlated to anaemia prevalence. Partners who attained primary education had anaemia prevalence in their wives reduced by 78.5 percent. In comparison to partners with higher education, the RR of being anaemic was 2.19 times in pregnant women whose partners attained primary education. This is because a woman's partner plays a significant role in health maintenance as most of the decisions on money allotted to food purchase and acquisition of health care are independently made by the woman's partner or jointly. Education as a base of all knowledge would enable partners make informed decisions and also help take care of their pregnant wives properly to maximise the outcome of pregnancy i.e. encourage them attend routine antenatal check-ups, eat balanced meals among others and exercise regularly.

Availability of wealth is a determining factor in type of food, frequency of meals and access to quality health care. Wealth was negatively correlated with severity of anaemia. Pregnant women who belonged to poorer households had a 2.23 times higher RR of being anaemic as compared to their counterparts who belonged to the richest households. This is because with limited money, comes less allocation of money to necessities like food (poorer households will depend on calorie dense foods with micronutrient deficiency), poor sanitary conditions and irregular antenatal check-up as the women might be busy working on fields/ households to earn some money for food. However Ramesh and Lopamudra (2010) did not find standard of living to have a significant influence on anaemia in pregnant women but Zehra *et al.* (2014) found family income significant to influence anaemia in pregnant Pakistani women.

4.5.2. Andhra Pradesh (2005/2006).

4.5.2.1. Profile of pregnant women in Andhra Pradesh during NFHS-3.

Data on approximately 273 pregnant women was included in the study in Andhra Pradesh state (pre-divided) of which 71.4 percent were living in rural AP and 28.6 percent were in urban AP. Results in Table.4.5.2 revealed majority of the pregnant women (78.4 %) were of Hindu religion, belonged to OBC (47.2 %), attained secondary education (48.3 %) and only (3.8 %) attained higher education. Majority of the women (68.0 %) were not working and among the pregnant working women, (23.5 %) were involved in agricultural work (Table.4.5.2). As far as social economic class using wealth index is concerned, majority of the pregnant women belonged to the richer households.

Results also revealed that majority of the pregnant women (46.2 percent were in the age bracket of 20-24 years. Out of the pregnant women included in the study, only 120 gave information on when they had their first child. Results show that (56.7 percent) of these women had their first baby between the ages 15-19 years of age. Majority of the pregnant women (57.7 percent) had no child by the time of the survey and (> 70 %) had a normal BMI.

Table.4.5. 2. Percentage association of Anaemia in pregnant women with selected socio-economic and demographic variables in Andhra Pradesh state during 2005/06

Background characteristics	Percent pregnant women with any Anaemia	Percentage of pregnant women with		Number of pregnant women (%)	Chi-square & p-value
		Mild anaemia	Moderate anaemia		
Residence					
Urban	51.7	45.9	5.7	78(28.6)	X²=1.1768 P=0.5552 (NS)
Rural	58.2	53.2	5.1	195(71.4)	
Religion					
Hindu	58.6	53.9	4.6	215(78.4)	X²=10.5581 P=0.032 *
Muslim	41.2	30.2	11.1	40(14.6)	
Christian	63.0	63.0	0.0	19(7.0)	
Others					
Caste					
SC	59.2	59.2	0.0	41(14.9)	X²=28.453 P<.0001 **
ST	89.2	89.2	0.0	25(9.3)	
OBC	59.0	51.5	7.5	129(47.2)	
Table.4.5.2. Continued					
None	40.0	34.0	6.0	79(28.7)	
Education level					
No education	61.0	50.4	10.6	88(32.1)	X²=27.668 P<0.0001 **
Primary	81.5	71.4	10.1	43(15.8)	
Secondary	46.0	45.7	0.3	132(48.3)	
Higher	44.1	40.8	3.3	10(3.8)	
Wealth index					
Poorest	76.1	62.1	14.0	31(11.3)	X²=14.1699 P=0.0774 (NS)
Poorer	57.2	57.2	0.0	39(14.3)	
Middle	56.1	49.5	6.7	75(27.4)	
Richer	54.6	49.4	5.2	91(33.2)	
Richest	43.8	43.0	0.7	38(13.8)	
Occupation					
Not working	55.0	47.3	7.7	186(68.0)	
Professional	85.5	85.5	0.0	5(1.9)	X²=17.7433 P=0.1237 (NS)
Sales	55.3	55.3	0.0	1(0.2)	
Agricultural	50.1	50.1	0.0	64(23.5)	
Services	97.2	97.2	0.0	2(0.8)	
Skilled & unskilled manual	83.6	83.6	0.0	15(5.5)	
Age of woman(in years)					
15 -19	48.2	46.2	2.0	94(34.4)	X²=11.5549 P=0.1722 (NS)
20 -24	59.0	51.6	7.4	127(46.2)	
25 -29	59.1	52.0	7.1	44(16.2)	
30- 34	84.9	84.9	0.0	4(1.5)	
35-39	98.6	98.6	0.0	5(1.7)	
Age of woman at first birth(in years)					
10 -14	75.0	75.0	0.0	10(8.2)	X²=34.7625 P=0.3377 (NS)
15- 19	67.0	53.3	13.8	68(56.7)	
20 -24	52.0	44.1	8.5	37(30.8)	
25 -29	48.8	48.8	0.0	5(4.4)	
BMI status					
Moderate thinness	32.7	21.9	10.8	23(8.4)	X²=15.5292 P=0.1139 (NS)
Mild thinness	57.4	57.2	0.2	28(10.1)	
Normal	58.9	53.0	5.9	199(72.7)	
Overweight	55.8	55.4	0.3	19(6.9)	
Obese class 1	17.0	17.0	0.0	3(1.0)	
Obese class 11	100.0	100.0	0.0	3(1.0)	
Number of children under five					
0	52.0	49.3	2.8	158(57.7)	X²=9.2822 P=0.1583 (NS)
1	60.3	52.1	8.2	92(33.5)	
2+	69.4	58.9	10.5	24(8.8)	
Total	**61.0**	**56.9**	**4.2**		
**= significant at 0.01, *= significant at 0.05, NS= Not significant.					

Source. NFHS-3

4.5.2.2. Prevalence of anaemia among pregnant women in Andhra Pradesh state during NFHS-3

Generally, anaemia among the pregnant women in AP stood at 61.0 percent of which 56.9 percent were mildly anaemic and only 4.2 percent were moderately anaemic. No cases of severe anaemia were reported among pregnant women in AP during NFHS-3 (figure.4.5.1). Similarly, pregnant women in Kakamega did not register any cases of severe anaemia (Mulambalah *et al*., 2014). These finding are similar to the national prevalence estimate of 59 percent in pregnant women during NFHS-3 survey (IIPS and Macro, 2007). Findings of this study are lower than those reported from DLHS-RCH 2002-2004 (IIPS and MoHFW, 2006) which found a higher prevalence of anaemia among pregnant women in Andhra Pradesh state (96.6 percent). In this report, prevalence of mild anaemia among pregnant women however, was similar to findings in the current study (57.8 percent). Ramesh and Lopamudra (2010) also reported a higher prevalence among Indian pregnant women (96.2 %). The difference in prevalence could be a result of different method of haemoglobin estimation employed between NFHS and DLHS surveys.

4.5.2.3. Association of anaemia and selected socio-economic and demographic variables.

Bivariate analysis using chi-square (Table.4.5.2) revealed that no significant association was found between anaemia and residence, wealth, occupation, age, age at first birth, BMI and number of children below five years. However, a significant association was found with religion, caste and education.

4.5.2.3.1. Socio-economic factors

The highest prevalence of anaemia was in Christian pregnant women (63.0 %) followed by (58.6 %) among the Hindu pregnant women and the least prevalence (41.2 %) among the Muslim pregnant women. This result is contradictory to findings from DLHS-RCH 2002-2204 survey which reported the least prevalence of anaemia among Christian pregnant women, followed by Muslims and Hindus having a much higher prevalence than the other two religions in Andhra Pradesh (IIPS and MoHFW, 2006). The differences could be due to different religious cultures and food taboos associated with pregnancy.

The study found a high prevalence (89.2 %) among pregnant women from ST caste. This result is similar to the finding in NNMB survey with ST pregnant women having the highest prevalence of 84 percent among states included in the survey

(NNMB. 2003). Also among states 25 states included in the DLHS-RCH survey, pregnant women from ST had the highest prevalence (97.6 %) of anaemia as compared to their counterparts from other states and union territories (IIPS and MoHFW, 2006).

This study also found anaemia prevalence to decrease with increase in the level of formal education from 81.5 percent among pregnant women who attained primary education to 44.1 percent among those who attained higher level of education. However the prevalence of those who were illiterate was 61.0 percent which was lower than those with primary education (81.5 %). This result infers that primary education has a stronger association with prevalence of anaemia. This could be due to lack of nutritional knowledge at that lower level of education and yet the women consider themselves literate so probably will question any nutritional knowledge and advise given to them compared to the illiterate pregnant women who would accept the advice given during antenatal visits. . Several studies have reported the similar effect (Ramesh and Lopamudra, 2010, Mulambalah *et al*., 2014 and IIPS and MoHFW, 2006 and IIPS and Macro, 2007).

Anaemia prevalence in pregnant women systematically decreased with increase in the wealth of the households from 76.1 percent in the poorest holds to 43.8 percent in the richest households though the association was not found significant ($p<0.05$). Similarly in DLHS-RCH survey in AP, pregnant women from low socio-economic class had the highest prevalence of anaemia (99.6 %) which reduced (92.2 %) among those from high socio-economic class (IIPS and MoHFW, 2006).

4.5.2.3.2. Demographic factors

Different from most studies which find a stronger association of anaemia prevalence with younger age in pregnant women, this study found the strongest association of anaemia prevalence with older age 35-39 years. There was a higher prevalence of anaemia among older pregnant women (98.6 percent) and the least prevalence among younger women (15-19) years (48.2 %) though age was not significant in influencing anaemia prevalence among the pregnant women. Getachew *et al*. (2012) reported similar finding in Ethiopian pregnant women living in Gilgel Gibe Dam area with highest prevalence of anaemia (87.5 percent) among women who were between 36-40 years of age as compared to other age groups which was equally not significant like in the current study. Maskey *et al.* (2014) also reported anaemia as highest among pregnant women above 30 years of age (67.5 percent). This could be a result of multiple pregnancies in older women with increased depletion of iron /haemoglobin reserves with each pregnancy.

Results in (Table.4.5.2) show a decrease in anaemia prevalence with an increase in the age as to when the woman first gave birth to a baby. Out of these women, anaemia prevalence was highest among the pregnant women who had their first child in early adolescence in the age bracket 10-14 years with a prevalence of 75.0 percent as compared to the women who had their first child between the ages 25-29 years. This is because 25-29 years is the prime age for child birth as the reproductive system of the woman is fully developed and odds of risky labour are lower where as the odds of high risk pregnancy is higher in younger women. In early adolescence, there is rapid growth which increases demand for iron.

4.5.2.3.3. Nutritional factor

BMI status showed differentials in anaemia prevalence. The highest prevalence was among the pregnant women who were obese-II where all were mildly anaemic. However mild thinness showed a slightly lower prevalence of anaemia (57.2 %) as compared to those with a normal BMI (58.9 %). This prevalence was almost the same between the thin and normal pregnant women. Similar results were found among Udipi pregnant women in Karnataka (51.09 % vs 51.99 %) among thin and normal BMI of pregnant women respectively (Noronha *et al.*, 2008). Poor anthropometric measurements are an indication of malnutrition as a result of poor feeding habits with either excess or low intake of nutrients.

4.5.2.4. Determinants of anaemia in pregnant women of Andhra Pradesh state during NFHS-3

Multivariate analysis using logistic regression found parity, BMI, caste, education of the woman, partner's educational level, wealth and occupation to have net influence on severity of anaemia among women in AP during 2005/06 survey.

Parity was positively correlated with severity of anaemia hence severity of anaemia increased with increase in number of children below five a woman had by the time of the survey (Table.4.5.2). Among women with no children, anaemia increased by 56.6 percent with a RR of 0.57 times being anaemic as compared to their counterparts who had two or more children. This is because with each successive pregnancy, there is a reduction of haemoglobin levels in the woman as the growing foetus draws its iron needs from the pregnant woman's reserves and a lot of blood is lost during child birth.

BMI was positively correlated to severity of anaemia among pregnant women in AP state. Pregnant women who were obese-I, had a 0.06 times RR of being anaemic in comparison to others grades of malnutrition. Usha *et al*. (2005) also reported one to two fold higher risk of caesarean section in pregnant women with a high BMI which would then increase their risk of being anaemic due to infections which result from caesarean (Sheiner, 2004).

Caste was negatively correlated with severity of anaemia. Pregnant women with ST registration had a 2.92 times RR of being anaemic as compared to their counterparts who belonged to other caste. The higher risk among ST pregnant women is due to the fact that scheduled tribes are more conservative and rely on traditional practices irrespective of their negative consequences. These women are less educated and have limited information in current nutritional knowledge. The lower educational level also hinders their ability to make informed decisions so they rely on traditional practices. Ramesh and Lopamudra (2010) and IIPS and MoHFW (2006) reported findings which are in-line with the findings from the current study.

Education of the woman was also significant in influencing severity of anaemia negatively. The RR of being anaemic was 2.87 times higher among primary educated pregnant women as compared to their counterparts who attained higher education.

Partner's education level was significant in influencing severity of anaemia prevalence negatively. The RR of being anaemic decreased with increase in educational level of the pregnant women partners. Pregnant women whose partners attained primary educational level had a 2.87 times RR of being anaemic which reduced to 2.02 times among pregnant women whose partners had attained secondary educational level in comparison to their counterparts whose partners had higher educational level.

Similar to education, wealth had an inverse relationship with severity of anaemia among pregnant women. Severity of anaemia decreased with increase in wealth of the household in which the pregnant women lived. Pregnant women from the poorest households had a 2.79 times RR of being anaemic as compared to their counterparts from the richest households and other wealth categories. The high relative risk among the poorest households is due to poverty which prevents the pregnant women from acquiring a balanced meal with all nutrients as required by the body and inability for the poor women to afford iron rich foods containing easily absorbable iron which are normally more expensive than the plant based food sources which contain high phytates that inhibit absorption of iron from food.

Table.4.5. 3.Results of ordinal logistic regression on prevalence of anaemia among pregnant women in Andhra Pradesh during 2005/06

Variable	1998-1999				2005-2006			
	Estimates	S.E	Significance	RR	Estimates	S.E	Significance	RR
Residence								
Urban	0.323	0.244	0.184	-	0.128	0.194	0.508	-
Rural	RC				RC			
Religion								
Hindu	0.357	0.411	0.385	-	0.200	0.613	0.745	-
Muslim	0.869	0.566	0.125	-	0.186	0.644	0.773	-
Christian	RC				RC			
Age of woman	0.014	0.025	0.585	-	-0.027	0.022	0.212	-
Age at first birth	0.011	0.046	0.808	-	0.057	0.039	0.146	-
Parity (below five years)								
No child	0.330	0.289	0.255	-	0.566	0.256	0.027*	0.57
1	0.183	0.285	0.522	-	0.310	0.261	0.234	-
2+	RC				RC			
BMI								
Moderate- T	0.214	1.871	0.909	-	-0.242	1.120	0.829	-
Mild- T	0.732	1.871	0.696	-	1.024	1.141	0.370	-
Normal	1.136	1.841	0.537	-	1.506	1.073	0.160	-
Overweight	1.349	1.900	0.478	-	1.666	1.109	0.132	-
Obese -1	RC				2.875	1.265	0.023*	0.06
					RC			
Caste								
SC	-0.645	0.320	0.044*	1.91	-0.259	0.310	0.403	-
ST	-0.313	0.473	0.509	-	-1.071	0.333	0.001**	2.92
OBC	-0.497	0.274	0.069	-	-0.280	-0.218	0.198	-
None	RC				RC			
Educational level of woman.								
No education	-1.168	0.596	0.050*	3.22	-0.685	0.398	0.085	-
Primary	-1.641	0.621	0.008**	5.16	-1.055	0.435	0.015*	2.87
Secondary	-1.401	0.610	0.022*	4.06	0.461	0.374	0.218	-
Higher	RC				RC			
Partner’s educational level								
No education	-0.384	0.328	0.242	-	-0.639	0.408	0.117	-
Primary	-0.785	0.366	0.032*	2.19	-1.055	0.394	0.007**	2.87
Secondary	-0.253	0.341	0.458	-	-0.701	0.343	0.041*	2.02
Higher	RC				RC			
Wealth								
Poorest	-0.256	0.420	0.541	-	-1.026	0.379	0.007**	2.79
Poorer	-0.802	0.358	0.025*	2.23	-0.451	0.370	0.222	-
Middle	-0.437	0.353	0.215	-	-0.290	0.285	0.308	-
Richer	-0.584	0.352	0.097	-	-0.455	0.249	0.068	-
Richest	RC				RC			
Occupation								
Not working	0.170	0.421	0.687	-	0.773	0.470	0.100	-
Professional	0.738	0.780	0.344	-	1.650	0.847	0.052*	0.19
Clerical	0.328	0.511	0.520	-	-0.527	1.370	0.701	-
Sales.	NA	NA	NA		0.505	0.872	0.563	-
Agricultural self employed	0.057	0.451	0.899	-	0.892	0.533	0.095	-
Agricultural employed	1.183	0.819	0.148	-	0.292	0.769	0.705	-
	RC				RC			
*= significant at 5%, **= significant at 1%,S.E= Standard Error, RC= Reference category, Moderate-T= Moderate thinness, Mild-T=Mild thinness, (-)=not applicable, NA= Not available.								

Source. NFHS-2 & 3

Severity of anaemia was positively correlated with occupation. Severity of anaemia increased with acquisition of employment. Among professional pregnant women, the relative risk of being anaemic was 0.19 times compared to their counterparts employed in the agricultural sector. This result indicates professional employment as high risk to prevalence of anaemia. This could be a result of the busy schedule that comes with most professional employment and the frequent travels which might affect the ability of the woman to attend antenatal clinic as scheduled by the doctors and also lack of enough time to eat proper meals.

4.5.3. Trends of anaemia in pregnant women between (1998- 2006)

Analysis of data revealed an increment in anaemia among the pregnant women in AP state over the years. Total anaemia increased by 22.2 percent. The differentials in anaemia prevalence over the years were due to mild anaemia. However, no cases of severe anaemia were accounted for (Figure.4.5.1). This is a great increase which is detrimental to the health of the pregnant women and would affect the outcome of pregnancy as any degree of anaemia has its side effects on the mother and the growing foetus (Kalaivani, 2009). The increment in anaemia prevalence could have been a result of increased unemployment among the pregnant women by (20.3 %) between the two surveys (Figure.4.5.3).

Figure.4.5.2 shows an increment in anaemia prevalence in pregnant women irrespective of their residence over the years. Rural residence however showed a stronger association with anaemia prevalence over the years . The increment (12.2 %) in anaemia prevalence over the years was higher among the urban pregnant women as compared to increment in rural pregnant women (6.5%). The lowered increment in rural pregnant women could be a result of several government programmes which have been implemented to offer assistance in rural areas with constant supervision of the women in folic acid consumption and antenatal care unlike in urban areas where the women are offered little attention.

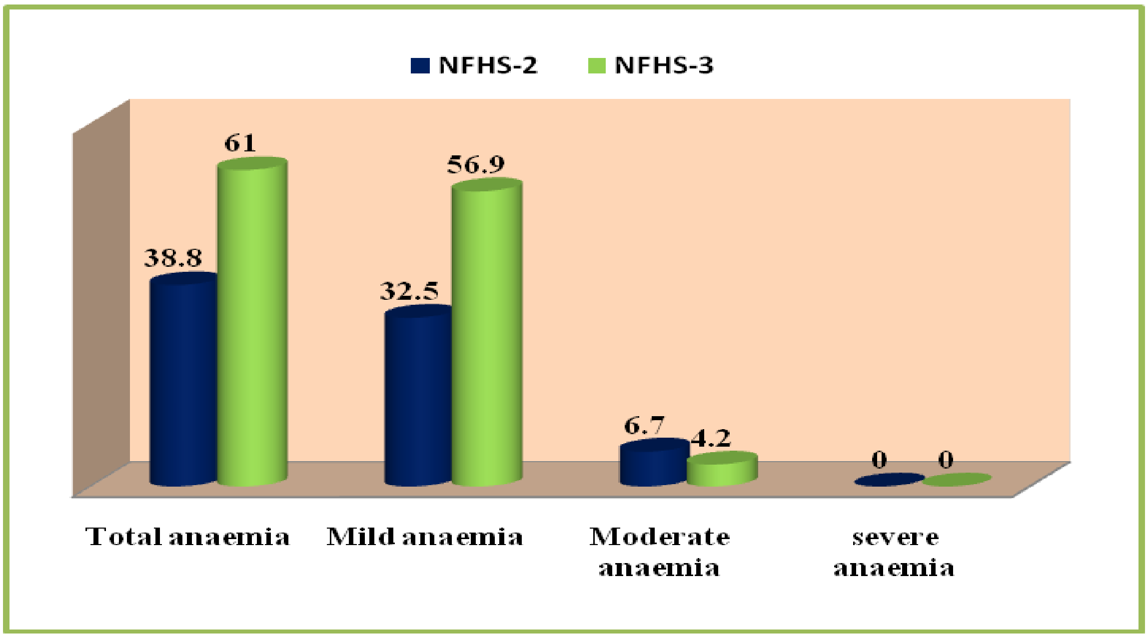

Figure.4.5. 1. Trends in anaemia prevalence among pregnant women in Andhra Pradesh state during 1998-2006.

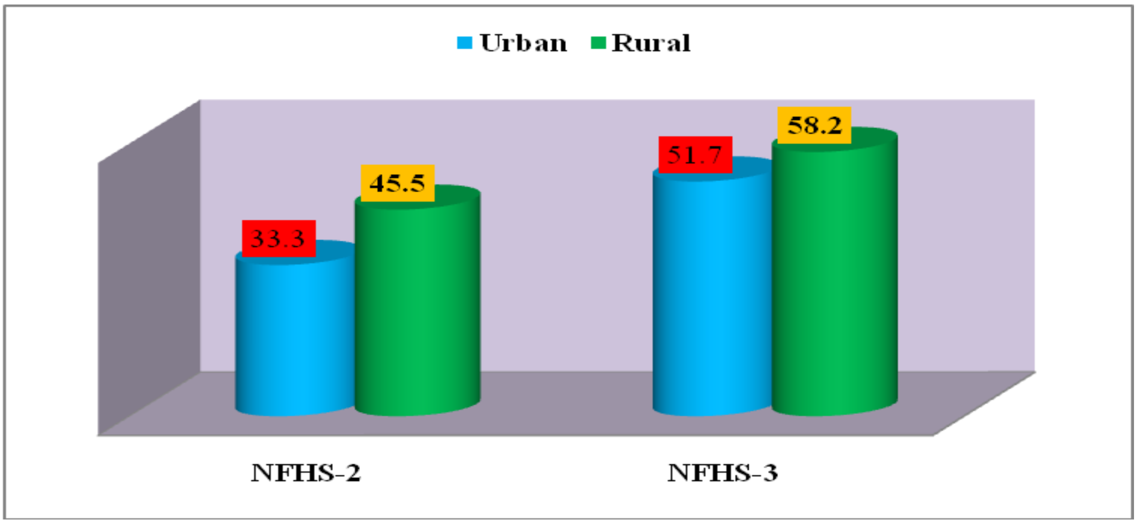

Figure.4.5. 2. Trends in anaemia prevalence of among pregnant women (15-49 years) by residence in Andhra Pradesh state during 1998-2006.

Over the years, anaemia prevalence based on socio-economic factors increased with the greatest increment among non- educated and primary educated, women from poorest households, ST, professional and those working in the skilled and unskilled sectors (Figure.4.5.3).

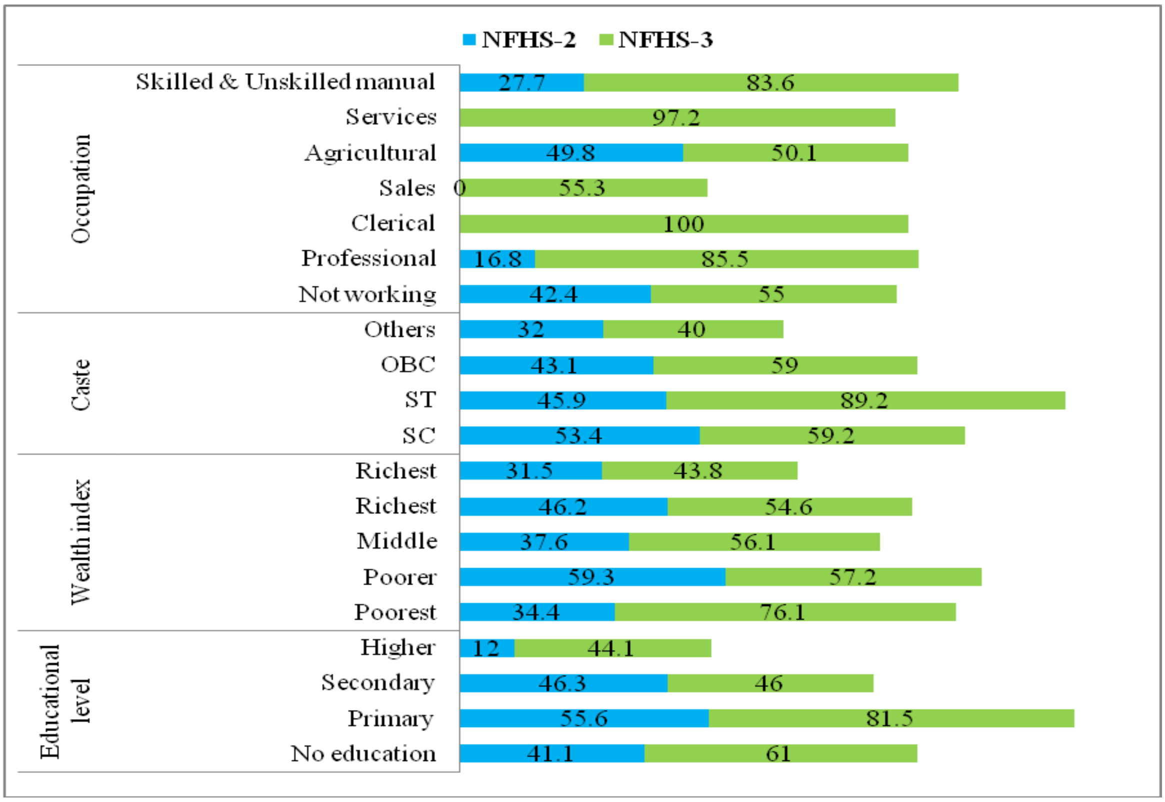

Figure.4.5.3. Trends in anaemia prevalence among pregnant women (15-49 years) in Andhra Pradesh state by occupation during 1998-2006.

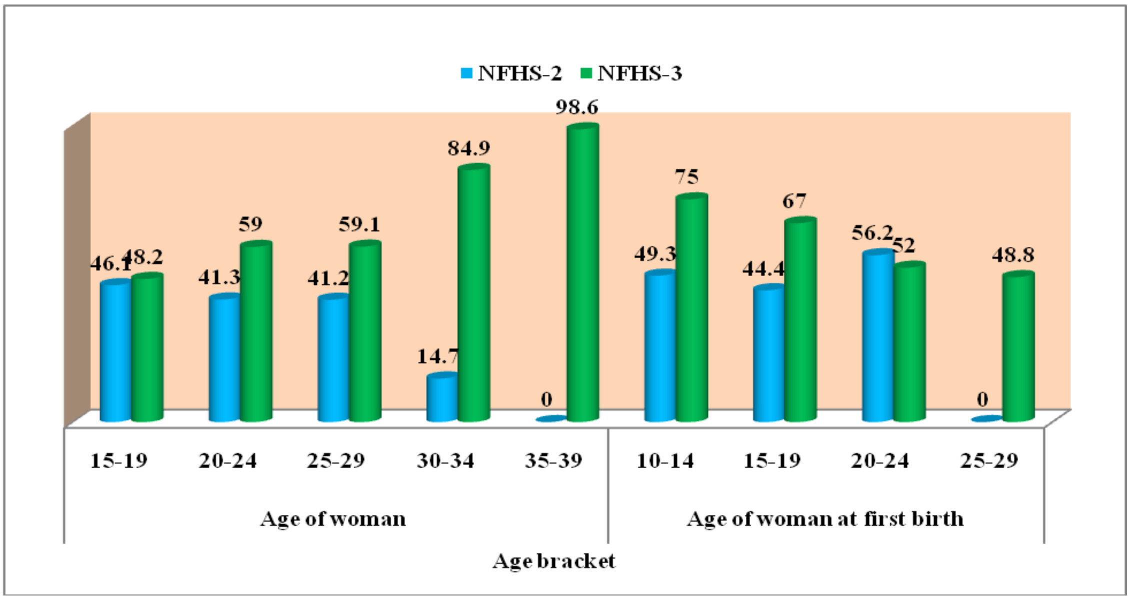

Figure.4.5. 4**. Anaemia prevalence among pregnant women in AP state based on age and age at first birth across the years between 1998-2006.**

Demographic variables also showed a substantial influence on anaemia prevalence among the pregnant women forexample age of the woman, age when the first baby was delivered and number of children also showed differentials in anaemia prevalence. There was a substantial difference in prevalence of anaemia based on the age of the pregnant women over the years. In 1998-99 survey, age was significant in influencing anaemia prevalence and was seen to decrease with increase in age of the pregnant woman while in 2005-06, age was insignificant to influence anaemia prevalence among pregnant women and anaemia was seen to increase with increase in the age of the pregnant woman(figure.4.5.4). The greatest increment in anaemia prevalence was among the women in the age bracket 35-39 years followed by 30-34 years where anaemia increased by 98.6 percent and 70.2 percent respectively. This result indicates that being pregnant within these age bracket as mentioned above was a great risk factor to increased prevalence of anaemia compared to being pregnant at a younger age.

Age at first birth was also significant in 1998-99 survey in influencing anaemia prevalence but its decrease / increase was not uniform as it drastically increased among pregnant women who were 20-24 years when they had their first child. However, in 2005-06 survey, anaemia prevalence showed a uniform/steady decrease as the age at which the first baby was produced increased though it was high across all ages. In 1998-99, none of the women who had their first child between 25-29 years was found anaemic compared to a higher prevalence (48.8%) in pregnant women who had their first baby in the same age bracket in 2005-06 survey. This indicates that over the years, much as age at first delivery reduced the high prevalence of anaemia, it did not control it meaning other factors were responsible in contributing to the high prevalence of anaemia.

Over the years, socio-economic factors remained predictors of anaemia among pregnant women but the RR varied over the years. The RR was higher by 1.0 times among ST women, 0.68 times among women whose partners attained primary education and 0.56 times among women from poorest households during 2005/06 survey whereas during 1998/99 survey, the RR was higher by 2.29 times among primary educated women. This indicates that improvement in womens' education alone did not protect them from anaemia as other aspects of SES were still low.

4.5.4. Maharashtra state (1998/99) NFHS-2

4.5.4.1. Profile of pregnant women in Maharashtra state during NFHS-2

Approximately data on 593 pregnant women was analyzed. Of the pregnant women included in the study, 55.0 percent were living in rural Maharashtra and the remaining (45.0 %) in urban part of the state. Majority (78.0 %) worshiped Hindu religion, did not belong to SC, ST or OBC (Table.4.5.4), attained secondary educational level (38.7 %), were from richer households according to wealth classification (28.3 %),

Table.4.5.4. Percentage association of Anaemia in pregnant women with selected socio-economic and demographic variables in Maharashtra state during 1998/99

Background characteristics	Percentage of pregnant women with any Anaemia	Percentage of pregnant women with			Number of pregnant women (%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	42.1	36.8	5.3	0.0	267(45.0)	X^2=26.539 P<.0001 **
Rural	61.7	51.1	8.4	2.2	326(55.0)	
Religion						
Hindu	56.7	46.8	8.4	1.5	436(78.0)	X^2=27.199 P=0.0753 (NS)
Muslim	32.1	29.6	2.5	0.0	87(14.7)	
Christian	44.4	44.4	0.0	0.0	5(0.8)	
Others	55.4	54.0	1.4	0.0	38(6.5)	
Caste						
SC	49.3	44.9	4.3	0.0	88(14.8)	X^2=23.773 P=0.0047 **
ST	72.0	62.7	6.2	3.0	72(12.2)	
OBC	56.4	50.1	6.3	0.0	119(20.1)	
NONE	47.8	38.8	8.2	0.9	313(53.0)	
Education level						
No education	56.5	46.1	8.9	1.6	173(29.1)	X^2=13.817 P=0.129 (NS)
Primary	51.7	42.2	7.6	1.9	113(19.1)	
Secondary	56.4	48.7	6.7	1.0	230(38.7)	
Higher	36.1	33.4	2.7	0.0	78(13.1)	
Wealth index						
Poorest	55.1	41.1	11.2	2.8	80(13.4)	X^2=57.875 P<.0001 **
Poorer	76.6	58.2	12.9	5.5	88(14.8)	
Middle	53.3	44.1	9.2	0.0	124(20.1)	
Richer	50.9	47.4	3.5	0.0	168(28.3)	
Richest	38.0	35.1	2.8	0.0	133(22.5)	
Occupation						
Not working	52.4	45.9	6.5	0.0	326(55.2)	X^2=66.981 P<.0001 **
Professional	0.0	0.0	0.0	0.0	11(1.9)	
Clerical	0.0	0.0	0.0	0.0	2(0.4)	
Sales	77.2	0.0	77.2	0.0	3(0.5)	
Agricultural	56.2	48.8	7.4	0.3	214(36.1)	
Domestic	74.1	74.1	0.0	0.0	4(0.8)	
Skilled & unskilled manual	25.6	18.0	2.8	0.0	31(5.2)	
Age of woman(in years)						
15 -19	53.9	47.0	5.4	1.5	177(29.9)	X^2=148.593 P<.0001**
20 -24	57.3	49.4	7.1	0.8	271(45.6)	
25 -29	42.9	34.6	6.4	1.8	125(21.1)	
30- 34	45.1	29.5	15.6	0.0	15(2.5)	
35-39	49.8	10.1	39.7	0.0	5(0.9)	
Age of woman at first birth(in years)						
10 -14	45.9	31.2	7.4	7.3	30(7.5)	X^2=82.022 P=0.0006 **
15- 19	58.1	47.2	9.0	1.9	264(66.3)	
20 -24	54.0	44.2	9.8	0.0	83(20.9)	
25 -29	28.1	28.1	0.0	0.0	19(4.7)	
30- 34	100.0	100.0	0.0	0.0	2(0.5)	
BMI status						
Moderate thinness	56.1	44.9	11.2	0.0	39(6.5)	X^2=32.713 P=0.0051 **
Mild thinness	45.1	35.8	9.3	0.0	109(18.4)	
Normal	56.9	48.7	6.5	1.7	415(70.1)	
Overweight	12.6	12.6	0.0	0.0	26(4.3)	
Obese class 1	0.0	0.0	0.0	0.0	2(0.2)	
Obese class 11	100.0	100.0	0.0	0.0	3(0.5)	
Number of children under five						
0	50.6	43.3	5.9	1.3	200(33.8)	X^2=32.035 P=0.1261 (NS)
1	51.9	39.4	10.2	2.3	194(32.8)	
2+	56.0	51.1	4.9	0.0	198(33.5)	
Total	**50.2**	**41.0**	**8.1**	**0.9**		
**= significant at 0.01, *= significant at 0.05, NS= Not significant						

Source. NFHS-2

were not working (55.2 %) and 45.6 percent were in the age bracket 20-24 years. Out of these pregnant women, 398 gave a response on when they had their first child. More than 60 percent of the pregnant women (66.3 %) had their first child between the ages of 15-19 years, had a normal BMI (70.1 %) while the remaining were malnourished with (24.9 %) having a BMI below normal and (5.0 %) having a BMI above the normal range.

4.5.4.2. Prevalence of anaemia among pregnant women in Maharashtra state during NFHS-2

The overall prevalence of anaemia among pregnant women was 50.2 percent of which 41.0 percent were mildly anaemic, 8.1 percent were moderately anaemic and only 0.9 percent were severely anaemic. Noronha *et al.* (2008), Tadege (2009) and Getachew *et al*. (2012) reported almost similar prevalence (50.1 percent, 51.9 percent and 53.9 percent) among Indian pregnant women in Udipu- Karnataka and Ethiopian pregnant women in Bushulo health centres and Gilgel Gibe dam area respectively. A similar prevalence of moderate anaemia (10.1 percent) and severe anaemia (0.7 percent) to the current study was reported in Mizoram and Manipur, North-east Indian states respectively (Gogoi and Prusty, 2013). However, Menon *et al*. (2014) reported a slightly higher prevalence of overall anaemia (55 percent) and severe anaemia (2.2 percent) in pregnant women on folic acid supplementation during their second visit at antenatal clinic in Ramtek, Maharashtra. These findings are lower than the national prevalence estimates (59 percent) reported in NFHS-3 (IIPS and Macro, 2007) but higher than the WHO estimates. The difference in prevalence is a sign of other contributing factors like altitude, social-cultural influences that exist between populations in the same country.

4.5.4.3. Association of anaemia and selected socio-economic and demographic variables

Results in Table.4.5.4 show there was a significant association between anaemia prevalence with residence, caste, wealth, occupation, age, age at first birth and BMI except for religion, educational level and number of children under five.

4.5.4.3.1. Socio-economic factors

Rural residence showed a stronger association with anaemia prevalence (61.7 %) compared to urban residence where the prevalence of anaemia was 42.1 percent. This can be due to the limited facilities in rural areas compared to the urban centres yet majority of the population live in the rural part of the state. Most of the health facilities are located at a distance and inaccessible due to the poor roads making it difficult for the women to attend antenatal clinics.

Pregnant women from ST caste had the highest prevalence of anaemia (72.0 %) followed by OBC (56.4 %) and SC (49.3 %). This result shows a high prevalence across all castes which infers that caste has a strong influence on anaemia prevalence as it determines the economic situation of most households in India.

Results in Table.4.5.4 shows illiteracy among pregnant women to have a stronger association with anaemia prevalence with the highest prevalence among the pregnant women with no education (56.5 %) and the least prevalence among those with higher education level (36.1 %).This relationship was not significant. Karaoglu *et al*. (2010) reported similar results and also did not find a significant relationship between pregnant women and their education just like the current study.

Pregnant women from poorer households had the highest prevalence of anaemia (76.6 %) with a higher association with severe anaemia (5.5 %) followed by pregnant women from the poorest households (55.1 %) with severe anaemia (2.8 %). The remaining categories (middle, richer and richest) had no association with severe anaemia. Lokare *et al*. (2012) reported similar prevalence with the highest prevalence of anaemia among pregnant women from class V (94.11 %) and class IV (94.4 %) and the least prevalence among class I (47.6 %) in Aurangabad city. This is because increase in wealth, increases purchasing power in household in-terms of food, supplements, timely and quality health care, encourages sanitary conditions to reduce infections through proper toilet facilities and hygienic sources of water.

Anaemia prevalence was (52.4 %) among pregnant non-working women which was lower compared to some working pregnant women like (77.2%, 74.1% and 56.2%) representing pregnant women in sales, household work and agricultural work respectively. This result is contradictory to Idowu *et al*. (2005) who reported anaemia as highest among the unemployed pregnant women (89 %) and least among civil servants (63.8 %).

4.5.4.3.2. Demographic factors

The highest prevalence of anaemia was among pregnant women between the ages of 20-24 years followed by 15-19 years (Table.4.5.4). This contradictory to the studies of Ogbeide *et al.* (1994), Thangaleeta (1994) and Idowu *et al.* (2005) who reported anaemia to be higher among adolescent pregnant women (15-19 years) as compared to other age groups. However, the current study also found higher prevalence of severe anaemia among pregnant women who had their first child between 10-14 years of age.

4.5.4.3.3. Nutritional factor

Result in table 4.5.4 found pregnant women with a normal BMI to have an association with severe anaemia (1.7 %) as compared to their counterparts with a higher BMI and lower BMI. Another study in India noted that obese and overweight pregnant women are less likely to be severely anaemic as compared to women with a normal BMI (Rammohan *et al*., 2012)

4.5.4.4. Determinants of anaemia in pregnant women

Using ordinal logistic regression, the net influence of each independent variable on severity of anaemia was established and results presented in Table.4.5.6. Although bivariate analysis found a significant association of anaemia prevalence with occupation, age, age at first birth and BMI, multivariate analysis did not find the above mentioned variables to have a net influence on severity of anaemia among the pregnant women.

Residence was positively correlated to severity of anaemia. In comparison to pregnant women in rural residence (RR=1.70 times), pregnant women in urban residence had a 0.59 times RR of being anaemic. Hence the rural women were twice at a higher risk of being anaemic than the urban women. Gebremedhin and Enquselassie (2011) reported similar findings among rural and urban women with rural women having higher odds of being anaemic than the urban women in Ethiopia. This could be a result of inequality in distribution of resources between urban and rural populations. i.e. health care, restricted access to variety of foods (dietary diversity) which is of importance.

Caste was negatively correlated with severity of anaemia. In comparison to pregnant women who did not belong to any of the mentioned caste, pregnant women in ST had a higher RR of 30.81 times of being anaemic. Arlappa *et al*. (2014) reported higher RR of 3.67 times among pregnant women who belonged to SC/ST caste in Maharashtra. This could be due the fact that pregnant women in ST category, on top of being less privileged in society with limited access to quality resources like health care, education, they are more likely to strongly hold on to cultural beliefs even when they do not favour their health. i.e., some will reject vaccination, folic acid supplementation, will not attend antenatal clinic and are most likely to deliver from home with help of traditional birth attendants rather than seek proper medical attention.

Educational level of the woman was negatively correlated with severity of anaemia with severity of anaemia decreasing with increase in educational level of the pregnant woman. The RR of being anaemic was 3.36 times, 2.44 times and 2.03 times among pregnant women with no education, primary education and secondary education respectively in comparison to their counterparts who attained higher educational level. Gebremedhin and Enquselassie (2011) reported similar findings with non-educated pregnant women having higher odds of being anaemic (AOR= 2.59) which decreased to 1.83 times and 1.20 times among the women with primary and secondary education respectively. This is because education is the base of all knowledge and educated women are empowered to care for themselves better as they are likely to have better paying jobs, make informed decision which favour health among others.

Partners' educational level was also negatively correlated with severity of anaemia among pregnant women. This infers that with improvement in educational level of the man, severity of anaemia in his wife would decrease concurrently. Among partners' who had no education, anaemia among their pregnant wives decreased by 87.6 percent and it decreased by 58.2 percent in women whose partners' had attained secondary education. The RR of being anaemic was 2.40 times and 1.79 times among pregnant women whose husbands had no education and among those who had achieved secondary education in comparison to their counterparts whose husbands had attained higher education. This is because women's partners play a significant role in determining where they attend antenatal care and the type of food cooked as seen in this state with more than half (55.2 %) of the pregnant women not working.

Similar to education, wealth of the household in which the pregnant woman lived was negatively correlated with severity of anaemia. Severity of anaemia decreased with improvement in wealth. In comparison to pregnant women from the richest households, the RR of being anaemic was highest in the poorer (3.55 times) and poorest households (2.02 times). The RR of being anaemic reduced to 1.66 times among the pregnant women from richer households. This is because with improvement in wealth comes the opportunity for the pregnant women to receive timely and quality medical attention with regular antenatal check –ups and also consumption of quality food sources of iron like animal sources which are more expensive.

4.5.5. Maharashtra state (2005/06) NFHS-3

4.5.5.1. Profile of pregnant women in Maharashtra state during NFHS-3

Approximately, data on 432 pregnant women was analyzed during the study and results presented in Table.4.5.5. Out of these women, majority lived in rural Maharashtra (61.6 %), were of Hindu religion (77.1 %), and belonged to other castes (46.2 %) other than SC, ST and OBC. Table 4.5.5 also shows that majority of the women attained secondary education (60.4 %), belonged to the richest and richer households according to wealth classification (24.3 % and 23.4 %) respectively and were not working (60.0 %) and were in the age bracket 20-24 years (45.5 percent). Out of the women included in the study, only 289 gave information on when they had their first child. Results revealed that majority of the pregnant women under study had their first child between 15-19 years of age. Most of the women had one child by the time of the survey and anthropometric data revealed majority of the pregnant women had a normal BMI (67.6 %).

4.5.5.2. Prevalence of anaemia among pregnant women in Maharashtra state during NFHS-3

The overall prevalence of anaemia among pregnant women was 60.9 percent. Out of the anaemic pregnant women, 50.9 percent were mildly anaemic, 7.9 percent were moderately anaemic and 2.2 percent were severely anaemic. A similar prevalence of severe anaemia (1.8 percent) though was reported in pregnant women in Maharashtra state during DLHS-RCH survey in 2002-2004 (IIPS and MoHFW, 2006). However, Bentley and Griffiths (2003) reported a prevalence of 96 percent anaemia among pregnant women in Delhi which was higher than in the current study. Some studies reported lower prevalence of anaemia among pregnant women like Gustavo *et al. (*2012) reported 21.4 percent among pregnant women in Peru and Karaoglu *et al. (*2010) reported a prevalence of 27.1 percent among pregnant women in Turkey.

Table.4.5.5. Percentage association of Anaemia in pregnant women with selected socio-economic and demographic variables in Maharashtra state during 2005/06

Background Characteristics	Percent pregnant women with any Anaemia	Percentage of pregnant women with			Number of pregnant women (%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	59.5	49.9	8.1	1.5	164(38.4)	X²=4.308 P=0.2301 (NS)
Rural	56.4	49.6	6.8	0.0	268(61.6)	
Religion						
Hindu	54.0	47.7	5.6	0.7	329(77.1)	X²=58.291 P<.0001 **
Muslim	60.7	51.1	9.6	0.0	60(14.0)	
Christian	65.3	15.7	49.6	0.0	5(1.1)	
Others	86.4	71.8	14.6	0.0	33(7.8)	
Caste						
SC	69.7	65.7	0.4	3.6	67(16.0)	X²=36.317 P<.0001 **
ST	79.3	63.5	15.8	0.0	58(13.8)	
OBC	46.1	39.1	7.0	0.0	100(23.8)	
None	52.5	47.3	5.3	0.0	194(46.2)	
Others	100.0	100.0	0.0		1(0.2)	
Education level						
No education	61.2	49.2	12.0	0.0	95(22.2)	X²=36.317 P<.0001 **
Primary	66.0	43.0	17.1	5.9	41(9.6)	
Secondary	55.9	51.3	4.6	0.0	258(60.4)	
Higher	50.5	47.4	3.1	0.0	33(7.8)	
Wealth index						
Poorest	75.1	57.4	17.8	0.0	63(14.8)	X²=38.609 P=0.0001 **
Poorer	69.9	58.6	11.2	0.0	61(14.4)	
Middle	52.2	47.4	4.8	0.0	97(22.7)	
Richer	47.9	45.3	0.3	2.4	102(23.8)	
Richest	54.2	46.3	7.9	0.0	104(24.3)	
Occupation						
Not working	52.2	44.4	6.9	0.9	256(60.0)	X²=20.018 P=0.3318 (NS)
Professional	52.1	52.1	0.0	0.0	15(3.5)	
Clerical	50.0	50.0	0.0	0.0	2(0.4)	
Sales	96.3	96.3	0.0	0.0	110(25.8)	
Agricultural	71.5	61.3	10.2	0.0	12(2.7)	
Services	64.4	64.4	0.0	0.0	30(7.0)	
Skilled & unskilled manual	49.5	41.4	8.1	0.0		
Age of woman(in years)						
15 -19	62.8	51.2	9.2	2.4	99(23.3)	X²=13.968 P=0.3028 (NS)
20 -24	54.6	49.8	4.8	0.0	194(45.5)	
25 -29	58.6	47.6	11.0	0.0	96(22.5)	
30- 34	59.6	52.5	7.1	0.0	32(7.4)	
35-39	42.0	42.0	0.0	0.0	6(1.3)	
Age of woman at first birth(in years)						
10 -14	100.0	27.7	0.0	72.3	3(1.2)	X²=272.548 P<.0001 **
15- 19	68.6	58.3	10.3	0.0	158(54.4)	
20 -24	44.5	36.3	8.2	0.0	113(39.1)	
25 -29	41.6	41.6	0.0	0.0	13(4.6)	
30-34	100.0	100.00	0.0	0.0	2(0.8)	
BMI status						
Moderate thinness	39.0	39.0	0.0	0.0	40(9.4)	X²=44.889 P<.0001 **
Mild thinness	49.9	35.5	10.7	3.6	67(15.6)	
Normal	63.5	56.0	7.5	0.0	289(67.6)	
Overweight	43.9	43.5	0.4	0.0	26(6.0)	
Obese class 1	40.9	0.0	40.9	0.0	6(1.4)	
Number of children under five						
0	52.9	47.4	5.5	0.0	145(33.9)	X²=16.729 P=0.160 (NS)
1	61.2	48.9	11.0	1.3	189(44.2)	
2+	57.6	54.8	0.0	0.0	94(22.0)	
Total	**60.9**	**50.9**	**7.9**	**2.2**		
**= significant at 0.01, *= significant at 0.05, NS= Not significant						

Source. NFHS-3

4.5.5.3. Association of anaemia and selected socio-economic and demographic variables.

Bivariate analysis using chi-square (Table.4.5.5) revealed a statistically significant association between anaemia prevalence and religion, caste, educational level, wealth, age at first birth and BMI. On the other hand, residence, occupation, age of woman and number of children below five years was not significantly associated with anaemia prevalence among pregnant women in this state during the survey.

4.5.5.3.1. Socio-economic factors

The highest prevalence of anaemia was among pregnant women who belonged to other religions (86.4 %) other than the mentioned ones (Table.4.5.5). The least prevalence of anaemia was among Hindu pregnant women. During NFHS-3, similar results were reported in Mizoram and Tripura states with anaemia being highest among pregnant women from other religions than Hindu, Islam and Christianity (70.0 % and 75.0 %) respectively (Gogoi and Prusty, 2013).

Though residence was found not significantly correlated to influence anaemia among pregnant women, figure.4.5.5 shows a higher prevalence of anaemia in urban pregnant women than their counterparts in rural Maharashtra. This result is contradictory to findings of IIPS and MoHFW, (2006) and Gogoi and Prusty (2013) but in- line with Hans *et al.* (2015) who reported anaemia to be more prevalent in urban pregnant women than rural pregnant women (42.7 % vs 26.8 %). This is could a result of dependence on street/ junk food which is very common in urban areas and yet it is deficient in micronutrients like iron, vitamins but dense in calories.

Pregnant women from ST had the highest prevalence of anaemia (79.3 %) followed by SC (69.7 %). This finding is in line with findings of Ramesh and Lopamudra (2010) who reported Indian pregnant women from SC/ST caste to have highest prevalence of anaemia (97.2 %). This study also reported a similar prevalence of severe anaemia as the current study (3.5 %).

Though pregnant women with no education had a lower prevalence of anaemia (61.2 %) than the women who attained primary education (66.0 %), anaemia prevalence decreased with increase in educational level of the pregnant women (Table.4.5.5). Similar trend of anaemia prevalence was reported in Meghalaya and Sikkim states of north east India during NFHS-3 among pregnant women (Gogoi and Prusty, 2013).

In all households, anaemia prevalence was way above the WHO cut-off of anaemia classification as a public health problem. As expected, the highest prevalence of anaemia was in pregnant women from poorest households (75.1 %), followed by the poorer households (69.9 %) compared to other households who had a fairly lower prevalence though still very high (Table.4.5.5). In NFHS-3 report, it was stated that anaemia prevalence was highest in women from the two lowest wealth quintiles similar to the current findings (IIPS and Macro, 2007). Noronha *et al.* (2008) reported similar findings with anaemia being highest among pregnant women from low SES (54.3 %) and lowest in high SES (41.9 %).Gogoi and Prusty (2013) also reported a similar trend in all the seven north Indian states analyzed.

Based on occupation, anaemia prevalence among non-working pregnant women was lower than that of the working pregnant women (Tabe.4.5.5). However, severe anaemia was only associated with lack of employment (among non-working pregnant women).

4.5.5.3.2. Demographic factors

Anaemia was highest among 15-19 year old pregnant women (62.8 %). Age at first delivery is also an important factor in the reproductive cycle of a woman. Pregnant women who had their child at earlier ages (early adolescence) while still young are prone to the negative consequences of early pregnancy, one of which is anaemia. Study results revealed a very high prevalence of severe anaemia among women who gave birth to their first child between 10-14 years of age (72.3 %) because at this stage growth is rapid which causes a decrease in haemoglobin and pregnancy too increases the demand of haemoglobin to sustain the growing foetus.

Though number of children below five years a pregnant woman had by the time of the survey was not significantly associated with anaemia prevalence, results in Table.4.5.5 revealed a higher prevalence in pregnant women who had one child (61.2 percent) as compared to the pregnant women with two or more children (57.6 percent). Similar results were reported by Getachew *et al.* (2012) in pregnant women in Gilgel Gibe Dam area in Ethiopia with a prevalence of (56.6 percent vs 53.9 percent).

4.5.5.3.3. Nutritional factor

This study found paradoxical results in which pregnant women with normal BMI had a higher prevalence of anaemia (63.5 %) than the malnourished pregnant women

(Table.4.5.5). This could be a result of total neglect of health among the women with normal BMI as they assume to be healthy as compared to under-nourished pregnant women who will devotedly take folic acid supplementation and feed as advised because they feel already threatened by their poor BMI status. Under-nourished women will also be more interested in attending antenatal check-up to track their health situation.

4.5.5.4. Determinants of anaemia in pregnant women in Maharashtra state during NFHS-3

All the selected variables were run in an ordinal logistic model to establish the independent effect of each variable on prevalence of anaemia among the pregnant women in this state during the survey. Results were presented in Table.4.5.6. Although bivariate analysis found a significant association between religions, age of the woman at first birth, caste, educational level and anaemia prevalence among the pregnant women, multivariate analysis using ordinal logistic regression did not find the above mentioned variable to have net effect on severity of anaemia among the women. Only BMI, wealth and occupation were found to significantly affect the severity of anaemia among these study population during this survey.

In comparison to obese-I pregnant women, the RR of being anaemia was 26.66 times among moderately thin pregnant women. This infers that under-nourishment is a more significant risk factor for anaemia prevalence and severity of anaemia decreased with increase in BMI of the pregnant women.

Among the richer households, wealth was positively correlated to severity of anaemia in pregnant women. The RR of being severely anaemic was 0.58 times among pregnant women from richer households in comparison to their counterparts from the richest households in which none was severely anaemic (Table.4.5.5). Samuel *et al*. (2013) reported an increased RR of being anaemic with increase in the family income from 0.71 times to 0.73 times among pregnant women with an income between Rs-5000- Rs. 8000 and Rs.>8000 respectively.

Occupation empowers a woman and improves her status in society. Occupation was negatively correlated with severity of anaemia among the pregnant women. In comparison to pregnant women employed in the skilled manual sector (RR=0.24 times), the RR of being anaemic was 4.09 times among professionally employed pregnant women. The higher risk among professional women could be a result of busy schedule with limited or no time to eat properly prepared and nutritionally balanced meals. Most professional women are known to snack and have irregular eating patterns due to lack of time.

Table.4.5.6. Results of ordinal logistic regression on prevalence of anaemia among pregnant women in Maharashtra state during 1998/99 and 2005/06 surveys.

Variable	Maharashtra state							
	1998-1999				2005-2006			
	Estimates	S.E	Significance	RR	Estimates	S.E	Significance	RR
Residence								
Urban	0.532	0.200	0.008**	0.59	-0.381	0.210	0.069	-
Rural	RC				RC			
Religion								
Hindu	0.322	0.378	0.394	-	NC	NC	NC	NC
Muslim	0.791	0.421	0.060	-	NC	NC	NC	NC
Christian	1.373	1.282	0.284	-	NC	NC	NC	NC
Others	RC				NC	NC	NC	NC
Age of woman	NC	NC	NC	NC	-0.011	0.014	0.426	-
Age at first birth	0.035	0.038	0.367	-	0.023	0.041	0.570	-
Parity(below five years)								
No child	0.242	0.240	0.313	-	-0.042	0.267	0.874	-
1	-0.135	0.242	0.579	-	-0.009	0.263	0.973	-
2+	RC				RC			
BMI								
Moderate- T	0.256	0.838	0.733	-	-3.283	1.112	0.003**	26.66
Mild- T	1.183	0.837	0.157	-	-0.852	1.111	0.443	-
Normal	0.940	0.819	0.251	-	-1.243	1.885	0.252	-
Overweight	1.864	0.899	0.038*	0.16	-0.642	1.148	0.576	-
Obese -1	RC				RC			
Caste								
SC	-0.034	0.301	0.909	-	-0.067	0.282	0.812	-
ST	-3.428	1.468	0.020*	30.81	-0.274	0.330	0.407	-
OBC	-0.010	0.273	0.972	-	0.332	0.251	0.186	-
None	RC				RC			
Educational level of woman.								
No education	-1.213	0.336	<0.0001**	3.36	0.216	0.358	0.546	-
Primary	-0.890	0.354	0.012*	2.44	0.165	0.401	0.681	-
Secondary	-0.706	0.318	0.026*	2.03	0.344	0.288	0.232	-
Higher	RC				RC			
Partner's educational level								
No education	-0.876	0.332	0.008**	2.40	-0.083	0.375	0.824	-
Primary	NA	NA	NA	NA	NA	NA	NA	NA
Secondary	-0.521	0.331	0.115	-	0.028	0.358	0.938	-
Higher	-0.582	0.251	0.020*	1.79	0.155	0.271	0.566	-
	RC				RC			
Wealth								
Poorest	-0.701	0.358	0.050*	2.02	-0.055	0.377	0.884	-
Poorer	-1.267	0.349	<0.0001**	3.55	0.161	0.360	0.654	-
Middle	-0.511	0.296	0.085	-	0.594	0.289	0.40	-
Richer	-0.506	0.250	0.043*	1.66	0.545	0.258	0.035*	0.58
Richest	RC				RC			
Occupation								
Not working	-0.761	0.843	0.366	-	-0.627	0.448	0.162	-
Professional	NA	NA	NA	NA	-1.410	0.704	0.045*	4.09
Clerical	NA	NA	NA	NA	-1.158	1.146	0.312	-
Sales.	-1.269	1.564	0.407	-	NA	NA	NA	NA
Agricultural self employed	-0.971	0.870	0.264	-	NA	NA	NA	NA
Agricultural	-1.140	0.886	0.198		-0.721	0.504	0.153	-
employed				-				
Household	-0.659	1.192	0.581		-0.585	0.756	0.439	-
Skilled	0.368	1.085	0.734		RC			
manual	RC			-				
Unskilled manual				-				

*= significant at 5%, **= significant at 1%,S.E= Standard Error, RC= Reference category, Moderate-T= Moderate thinness, Mild-T=Mild thinness, (-)=not applicable, NA=not available, NC= Not computed.

Source. NFHS-2 & 3

4.5.6. Trends of anaemia among pregnant women between 1998- 2006 in Maharashtra state.

Figure.4.5.5 shows a general increase in anaemia prevalence over the years except for moderate anaemia which decreased slightly. Generally, overall anaemia among the pregnant women in Maharashtra state increased by 10.7 percent and severe anaemia increased by 1.3 percent between the NFHS-2 and NFHS-3.

Figure.4.5.6 below shows a 17.4 percent increment in anaemia prevalence over the years among urban pregnant women while anaemia among rural pregnant women decreased by 5.3 percent. This can be due to improvement in monitoring and evaluation of government programmes in rural areas where antenatal services are provided at almost no cost or subsidised costs compared to the urban areas where medical care is quite expensive which hinders most women from attending regular antenatal clinics where nutritional education is also disseminated.

In both surveys, BMI and wealth of the household in which the pregnant women lived were found to constantly influence the severity of anaemia among pregnant women (Table.4.5.6) with anaemia being highest among the last two wealth quintiles. Among the pregnant women from the richer households, the RR of being anaemic was 1.08 times higher during NFHS-2 and decreased in NFHS-3 which can be attributed to improved wealth in NFHS-3.

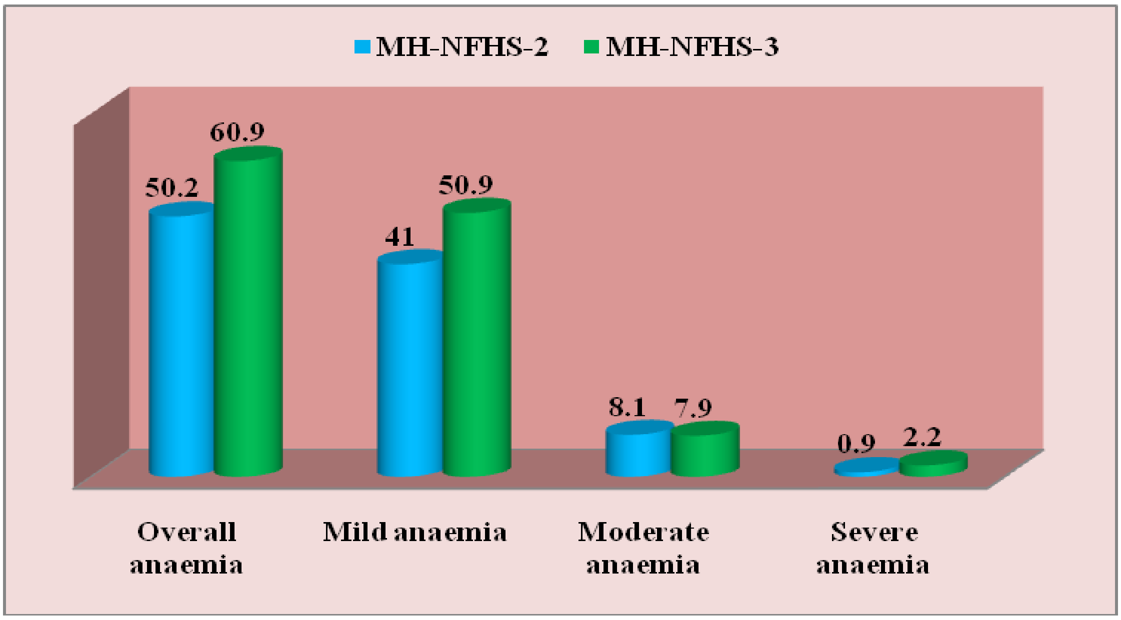

Figure.4.5. 5. Trends in anaemia prevalence among pregnant women in Maharashtra state during 1998-2006 surveys.

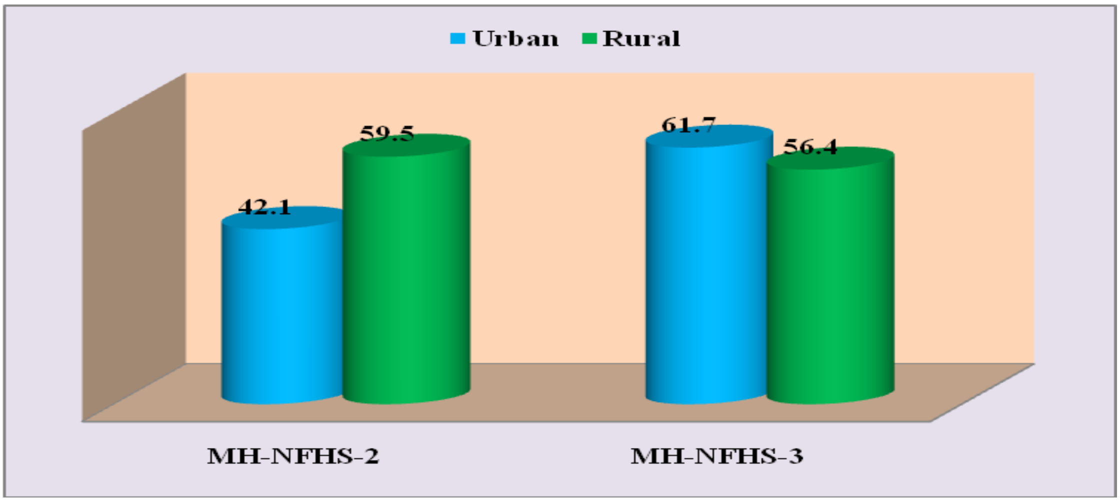

Figure.4.5. 6. Trends in anaemia prevalence among pregnant women in Maharashtra state during 1998-2006 surveys

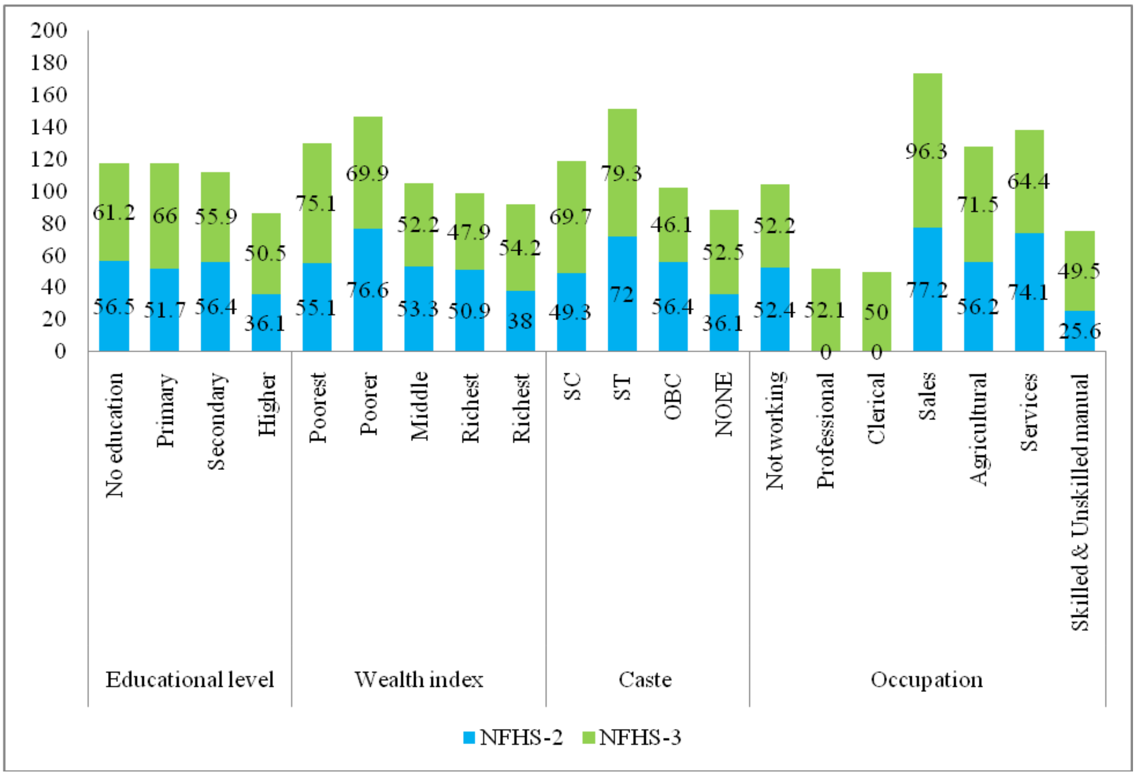

Figure.4.5. 7. Trends in anaemia prevalence among pregnant women (15-49 years) in Maharashtra state by occupation, caste, wealth during 1998-2006

Figure.4.5.7 also shows that over the years, anaemia prevalence increased pregnant women from the poorest households, SC/ST, those with no education and primary education which clearly indicates that among this population, social economic status as streamlined by caste, education, employment and wealth plays a role in determining the health of the pregnant women.

4.5.7. Karnataka state (1998/99)

4.5.7.1. Profile of pregnant women in Karnataka during NFHS-2.

Approximately data of 308 pregnant was included in the study. Of these pregnant women, majority (68.1 %) were living in rural Karnataka. Results in Table.4.5.7 revealed that, majority of the pregnant women were of Hindu religion (83.9 %), belonged to OBC caste category (43.3 %), were illiterate (38.0 %) with a good number having attained secondary education (35.4 %). Twenty eight percent (28.0 %) of the pregnant women belonged to the middle class households according to wealth classification and the least percentage of the women were from the poorest households (13.9 %). Majority of the pregnant women were unemployed (64.3 %) and among the working pregnant women, 26.3 percent were involved in agricultural work.

Majority of the pregnant women were in the age bracket 20-24 years (41.8 percent) followed by 15-19 years (36.9 percent). Out of the pregnant women included in the study, only 191 gave a response on when they had their first child. Results revealed that 60.4 percent of the women had their first child between 15-19 years of age which signifies a high existence of teenage marriages in the state. Majority of the pregnant women were found not to have a child by the time the survey was conducted (41.0 %). Anthropometric data revealed majority of the pregnant women had a normal BMI (71.7 %) while others were malnourished with (21.8 %) having a BMI below normal (<18.5kg/m^2) and (6.6 %) having a BMI above the normal (>25kg/m^2).

4.5.7.2. Prevalence of anaemia among pregnant women in Karnataka during NFHS-2.

The overall prevalence of anaemia was 47.3 percent of which 38.6 percent were mildly anaemic while 8.7 percent were moderately anaemic. The study result found no cases of severe anaemia among these pregnant women. Larocque *et al*. (2005) reported a similar prevalence among pregnant women in Peru (47.31 percent) and Maskey *et al.* (2014) reported a similar prevalence of 46.6 percent among pregnant women in Nepal with none of the women being severely anaemic just like in the present study. Gogoi and Prusty (2013) reported 46.7 percent prevalence among pregnant women in Mizoram state during NFHS-3 which is similar to the current study. This is lower than the estimated prevalence in Karnataka during NFHS-2 (58 percent). However analysis of DLHS-RCH 2002-2004 data reported a very high prevalence of anaemia (91.9 percent) among pregnant women in Karnataka (IIPS and MoHFW, 2006). Lack of severely anaemic pregnant women can be attributed to folic acid supplementation given to all pregnant women as part of antenatal care

Table.4.5.7. Percentage association of Anaemia in pregnant women with selected socio-economic and demographic variables in Karnataka state during1998/99

Background characteristics	Percent pregnant women with any Anaemia	Percentage of pregnant women with		Number of pregnant women (%)	Chisquare & p-value
		Mild anaemia	Moderate anaemia		
Residence					
Urban	33.0	29.6	3.4	98(31.9)	X^2=13.241 P=0.0013 **
Rural	55.1	47.8	7.3	210(68.1)	
Religion					
Hindu	50.0	43.6	6.4	259(83.9)	X^2=6.264 P=0.3943 (NS)
Muslim	42.7	37.4	5.3	42(13.5)	
Christian	0.0	0.0	0.0	6(1.8)	
Others	46.6	46.6	0.0	2(0.7)	
Caste					
SC	41.4	34.9	6.5	52(17.0)	X^2=10.825 P=0.0939 (NS)
ST	56.7	35.3	21.4	15(5.1)	
OBC	52.2	48.0	4.1	131(43.3)	
None	43.2	37.0	6.3	105(34.6)	
Others	NA	NA	NA	NA	
Education level					
No education	58.4	50.1	8.4	117(38.0)	X^2=12.217 P=0.0573 *
Primary	38.4	33.6	4.7	46(15.0)	
Secondary	46.6	40.5	6.1	109(35.4)	
Higher	31.3	31.3	0.0	35(11.6)	
Wealth index					
Poorest	54.0	43.9	10.1	43(13.9)	X^2=10.485 P=0.2327 (NS)
Poorer	52.6	48.8	3.8	58(18.9)	
Middle	55.0	46.1	8.9	86(28.0)	
Richer	42.3	37.2	5.1	66(21.4)	
Richest	34.7	32.7	2.0	55(17.8)	
Occupation					
Not working	42.0	38.0	3.9	198(64.3)	X^2=35.425 P=0.0013 *
Professional	43.4	29.1	14.3	8(2.5)	
Sales	32.3	32.3	0.0	7(2.2)	
Agricultural	60.9	50.3	10.6	81(26.3)	
domestic	100.0	0.0	100.0	1(0.4)	
Continued					
Skilled & unskilled manual	66.8	66.8	0.0	13(4.3)	
Age of woman(in years)					
15 -19	42.6	37.8	4.8	114(36.9)	X^2=40.583 P=0.4446 (NS)
20 -24	51.6	44.8	6.9	129(41.8)	
25 -29	51.8	45.7	6.1	54(17.4)	
30- 34	42.4	42.4	0.0	8(2.5)	
35-39	49.6	25.2	24.4	4(1.4)	
Age of woman at first birth(in years)					
10 -14	81.5	57.1	24.4	18(9.2)	X^2=42.883 P=0.0357 *
15- 19	50.1	43.4	6.7	115(60.4)	
20 -24	53.2	47.2	6.0	54(28.1)	
25 -29	50.5	50.2	0.0	4(2.32)	
BMI status					
Moderate thinness	39.1	30.4	8.7	25(8.2)	X^2=8.346 P=0.4004 (NS)
Mild thinness	52.8	47.6	5.2	42(13.6)	
Normal	50.6	44.1	6.5	221(71.1)	
Overweight	21.6	21.6	0.0	16(5.1)	
Obese class 1	24.2	24.2	0.0	4(1.5)	
Number of children under five					
0	37.6	32.4	5.3	126(41.0)	X^2=23.747 P=0.0083 *
1	47.0	39.6	7.4	103(33.5)	
2+	66.2	60.7	5.5	79(25.5)	
Total	**47.3**	**38.6**	**8.7**		
**= significant at 0.01, *= significant at 0.05, NS= Not significant					

Source. NFHS-2

4.5.7.3. Association of anaemia and selected socio-economic and demographic variables.

Bivariate analysis using chi-square was conducted to find the association of anaemia prevalence with the selected socio-economic and demographic variable and results presented in Table.4.5.7. Results revealed a significant association of anaemia prevalence with residence, occupation, age at first birth and number of children below five. However, religion, caste, educational level, wealth, age and BMI status were found not significantly associated with the prevalence of anaemia among pregnant women in this state during the survey.

4.5.7.3.1. Socio-economic factors.

Residence was found to significantly influence anaemia prevalence among pregnant women with rural residence showing a higher association with anaemia prevalence of (55.1 %) compared to (33.0 %) prevalence of anaemia among the urban pregnant women in Karnataka (figure.4.5.9). Getachew *et al.* (2012) reported a significant association of anaemia with residence and found rural pregnant women to have a higher association of anaemia (62.2 %) than the urban pregnant women (45.3 %) in Gilgel Gibe dam area in Ethiopia. This could be due to the poor medical facilities found in rural hospitals and health care centres in which the women attend for antenatal care as compared to urban hospitals with improved facilities, technologies for early detection of different types of anaemia and their causes plus well trained and sufficient qualified medical personnel to attend to the women.

Occupation was found significant to influence prevalence of anaemia among pregnant women. Result of this study however, found contradicting results from most researchers (Idowu *et al*., 2005, Ogibeide *et al*. 1994 and Thangaleela, 1994) with a higher prevalence of anaemia among employed pregnant women as compared to unemployed pregnant women (figure.4.5.10).

4.5.7.3.1. Demographic factors.

Age at first birth was found significant to influence the prevalence of anaemia among pregnant women ($p<0.05$). Delivery of the first child in early adolescence (10-14 years) showed the strongest association with anaemia prevalence (81.5%) as compared to other age brackets. Another study in Karnataka reported the highest prevalence (55.7 %). among pregnant women who had their first child below 21 years of age just like in the current study (Noronha *et al*., 2008).

Figure.4.5.Anaemia prevalence is said to increase with increase in the number of children a woman has as it is a direct indication on the number of pregnancies. Each pregnancy is believed to task the iron stores. The highest prevalence of anaemia was found in pregnant women who had two or more children (66.2%) and the least prevalence in those who had no children (37.6%). Noronha *et al*. (2008) reported a similar trend with anaemia increasing with the number of children a woman had. Anaemia was highest among women who had three or more children (61.54 percent) and lower in the women who had one to two children (48.4 percent).

4.5.7.3.3. Nutritional factors

Results presented in Table.4.5.7 show that under-nutrition has a stronger association with anaemia prevalence among these pregnant women as compared to over-nutrition though it was found not significant in influencing anaemia prevalence.

4.5.7.4. Determinants of anaemia among pregnant women in Karnataka state during NFHS-2.

Using ordinal logistic regression, the net influence of the selected socio-economic and demographic variables was assessed and results presented in Table.4.5.6. Results revealed that residence, number of children below five, educational level of the woman, partners' educational level and wealth had a net influence on severity of anaemia among pregnant women as they are were statistically significant ($p<0.05$).

Residence was positively correlated to severity of anaemia. Among urban pregnant women, anaemia increased by 74.5 % with a 0.47 times RR of being anaemic as compared to their rural counterparts (RR= 2.11 times). Gatechew *et al.* (2012) reported similar results with rural resident pregnant women having 1.62 higher odds of being anaemic than their urban counterparts in Gilgel Gibe in Ethiopia.

Number of children below five years of age was also positively correlated with severity of anaemia. The RR of being anaemic increased with increase in the number children below five years that a woman had at the time of the survey. The RR of being anaemic was 0.43 times for pregnant women with no child and 0.59 times for pregnant women who had one child at the time of the survey. This could be due to the fact that there is a decrease in iron stores with each successive pregnancy especially if the woman's body is not allowed enough time to recuperate with limited spacing between births.

Education of the woman was negatively correlated with severity of anaemia among pregnant women. In comparison to women who attained higher education, the pregnant women with no education had a 2.62 times RR of being anaemic. Jufar and Zewde, (2014) reported a similar risk (2.12 times) in illiterate pregnant women which was equally significant like in this study. This could be with lack of an education; the woman cannot follow simple instructions given at antenatal clinic as they cannot read / write.

Partner's education was also negatively correlated with severity of anaemia among their pregnant wives. In partners with no education, the RR of their wives being anaemic was 1.75 times as compared to those who attained higher education. Arlappa *et al.* (2014) reported a similar risk in pregnant women (1.71 times). This is because in Indian societies, most of the family decisions are dominated by men in the household.

Similar to education, wealth was negatively correlated with severity of anaemia among pregnant women. The relative risk of being anaemic reduced with improvement in wealth of the household in which the woman lived. In comparison to richest households, RR of being anaemic among pregnant women was 2.08 times, 1.81 times and 1.83 times among women from poorest, poorer and middle class households respectively. Gebremedhin and Enquselassie (2011) reported similar findings in Ethiopian Pregnant women (AOR= 2.45, AOR=2.15 and AOR= 1.73) among women from poorest, poorer and middle class households.

4.5.8. Karnataka state (2005/06)

4.5.8.1. Profile of pregnant women in Karnataka during 2005/06.

Data on 286 pregnant women was included in the study**.** Majority of the pregnant women were living in rural Karnataka (64.0 %) and the remaining (36.0 %) in Urban Karnataka. Majority of the pregnant women, (82.0 %) of these pregnant women were of Hindu religion, belong to OBC (64.5 %), attained secondary level of education (53.8 %), were from richer (28.3 %), were not working (63.2 %) and among those working, 23.1 percent were involved in agricultural work as a form of occupation to earn money.

Majority of the pregnant women were in the age bracket 20-24 years (41.8 %). Only 168 of the pregnant women included in the study gave a response as to when they had their first child. Out of these women, majority had their first child between the age 15-19 years (49.0 %) followed by 20-24 years (31.0 %) and the remaining in other age

Table.4.5. 8. Percentage association of Anaemia in pregnant women with selected socio-economic and demographic variables in Karnataka state during 2005/06

Background characteristics	Percent pregnant women with any Anaemia	Percentage of pregnant women with			Number of pregnant women (%)	Chi-square & p-value
		Mild anaemia	Moderate anaemia	Severe anaemia		
Residence						
Urban	48.7	46.2	2.6	0.0	103(35.0)	X^2=11.575 P=0.009 **
Rural	65.6	54.2	9.7	1.3	183(64.0)	
Religion						
Hindu	62.6	54.4	7.2	1.0	234(82.0)	X^2=21.879 P=0.0093 **
Muslim	44.8	39.4	5.4	0.0	44(15.4)	
Christian	39.6	39.4	0.0	0.0	6(2.2)	
Others	100.0	0.0	100.0	0.0	1(0.4)	
Caste						
SC	72.6	62.9	9.8	0.0	49(17.0)	X^2=31.611 P=0.0016 **
ST	50.0	21.5	21.5	6.9	17(6.0)	
OBC	55.9	50.7	4.6	0.6	184(64.6)	
None	77.2	68.3	8.9	0.0	27(9.3)	
Others	27.3	13.6	13.6	0.0	9(3.1)	
Education level						
No education	73.1	63.3	7.0	2.7	87(17.0)	X^2=23.669 P=0.0049 **
Primary	36.6	32.9	3.7	0.0	32(11.4)	
Secondary	59.1	50.5	8.6	0.0	154(53.8)	
Higher	30.9	30.9	0.0	0.0	13(4.5)	
Wealth index						
Poorest	83.1	69.9	6.6	6.6	36(12.6)	X^2=37.281 P=0.0002 **
Poorer	63.3	45.7	17.5	0.0	56(19.5)	
Middle	57.8	52.9	4.9	0.0	72(25.3)	
Richer	51.5	47.1	4.4	0.0	81(28.3)	
Richest	52.6	49.7	2.9	0.0	41(14.4)	
Occupation						
Not working	59.8	51.8	8.0	0.0	180(63.2)	X^2=32.428 P=0.0196 *
Professional	18.8	0.0	18.8	0.0	6(2.2)	
clerical	70.2	70.2	0.0	0.0	9(3.1)	
Sales	100.0	100.0	0.0	0.0	4(1.3)	
Agricultural	56.1	50.7	3.6	1.8	66(23.1)	
services	34.5	0.0	34.5	0.0	4(1.3)	
Skilled & unskilled manual	77.2	62.6	7.3	7.3	16(5.7)	
Age of woman(in years)						
15 -19	62.8	56.7	6.1	0.0	79(27.8)	X^2=21.467 P=0.1225 (NS)
20 -24	59.5	51.5	7.0	1.0	119(41.8)	
25 -29	56.3	46.9	7.5	1.9	63(22.2)	
30- 34	52.5	46.9	5.6	0.0	21(7.4)	
35-39	100.0	100.0	0.0	0.0	1(0.4)	
40-44	100.0	0.0	100.0	0.0	1(0.5)	
Age of woman at first birth(in years)						
10 -14	60.2	60.2	0.0	0.0	12(7.3)	X^2=63.617 P=0.1105 (NS)
15- 19	70.6	51.6	16.1	2.9	82(49.0)	
20 -24	58.9	54.3	4.5	0.0	52(31.0)	
25 -29	41.8	28.4	13.4	0.0	18(10.5)	
30-34	47.4	47.4	0.0	0.0	3(1.5)	
35- 39	100.0	100.0	0.0	0.0	1(0.7)	
BMI status						
Moderate thinness	47.6	43.4	4.2	0.0	28(9.8)	X^2=14.354 P=0.2787 (NS)
Mild thinness	65.3	56.8	4.2	4.2	28(9.8)	
Normal	58.9	50.3	8.0	0.6	197(68.9)	
Overweight	75.6	71.1	4.5	0.0	26(9.3)	
Obese class 1	37.5	18.8	18.8	0.0	6(2.2)	
Number of children under five						
0	58.4	53.4	5.0	0.0	119(41.8)	X^2=17.004 P=0.5228 (NS)
1	56.8	44.3	10.5	2.0	116(40.6)	
2+	68.5	63.8	4.7	0.0	50(17.6)	
Total	**60.6**	**48.4**	**11.3**	**0.9**		
**= significant at 0.01, *= significant at 0.05, NS= Not significant						

Source. NFHS-3

brackets. More than 60 percent of the pregnant women were found to have a normal BMI (68.9 %) while (19.6 %) were under-nourished and (11.5 %) had a BMI above normal. Few of the pregnant women had two or more children (17.6 %) while the majority had either one child (40.6 %) or none (41.8 %).

4.5.8.2. Prevalence of anaemia among pregnant women in Karnataka state during NFHS-3

Prevalence of anaemia among the pregnant women in Karnataka state was 60.6 percent of which 48.4 percent were mildly anaemic, 11.3 percent were moderately anaemic and 0.9 percent were severely anaemic. According to Rapid Household Survey-Reproductive Child Health (RHS-RCH) project, the prevalence of anaemia in Kodagu district of Karnataka during 2002 was 61.5 per cent. A similar prevalence of severe anaemia (0.9 percent) was reported among pregnant women in Karnataka during the DLHS-RCH survey in 2002-2004. However, overall anaemia was high with a prevalence of 91.9 percent (IIPS and MoHFW, 2006).

The current study found mild anaemia as the most prevalent degree of anaemia while NNMB (2003) reported moderate anaemia as the most prevalent degree of anaemia among the pregnant women (56.5 %). The same report found a higher overall prevalence among pregnant women in Karnataka state (79.8 %).

4.5.8.3. Association of anaemia and selected socio-economic and demographic variables

Results using chi-square were presented in Table.4.5.8 in which all socio-economic variables found to significantly influence anaemia prevalence among pregnant women but not the demographic variables and BMI ($P<0.05$).

4.5.8.3.1. Socio-economic factors

Rural residence showed a stronger association with anaemia prevalence among rural pregnant women as 65.6 percent prevalence was found compared to 48.7 percent among the urban residents. This association was significant ($p<0.05$). Gogoi and Prusty (2013) reported similar results in Mizoram state (56.5 % vs 48.7 %), Tripura state (73.0 % vs 59.7 %) and Assam state (73.5 % vs 64.4 %) respectively.

Religion was found to be significant in influencing anaemia prevalence among pregnant women with those worshiping Hindu religion having the highest prevalence (62.2 %), followed by Muslim pregnant women (44.8 %) and the least prevalence was among Christian pregnant women (39.6 %). Ramesh and Lopamudra (2010) and

NNMB (2003) reported similar results in which Hindu pregnant women had the highest prevalence of anaemia as compared to other religions.

Analysis of this data set on pregnant women revealed a higher prevalence of anaemia (73.1 %) among illiterate pregnant women as opposed to the least prevalence of anaemia (30.9 %) among the pregnant women who attained higher education level. Noronha *et al.* (2008) reported similar findings with the least prevalence among pregnant women who attained postgraduate education (33.3 %), which increased to 44.8 percent among the women with graduate education and the highest among the illiterate pregnant women (65.60 %) in Udipi district in Karnataka state. Also, in the second report of NNMB, the highest prevalence was among illiterate pregnant women 78.7 percent as compared to those who are literate (NNMB, 2003). This result indicates that formal educational level has a protective role in prevalence of anaemia among the pregnant women. However, another report IIPS and MoHFW (2006) found the highest prevalence of anaemia among pregnant women in Karnataka state with 10 years and above of schooling (95.5%) as compared to the illiterate women (94.2 %) which is contradictory to findings in the current study.

Similar to educational level, wealth of the household in which the pregnant women lives determines their nutritional and health status. Results in (Table.4.5.8) show a decrease in anaemia prevalence among pregnant women with increase in the wealth of the household from 83.1 percent among the pregnant women from the poorest households to 52.6 percent among those from the richest households. The poorest households had the highest prevalence of severe anaemia (6.0 %) which decreased to zero with improvement in household wealth. A similar trend in severe anaemia was reported among pregnant women in Karnataka with 1.3 percent severe anaemia among women with low standard of living which decreased to 1.1 percent in high standard of living (IIPS and MoHFW, 2006).

Pregnant women who were not working had anaemia prevalence of (59.8 %) which was lower compared to some of the employed pregnant women like (100%, 77.2% and 70.2%) among those who were involved in sales, skilled and unskilled manual labour and clerical work respectively.

4.5.8.3.2. Demographic factors

All the pregnant women who were in the age bracket (35-39 and 40-44) years were found to be anaemic but this could be due to the very small numbers of the pregnant women in this age bracket. The adolescent pregnant women were also found to have a high prevalence of anaemia (62.8%) and it was seen to decrease with increase in age up to age bracket 30-34 years (52.5 %). Similar trend was observed in analysis of NFHS-3 data of Tripura state in north –east India (Gogoi and Prusty, 2013). The current study found age group 25-29 years to be more associated with severe anaemia (1.9 percent). Similarly, pregnant women in the same age bracket were reported to be associated with severe anaemia in DLHS-RCH survey during 2002-2004 in Karnataka (IIPS/ MoHFW, 2006).

Delivery in adolescent age posed an increased risk to anaemia prevalence with a prevalence >60 percent in the pregnant women who gave birth to their first child during adolescence (10-19 years) which reduced to (47.4%) among those who gave birth between 30-34 years and thereafter increased as the age increased with all those who gave birth to their first child between the age 35-39 years being anaemic (100.0%). Noronha *et al*. (2008) reported a similar trend with women who had their first child below 21years having a higher prevalence (56 percent) which decreased in the prime age of 22-29 years (48 percent) and increased among those who were above 30 years (49 percent).

4.5.8.3.3. Nutritional factors

Malnutrition also proved a risk to increase anaemia prevalence with overweight women having a higher prevalence of anaemia (75.6 %) and mildly thin pregnant women with anaemia prevalence (65.7 %). However the pregnant women who had a normal BMI had a high prevalence as well (58.9 %). The higher prevalence in overweight women could be due to the elevated levels of hepicidin which squatters' iron and prevents its absorption and utilisation.

Mild thinness also showed a stronger association with severe anaemia (4.2%) as compared to other BMI categories which showed no cases of severe anaemia. This could be a result of protein deficiency which is necessary together with iron to manufacture haemoglobin.

4.5.8.4. Determinants of anaemia among pregnant women Maharashtra state during NFHS-3

Even though results in Table.4.5.8 showed a significant association between anaemia prevalence with residence, religion, caste, education and occupation using chi-square, multivariate analysis using ordinal logistic regression did not find any

Table.4.5.9. Results of ordinal logistic regression on prevalence of anaemia among pregnant women in Karnataka state during 1998/99 and 2005/06 surveys

Variable	1998-1999				2005-2006			
	Estimates	S.E	Significance	RR	Estimates	S.E	Significance	RR
Residence								
Urban	0.745	0.207	<0.0001**	0.47	0.190	0.237	0.423	-
Rural	RC				RC			
Religion								
Hindu	-0.091	0.247	0.713	-	1.624	1.167	0.164	-
Muslim	RC				2.020	1.185	0.088	-
Christian					2.084	1.300	0.109	-
Others					RC			
Age of woman	-0.021	0.019	0.283	-	-0.019	0.026	0.455	-
Age at first birth	0.036	0.035	0.296	-	0.041	0.039	0.290	-
Parity(below five years)								
No child	0.851	0.207	<0.0001**	0.43	0.221	0.210	0.293	-
1	0.529	0.205	0.010*	0.59	0.255	0.213	0.231	-
2+	RC				RC			
BMI								
Moderate- T	-1.210	1.039	0.244	-	-1.794	0.820	0.029*	6.01
Mild- T	-1.038	1.035	0.316	-	-0.046	0.859	0.958	-
Normal	-0.910	1.017	0.371	-	0.120	0.782	0.878	-
Overweight	0.173	1.168	0.883	-	-0.378	0.862	0.661	-
Obese -1	RC				RC			
Caste								
SC	0.132	0.269	0.623	-	-0.032	0.422	0.939	-
ST	-0.573	0.347	0.098	-	-0.065	0.551	0.906	-
OBC	-0.155	0.195	0.427	-	0.337	0.349	0.335	-
None	RC							
Educational level of woman.								
No education	-0.965	0.344	0.005**	2.62	-0.480	0.543	0.376	-
Primary	-0.381	0.399	0.339	-	0.621	0.615	0.312	-
Secondary	-0.580	0.353	0.101	-	-0.236	0.525	0.653	-
Higher	RC				RC			
Partner's educational level								
No education	-0.561	0.250	0.025*	1.75	-0.321	0.279	0.250	-
Primary	-0.168	0.310	0.587	-	-0.618	0.336	0.066	-
Secondary	-0.230	0.259	0.374	-	-0.339	0.256	0.186	-
Higher	RC				RC			
Wealth								
Poorest	-0.732	0.312	0.019*	2.08	-0.161	0.427	0.706	-
Poorer	-0.593	0.300	0.049*	1.81	-0.062	0.374	0.868	-
Middle	-0.605	0.283	0.033*	1.83	0.618	0.367	0.093	-
Richer	-0.283	0.307	0.356	-	0.748	0.361	0.039*	0.47
Richest	RC				RC			
Occupation								
Not working	0.552	0.754	0.464	-	0.464	0.499	0.352	-
Professional	0.534	0.941	0.570	-	2.323	1.157	0.045	-
Clerical	NA	NA	NA	NA	0.388	0.813	0.633	-
Sales.	0.926	1.036	0.372	-	0.131	1.171	0.911	-
Agricultural self employed	-0.042	0.780	0.957	-	NA	NA	NA	NA
Agricultural employed	-0.033	0.768	0.966	-	0.649	0.534	0.224	-
Services	-2.440	1.384	0.078	-	NA	NA	NA	NA
Household	0.160	0.843	0.849	-	0.246	1.048	0.813	-
Skilled manual	RC				RC			
Unskilled manual								
*= significant at 5%, **= significant at 1%, S.E= Standard Error, RC= Reference category, Moderate-T= Moderate thinness, Mild-T=Mild thinness, (-)=not applicable, NA=not available.								

Source. NFHS-2 & 3.

significant correlation of the above variables with severity of anaemia. Results in Table.4.5.9 revealed a significant net influence of BMI and wealth on severity of anaemia among pregnant women in this state during this survey.

BMI was negatively correlated with severity of anaemia. In comparison to obese pregnant women, the RR of being anaemic was 6.01 times among moderately thin pregnant women. This indicates that under-nourishment is a risk factor in influencing severity of anaemia. This is because in unnourished pregnant women, there is poor growth as the protein is used to provide energy instead of its primary duty of growth and repair. Hence all hormones, enzymes inclusive of haemoglobin require sufficient proteins in the body to function properly as they are partly proteins themselves.

Wealth was positively correlated to severity of anaemia. The RR of being anaemic was 0.47 times among pregnant women from richer households as compared to women from richest households. The low risk is due to affordability of rich sources of easily absorbable iron and quality supplements of iron to enhance the stores.

4.5.9. Trends of anaemia in pregnant women between 1998- 2006

Figure.4.5.8 below shows a general increase in anaemia prevalence over the years. Prevalence of anaemia among pregnant women in Karnataka increased by 13.3 percent. Anaemia increased in all degrees and there was development of severe anaemia in 2005/06 survey which was not accounted for in 1998/99 (NFHS-2) survey among the pregnant women in Karnataka state. This can only mean the situation of the pregnant women worsened over the years. This could be due to the fact that socio-economic situation among the pregnant women worsened over the years i.e percentage of pregnant women who attained higher education reduced (11.6%Vs 4.5%) which in turn reduced the percentage of pregnant women with professional jobs (2.5% Vs 2.2%) and also percentage of pregnant women belonging the richest households reduced (17.8% Vs 14.4%). With reduced socio-economic status, access to timely and quality medical care and purchase of high quality food sources are limited.

Residence was also found to significantly influence anaemia prevalence among pregnant women over the years. Figure.4.5.9 shows a higher prevalence of anaemia among rural pregnant women as compared to the urban pregnant women. Analysis of this data set showed a higher increment of anaemia prevalence among urban pregnant women where anaemia increased by 15.7 percent as compared to rural pregnant women where anaemia increased by 10.5 percent. This indicates that the situation among urban pregnant women got worse over the years and this could be due to poor supervision of government programmes like folic acid tablet distribution, poor attendance of anternatal clinic which can be caused by unstable settlement in urban homes or where families relocate time to time due to rent increment, change of job station among others thereby making follow–up difficult. In urban areas, health care is commercialised and the poor are not in position to access quality health care due to the high costs.

On the other hand in rural residence, there is settlement stability as most families will own the homes where they live or have leased them for a long time. Hence the pregnant women can attend the same clinic for antenatal check-up until child delivery. In the rural areas, most households live in a joint family system and the care of the woman in her state is a responsibility of all those in the household. Because of this, food consumption is monitored and the women have enough rest as there will be other people in the household to assist with the household work as opposed to a pregnant woman living in a nuclear family where the household duties are entirely her burden with little assistance from outside for most of them.

Figure.4.5.10 shows association of anaemia prevalence with socio-economic variables over the years. In 2005/06 survey, all socio-economic variables were found to significantly influence anaemia prevalence among the pregnant women as opposed to just educational level and occupation which were significant during 1998/99 survey.

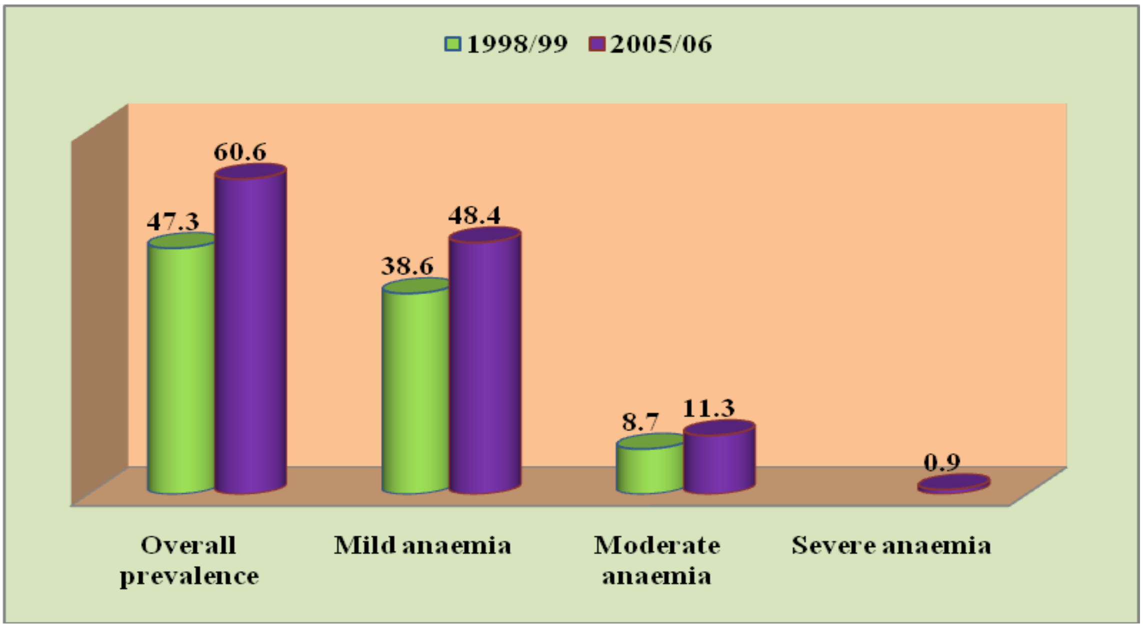

Figure.4.5. 8.Percentage prevalence of anaemia among pregnant women (15-49 years) in karnataka state during 1998-2006

.

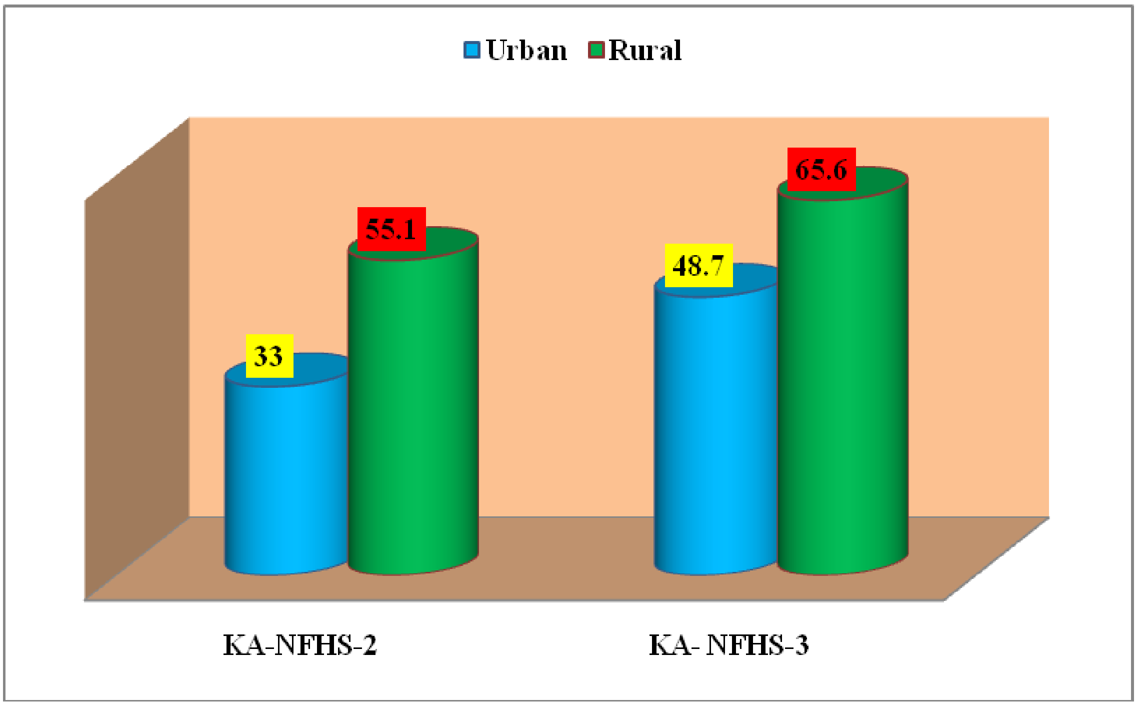

Figure.4.5. 9. Percentage prevalence of anaemia among pregnant women by residence in Karnataka state between 1998-2006

.

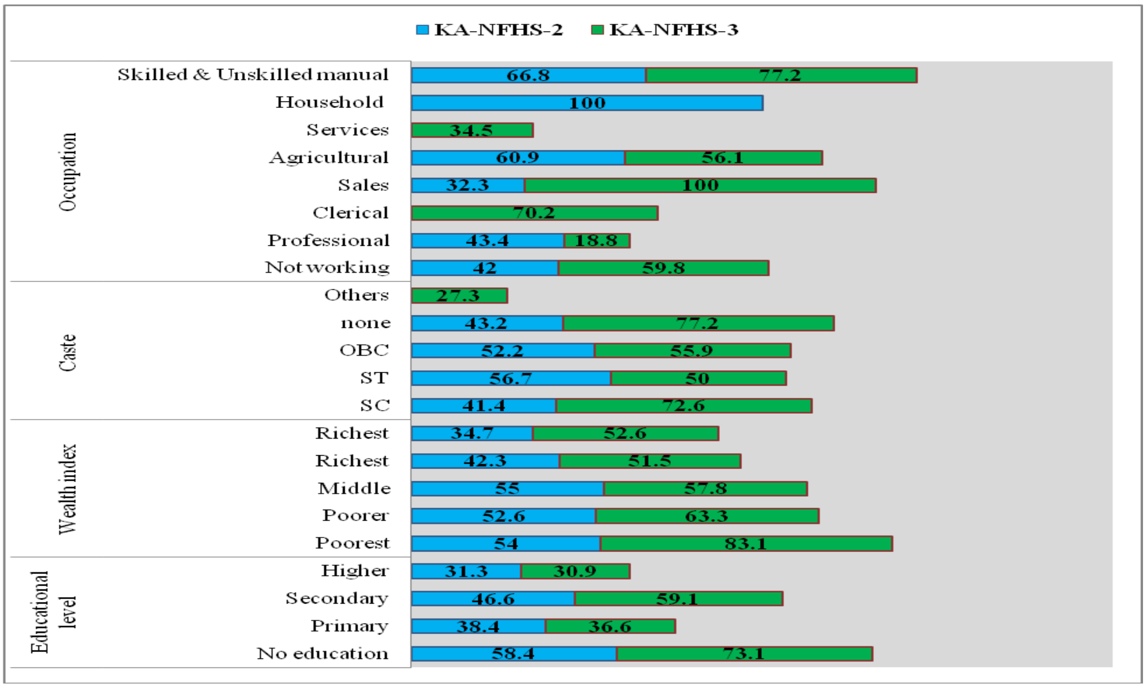

Figure.4.5. 10. Trends in anaemia prevalence among pregnant women (15-49 years) in Karnataka state by occupation, caste, wealth and educational level during 1998-2006.

Anaemia prevalence was seen to increase in almost all socio-economic aspects over the years except in some peculiar cases where the prevalence decreased. The level of anaemia was seen to decrease in pregnant women with professional jobs by (24.6%), ST by (6.7%), among those who attained higher education (0.4%) and primary education (1.8%) over the years.

4.5.10. Conclusion on anaemia prevalence among pregnant women in all studied areas

Anaemia prevalence remains high in all study areas and across years but was lower than the prevalence reported by ICMR (2001), NNMB (2003), IIPS and MoHFW, (2006) and many internal studies (84.9 %, 74.6 %, 96.2 %) respectively.

Across the years, anaemia increased in all states with the highest increment in Andhra Pradesh (22.2 %), Karnataka (13.3 %) and lastly Maharashtra (10.7 %). Socio-economic variables were also significant in influencing anaemia prevalence especially education, partners education, wealth and occupation (with employed pregnant women being more anaemic than unemployed women). Due to this, it is advisable for a pregnant woman to live in a household with an elderly person familiar with pregnancy for better care. Nutrition education should be offered to all members of the household as decisions are made by women partners as well and care is a responsibility of all members in the household. This would maximise the outcomes of pregnancy and minimise occurrence of anaemia in pregnancy. Also equal opportunity to well paying jobs should be availed to increase their autonomy which will inturn reduced the rate at which women give birth hence indirectly improve on birth spacing which will allow the women’s bodies to recuprate and thus lower chronic anaemia which is common with short birth interval. Lastly, improved supervision of government programmes to evaluate their impact on the intended population.

Chapter V

SUMMARY AND CONCLUSION

Health is a fundamental human right which is central to the concept of quality of life and to achieve this, proper nutrition is vital (Sundar, 2007) which is normally sabotaged by hunger, poverty and other environmental factors like sanitation, hygiene and absence of clean water especially in developing countries among the less privileged sectors of the population. Nutritional status of a population is a prominent reflection of a nation's economic development and public welfare policies.

Nutritional status is assessed using anthropometric measurements in a population, supported by other methods like diet surveys. For adults, BMI is used and among children under 5 years of age, indicators like stunting, wasting, underweight and overweight are used and calculated based on weight and height measurements of each individual. The WHO Z-score is used to categorise the severity of these indicators in children with under nutrition being z-score (-2) and over-nutrition z-score (+2) (WHO, 2006). Apart from the use of anthropometric measurements, the nutritional status of children and women in any population is also reflected by the haemoglobin level, which indicates the presence or absence of iron-deficiency anaemia (UNICEF, 2001).

Both national and local studies have documented high prevalence of malnutrition in the vulnerable groups with most of the malnourished children globally living in India. In India, studies have reported a prevalence of 54 percent and 22 percent underweight and severely underweight in NFHS-1 respectively (Vinod *et al*., 1999), 49.2 percent (IIPS and MoHFW, 2006), 43 percent in NFHS-3 (Arnold *et al*., 2009), 35.2 percent (Anwar *et al*., 2013) and 38.6 percent (Shahjada *et al*., 2014). Among women between 15-49 years, CED was reported to decrease (35.8 % vs 35.6 %) while OW/OB increased from (12.8 % vs 15.2 %) between NFHS-2 and NFHS-3 respectively and anaemia prevalence was (69.2 % and 2.9 %) for total anaemia and severe anaemia during NFHS-3 (IIPS and ORC Macro, 2000 and IIPS and Macro, 2007). Another national report (DLHS-RCH- 2002/04) stated that the prevalence of anaemia was very high with (98 %, 97 %, and 96 %) among adolescent girls, children below five years and pregnant women (IIPS and MoHFW, 2006).

With that background, the study was carried out with an aim to analyze the nutritional status of children and women and prevalence of anaemia among children below five years, adolescent girls and pregnant women in Prakasam, Mahbubnagar, Akola, Solapur, Bijapur, Tumkur, Andhra Pradesh, Maharashtra and Karnataka state. NFHS-2, NFHS-3data was analyzed and compared with NSSO data to find any relations between consumption and expenditure to the pattern of malnutrition. Bivariate and ordinal logistic regression using SAS and SPSS were used to analyze the data.

Underweight in children below five years was analyzed as a representation of both acute and chronic malnutrition and results presented in Tables. 4.1.1- 4.1.36. Results showed variation between districts of the same state and within the same states over the years in terms of predictors which is an indication of nutrition transition which could be a result of many factors in play. Prevalence of underweight and severe underweight in children below five years was (58.8 % and 13.5 %) in Prakasam, (81 % and 15.5 %) in Mahbubnagar, (83.7 % and 2.9 %) in Akola, (79.2 % and 12 %) in Solapur, (73.1 % and 18.9 %) in Bijapur and (79 % and 24. 8 %) in Tumkur districts during NFHS-2 survey. Regression revealed that the common predictors of underweight at district level were age of the child, child anaemia and occupation of the mother.

At state level however, prevalence varied in trends between the two surveys with (74.9 % vs 74.1 %) for Andhra Pradesh, (75.5 % vs 79.7 %) for Maharashtra and (70.9 % vs 76.0 %) for Karnataka states during NFHS-2 and NFHS-3 respectively. The common predictors were residence, age of the child, ethnicity (caste), education and occupation of mother, child immunization and toilet facility. Overall, underweight was highest among children in Akola district but severe anaemia was highest among children in Tumkur district. Also over the years, underweight and severe underweight decreased in all the states but overall underweight prevalence increased which could have been due to mild underweight.

Prevalence of malnutrition among women (15-49 years) ranged between 46.7 percent and 56.1 percent. However, CED ranged between (31.3 % to 50.5 %) while OW/OB ranged between (10.2 % to 23.2 %). Results also show that between the two surveys, CED decreased slightly while OW/OB increased giving rise to a dual burden of malnutrition in women especially Andhra Pradesh state (31.3 % CED and 23.2 % OW/OB during NFHS-3).

Comparison of NSSO data and NFHS data in the studied population (women and children) revealed that SES of the woman affects her dietary consumption of food nutrients with higher percentage of inadequate consumption of calories and proteins being among low SES and consumption improving with improvement of SES. This explains the higher prevalence of CED among low SES. Consumption of fat was almost adequate in all SES but remains highest among high SES which explains the higher prevalence of OW/OB. Also in all studied areas, no significant differences were found between males and females which indicates that both gender are at equal risk of malnutrition if their diet is not catered for well.

Prevalence of child anaemia was (62.3 %, 52.0 %, 55.5 %, 69.0 %, 69.3 %, and 63.0 %) for Prakasam, Mahbubnagar, Akola, Solapur, Bijapur and Tumkur districts respectively. Regression analysis found stunting, wasting, age, mothers' education and occupation as predictor variables for child anaemia in Prakasam, Mahbubnagar and Tumkur districts only as none of the variables predicted anaemia prevalence in the remaining districts. However, trend analysis between the surveys at state level revealed a prevalence of (67.3 % vs 66.0 %, 74.6 % vs 62.3 % and 66.4 % vs 68.7 %) for Andhra Pradesh, Maharashtra and Karnataka states during NFHS-2 and NFHS-3 respectively. The prominent predictors were age, caste, poor nutritional status of the child and poor education of the mother. The prevalence of severe anaemia in children below five years ranged between (0.3 % to 8.7 %) but in some areas like Mahbubnagar, Akola, Tumkur, none of the children were severely anaemic.

Prevalence of anaemia among adolescent girls (15-19 years) was (69.1 %, 60.2 %, 43.7 %, 51.1 %, and 51.7 %) for Prakasam, Mahbubnagar, Solapur, Tumkur and Bijapur districts respectively during NFHS-2. Regression results found age, caste, wealth and occupation as predictors of anaemia at district level except for Akola which was not included in the analysis. However, at state level, anaemia increased in Andhra Pradesh and Maharashtra state with a prevalence of (59.4 % vs 69.4 % and 54.9 % vs 55.2 %) for NFHS-2 and NFHS-3 respectively while anaemia decreased in Karnataka adolescent girls of the same age (54.8 % vs 48.9 %) over the years. Predictors identified were age, BMI, caste, education, wealth and occupation. In all the study areas, severe anaemia among adolescent girls between 15-19 years of age ranged from as low as 1.3 percent in Mahbubnagar to 11.4 percent in Tumkur districts but in Bijapur adolescents, none was severely anaemic. However, in Akola district, analysis was not performed as the sample size was below 30 which is the minimum for analysis in order to make conclusions that can be generalised and comparable to others.

Among the pregnant women, analysis was performed at state level due to small sample size at district level. Trend analysis of anaemia prevalence revealed an increase in anaemia prevalence over the year between the two surveys. The prevalence of anaemia was (38.8 % vs 61.0 %, 50.2 % vs 60.9 % and 47.3 % vs 60.6 %) for Andhra Pradesh, Maharashtra and Karnataka states between NFHS-2 and NFHS-3 respectively. None of the women were severely anaemic in Andhra Pradesh across the years but in the other two states, severe anaemia increased as well from (0.9 % to 2.2 % and 0 % to 0.9 percent) for Maharashtra and Karnataka state between NFHS-2 and NFHS-3 respectively. Across the years, socio-economic factors (caste, education of woman and partner, occupation and BMI were identified as predictors for anaemia.

In most of the studied areas, sex of the child did not seem to have a correlation with underweight and anaemia which is a confirmation that both male and female children are affected with malnutrition equally.

To sum it all up, malnutrition in the studied areas remains critical and a point of concern among all the studied groups. With all the variations in each district and state on predictors, it is clear that the causes of malnutrition are multi faceted and any approach to avert the situation must tackle a lot of areas like education, nutrition, sanitation and immunization. However, one thing is clear that socio-economic factors are directly correlated with malnutrition of any kind in this study hence approaches would best achieve results if tackled at district level or better household level to cater for SES influence.

5.1.Recommendations

- To ensure effectiveness, nutritional intervention programmes should be planned to be specific to suite the vulnerable groups at district level as results of the study clearly show differences within districts of the same state.
- To alleviate malnutrition and its side effectives, government policies and other nutrition intervention programmes should consider study and care of children between 6-10 years as neglect of this age group is possibly one of the leading causes of adolescent poor nutritional status which later translates to adulthood as there is currently paucity of information concerning health and nutritional status of this age group.
- Nutrition and sanitary education should be incorporated into the school curriculum at an early stage to equip all individuals with basic information on signs, symptoms of nutritional deficiencies, appropriate foods and their preparation and cooking methods to enable children care for themselves as well as guide their illiterate parents on how to keep healthy.

- Nutritional education should be offered to all members of the household during interventions irrespective of SES, educational level, caste as results in some districts have shown high prevalence's of malnutrition among the elite groups as well.
- Timely introduction of quality complementary foods should be advised and proper feeding during pregnancy and lactation to minimize underweight and anaemia among women and subsequently children.
- School retention should be advocated for and early marriages discouraged to reduce on adolescent pregnancies which increase the prevalence of anaemia and low birth weight among women and children respectively.
- Supplementation of iron and other interventions to eradicate anaemia should be made available for male persons as some of the results indicated male children to be more anaemic than female children in some district which could be due to the fact that intervention programmes target more of the female gender neglecting male gender.
- Lastly, anaemia testing should be specific to morphology so as to administer the correct treatment since massive folic acid supplementation does not seem to control the situation in majority of the population because it does not counter the exact cause of anaemia and type of anaemia.

5.2. Suggestions for future research

- District analysis should be carried out across the years for each group to get a glimpse of the predictor factors for malnutrition across the years to enable proper evaluation of community programmes and re-adjustment in policies and programmes to suite the prevailing situation.
- Analysis of the age group 6-14 years should be carried out to give a better understanding of the causes of high prevalence of malnutrition in adolescence and also enable avert the problem at an earlier stage in order to avoid the vicious cycle of malnutrition which is evident among malnourished teenage mothers in the country. Also inclusion of this age group will enable policy makers get a deeper understanding of malnutrition throughout the life span.
- NFHS should include data collection on food consumption and dietary patterns at the time of the survey so as get a proper understanding of its contribution to malnourishment alongside other factors.

- Data on adolescent boys should also be analysed for comparison between girls and boys of the same age as it was seen in some districts with male children below five years being more anaemic than girls of the same age.

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Table.4.1.37. Prevalence of Malnutrition among women (15-49 years) in Prakasam district during 1998/99 survey.

Variables	Total % Malnutri	% of Women CED	OW/OB	% Women with Anaemia Mod-T	Mild-T	OW	Obese 1	Obese 11	Obese 111	Total Number of Women(%)	Chi-Square Value & P- Value
Residence											DF=4
Urban	50.0	16.7	33.3	8.8	8.3	16.7	16.7	NA	NA	22(8.6)	X^2=29.7629
Rural	43.6	37.5	6.1	15.7	21.8	5.2	0.9	-	-	237(91.4)	P<0.0001**
Caste											
SC	56.9	48.8	8.1	24.3	24.5	8.1	0.0	NA	NA	76(29.3)	DF=12
ST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	4(1.6)	X^2=43.7276
OBC	29.1	27.6	2.1	4.2	22.8	2.1	0.0	-	-	99(38.1)	P<0.0001**
None	50.2	33.2	16.9	20.3	12.9	9.8	7.2	-	-	81(31.0)	
Age											
15-19	53.0	53.0	0.0	29.4	23.7	0.0	0.0	NA	NA	35(13.3)	
20-24	45.0	41.0	4.6	13.6	27.4	4.6	0.0	-	-	45(17.1)	DF=12
25-29	71.7	57.3	14.4	35.6	21.7	14.4	0.0	-	-	29(10.8)	X^2=55.5294
30-34	14.0	9.7	4.3	4.9	4.9	0.0	4.3	-	-	43(16.2)	P=0.0003**
35-39	37.8	31.5	6.3	6.3	25.2	6.3	0.0	-	-	33(12.5)	
40-44	52.8	38.3	14.5	14.6	23.7	9.6	4.9	-	-	43(16.2)	
45-49	43.6	28.3	15.3	5.7	22.7	10.2	5.1	-	-	36(13.8)	
Religion											
Hindu	39.1	30.1	9.0	9.3	20.8	6.1	2.8	NA	NA	198(76.2)	DF=8
Muslims	71.4	71.4	0.0	28.6	42.9	0.0	0.0	-	-	15(5.6)	X^2=30.4218
Christians	56.4	48.0	8.7	34.8	13.2	8.7	0.0	-	-	47(18.2)	P=0.0002**
Others	NA	-	-	-	-	-	-	-	-	NA	
Age at First Birth											
10-14	43.9	43.9	0.0	18.8	25.1	0.0	0.0	NA	NA	33(15.0)	DF=52
15-19	49.4	29.8	19.5	9.9	19.9	9.8	9.8	-	-	146(66.6)	X^2=103.4661
20-24	52.4	41.8	10.8	18.1	23.4	5.4	5.4	-	-	34(15.7)	P<0.0001**
25-29	100.0	100.0	0.0	30.9	69.1	0.0	0.0	-	-	6(2.7)	
Number of Children											
0	40.9	29.3	11.6	16.0	13.2	9.1	2.5	NA	NA	155(59.7)	DF=12
1	48.0	44.9	3.1	10.1	34.8	0.0	3.1	-	-	59(22.9)	X^2=32.872
2+	50.0	45.5	4.5	18.2	27.4	4.5	0.0	-	-	45(17.5)	P<0.0001**
Occupation											
Not Working	40.5	25.6	14.9	10.2	15.5	25.6	14.9	NA	NA	79(30.9)	
Professional	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	10(3.7)	
Clerical	-	-	-	-	-	-	-	-	-	-	DF=28
Sales	41.0	20.5	20.5	20.5	0.0	20.5	0.0	-	-	10(4.0)	X^2=124.5752
Agriculture	47.9	43.6	4.3	20.3	23.3	4.3	0.0	-	-	142(54.8)	P<0.0001**
Service	100.0	0.0	100	0.0	0.0	0.0	100	-	-	2(0.7)	
Skill & Unskilled	50.0	50.0	0.0	0.0	50.0	0.0	0.0	-	-	17(6.4)	

Table.4.1.37 continued

Educational Level											
No Education	42.6	38.5	4.1	16.5	22.0	2.7	1.4	NA	NA	151()58.0	DF=48
Primary	48.5	37.5	10.9	14.4	23.1	10.9	0.0	-	-	72(27.6)	X^2=111.595
Secondary	40.0	20.0	20.0	6.9	13.1	13.8	6.2	-	-	30(11.6)	P<0.0001**
Higher	50.0	25.0	25.0	25.0	0.0	0.0	25.0	-	-	7(2.9)	
Educational Level of Partner											
No Education	40.1	38.0	2.0	14.0	24.0	2.0	0.0	NA	NA	103(39.8)	DF=12
Primary	34.5	27.6	6.9	10.4	17.3	6.9	0.0	-	-	60(23.0)	X^2=55.7397
Secondary	57.0	47.3	9.7	27.0	20.3	9.7	0.0	-	-	61(23.6)	P<0.0001**
Higher	49.7	22.2	27.5	5.2	17.0	11.1	16.4	-	-	35(13.6)	
Wealth Index											
Poorest	45.4	36.4	9.0	13.6	22.8	9.0	0.0	NA	NA	45(17.1)	
Poorer	32.5	32.4	0.0	8.8	23.7	0.0	0.0	-	-	70(26.6)	DF=16
Middle	47.8	45.4	2.4	21.5	23.9	2.4	0.0	-	-	87(32.9)	X^2=84.1026
Richer	58.6	40.8	17.8	17.8	23.0	17.8	0.0	-	-	35(13.3)	P<0.0001**
Richest	42.6	7.0	35.7	7.0	0.0	13.9	21.7	-	-	27(10.1)	
Toilet Facility											
Flush toilet	66.7	0.0	66.7	0.0	0.0	33.3	33.3	NA	NA	6(2.2)	DF=12
Pit latrine	54.6	31.4	23.1	7.4	24.0	7.4	15.7	-	-	25(9.6)	X^2=70.9745
Bush	42.4	37.0	5.4	16.2	20.8	5.4	0.0	-	-	229(88.2)	P<0.0001**
Others	-	-	-	-	-	-	-	-	-		
Place of delivery											
Home	65.1	60.1	5.0	19.9	40.1	5.0	0.0	NA	NA	41(71.6)	DF=18
Gov't facility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	6(10.8)	X^2=69.3593
Private Facility	38.7	38.7	0.0	18.3	20.4	0.0	0.0	-	-	10(17.6)	P<0.0001**
Others											
Who decide how to Spend money											
Respondent s	46.2	41.6	4.6	23.1	18.5	4.6	0.0	NA	NA	45(34.2)	DF=12
Partner	55.1	45.2	9.9	10.1	35.1	9.9	0.0	-	-	41(31.3)	X^2=16.0474
Jointly	47.0	47.0	0.0	20.0	27.0	0.0	0.0	-	-	31(23.4)	P=0.1891(NS)
Someone Else	60.0	60.0	0.0	40.0	20.0	0.0	0.0	-	-	10(7.9)	
Jointly Someone	-	-	-	-	-	-	-	-	-	4(3.2)	
Who decide on obtaining Health Care											
Respondent	44.1	32.2	11.9	14.8	17.3	7.2	4.7	NA	NA	84(32.2)	
Partner	39.9	33.4	6.5	8.4	25.0	6.5	0.0	-	-	123(47.4)	DF=16
Jointly	50.4	42.8	7.7	17.1	25.7	0.0	7.7	-	-	24(9.3)	X^2=54.5095
Someone Else	57.9	57.9	0.0	49.5	8.4	0.0	0.0	-	-	25(9.5)	P<0.0001**
Jointly Someone	50.0	0.0	50.0	0.0	0.0	50.0	0.0	-	-	4(1.6)	
Total	**47.5**	**34.9**	**12.6**	**15.1**	**19.8**	**7.2**	**5.4**				

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition, NA=not available

Table.4.1.38. Prevalence of Malnutrition among women (15-49 years) in Mahbubnagar district during 1998/99 survey

Variables	Total % Mulnutri	% of Women		% Women with Anaemia						Total Number of Women (%)	Chi-Square Value & P-Value
		CED	OW/OB	Mod T.	Mild T.	OW	Obese 1	Obese 11	Obese 111		
Residence											
Urban	36.4	0.0	36.4	0.0	0.0	31.8	4.5	NA	0.0	42(9.0)	DF=5
Rural	47.4	40.16	6.8	17.9	22.8	6.3	0.0	NA	0.5	426(91.0)	X^2=66.5876
											P=0.0001**
Caste											
SC	41.6	41.6	0.0	16.6	25.0	0.0	0.0	NA	0.0	73(15.7)	DF=15
ST	39.1	34.7	4.4	4.3	30.4	4.4	0.0	NA	0.0	48(10.24)	X^2=87.959
OBC	49.3	44.4	4.9	22.6	21.8	4.9	0.0	NA	0.0	247(52.7)	P=0.0001**
None	46.4	16.4	30.0	6.2	10.3	26.0	1.9	NA	2.0	100(21.4)	
Age											
15-19	32.9	30.5	2.3	16.4	14.1	2.3	0.0	NA	0.0	88(18.7)	
20-24	67.0	64.3	2.8	25.2	39.1	2.8	0.0	NA	0.0	74(15.8)	DF=30
25-29	47.7	34.4	13.3	18.3	16.1	11.0	0.0	NA	2.3	89(19.0)	X^2=84.9633
30-34	52.6	35.2	17.4	17.5	17.7	15.0	2.3	NA	0.0	81(17.3)	P=0.0001**
35-39	26.0	18.8	7.2	3.7	15.1	7.2	0.0	NA	0.0	55(11.7)	
40-44	58.0	53.1	4.9	15.9	37.2	4.9	0.0	NA	0.0	39(8.3)	
45-49	37.9	19.1	18.8	9.5	9.6	18.8	0.0	NA	0.0	43(9.2)	
Religion											
Hindu	45.9	36.6	9.2	16.3	20.4	8.4	0.4	NA	0.4	456(97.4)	DF=10
Muslims	60.2	40.3	19.9	0.0	40.3	19.0	0.0	NA	0.0	10(2.2)	X^2=16.1917
Christians	100.0	100.0	0.0	100.0	0.0	0.0	0.0	NA	0.0	2(0.4)	P=0.0943
Others	-	-	-	-	-	-	-	NA	-	NA	(NS)
Age at First Birth											
10-14	37.7	31.0	6.7	20.6	10.5	6.7	0.0	NA	0.0	59(15.1)	DF=80
15-19	50.2	40.2	10.0	15.8	24.5	9.2	0.7	NA	0.0	262(66.8)	X^2=133.1917
20-24	46.8	30.5	16.3	10.2	20.3	13.0	0.0	NA	3.4	61(15.6)	P=0.0002**
25-29	40.3	4.03	0.0	20.2	20.2	0.0	0.0	NA	0.0	10(2.6)	
Number of Children											
0	42.0	36.3	5.7	15.1	21.2	4.8	0.9	NA	0.0	206(43.7)	DF=25
1	53.2	40.4	12.8	20.2	20.2	11.3	0.0	NA	1.4	143(30.5)	X^2=35.774
2+	46.0	34.2	11.8	13.7	20.5	11.8	0.0	NA	0.0	121(25.8)	P=0.0751
Occupation								NA			
Not Working	44.6	13.3	31.2	5.7	7.6	27.6	1.8	NA	16.9	108(23.1)	
Professional	-	-	-	-	-	-	-	NA	-	-	DF=30
Clerical	-	-	-	-	-	-	-	NA	-	-	X^2=122.3104
Sales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	0.0	4(0.8)	P<0.0001**
Agriculture	47.5	44.9	2.6	19.8	25.1	2.6	0.0	NA	0.0	239(51.0)	
Household	-	-	-	-	-	-	-	NA	-	2(0.4)	

Table.4.1.38 continued											
Skill & Unskilled	48.3	44.7	3.6	19.7	25.1	3.6	0.0	NA	0.0	115(24.6)	
Educational Level											
No Education	48.0	45.0	3.0	19.7	25.2	3.0	0.0	NA	0.0	344(73.5)	DF=50
Primary	45.2	22.9	22.3	6.6	16.3	22.3	0.0	NA	0.0	63(13.5)	X^2=181.0727
Secondary	38.2	7.1	31.1	7.1	0.0	24.2	3.3	NA	3.6	57(12.2)	P<0.0001**
Higher	50.0	0.0	50.0	0.0	0.0	50.0	0.0	NA	0.0	4(0.8)	
								NA			
Educational Level of Partner											NA
No Education	49.3	47.0	2.3	19.9	27.0	2.3	0.0	NA	0.0	268(57.3)	DF=51
Primary	50.0	50.0	0.0	20.1	29.9	0.0	0.0	NA	0.0	41(8.8)	X^2=96.0565
Secondary	38.8	16.5	22.3	8.2	8.3	20.2	0.0	NA	2.1	100(21.3)	P<0.0001**
Higher	43.8	17.5	26.4	10.6	6.9	23.1	3.2	NA	0.0	59(12.7)	
Wealth Index											
Poorest	41.1	38.4	2.8	15.0	23.3	2.8	0.0	NA	0.0	150(31.9)	DF=20
Poorer	52.8	52.8	0.0	22.7	30.0	0.0	0.0	NA	0.0	118(25.0)	X^2=123.2305
Middle	52.1	41.7	10.4	22.9	18.7	10.4	0.0	NA	0.0	99(21.1)	P<0.0001**
Richer	43.0	29.0	14.0	9.7	19.3	14.0	0.0	NA	0.0	43(9.1)	
Richest	39.0	0.0	39.0	0.0	0.0	32.4	3.1	NA	3.4	61(12.9)	
Toilet Facility											
Flush toilet	33.1	3.5	29.6	3.5	0.0	26.4	3.3	NA	0.0	59(12.5)	DF=20
Pit latrine	50.1	33.6	16.5	16.9	16.6	16.5	0.0	NA	0.0	12(2.7)	X^2=68.1001
Bush	48.3	42.1	6.2	18.1	23.9	5.7	0.0	NA	0.5	397(84.8)	P<0.0001**
Others	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Place of delivery											
Home	47.9	46.1	1.9	20.1	26.0	1.9	0.0	NA	0.0	103(76.2)	DF=12
Gov't facility	50.3	50.3	0.0	0.0	50.3	0.0	0.0	NA	0.0	4(3.0)	X^2=16.02
Private Facility	36.4	29.6	6.8	7.3	22.2	6.8	0.0	NA	0.0	28(20.8)	P=0.1903
Others	-	-	-	-	-	-	-	NA	-	-	(NS)
Who decide how to Spend money											NA
Respondent	44.8	37.3	7.5	18.6	18.7	7.5	0.0	NA	0.0	55(23.4)	
Partner	52.4	50.0	2.4	23.8	26.2	2.4	0.0	NA	0.0	87(36.6)	DF=12
Jointly	54.1	54.1	0.0	29.1	25.0	0.0	0.0	NA	0.0	49(20.8)	X^2=21.9259
Someone Else	58.7	58.7	0.0	8.3	50.4	0.0	0.0	NA	0.0	25(10.4)	P=0.0384*
Jointly Someone	40.2	40.2	0.0	30.0	10.1	0.0	0.0	NA	0.0	21(8.7)	
Who decide on obtaining Health Care											NA
Respondent	52.0	41.6	10.4	15.2	26.3	8.4	2.0	NA	0.0	94(20.1)	DF=20
Partner	38.4	29.6	8.7	8.8	20.9	7.6	0.0	NA	1.1	188(40.1)	X^2=63.1651
Jointly	51.1	45.4	5.6	33.5	11.9	5.6	0.0	NA	0.0	104(22.2)	P<0.0001**
Someone Else	56.9	29.1	27.8	14.6	14.6	27.8	0.0	NA	0.0	28(6.1)	
Jointly Someone	50.3	42.6	7.1	11.6	31.0	7.7	0.0	NA	0.0	53(11.4)	
Total	**46.1**	**35.1**	**11.6**	**15.6**	**19.5**	**10.4**	**0.5**	**-**	**0.7**		

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition

Table.4.1.39. Prevalence of Malnutrition among women (15-49 years) in Andhra Pradesh state during 1998/99 survey

Variables	Total % Malnutri	% of Women		% Women with Anaemia						Total Number of Women(%)	Chi-Square Value & P- Value
		CED	OW/OB	Mod-T	Mild-T	OW	Obese 1	Obese 11	Obese 111		
Residence											DF=6
Urban	46.4	22.1	24.2	11.7	10.4	19.6	3.6	0.9	0.1	2007(24.9)	X^2=565.01
Rural	51.0	43.6	7.5	21.3	22.3	6.1	1.1	0.1	0.1	6068(75.1)	P<0.0001**
Caste											
SC	50.5	45.0	5.6	21.0	24.0	5.1	0.2	0.2	0.0	1599(19.8)	
ST	45.8	43.2	2.6	20.5	22.7	2.6	0.0	0.0	0.0	388(4.8)	DF=18
OBC	50.7	41.6	9.1	20.9	20.7	7.5	1.5	0.1	0.1	3571(44.3)	X^2=389.33
None	48.8	28.2	20.6	14.5	13.7	16.2	3.3	0.8	0.2	2499(31.0)	P<0.0001
Age											
15-19	45.6	44.9	0.7	23.3	22.6	0.7	0.0	0.0	0.0	855(10.5)	
20-24	50.1	44.9	5.1	18.8	26.1	4.5	0.5	0.1	0.0	1554(19.1)	
25-29	51.9	42.8	9.1	21.3	21.5	7.5	1.2	0.2	0.1	1628(20.0)	DF=36
30-34	48.6	34.7	14.0	18.4	16.2	11.4	2.2	0.3	0.0	1224(15.0)	X^2=486.05
35-39	46.6	31.2	15.4	15.8	15.4	12.6	2.7	0.0	0.2	1174(14.4)	P<0.0001
40-44	50.6	31.7	18.9	15.6	16.1	14.8	2.4	1.3	0.4	902(11.1)	
45-49	55.6	31.1	24.4	19.4	11.7	19.1	4.4	0.7	0.2	806(10.0)	
Religion											
Hindu	50.0	39.2	10.8	19.2	19.9	8.9	1.6	0.2	0.1	7053(87.4)	
Muslims	51.6	27.5	24.1	15.7	11.8	19.1	3.6	1.4	0.0	537(6.7)	DF=18
Christians	46.3	37.3	9.1	18.3	19.0	7.1	1.6	0.4	0.0	476(5.9)	X^2=132.54
Others	NA										P<0.0001
No Religion	100.0	0.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	2(0.02)	
Age at First Birth											
10-14	54.3	42.9	11.4	23.5	19.4	8.6	2.6	0.2	0.0	996(13.9)	
15-19	49.7	38.7	11.0	17.6	21.1	9.2	1.2	0.4	0.2	4471(62.7)	
20-24	51.4	34.1	11.3	18.7	15.4	13.6	3.2	0.4	0.1	1399(19.6)	
25-29	55.7	39.1	16.6	26.4	12.7	12.2	4.4	0.0	0.0	220(3.1)	
30-34	33.7	29.0	4.6	15.1	14.0	4.6	0.0	0.0	0.0	41(0.6)	
35-39	49.0	25.7	23.3	0.0	25.7	23.3	0.0	0.0	0.0	8(0.1)	
40-44	100.0	100.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	2(0.03)	
Number of Children											
0	48.3	34.4	13.9	17.1	17.3	11.2	2.1	0.4	0.1	4403(54.5)	DF=42
1	51.4	42.6	8.8	22.3	20.3	7.1	1.4	0.2	0.2	2136(26.5)	X^2=140.68
2+	52.4	43.2	9.2	19.6	23.6	7.8	1.1	0.3	0.0	1536(19.0)	P<0.0001**
Occupation											
Not Working	34.1	27.0	7.1	13.3	13.7	3.1	3.1	0.7	0.2	3347(41.5)	
Professional	42.7	30.2	12.5	15.7	14.5	9.3	3.2	0.0	0.0	126(1.6)	
Clerical	33.6	11.1	22.6	11.1	0.0	22.6	0.0	0.0	0.0	17(0.2)	
Sales	45.2	20.6	24.6	5.4	15.2	20.7	2.7	1.3	0.0	145(1.8)	DF=54

Table.4.1.39 continued

Agriculture	53.1	49.3	3.9	24.7	24.6	3.5	0.3	0.1	0.0	3336(41.3)	X^2=827.61
Service	45.6	18.7	26.7	13.9	4.9	13.2	13.6	0.0	0.0	42(0.5)	P<0.0001**
Household	43.0	30.9	12.1	15.1	15.9	12.1	0.0	0.0	0.0	50(0.6)	
Skill & Unskilled	50.9	44.4	6.6	21.5	22.8	5.2	1.0	0.0	0.4	1013(12.6)	
Educational Level											
No Education	52.0	45.6	6.5	22.8	22.8	5.2	0.9	0.2	0.1	4771(59.1)	
Primary	46.7	30.7	16.0	14.1	16.6	13.0	2.5	0.4	0.1	2044(25.3)	DF=114
Secondary	46.9	23.6	23.3	12.4	11.2	19.7	2.7	0.7	0.2	1077(13.3)	X^2=795.69
Higher	46.8	17.8	29.0	10.5	7.3	19.7	8.3	1.0	0.0	183(2.3)	P<0.0001**
Educational Level of Partner											
No Education	53.0	47.8	5.2	23.9	23.9	4.6	0.5	0.1	0.0	3363(41.7)	
Primary	49.8	39.8	10.0	20.0	19.9	8.1	1.3	0.4	0.3	1540(19.1)	DF=18
Secondary	45.6	30.4	15.2	14.4	16.0	12.3	2.2	0.4	0.3	2052(25.4)	X^2=608.87
Higher	48.4	21.6	26.9	10.6	10.9	20.8	5.0	1.0	0.0	1110(13.8)	P<0.0001**
Wealth Index											
Poorest	54.8	52.5	2.4	24.7	27.7	2.0	0.3	0.1	0.0	1439(17.7)	
Poorer	54.2	50.8	3.4	27.4	23.4	2.6	0.7	0.0	0.0	1605(19.7)	
Middle	49.3	41.4	7.9	19.9	21.6	6.8	1.0	0.1	0.1	2073(24.5)	DF=24
Richer	44.3	30.1	14.2	14.0	16.1	12.1	1.7	0.4	0.1	1674(20.6)	X^2=1284.29
Richest	47.2	12.9	34.2	7.3	5.7	26.7	5.8	1.3	0.4	1353(16.6)	P<0.0001**
Toilet Facility											
Flush toilet	45.5	19.5	26.0	10.4	9.2	20.7	4.0	1.1	0.1	1495(18.5)	
Pit latrine	50.0	20.1	29.9	9.1	11.0	23.3	5.2	0.8	0.5	731(9.1)	DF=36
Bush	51.0	45.3	5.7	22.4	23.0	4.9	0.7	0.1	0.1	5842(72.4)	X^2=1067.78
Others	NA	NA	NA	NA	NA	NA	NA	NA	NA		P<0.0001**
Place of delivery											
Home	54.2	53.0	1.2	21.9	31.0	1.0	0.0	0.2	0.0	1002(50.5)	
Gov't facility	54.9	46.5	8.4	21.8	24.7	6.9	1.6	0.0	0.0	250(12.6)	DF=55
Private Facility	46.4	35.8	10.6	17.9	17.9	9.0	1.3	0.3	0.0	729(36.7)	X^2=186.35
Others	100.0	100.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	4(0.2)	P<0.0001**
Who decide how to Spend money											
Resdent Alone	50.7	42.7	8.0	21.3	21.4	6.7	1.0	0.2	0.2	1169(32.9)	
Partner	54.4	50.5	3.9	26.2	24.3	3.5	0.4	0.0	0.0	1076(29.5)	DF=24
Jointly	51.3	46.3	5.0	23.4	22.9	3.8	0.9	0.2	0.2	1102(30.3)	X^2=63.98
Someone Else	59.8	59.8	0.0	25.8	34.1	0.0	0.0	0.0	0.0	200(5.5)	P<0.0001**
Jointly Someone	81.0	76.9	4.1	34.2	42.6	4.1	0.0	0.0	0.0	96(2.6)	
Who decide on obtaining Health Care											
Resident Alone	49.2	35.6	13.6	18.0	17.6	11.2	2.1	0.4	0.0	2064(25.6)	
Partner	49.7	37.9	11.8	17.8	20.1	9.7	1.7	0.3	0.1	3056(37.8)	DF=24
Jointly	50.2	39.5	10.7	19.8	19.7	8.5	1.6	0.5	0.2	2092(25.9)	X^2=54.57
Someone Else	49.6	43.2	6.5	24.5	18.7	4.8	1.6	0.0	0.0	488(6.1)	P=0.0004**
Jointly Someone	53.3	42.2	11.1	21.1	21.1	9.4	1.1	0.0	0.6	375(4.7)	
TOTAL	**51.8**	**38.3**	**13.5**	**19.0**	**19.3**	**11.2**	**1.9**	**0.3**	**0.1**		

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition

Table.4.1.40. Prevalence of Malnutrition among women (15-49 years) in Andhra Pradesh state during 2005/06 survey

Variables	Total %	% of Women		% Women with Anaemia						Total Number of	Chi-Square Value
	Mal-nutri	CED	OW/OB	Mod-T	Mild -T	OW	Obese 1	Obese 11	Obese 111	Women(%)	& P- Value
Residence											DF=6
Urban	54.7	26.9	27.9	16.7	10.2	19.3	6.4	1.7	0.5	4451(65.6)	X^2=377.70
Rural	50.5	40.5	10.0	19.7	20.7	7.3	1,8	0.4	0.1	2442(35.4)	P<0.0001**
Caste											
SC	53.1	36.7	16.5	20.7	15.9	12.6	3.3	0.5	0.2	1099(16.0)	DF=18
ST	51.9	43.1	8.8	25.1	18.0	7.8	0.7	0.0	0.3	295(4.3)	X^2=246.59
OBC	51.0	34.0	17.0	17.7	16.2	12.7	3.2	0.9	0.2	2899(42.2)	P<0.0001**
None	55.9	25.7	30.2	15.7	10.0	19.9	7.6	2.1	0.6	2582(37.6)	
Age											
15-19	52.1	46.8	5.3	26.0	20.8	4.5	07	0.1	0.0	1238(18.0)	DF=36
20-24	50.8	40.7	10.1	20.8	19.9	8.3	1.4	0.2	0.2	1221(17.7)	X^2=745.78
25-29	50.5	31.4	19.0	18.8	12.6	14.4	3.5	1.1	0.1	1197(17.4)	P<0.0001**
30-34	52.7	26.2	26.6	14.5	11.7	19.5	4.9	1.6	0.6	891(12.9)	
35-39	53.9	23.1	30.8	13.4	9.6	21.3	7.5	1.7	0.3	967(14.0)	
40-44	60.9	20.0	40.9	11.5	8.5	25.4	11.5	2.8	1.2	750(10.9)	
45-49	58.0	20.0	38.0	12.7	7.3	25.4	9.1	2.7	0.8	629(9.1)	
Religion											
Hindu	52.0	32.5	19.4	17.9	14.6	13.8	4.3	1.0	0.3	1238(17.96)	DF=30
Muslims	57.7	28.5	29.2	16.9	11.6	19.7	6.7	2.1	0.7	1371(19.9)`	X^2=77.11
Christians	54.5	31.1	23.5	18.5	12.6	17.9	4.1	1.2	0.3	341(5.0)	P<0.0001**
Others	37.5	12.5	25	12.5	0	25	0	0	0	8(0.1)	
Age at First Birth											
10-14	51.0	26.9	24.1	13.9	13.0	16.6	5.5	1.5	0.6	531(10.9)	DF=174
15-19	52.1	29.1	23.0	15.4	13.6	16.3	4.9	1.4	0.4	2557(52.5)	X^2=468.42
20-24	55.4	25.8	29.6	15.2	10.5	21.1	6.2	1.8	0.5	1423(29.2)	P<0.0001**
25-29	60.5	21.4	39.1	14.5	6.9	26.6	9.5	2.6	0.3	304(6.2)	
30-34	56.9	19.6	73.3	15.7	3.9	21.6	15.7	0.0	0.0	51(1.02)	
35-39	75.0	12.5	62.5	12.5	0.0	12.5	37.5	0.0	12.5	8(0.2)	
40-44											
Number of Children											
0	53.5	30.7	22.8	17.6	13.0	15.6	5.3	1.5	0.4	4708(68.3)	DF=36
1	52.7	34.1	18.7	17.8	16.3	14.3	3.6	0.6	0.2	1254(18.2)	X^2=102.28
2+	52.5	33.6	18.9	18.6	15.0	14.5	3.4	0.8	0.2	931(13.5)	P<0.0001**
Occupation											
Not Working	54.6	28.0	26.7	16.4	11.6	18.4	6.0	1.8	0.5	4000(58.1)	DF=36
Professional	57.2	26.8	30.4	18.1	8.7	22.1	6.7	1.3	0.3	299(4.3)	X^2=356.72
Clerical	56.9	30.3	26.6	20.2	10.1	17.2	9.1	0.0	0.3	99(1.4)	P<0.0001**

Table.4.1.40 continued

Sales	52.1	25.2	27.0	13.5	11.7	17.2	8.6	1.2	0.0	163(2.4)	
Agriculture	50.6	44.7	6.0	22.6	22.1	5.1	0.6	0.1	0.2	1240(18.0)	
Service	47.0	28.6	18.4	17.8	10.8	13.5	4.1	0.8	0.0	370(5.4)	
Skill & Unskilled	51.3	35.5	15.9	18.1	17.4	12.2	3.1	0.4	0.1	719(10.4)	
Educational Level											
No Education	50.5	35.7	14.9	18.9	6.8	10.8	3.0	0.8	0.2	2386(34.6)	DF=18
Primary	49.4	27.1	22.3	13.3	13.8	16.0	4.2	1.6	0.4	923(13.4)	X^2=168.94
Secondary	55.1	31.3	23.8	18.3	12.9	16.5	5.6	1.4	0.4	2802(40.7)	P<0.0001**
Higher	59.3	26.5	32.9	17.8	8.7	23.0	7.8	1.3	0.8	782(11.3)	
Educational Level of Partner											
No Education	48.6	35.3	13.3	18.1	17.1	99	2.6	0.7	0.2	1653(30.9)	DF=24
Primary	53.9	25.0	21.2	14.4	10.6	14.8	5.0	1.4	0.0	783(14.6)	X^2=380.38
Secondary	53.3	24.4	28.9	13.9	10.6	20.0	6.5	1.8	0.5	2085(39.0)	P<0.0001**
Higher	63.6	17.4	46.2	12.8	4.6	30.9	11.3	2.7	1.2	805(15.0)	
DK	53.3	33.3	20.0	13.3	20.0	20.0	0.0	0.0	0.0	30(0.6)	
Wealth Index											
Poorest	53.5	49.1	4.4	25.6	23.5	3.7	0.8	0.0	0.0	383(5.6)	DF=24
Poorer	52.9	46.2	6.6	24.6	21.6	4.9	1.5	0.1	0.1	679(9.9)	X^2=706.98
Middle	48.6	39.3	9.3	19.5	19.8	7.6	1.1	0.4	0.2	1416(20.5)	P<0.0001**
Richer	51.0	29.6	21.4	16.5	13.1	15.5	4.6	1.2	0.0	2068(30.0)	
Richest	58.1	21.9	36.2	14.7	7.2	24.4	8.7	2.3	0.9	2347(34.1)	
Toilet Facility											
Flush toilet	55.3	26.6	28.6	16.4	10.2	19.6	6.7	1.8	0.5	4315(62.7)	DF=66
Pit latrine	50.3	22.7	27.8	13.6	9.1	22.2	3,5	2.0	0.0	198(2.9)	X^2=546.898
Bush	49.8	42.9	6.9	21.3	21.6	5.6	1.0	0.1	0.1	2092(30.4)	P<0.0001**
Others	55.5	36.1	19.4	22.2	13.9	19.4	0.0	0.0	0.0	36(0.5)	
Not dejure resident	48.8	31.6	17.2	15.2	16.4	12.7	4.1	0.4	0.0	244(3.5)	
Place of delivery											
Home	52.0	48.6	3.4	23.0	25.6	3.1	0.0	0.3	0.0	383(24.2)	DF=66
Gov't facility	49.2	35.6	13.6	17.2	18.4	10.6	2.8	0.2	0.0	435(27.5)	X^2=154.19
Private Facility	52.1	26.1	26.1	15.1	11.0	20.2	4.5	1.1	0.3	748(47.3)	P<0.0001**
Others	35.7	35.7	0.0	7.1	28.6	0.0	0.0	0.0	0.0	14(0.9)	
Who decide how to Spend money											
Respondent	51.3	30.3	21.0	15.5	14.8	15.3	4.9	0.6	0.2	485(26.5)	DF=18
											X^2=54.75
Partner	56.6	46.1	10.5	26.7	19.3	8.4	1.9	0.0	0.2	419(22.9)	P<0.0001**
Jointly	49.5	32.3	17.2	17.2	15.1	12.4	4.3	0.3	0.1	885(48.3)	
Someone Else	54.5	54.5	0.0	27.3	27.3	0.0	00	0.0	0.0	44(2.4)	
Allowed to go to hospital											
Respondent	55.0	29.7	25.3	16.8	12.9	17.6	5.7	1.5	0.4	3360(48.8)	DF=12
With someone	51.4	33.4	18.0	18.5	14.9	13.1	3.8	0.8	0.3	3197(46.4)	X^2=62.04
Not at all	52.3	33.4	17.8	19.6	14.8	10.9	4.2	2.1	0.6	331(4.8)	P<0.0001**
TOTAL	**54.5**	**31.3**	**23.2**	**17.5**	**13.8**	**16.5**	**5.2**	**1.0**	**0.5**		

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition

Table.4.1.41. Prevalence of Malnutrition among women (15-49 years) in Akola district during 1998/99 survey

VARIABLES	Total % Malnutri	% of Women		% Women with		OW	Obese 1	Obese 11	Obese 111	Total Number of Women(%)	Chi-Square Value & P- Value
		CED	OW/OB	Mod-T	Mild T						
Residence											
Urban	61.5	19.2	42.3	7.7	11.5	15.4	26.9	NA	NA	55(33.7)	DF=4
Rural	42.5	40.4	2.1	23.3	17.1	2.1	0.0	-	-	109(66.3)	X^2= 47.6374
											P<0.0001**
Caste											
SC	62.4	50.7	11.7	12.4	38.3	0.0	11.7	NA	NA	18(11.4)	DF=12
ST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	4(2.8)	X^2=25.5366
OBC	65.9	49.8	16.1	33.6	16.1	16.1	0.0	-	-	27(17.0)	P=0.0125*
None	46.4	29.0	17.4	16.6	12.4	5.8	11.6	-	-	110(68.8)	
Age											
15-19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	NA	2(1.4)	
20-24	26.4	17.8	8.6	0.0	17.8	8.6	0.0	-	-	25(15.0)	DF=24
25-29	43.4	35.3	8.1	8.8	26.5	0.0	8.1	-	-	52(31.9)	X^2=88.3604
30-34	53.1	34.2	19.0	27.1	7.0	6.3	12.6	-	-	34(20.5)	P<0.0001**
35-39	59.5	40.0	19.5	40.0	0.0	19.5	0.0	-	-	23(13.7)	
40-44	74.3	62.5	11.8	38.2	24.3	11.8	0.0	-	-	18(11.0)	
45-49	60.0	0.0	0.0	0.0	0.0	0.0	60.0	-	-	11(6.5)	
Religion											
Hindu	48.8	32.1	16.6	17.7	14.4	7.6	9.0	NA	NA	142(86.1)	DF=8
Muslims	NA	NA	NA	NA	NA	NA	NA	-	-	-	X^2=5.1066
Christians	NA	NA	NA	NA	NA	NA	NA	-	-	-	P=0.7461(NS)
Others	49.8	40.5	9.3	20.2	2.02	0.0	9.3	-	-	23(13.9)	
Age at First Birth											
10-14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	NA	NA	2(1.6)	
15-19	58.3	45.4	13.0	27.8	17.5	3.2	9.7	-	-	66(42.9)	DF=56
20-24	44.4	24.2	20.2	12.1	12.1	11.6	8.6	-	-	74(48.6)	X^2=107.9793
25-29	33.3	0.0	33.3	0.0	0.0	0.0	33.3	-	-	6(4.2)	P<0.0001**
30-34	50.0	50.0	0.0	0.0	50.0	0.0	0.0	-	-	4(2.8)	
Number of Children											
0	61.8	45.5	16.4	31.6	13.9	6.5	9.8	NA	NA	65(39.6)	DF=16
1	33.7	19.0	14.7	7.7	11.3	7.5	7.3	-	-	59(35.7)	X^2=56.4252
2+	50.1	34.4	15.7	11.4	23.1	5.2	10.5	-	-	41(24.8)	P<0.0001**
Occupation											
Not Working	39.0	17.0	22.0	11.5	5.5	8.3	13.8	NA	NA	77(47.1)	
Professional	75.7	25.7	50.0	0.0	25.7	50.0	0.0	-	-	9(5.3)	DF=24
Clerical	NA	NA	NA	NA	NA	NA	NA	-	-	NA	X^2=99.0619
Sales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	2(1.4)	P<0.0001**
Agriculture	53.9	53.9	0.0	28.7	25.2	0.0	0.0	-	-	65(39.5)	
Service	NA	NA	NA	NA	NA	NA	NA	-	-	NA	
Household	100.0	100.0	0.0	0.0	100.0	0.0	0.0	-	-	2(1.3)	

Table.4.1.41 continued

Skill & Unskilled	72.9	24.3	48.6	24.3	0.0	0.0	48.6	-	-	9(5.3)	
Educational Level of a woman											
No Education	63.6	63.6	0.0	45.2	18.4	0.0	0.0	NA	NA	26(15.7)	DF=56
Primary	45.8	32.3	13.5	14.3	18.0	6.7	6.7	-	-	63(38.5)	X^2=115.656
Secondary	44.3	24.4	19.9	13.9	10.4	6.8	13.1	-	-	65(39.4)	P<0.0001**
Higher	60.0	20.0	40.0	0.0	20.0	20.0	20.0	-	-	11(6.5)	
Educational Level of Partner											
No Education	50.5	50.5	0.0	30.1	20.4	0.0	0.0	NA	NA	23(14.2)	DF=12
Primary	43.9	38.0	5.9	25.6	12.4	0.0	5.9	-	-	36(22.0)	X^2=30.0845
Secondary	43.2	28.4	14.7	15.6	12.8	8.8	5.9	-	-	72(43.9)	P=0.0027*
Higher	65.9	26.5	39.5	6.5	19.9	13.4	26.1	-	-	33(19.9)	
Wealth Index											
Poorest	56.6	56.6	0.0	42.1	14.5	0.0	0.0	NA	NA	16(10.0)	DF=16
Poorer	77.5	77.5	0.0	33.7	43.9	0.0	0.0	-	-	21(12.9)	X^2=101.3941
Middle	25.2	25.2	0.0	6.2	19.1	0.0	0.0	-	-	37(22.3)	P<0.0001
Richer	33.1	33.1	0.0	22.6	10.5	0.0	0.0	-	-	40(24.6)	
Richest	64.5	12.8	51.6	8.6	4.3	21.7	30.0	-	-	50(30.2)	
Toilet Facility											
Flush toilet	50.8	20.1	30.7	11.8	8.3	14.1	16.7	NA	NA	77(46.6)	DF=8
Pit latrine	100.0	0.0	100.0	0.0	0.0	0.0	100.0	-	-	2(1.3)	X^2=54.705
Bush	45.9	45.9	0.0	24.1	21.8	0.0	0.0	-	-	85(52.1)	P<0.0001**
Place of delivery											
Home	58.0	58.0	0.0	14.5	43.5	0.0	0.0	NA	NA	16(32.9)	DF=12
Gov't facility	17.6	17.6	0.0	9.1	8.5	0.0	0.0	-	-	25(50.0)	X^2=26.9162
Private Facility	50.0	25.0	25.0	0.0	25.0	25.0	0.0	-	-	9(17.1)	P=0.0079*
Who decide how to Spend money											
Respondent	72.7	55.5	17.2	36.9	18.7	0.0	17.2	NA	NA	25(43.9)	DF=12
Partner	57.9	51.3	6.6	21.8	29.5	6.6	0.0	-	-	32(44.0)	X^2=20.2407
Jointly	48.3	31.9	16.4	16.4	15.5	16.4	0.0	-	-	14(18.8)	P=0.0627(NS)
Someone Else	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	2(3.3)	
Jointly Someone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Who decide on obtaining Health Care											
Respondent	58.7	41.5	17.2	32.2	9.4	0.0	17.2	NA	NA	50(30.1)	
Partner	42.3	30.4	11.9	12.6	17.8	7.2	4.7	-	-	91(55.1)	DF=12
Jointly	NA	NA	NA	NA	NA	NA	NA	-	-	NA	X^2=46.5213
Someone Else	36.8	13.2	23.6	13.2	0.0	11.8	11.8	-	-	18(11.0)	P<0.0001**
Jointly Someone	100.0	66.7	33.3	0.0	66.7	33.3	0.0	-	-	6(3.9)	
TOTAL	**49.3**	**32.5**	**16.8**	**15.3**	**17.2**	**6.7**	**10.1**				

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition

Table.4.1.42. Prevalence of Malnutrition among women (15-49 years) in Solapur district during 1998/99 survey

VARIABLES	Total % Malnutrion	% of Women CED	OW/OB	% Women with Anaemia Mod - T	Mild-T	OW	Obese 1	Obese 11	Obese 111	Total Number of Women(%)	Chi-Square Value & P- Value
Residence											DF=4
Urban	56.2	46.9	9.4	21.9	25.0	6.3	3.1	NA	NA	69(19.7)	X^2=11.8409
Rural	52.8	50.2	2.6	27.5	22.7	2.6	0.0	-	-	279(80.3)	P=0.0186*
Caste											
SC	26.0	26.0	0.0	15.7	10.3	0.0	0.0	NA	NA	44(12.8)	DF=12
ST	51.7	44.9	6.8	17.1	27.8	3.4	3.4	-	-	63(18.1)	X^2=31.4109
OBC	53.1	49.5	3.6	30.2	19.4	3.6	0.0	-	-	60(17.3)	P=0.0017**
None	NA										
DK	61.0	57.0	4.0	31.1	25.9	4.0	0.0	-	-	180(51.9)	
Age											
15-19	47.8	47.8	0.0	13.1	34.7	0.0	0.0	NA	NA	66(19.0)	
20-24	50.7	50.7	0.0	35.3	15.4	0.0	0.0	-	-	89(25.7)	DF=24
25-29	68.5	60.6	7.9	32.9	27.6	7.9	0.0	-	-	57(16.5)	X^2=68.7954
30-34	55.1	47.9	7.2	22.5	25.4	7.2	0.0	-	-	64(18.3)	P<0.0001**
35-39	63.6	57.0	6.5	37.3	19.7	6.5	0.0	-	-	37(10.6)	
40-44	30.0	22.7	7.2	15.5	7.2	0.0	7.2			30(8.5)	
45-49	50.0	50.0	0.0	0.0	50.0	0.0	0.0			4(1.3)	
Religion											
Hindu	53.7	49.5	4.2	26.5	23.0	3.5	0.7	NA	NA	328(94.4)	DF=8
Muslims	57.1	57.1	0.0	28.6	28.4	0.0	0.0	-	-	17(4.9)	X^2=3.8089
Christians	NA										P=0.8739(NS)
Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	2(0.7)	
Age at First Birth											
10-14	69.6	69.6	0.0	30.3	39.3	0.0	0.0	NA	NA	30(9.9)	
15-19	51.6	47.0	4.6	26.6	20.4	3.7	0.9	-	-	244(79.7)	DF=48
20-24	58.9	50.1	8.9	24.5	25.6	8.9	0.0	-	-	28(9.0)	X^2=84.7856
25-29	50.0	50.0	0.0	50.0	0.0	0.0	0.0	-	-	4(1.4)	P=0.0008**
Number of Children											
0	53.3	49.8	3.5	26.3	23.6	2.4	1.1	NA	NA	192(55.4)	DF=16
1	50.1	46.8	3.3	18.5	28.3	3.3	0.0	-	-	74(21.4)	X^2=22.8242
2+	57.0	51.4	5.6	34.0	17.3	5.6	0.0	-	-	84(23.3)	P=0.1185(NS)
Occupation											
Not Working	54.2	46.5	7.7	27.1	19.5	7.7	0.0	NA	NA	149(43.0)	
Professional	NA	NA	NA	NA	NA	NA	NA	-	-		DF=16
Clerical	NA	NA	NA	NA	NA	NA	NA	-	-		X^2=32.7806
Sales	NA	NA	NA	NA	NA	NA	NA	-	-		P=0.0079**
Agriculture	52.4	51.3	1.1	25.6	25.7	0.0	1.1	-	-	191(55.1)	

Service	NA	NA	NA	NA	NA	NA	NA			NA	
Domestic	100.0	100.0	0.0	0.0	100.0	0.0	0.0	-	-	2(0.6)	
Skill & Unskilled	53.2	53.2	0.0	53.2	0.0	0.0	0.0	-	-	5(1.3)	
Educational Level											
No Education	52.9	50.6	2.3	26.0	24.7	1.1	1.1	NA	NA	187(53.8)	DF=40
Primary	59.1	55.0	4.1	30.6	24.3	4.1	0.0	-	-	112(32.2)	X^2=73.6425
Secondary	42.8	32.8	10.0	18.4	14.4	10.0	0.0	-	-	48(14.0)	P=0.0009**
Higher	NA										
Educational Level of Partner											
No Education	57.9	57.9	0.0	30.3	27.6	0.0	0.0	NA	NA	93(26.7)	DF=12
Primary	64.0	60.2	3.8	35.2	25.0	3.8	0.0	-	-	64(18.3)	X^2=22.9687
Secondary	46.5	41.9	4.5	20.3	21.7	3.1	1.4	-	-	148(42.7)	P=0.028*
Higher	52.8	42.1	10.7	26.5	15.7	10.7	0.0	-	-	43(12.3)	
Wealth Index											
Poorest	59.3	59.3	0.0	38.0	21.2	0.0	0.0	NA	NA	108(31.1)	
Poorer	53.3	53.3	0.0	32.7	29.7	0.0	0.0	-	-	80(23.0)	
Middle	48.8	40.4	8.4	21.9	18.5	8.4	0.0	-	-	86(24.9)	DF=12
Richer	53.4	49.4	4.0	16.1	33.3	4.0	0.0	-	-	53(15.3)	X^2=71.5526
Richest	43.2	21.6	21.6	21.6	0.0	10.8	10.8	-	-	20(5.7)	P<0.0001**
Toilet Facility											
Flush toilet	57.9	47.4	10.5	26.3	21.1	10.5	0.0	NA	NA	41(11.7)	DF=8
Pit latrine	NA	NA	NA	NA	NA	NA	NA	-	-		X^2=11.328
Bush	52.9	49.8	3.1	26.4	23.4	2.4	0.7	-	-	307(88.3)	P=0.1838(NS)
Others	NA	NA	NA	NA	NA	NA	NA	-	-		
Place of delivery											
Home	46.5	46.5	0.0	7.7	28.8	0.0	0.0	NA	NA	66(60.9)	DF=12
Gov't facility	62.1	62.1	0.0	37.9	24.2	0.0	0.0	-	-	18(16.4)	X^2=22.6605
Private Facility	53.8	43.9	9.9	35.1	8.8	9.9	0.0	-	-	24(22.7)	P=0.0308*
Others	NA	NA	NA	NA	NA	NA	NA	-	-	NA	
Who decide how to Spend money											
Respondent	66.3	61.1	5.2	33.2	27.9	0.0	5.2	NA	NA	41(33.0)	
Partner	40.4	40.4	0.0	13.0	27.4	0.0	0.0	-	-	35(28.2)	DF=12
Jointly	43.5	43.5	0.0	22.2	21.3	0.0	0.0	-	-	33(26.2)	X^2=21.8363
Someone Else	66.0	66.0	0.0	18.1	48.0	0.0	0.0	-	-	13(10.7)	P=0.0394*
Jointly Someone	100.0	100.0	0.0	100.0	0.0	0.0	0.0	-	-	2(1.9)	
Who decide on obtaining Health Care											
Respondent	57.9	55.5	2.5	33.8	21.7	0.0	2.5	NA	NA	87(25.1)	
Partner	51.2	44.9	6.3	22.3	22.6	6.3	0.0	-	-	184(52.9)	DF=16
Jointly	44.9	44.9	0.0	44.9	0.0	0.0	0.0	-	-	21(6.1)	X^2=37.3256
Someone Else	54.7	54.7	0.0	13.2	41.5	0.0	0.0	-	-	37(10.6)	P=0.0019**
Jointly Someone	62.3	62.3	0.0	37.7	24.6	0.0	0.0	-	-	19(5.4)	
	54.1	50.4	3.7	27.1	23.3	3.0	0.7	-	-		

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition

Table.4.1.43. Prevalence of Malnutrition among women (15-49 years) in Maharashtra state during 1998/99 survey

VARIABLES	Total % Mal-nutri	% of Women CED	OW/OB	% Women with Anaemia Mod T	Mild T	OW	Obese 1	Obese 11	Obese 111	Total Number of Women (%)	Chi-Square Value & P- Value
Residence											DF=6
Urban	49.9	28.9	21.0	15.9	13.0	15.6	4.5	0.7	0.1	3599(41.3)	X^2=828.09
Rural	54.1	50.4	3.7	26.5	23.9	2.9	0.6	0.0	0.1	5107(58.7)	P<0.0001**
Caste											
SC	48.7	39.4	9.3	18.0	21.4	7.9	1.3	0.2	0.0	1176(13.6)	DF=18
ST	58.3	53.9	4.4	28.0	25.9	3.0	0.9	0.2	0.2	897(10.3)	X^2=174.35
OBC	51.7	42.8	8.8	23.3	19.5	7.3	1.0	0.2	0.3	1877(52.1)	P<0.0001**
None	52.3	39.0	13.3	21.5	17.5	9.6	3.2	0.5	0.0	4721(54.5)	
Age											
15-19	51.0	50.2	0.8	22.1	28.1	0.8	0.0	0.0	0.0	809(9.3)	
20-24	51.2	48.5	2.7	24.9	23.6	2.3	0.0	00	0.0	1557(17.8)	DF=36
25-29	53.0	46.0	7.0	22.9	23.1	5.6	0.2	0.0	0.0	1775(20.3)	X^2=531.32
30-34	53.4	40.0	13.4	21.6	18.4	10.3	0.4	0.3	0.3	1549(17.7)	P<0.0001*
35-39	52.2	36.1	16.1	20.8	15.2	11.2	0.3	0.2	0.2	1259(14.4)	
40-44	53.4	32.9	20.4	21.2	11.8	15.0	1.1	0.3	0.3	1118(12.3)	
45-49	51.6	32.3	19.2	19.1	13.2	14.6	4.2	0.5	0.0	686(7.8)	
Religion											
Hindu	52.9	43.6	9.3	23.0	20.6	7.1	1.8	0.2	0.1	6973(80.1)	DF=42
Muslims	49.3	30.7	18.5	17.5	12.8	13.1	4.7	0.7	0.0	857(9.8)	X^2=376.85
Christians	62.3	32.2	30.1	20.0	12.3	22.5	1.5	6.1	0.0	114(1.3)	P<0.0001
Others	49.1	35.2	13.8	18.5	16.7	10.0	3.1	06	0.1	762(8.8)	
Age at First Birth											
10-14	53.8	48.3	5.5	24.5	23.6	4.0	1.2	00	0.4	643(8.2)	DF=156
15-19	54.9	45.5	9.4	23.9	21.6	7.0	2.0	02	0.1	4732(60.5)	
20-24	48.3	34.3	14.0	19.9	14.9	10.6	2.8	0.5	0.0	2003(25.7)	X^2=553.85
											P<0.0001**
25-29	54.8	23.9	30.8	13.0	10.9	23.5	44	3.0	0.0	367(4.6)	
30-34	54.0	28.1	25.9	16.9	11.2	18.9	6.1	0.8	0.0	62(0.8)	
35-39	71.9	33.4	38.5	5.7	27.7	16.7	21.9	0.0	0.0	10(0.1)	
40-44	NA										
Number of Children											
0	52.4	38.6	13.9	22.5	16.1	10.3	2.9	0.5	0.2	4586(52.70	DF=48
1	51.9	42.8	9.0	20.0	22.1	7.2	1.6	0.2	0.0	2133(24.5)	X^2=235.96
2+	52.6	46.8	5.8	22.6	24.2	4.4	1.2	0.2	0.0	1988(22.8)	P<0.0001**
Occupation											
Not Working	49.1	32.7	16.4	17.8	14.8	12.4	3.4	0.6	0.0	3869(44.5)	DF=60
											X^2=916.50
Professional	51.8	25.0	26.8	11.6	13.5	20.6	5.6	0.4	0.2	262(3.0)	P<0.0001**
Clerical	54.0	13.8	40.2	8.4	5.4	32.9	6.9	0.7	0.0	78(0.9)	
Sales	48.1	28.3	19.8	14.5	13.8	12.8	5.4	1.5	0.0	145(1.7)	
Agricultural	56.2	54.2	2.0	28.3	25.9	1.6	0.3	0.0	0.1	3371(38.8)	
Service	63.1	37.5	25.6	20.6	16.9	18.0	5.2	2.3	0.0	91(1.0)	

Table.4.1.43.continued											
Household	48.8	36.1	12.7	17.8	18.2	10.9	0.7	0.0	1.1	191(2.10	
Skill & Unskilled	52.2	43.8	8.4	24.6	19.2	5.8	2.3	0.0	0.3	689(8.0)	
DK	52.1	0.0	52.1	0.0	0.0	37.8	14.3	0.0	0.0	15(0.2)	
Educational Level											
No Education	54.7	50.0	4.8	26.6	23.4	4.0	0.7	0.0	0.1	3346(38.4)	DF=120
Primary	52.1	41.6	10.6	22.7	18.9	7.9	2.2	0.4	0.0	2876(33.0)	X^2=759.32
Secondary	49.1	31.8	17.3	16.5	15.3	12.6	4.0	0.6	0.0	2063(23.7)	P<0.0001**
Higher	49.2	20.9	28.3	10.2	10.7	21.3	6.1	0.7	0.1	421(4.8)	
Educational Level of Partner											
No Education	56.8	53.1	3.7	29.1	24.0	2.8	0.6	0.0	0.3	1578(18.2)	DF=18
Primary	53.5	46.9	6.6	23.3	23.7	5.2	0.8	0.5	0.1	1668(19.2)	X^2=455.38
Secondary	51.5	40.5	11.0	22.4	18.1	8.6	1.9	0.3	0.1	3613(41.6)	P<0.0001**
Higher	49.1	28.6	20.5	14.7	13.9	14.6	5.4	0.5	0.0	1819(21.0)	
Wealth Index											
Poorest	61.3	60.9	0.4	32.8	28.1	0.4	0.0	0.0	0.0	1062(12.1)	DF=24
Poorer	59.1	56.9	2.2	28.9	28.1	2.0	0.0	0.0	0.2	1249(14.3)	X^2=1422.85
Middle	53.4	50.5	2.9	28.7	21.8	2.0	0.6	0.1	0.1	1850(21.1)	P<0.0001
Richer	45.9	37.0	8.9	19.5	17.5	7.2	1.4	0.2	0.1	2123(24.3)	
Richest	49.9	22.8	27.1	11.4	11.3	19.9	6.2	0.9	0.1	2470(28.2)	
Toilet Facility											
Flush toilet	49.4	27.7	21.6	14.8	12.9	16.1	4.6	0.8	0.2	3447(39.6)	DF=42
											X^2=1119.56
Pit latrine	53.1	36.8	16.2	17.6	19.2	10.9	4.7	0.6	0.0	380(4.4)	P<0.0001**
Bush	54.5	51.7	2.8	27.6	24.0	2.4	0.3	0.0	0.1	4870(56.0)	
Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9(0.1)	
Place of delivery											
Home	55.5	55.1	0.4	24.6	30.5	0.4	0.0	0.0	0.0	1169(46.8)	DF=50
Gov't facility	53.7	48.9	4.8	23.5	25.4	4.2	0.6	0.0	0.0	625(25.1)	X^2=198.67
Private Facility	49.0	38.8	10.2	19.6	19.2	7.7	2.3	0.2	0.0	697(27.9)	P<0.0001**
Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6(0.2)	
Who decide how to Spend money											
Respondent Alone	54.8	43.8	11.0	25.5	18.3	8.7	1.7	0.3	0.2	1224(39.2)	DF=24
Partner	57.1	52.5	4.6	25.5	27.0	3.9	0.7	0.0	0.0	1013(32.4)	X^2=96.89
Jointly	54.5	45.1	9.4	24.3	20.8	7.2	1.9	0.0	0.3	620(19.8)	P<0.0001**
Someone Else	54.0	50.7	3.3	2.0	30.3	1.5	1.8	0.0	0.0	148(4.7)	
Jointly Someone	50.8	46.2	4.6	16.0	30.1	0.9	2.0	1.8	0.0	121(3.9)	
Who decide on obtaining Health Care											
Respondent Alone	51.8	36.2	15.5	20.2	16.1	11.2	3.5	0.7	0.2	3080(35.4)	DF=24
Partner	52.9	44.9	7.9	23.9	21.1	6.3	1.3	0.2	0.1	3551(40.8)	X^2=196.90
Jointly	52.9	39.9	13.0	22.6	17.3	10.1	2.7	0.0	0.2	920(10.6)	P<0.0001**
Someone Else	51.1	44.7	6.3	21.2	23.5	5.0	1.3	0.0	0.0	808(9.3)	
Jointly Someone	52.6	49.1	3.6	21.5	27.6	2.4	0.9	0.2	0.0	345(4.0)	
Total	**51.5**	**38.6**	**12.9**	**19.6**	**18.7**	**9.4**	**3.3**	**0.6**	**0.1**		

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition, NA=not available

Table.4.1.44. Prevalence of Malnutrition among women (15-49 years) in Maharashtra state during 2005/06 survey

Variables	Total % Mal-nutri	% of Women		% Women with Anaemia						Total Number of Women (%)	Chi-Square Value & P- Value
		CED	OW/OB	Mod T	Mild T	OW	Obese 1	Obese 11	Obese 111		
Residence											
Urban	55.2	35.9	19.3	23.4	12.5	14.1	4.2	0.9	0.1	6177(71.1)	X^2=828.09
Rural	54.1	47.4	6.7	23.7	23.7	5.6	1.0	0.0	0.2	1477(28.9)	P<0.0001**
Caste											
SC	54.2	40.4	13.8	23.0	17.5	11.0	2.5	0.3	0.1	1477(17.1)	
ST	55.9	50.0	5.9	28.2	21.8	4.3	1.1	0.3	0.1	716(8.3)	X^2=139.28
OBC	51.4	36	15.2	20.3	15.8	11.4	3.2	0.6	0.0	2408(27.8)	P<0.0001**
None	57.1	38.8	18.3	24.7	14.1	13.3	4.0	0.8	0.1	4053(46.8)	
Age											
15-19	60.0	56.7	3.3	32.8	23.9	2.7	0.5	0.1	0.0	1578(18.2)	
20-24	53.4	47.3	6.1	27.7	19.6	5.0	0.9	0.2	0.0	1516(17.4)	
25-29	53.1	39.9	13.2	22.9	17.0	10.5	2.2	0.3	0.1	1433(16.5)	X^2=838.52
30-34	52.9	34.2	18.7	21.5	12.7	13.9	3.8	0.9	0.1	1335(15.4)	P<0.0001**
35-39	56.1	31.8	24.3	19.5	12.3	17.1	5.6	1.4	0.2	1170(13.5)	
40-44	53.5	25.4	28.1	16.1	9.2	20.3	6.7	0.9	0.2	997(11.5)	
45-49	53.9	21.8	32.2	14.8	6.9	23.3	7.3	1.2	0.5	662(7.6)	
Religion											
Hindu	54.2	39.0	15.2	22.4	16.6	11.4	3.1	0.6	0.1	6456(74.3)	
Muslims	59.4	41.4	18.0	29.6	11.8	12.4	4.7	0.7	0.2	1105(12.7)	X^2=123.90
Christians	54.9	34.0	20.8	26.4	7.6	17.4	1.4	1.4	0.7	114(1.7)	P<0.0001**
Others	54.2	39.4	14.8	23.4	16.0	11.1	3.1	0.4	0.2	980(11.2)	
Age at First Birth											
10-14	50.2	32.5	17.7	19.5	13.0	12.1	5.2	0.4	0.0	231(3.9)	
15-19	54.0	36.3	15.7	19.9	16.4	11.3	3.7	0.5	0.2	2801(47.0)	X^2=238.59
20-24	55.0	32.6	22.5	19.9	12.7	17.3	4.2	0.8	0.1	2229(37.4)	P<0.0001**
25-29	55.1	29.3	25.8	20.6	8.7	18.8	5.5	1.4	0.0	621(10.4)	
30-34	60.8	25.7	35.1	20.3	5.4	24.3	9.5	1.4	0.0	74(1.2)	
35-39	50.0	30.0	20.0	30.0	0.0	10.0	10.0	0.0	0.0	10(0.2)	
40-44	100	0.0	100	0.0	0.0	0.0	100	0.0	0.0	1(0.02)	
Number of Children											
0	55.3	38.2	17.1	23.5	14.7	12.7	3.6	0.7	0.1	5686(65.4)	
1	54.2	39.9	14.4	23.5	16.3	10.5	3.0	0.7	0.2	1726(19.9)	X^2=73.68
2+	54.1	43.1	11.0	23.4	19.7	8.7	2.1	0.2	0.0	1279(14.7)	P<0.0002**
Occupation											
Not Working	55.7	37.5	18.2	23.9	13.6	13.3	4.1	0.7	0.1	5008(57.7)	
											X^2=367.78
Professional	55.3	29.3	26.0	22.3	7.0	20.8	4.5	0.5	0.3	400(4.6)	P<0.0001**
Clerical	58.8	36.8	22.0	22.0	14.8	15.9	5.5	0.5	0.0	182(2.1)	
Sales	51.3	31.4	19.9	16.9	14.6	14.9	3.1	1.5	0.4	261(3.0)	
Agricultural	55.5	50.7	4.8	24.9	25.8	3.8	0.8	0.0	0.3	1555(17.9)	
Services	48.8	31.3	17.5	20.0	11.3	12.4	4.1	1.1	0.0	565(6.5)	

Table.4.1.44.continued

Skill & Unskilled	52.8	41.5	11.3	23.7	17.7	9.1	1.4	0.8	0.0	716(8.2)	
Educational Level											
No Education	52.7	42.2	10.4	23.9	18.3	7.4	2.6	0.4	0.1	1572(18.1)	
Primary	53.1	37.4	15.7	20.2	17.2	11.4	3.4	0.6	0.3	1145(13.2)	X^2=93.72
Secondary	55.9	39.7	16.2	23.8	15.9	12.2	3.3	0.6	0.1	4704(54.1)	P<0.0001**
Higher	55.5	35.4	20.1	24.7	10.6	15.1	4.0	0.9	0.1	1269(14.6)	
Educational Level of Partner											
No Education	54.4	43.8	10.7	23.0	20.7	7.6	2.4	0.4	0.3	777(12.0)	
Primary	51.0	38.0	13.1	21.1	16.8	9.5	2.9	0.4	0.2	956(14.8))	X^2=183.33
Secondary	53.1	33.5	19.6	19.4	14.1	14.5	4.0	0.9	0.1	3564(55.1)	P<0.0001**
Higher	56.1	27.3	28.8	19.5	7.8	21.3	6.4	1.0	0.1	1148(17.8)	
DK	36.8	31.6	5.3	21.1	10.5	5.3	0.0	0.0	0.0	19(0.3)	
Wealth Index											
Poorest	61.5	59.2	2.3	30.3	28.9	1.4	0.4	0.0	0.4	488(5.6)	
Poorer	57.1	53.5	3.6	28.4	25.1	2.7	0.5	0.4	0.0	772(8.9)	X^2=633.76
Middle	54.3	46.9	7.4	24.4	22.5	6.3	0.9	0.1	0.2	1223(14.1)	P<0.0001
Richer	50.3	37.4	12.9	21.4	16.0	10.3	2.5	0.1	0.0	2213(25.5)	
Richest	56.3	32.7	23.7	22.6	10.1	17.0	5.4	1.2	0.1	3995(46.0)	
Toilet Facility											
Flush toilet	55.3	35.4	19.9	23.0	12.5	14.6	4.4	0.8	0.1	6060(69.8)	
											X^2=477.32
Pit latrine	31.8	27.3	4.5	13.6	13.6	4.5	0.0	0.0	0.0	22(0.3)	P<0.0001**
Bush	54.5	49.0	5.4	24.9	24.1	4.6	0.6	0.1	0.2	2355(27.1)	
Others	60.0	46.7	13.3	26.7	20.0	13.3	0.0	0.0	0.0	15(0.2)	
Not dejure resident	50.4	38.8	11.6	22.8	15.9	7.8	3.4	0.4	0.0	232(2.7)	
Place of delivery											
Home	59.7	57.2	2.5	27.0	30.2	1.9	0.0	0.0	0.4	526(25.0)	
Gov't facility	52.4	40.4	12.0	22.2	18.2	9.4	2.4	0.3	0.0	715(34.0)	X^2=188.86
Private Facility	51.2	33.1	18.1	21.0	12.1	13.7	3.4	1.0	0.0	842(40.0)	P<0.0001**
Others	57.1	38.1	19.0	19.0	19.0	9.5	9.5	0.0	0.0	21(1.0)	
Who decide how to Spend money											
Respondent Alone	51.9	33.7	18.1	20.2	13.5	12.6	4.1	1.3	0.2	540(28.2)	
Jointly with partner	50.7	35.5	15.2	19.6	15.8	12.2	2.3	0.5	0.3	1111(58.1)	X^2=38.11
Partner	57.7	49.5	8.2	25.9	23.6	5.5	2.3	0.5	0.0	220(11.5)	P<0.0001**
Someone Else	42.9	38.1	4.8	16.7	21.4	2.4	2.4	0.0	0.0	42(2.2)	
Allowed to go to hospital											
Respondent Alone	51.9	36.0	18.5	22.5	13.5	13.5	3.9	0.8	0.1	5670(65.3)	
With someone else	55.3	45.7	9.6	25.8	19.9	7.3	2.0	0.2	0.0	2438(28.1)	X^2=154.06
Not at all	57.2	43.3	13.9	22.7	20.6	10.3	2.7	0.7	0.2	582(6.7)	P<0.0001**
Total	**54.7**	**37.9**	**16.8**	**22.5**	**15.4**	**11.0**	**5.2**	**0.6**	**0.1**		

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition, NA=not available

Table.4.1.45. Prevalence of Malnutrition among women (15-49 years) in Bijapur district during 1998/99 survey

Variables	Total % Mal-nutri	% of Women		% Women with Anaemia						Total Number of Women(%)	Chi-Square Value & P- Value
		CED	OW/OB	Mod-T	Mild-T	OW	Obese 1	Obese 11	Obese 111		
Residence											DF=4
Urban	57.5	48.3	9.2	28.7	19.5	3.4	5.7	NA	NA	94(34.0)	X^2=14.0111
Rural	52.7	49.0	3.7	21.3	27.8	3.7	0.0	-	-	183(66.0)	P=0.0013
Caste											
SC	47.2	47.2	0.0	18.0	29.3	0.0	0.0	NA	NA	39(14.6)	DF=12
ST	58.3	58.3	0.0	41.7	16.5	0.0	0.0	-	-	14(5.1)	X^2=8.527
OBC	55.3	`49.3	6.2	27.1	22.2	3.8	2.4	-	-	89(33.7)	P=0.7427(NS)
None	53.0	48.9	7.1	21.2	24.7	5.3	1.8	-	-	123(46.6)	
Age											
15-19	100.0	100.0	0.0	100.0	0.0	0.0	0.0	NA	NA	1(0.5)	
20-24	59.9	59.9	0.0	24.1	35.8	0.0	0.0	-	-	23(9.7)	DF=24
25-29	57.4	50.4	7.0	34.0	16.4	7.0	0.0	-	-	50(21.3)	X^2=46.0916
30-34	62.4	30.9	31.3	13.9	17.1	31.3	0.0	-	-	33(13.9)	P=0.0043
35-39	42.7	27.6	15.1	21.6	6.0	11.2	4.0	-	-	53(23.4)	
40-44	53.6	34.6	19.0	29.0	5.6	19.0	0.0	-	-	41(17.3)	
45-49	64.4	34.9	29.5	22.8	12.0	22.6	6.9	-	-	35(15.0)	
Religion											
Hindu	53.4	47.6	5.8	23.8	23.98	3.4	2.4	NA	NA	228(82.0)	DF=8
Muslims	58.0	53.4	4.6	25.5	27.9	4.6	0.0	-	-	47(16.9)	X^2=5.1223
Christians	NA	-	-	-	-	-	-	-	-		P=0.7444(NS)
Others	66.2	66.2	0.0	0.0	66.2	0.0	0.0	-	-	3(1.2)	
Age at First Birth											
10-14	58.9	58.9	0.0	35.8	23.0	0.0	0.0	NA	NA	43(17.4)	
15-19	52.6	44.3	8.2	20.1	24.3	4.8	3.4	-	-	160(65.2)	DF=80
20-24	51.3	47.8	3.5	24.1	23.7	3.5	0.0	-	-	32(13.0)	X^2=73.856
25-29	75.0	62.1	12.8	37.3	24.8	12.8	0.0	-	-	9(3.5)	P=0.672(NS)
30-34	100.0	100.0	0.0	0.0	100.0	0.0	0.0	-	-	1(0.4)	
35-39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	1(0.4)	
40-44											
Number of Children											
0	58.2	50.4	7.8	25.3	25.1	4.0	3.4	NA	NA	127(45.6)	DF=28
1	54.0	50.8	3.2	29.4	21.4	3.2	0.0	-	-	67(24.1)	X^2=31.3374
2+	48.7	44.8	3.9	17.1	27.7	2.6	1.3	-	-	84(30.2)	P=0.3023(NS)
Occupation											
Not Working	45.9	37.1	8.8	19.3	17.8	5.3	3.5	NA	NA	124(44.8)	
Professional	50.0	50.0	0.0	0.0	50.0	0.0	0.0	-	-	4(1.6)	
Clerical	-	-	-	-	-	-	-	-	-	-	DF=32
Sales	68.2	68.2	0.0	0.0	68.2	0.0	0.0	-	-	3(1.2)	X^2=41.2242
Agriculture	62.2	60.9	1.3	24.4	36.4	1.3	0.0	-	-	90(32.5)	P=0.1273(NS)
Service	100.0	100.0	0.0	0.0	100.0	0.0	0.0	-	-	checked	

Table.4.1.45.continued											
Skill & Unskilled	60.4	54.2	6.2	37.6	16.6	4.16	2.0	-	-	53(19.1)	
Household	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	-	1(0.4)	
Educational Level											
No Education	55.1	51.5	3.6	26.4	25.1	1.8	1.8	NA	NA	185(66.5)	DF=52
Primary	48.9	42.8	6.1	18.2	24.5	2.1	4.1	-	-	54(19.3)	X^2= 53.4596
Secondary	56.1	40.4	15.7	18.7	21.7	15.7	0.0	-	-	35(12.9)	P=0.418(NS)
Higher	75.0	75.0	0.0	25.0	50.0	0.0	0.0	-	-	4(1.6)	
Educational Level of Partner											
No Education	53.9	51.1	2.8	24.8	26.3	1.9	0.9	NA	NA	118(42.3)	DF=12
Primary	63.9	56.9	7.0	28.3	28.6	7.0	0.0	-	-	31(11.1)	X^2=12.8471
Secondary	48.3	42.8	5.5	21.9	20.9	1.4	4.1	-	-	79(28.4)	P=0.3803(NS)
Higher	58.8	47.8	11.0	21.7	26.0	8.8	2.2	-	-	50(18.2)	
Wealth Index											
Poorest	86.0	80.0	6.0	60.9	19.1	6.0	0.0	NA	NA	18(17.4)	DF=16
Poorer	47.0	43.6	3.4	25.2	18.4	3.4	0.0	-	-	31(13.3)	X^2=59.1403
Middle	62.0	58.9	3.1	39.5	19.5	3.1	0.0	-	-	40(16.8)	P<0.0001
Richer	57.1	43.9	13.2	23.1	20.8	9.7	3.5	-	-	60(25.4)	
Richest	48.8	16.1	32.8	13.3	2.8	30.0	2.8	-	-	88(37.1)	
Toilet Facility											
Flush toilet	50.2	24.7	25.4	24.7	0.0	25.4	0.0	NA	NA	9(3.2)	DF=12
Pit latrine	21.4	21.4	0.0	21.4	0.0	0.0	0.0	-	-	11(4.0)	X^2=24.095
Bush	55.9	50.8	5.1	23.9	26.9	3.0	2.1	-	-	258(92.9)	P=0.0197
Others	NA	NA		-	-	-	-		-		
Place of delivery											
Home	43.1	43.1	0.0	9.2	33.9	0.0	0.0	NA	NA	49(57.5)	DF=18
Gov't facility	50.0	50.2	0.0	35.3	14.9	0.0	0.0	-	-	22(25.7)	X^2=23.6897
Private Facility	53.7	45.8	7.9	7.5	38.3	7.9	0.0	-	-	14(16.8)	P=0.1655(NS)
Others	NA										
Who decide how to Spend money											
Respondent	71.8	65.7	6.1	31.1	34.6	6.1	0.0	NA	NA	36(30.0)	
Partner	61.6	61.6	0.0	28.1	33.5	0.0	0.0	-	-	43(36.1)	DF=16
Jointly	37.5	33.9	3.6	22.9	11.0	0.0	3.6	-	-	30(25.5)	X^2=26.0958
Someone Else	61.9	61.9	0.0	0.0	61.9	0.0	0.0	-	-	9(7.5)	P=0.0527(NS)
Jointly Someone	100.0	100.0	0.0	100.0	0.0	0.0	0.0	-	-	1(1.0)	
Who decide on obtaining Health Care											
Respondent	64.2	53.9	10.3	28.5	25.4	5.9	4.4	NA	NA	75(27.0)	DF=16
Partner	51.3	47.6	3.7	22.7	24.9	3.0	0.7	-	-	149(53.7)	X^2=10.8633
Jointly	47.8	39.2	8.5	17.4	21.9	4.3	4.3	-	-	25(9.2)	P=0.8178(NS)
Someone Else	52.1	52.1	0.0	23.6	28.5	0.0	0.0	-	-	23(8.2)	
Jointly Someone	41.1	41.1	0.0	21.4	19.7	0.0	0.0	-	-	6(2.0)	
TOTAL	**56.7**	**50.5**	**6.2**	**24.4**	**26.1**	**5.0**	**1.2**				

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition, NA=not available

Table.4.1.46. Prevalence of Malnutrition among women (15-49 years) in Tumkur district during 1998/99 survey

Variables	Total % Mal-nutri	% of Women CED	OW	% Women with Anaemia Moderate	Mild	OW	Obese 1	Obese 11	Obese 111	Total Number of Women(%)	Chi-Square Value & P- Value
Residence											DF=3
Urban	47.5	45.0	2.5	27.5	17.5	2.5	NA	NA	NA	45(10.2)	X^2=2.689
Rural	52.2	45.5	6.7	22.3	23.2	6.7	NA	NA	NA	397(89.9)	P=0.4995(NS)
Caste											
SC	58.6	55.4	3.2	25.5	29.9	3.2	NA	NA	NA	105(23.8)	DF=9
ST	52.6	47.7	5.0	30.1	17.6	5.0	NA	NA	NA	45(10.2)	X^2=22.6423
OBC	52.7	47.9	4.8	25.5	22.4	4.8	NA	NA	NA	186(42.0)	P=0.0071*
None	42.7	30.3	12.5	12.5	17.7	12.5	NA	NA	NA	107(24.1)	
Age											
15-19	26.9	26.9	0.0	13.5	13.5	0.0	NA	NA	NA	32(9.4)	DF=36
20-24	63.3	59.5	3.9	36.5	23.0	3.9	NA	NA	NA	56(16.3)	X^2=52.3618
25-29	44.1	37.2	6.9	11.8	25.4	6.9	NA	NA	NA	64(18.6)	P=0.0382*
30-34	46.2	35.0	11.2	14.8	20.3	11.2	NA	NA	NA	59(17.0)	
35-39	63.6	40.8	22.8	20.4	20.4	22.8	NA	NA	NA	48(13.8)	
40-44	54.4	36.3	18.2	21.2	15.1	18.2	NA	NA	NA	36(10.4)	
45-49	47.8	30.2	17.6	19.4	10.8	17.6	NA	NA	NA	50(14.5)	
Religion											
Hindu	51.5	45.2	6.3	32.5	22.7	6.3	NA	NA	NA	424(95.9)	DF=3
Muslims	56.3	50.0	6.2	31.3	18.8	6.2	NA	NA	NA	18(4.1)	X^2=0.7818
Christians	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	P=0.8538(NS)
Others	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Age at First Birth											
10-14	66.8	66.8	0.0	41.7	25.0	0.0	NA	NA	NA	54(13.9)	
15-19	54.7	48.1	6.6	24.1	24.0	6.6	NA	NA	NA	252(65.1)	DF=45
20-24	33.4	24.3	9.0	9.1	15.5	9.0	NA	NA	NA	74(19.0)	X^2=73.8326
25-29	50.2	33.4	16.7	16.9	16.5	16.7	NA	NA	NA	7(1.7)	P=0.0045*
30-34	100.0	0.0	100.0	0.0	0.0	100.0	NA	NA	NA	1(0.3)	
Number of Children											
0	47.8	40.2	7.7	21.5	18.7	7.7	NA	NA	NA	276(62.5)	DF=12
1	57.2	55.1	2.0	23.5	31.7	2.0	NA	NA	NA	110(24.8)	X^2=19.0485
2+	60.1	52.2	7.9	28.2	24.0	7.9	NA	NA	NA	56(12.7)	P=0.0874(NS)
Occupation											
Not Working	47.8	35.3	12.5	16.9	18.4	12.5	NA	NA	NA	152(34.3)	
Professional	33.5	33.5	0.0	0.0	33.5	0.0	NA	NA	NA	3(0.8)	
Clerical	NA										
Sales	33.5	33.5	0.0	6.6	26.8	0.0	NA	NA	NA	17(3.8)	DF=12
Agriculture	56.5	53.7	2.8	26.6	27.1	2.8	NA	NA	NA	236(53.5)	X^2=46.5322
Service	NA										P=0.0011*
Household	50.0	0.0	50.0	0.0	0.0	50.0	NA	NA	NA	2(0.5)	

Table.4.1.46.continued

Skill & Unskilled	46.6	43.1	3.6	35.9	7.1	3.6	NA	NA	NA	31(7.1)	
Educational Level											
No Education	59.4	56.4	3.0	29.9	26.4	3.0	NA	NA	NA	259(56.7)	
Primary	41.8	31.4	10.4	15.1	16.3	10.4	NA	NA	NA	96(21.7)	DF=39
Secondary	37.9	28.4	9.4	9.5	19.0	9.4	NA	NA	NA	82(18.6)	X^2=82.7405
Higher	75.2	25.2	50.0	25.2	0.0	50.0	NA	NA	NA	4(1.0)	P<0.0001**
Educational Level of Partner											
No Education	56.5	53.3	3.2	30.6	22.7	3.2	NA	NA	NA	173(39.0)	DF=9
Primary	47.8	44.6	3.2	22.3	22.3	3.2	NA	NA	NA	71(16.0)	X^2=24.1689
Secondary	53.0	41.0	12.0	18.2	22.8	12.0	NA	NA	NA	147(33.3)	P=0.004*
Higher	37.2	32.9	4.3	10.9	21.9	4.3	NA	NA	NA	51(11.6)	
Wealth Index											
Poorest	49.1	47.5	1.6	29.5	18.0	1.6	NA	NA	NA	66(19.0)	DF=24
Poorer	64.2	64.2	0.0	37.8	26.5	0.0	NA	NA	NA	57(16.6)	X^2=70.4071
Middle	53.6	46.3	7.3	23.2	23.2	7.3	NA	NA	NA	74(21.6)	P<.0001**
Richer	48.5	31.4	17.0	12.8	18.6	17.0	NA	NA	NA	76(22.1)	
Richest	47.7	19.9	27.8	9.2	10.7	27.8	NA	NA	NA	71(20.7)	
Toilet Facility											
Flush toilet	40.0	20.0	20.0	0.0	20.0	20.0	NA	NA	NA	6(1.3)	DF=12
Pit latrine	62.5	50.1	12.4	25.1	25.0	12.4	NA	NA	NA	36(8.1)	X^2=10.1349
Bush	50.9	45.4	5.5	23.0	22.4	5.5	NA	NA	NA	401(90.7)	P=0.6041(NS)
Others	NA										
Place of delivery											
Home	53.5	51.2	2.3	28.0	23.2	2.3	NA	NA	NA	48(47.8)	DF=27
Gov't facility	46.6	39.5	7.1	17.9	21.5	7.1	NA	NA	NA	31(31.2)	X^2=24.9733
Private Facility	47.5	42.4	5.2	21.1	21.2	5.2	NA	NA	NA	21(21.1)	P=0.576(NS)
Others	NA										
Who decide how to Spend money											
Respondent Alone	56.5	52.2	4.3	23.9	28.3	4.3	NA	NA	NA	51(29.3)	DF=12
Partner	57.2	54.1	3.1	30.2	23.9	3.1	NA	NA	NA	71(40.2)	X^2=10.3487
Jointly	56.8	51.4	5.4	27.2	24.2	5.4	NA	NA	NA	41(23.5)	P=0.5854(NS)
Someone Else	28.7	28.7	0.0	0.0	28.7	0.0	NA	NA	NA	8(4.5)	
Jointly Someone	74.8	74.8	0.0	74.8	0.0	0.0	NA	NA	NA	5(2.6)	
Who decide on obtaining Health Care											
Respondent Alone	49.2	45.6	3.6	25.6	20.0	3.6	NA	NA	NA	61(13.9)	DF=1
Partner	56.2	50.8	5.4	24.4	26.4	5.4	NA	NA	NA	166(37.6)	X^2=12.7034
Jointly	47.2	37.9	9.2	18.6	19.3	9.2	NA	NA	NA	156(35.3)	P=0.391(NS)
Someone Else	55.2	52.6	2.6	23.6	29.0	2.6	NA	NA	NA	43(9.6)	
Jointly Someone	50.0	43.0	7.1	35.7	7.3	7.1	NA	NA	NA	16(3.6)	
TOTAL	**51.8**	**41.6**	**10.2**	**21.9**	**19.9**	**10.2**					

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition, NA=not available

Table.4.1.47. Prevalence of Malnutrition among women (15-49 years) in Karnataka state during 1998/99 survey

VARIABLES	Total % Malnutri	% of Women CED	OW/OB	% Women with Mod -T	Mild -T	OW	Obese 1	Obese 11	Obese 111	Total Number of Women (%)	Chi-Square Value & P- Value
Residence											DF=6
Urban	51.6	26.0	25.6	13.5	12.5	19.0	5.9	0.5	0.2	1691(34.8)	X^2=491.6001
Rural	54.2	48.4	5.8	25.1	23.3	5.1	0.6	0.1	0.1	3167(65.2)	P<0.0001**
Caste											
SC	53.5	45.0	8.5	23.0	22.0	6.6	1.4	0.1	0.3	783(16.3)	DF=18
ST	55.8	4.3	51.5	30.0	21.5	3.9	0.4	0.0	0.0	280(5.8)	X^2=97.154
OBC	53.2	41.7	11.5	22.2	19.5	9.0	2.2	0.2	0.2	2010(41.8)	P<0.0001**
None	52.6	35.0	17.6	17.3	17.7	13.6	3.6	0.3	0.1	1732(36.1)	
Age											
15-19	47.7	46.1	1.6	20.6	25.5	1.6	0.0	0.0	0.0	476(9.8)	DF=36
20-24	51.7	47.3	4.4	24.1	23.2	3.8	0.7	0.0	0.0	865(17.8)	X^2=256.0099
25-29	49.4	40.9	8.5	20.4	20.4	6.9	1.5	0.1	0.2	960(19.7)	P<.0001**
30-34	54.0	38.7	15.2	20.1	18.6	12.0	2.6	0.3	0.3	801(16.5)	
35-39	56.7	36.5	20.2	21.2	15.4	15.9	3.8	0.5	0.0	703(14.5)	
40-44	57.4	36.9	20.5	19.8	17.0	15.7	4.1	0.4	0.4	596(12.2)	
45-49	58.5	36.7	21.8	20.4	16.3	15.9	5.6	0.2	0.0	457(9.5)	
Religion											
Hindu	53.7	41.8	11.9	21.7	20.1	9.5	2.1	0.2	0.2	4155(85.5)	DF=36
Muslims	51.2	35.4	15.8	18.2	17.2	11.5	4.1	0.2	0.0	547(11.3)	X^2=76.61149
Christians	49.8	21.0	28.8	9.6	11.4	19.2	7.6	0.9	0.0	117(2.4)	P<0.0001**
Others	55.1	43.2	11.9	26.0	17.3	11.9	0.0	0.0	0.0	38(0.8)	
Age at First Birth											
10-14	56.1	51.7	4.4	30.2	21.5	2.3	1.6	0.0	0.5	475(10.9)	DF=168
15-19	54.9	43.6	11.3	22.4	21.2	8.8	2.2	0.2	0.1	2525(57.9)	X^2=345.9228
20-24	51.6	34.0	17.6	15.8	18.2	13.8	2.3	0.4	0.1	1068(24.5)	P<0.0001**
25-29	55.2	23.4	31.9	16.0	7.3	25.8	6.1	0.0	0.0	245(5.6)	
30-34	52.5	23.0	29.4	14.4	8.7	29.4	0.0	0.0	0.0	38(0.9)	
35-39	33.3	11.0	22.3	11.0	0.0	22.3	0.0	0.0	0.0	10(0.2)	
40-44	NA										
Number of Children											
0	53.9	37.8	16.1	20.3	17.5	12.2	3.4	0.3	0.2	2642(54.4)	DF=42
1	54.2	43.3	10.8	21.5	21.8	9.1	1.6	0.1	0.1	1166(24.0)	X^2=98.5999
2+	50.8	44.6	6.3	22.4	22.2	5.2	0.9	0.0	0.0	1051(21.6)	P<0.0001**
Occupation											
Not Working	50.7	30.8	19.9	15.5	15.2	15.2	4.2	0.4	0.1	2333(48.0)	DF=60
Professional	51.1	21.5	29.6	11.3	10.1	24.8	3.9	1.0	0.0	119(2.5)	X^2=495.591
Clerical	63.9	24.4	39.5	12.0	12.4	31.4	8.1	0.0	0.0	28(0.6)	P<0.0001**
Sales	49.1	33.0	16.1	15.8	17.2	12.3	3.7	0.0	0.0	90(1.9)	
Agriculture	57.0	54.3	2.7	28.2	26.1	2.4	0.2	0.0	0.1	1809(37.2)	

Table.4.1.47.continued	42.4	31.8	10.5	17.0	14.8	10.5	0.0	0.0	0.0	53(1.1)	
Household											
Service	53.8	35.8	18.3	9.0	26.6	18.3	0.0	0.0	0.0	12(0.3)	
Skilled- manual	54.7	44.7	10.1	23.6	21.1	7.6	1.7	0.0	0.8	269(5.5)	
Unskilled-manual	53.9	47.8	6.1	32.3	15.5	7.6	1.5	0.0	0.0	144(3.0)	
DK	47.7	47.7	0.0	0.0	47.7	0.0	0.0	0.0	0.0	2(0.1)	
Educational Level											
No Education	56.1	50.8	5.3	27.6	23.3	4.3	0.8	0.0	0.1	2410(49.6)	DF=114
Primary	52.7	38.1	14.6	19.0	19.1	11.2	3.3	0.1	0.0	1180(24.3)	X^2=650.7603
Secondary	48.1	24.7	23.4	10.6	14.1	18.1	4.6	0.3	0.3	1048(21.6)	P<0.0001**
Higher	51.3	17.8	33.6	10.2	7.6	26.4	5.1	2.1	0.0	221(4.5)	
Educational Level of Partner											
No Education	57.2	53.0	4.2	27.6	25.4	3.7	0.3	0.0	0.2	1649(34.0)	DF=18
Primary	55.0	43.8	11.3	23.2	20.6	8.5	2.6	0.0	0.1	769(15.8)	X^2=356.794
Secondary	50.1	34.2	15.9	17.7	16.5	12.3	3.2	0.3	0.1	1600(33.0)	P<0.0001**
Higher	50.2	25.4	24.8	12.5	12.9	19.1	5.1	0.5	0.0	836(17.2)	
Wealth Index											
Poorest	56.2	54.6	1.6	31.7	22.9	1.4	0.0	0.0	0.2	621(12.8)	DF=24
Poorer	57.0	54.1	2.9	28.3	25.8	2.5	0.2	0.0	0.1	938(19.3)	X^2=906.2116
Middle	54.2	48.6	5.5	25.6	23.0	4.8	0.5	0.1	0.2	1158(23.8)	P<0.0001**
Richer	50.5	37.6	12.9	17.3	20.2	10.4	2.4	0.0	0.1	1061(21.8)	
Richest	50.5	15.6	34.9	7.6	8.0	26.1	7.9	0.1	0.1	1089(23.4)	
Toilet Facility											
Flush toilet	51.6	22.8	28.8	11.9	10.9	20.7	7.0	1.0	0.1	945(19.5)	DF=36
Pit latrine	51.0	25.9	25.1	12.6	13.4	20.4	4.4	0.0	0.3	828(17.1)	X^2=906.2116
Bush	54.5	50.0	4.5	26.2	23.9	3.8	0.5	0.0	0.0	3086(63.5)	P<0.0001**
Place of delivery											
Home	54.1	52.6	1.5	27.2	25.4	1.3	0.2	0.0	0.0	604(47.6)	DF=60
Gov't facility	48.0	42.0	6.0	18.7	23.3	5.1	0.6	0.0	0.3	351(27.7)	X^2=114.7162
Private Facility	48.1	35.3	12.8	18.2	17.1	12.8	0.0	0.0	0.0	313(24.7)	P<0.0001**
Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1(0.1)	
Who decide how to Spend money											
Respondent	57.0	46.3	10.7	24.5	21.8	9.0	1.5	0.0	0.2	736(40.5)	DF=24
Partner	58.5	55.9	2.6	31.6	24.3	2.3	0.2	0.2	0.0	590(32.5)	X^2=93.9245
Jointly	44.3	38.5	5.8	20.5	18.0	5.2	0.3	0.0	0.3	364(20.1)	P<0.0001**
Someone Else	53.9	50.1	3.9	18.0	32.0	3.9	0.0	0.0	0.0	86(4.8)	
Jointly Someone	69.5	60.9	8.6	38.8	22.2	5.8	0.0	0.0	2.8	40(2.2)	
Who decide on obtaining Health Care											
Respondent	55.4	37.2	18.1	19.7	17.5	14.2	3.5	0.3	0.1	1242(25.6)	DF=24
Partner	53.7	43.5	10.2	23.0	20.5	7.8	2.3	0.1	0.1	2085(43.0)	X^2=93.8235
Jointly	50.0	36.2	13.9	18.2	18.0	11.1	2.2	0.2	0.3	1030(21.2)	P<0.0001**
Someone Else	52.7	46.9	5.9	23.3	23.6	4.7	0.6	0.6	0.0	380(7.8)	
Jointly Someone	56.2	43.8	12.4	19.3	24.5	9.5	1.9	0.0	0.9	121(2.5)	
TOTAL	**52.1**	**37.8**	**14.3**	**19.7**	**18.8**	**11.0**	**2.3**	**0.2**	**0.2**		

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition, NA=not available.

Table.4.1.48. Prevalence of Malnutrition among women (15-49 years) in Karnataka state during 2005/06 survey

Variables	Total % Mal-nutri	% of Women CED	OW/OB	% Women with Mod-T	Mild-T	OW	Obese 1	Obese 11	Obese 111	Total Number of Women (%)	Chi-Square Value & P- Value
Residence											DF=6
Urban	57.1	33.8	23.3	11.2	16.5	16.5	5.2	1.2	0.4	2195(38.2)	X^2=331.37
Rural	52.6	44.6	8.1	21.1	6.8	6.8	1.0	0.1	0.1	3545(61.8)	P<0.0001**
Caste											
SC	53.3	42.4	11.0	21.2	21.1	8.7	1.5	0.5	0.3	876(15.3)	DF=24
ST	56.7	52.2	4.5	28.4	23.9	3.7	0.8	0.0	0.0	356(6.2)	X^2=76.77
OBC	54.5	39.2	15.2	22.7	16.5	11.2	3.1	0.6	0.3	3348(58.6)	P<0.0001**
None	54.0	37.4	16.6	22.8	14.6	12.7	3.2	0.6	0.0	802(14.0)	
DK	54.2	43.0	11.2	27.3	15.8	9.4	1.5	0.0	0.3	330(5.8)	
Age											
15-19	57.8	54.5	3.3	30.9	23.6	2.9	0.2	0.1	0.1	1058(18.4)	
20-24	54.3	47.1	7.2	25.3	21.7	5.2	1.3	0.4	0.3	1030(17.9)	DF=36
25-29	51.8	40.3	11.5	24.2	16.1	9.3	1.6	0.5	0.1	965(16.8)	X^2=395.86
30-34	51.7	34.8	16.9	20.5	14.4	12.3	3.4	0.9	0.2	870(15.2)	P<0.0001**
35-39	54.4	32.9	21.4	18.9	14.1	15.3	5.4	0.5	0.3	747(13.0)	
40-44	57.0	31.1	26.0	18.3	12.7	20.1	4.8	0.6	0.5	628(10.9)	
45-49	52.9	28.5	24.4	15.8	12.7	18.3	4.8	0.9	0.5	442(7.7)	
Religion											
Hindu	53.7	41.8	12.4	23.1	18.2	9.7	2.2	0.3	0.2	4925(85.9)	DF=42
Muslims	57.8	33.1	24.7	21.9	11.2	16.6	5.8	1.5	0.8	590(10.3)	X^2=136.22
Christians	58.6	36.1	22.5	22.5	13.6	14.2	5.9	2.4	0.0	169(3.0)	P<0.0001**
Others	59.6	53.8	5.8	34.6	19.2	3.8	1.9	0.0	0.0	52(0.9)	
Age at First Birth											
10-14	48.6	38.9	9.8	22.3	16.6	6.3	3.3	0.0	0.3	368(9.0)	DF=168
15-19	53.9	39.8	14.1	21.8	18.0	10.6	2.9	0.4	0.2	2092(51.0)	X^2= 237.09
20-24	53.3	34.3	19.0	19.9	14.4	14.7	2.9	1.1	0.2	1222(29.8)	P=0.0004**
25-29	51.1	22.0	29.1	14.4	7.6	21.1	7.0	0.9	0.0	327(7.9)	
30-34	62.3	26.0	36.4	11.7	14.3	29.9	5.2	1.3	0.0	77(1.9)	
35-39	64.7	41.2	23.5	41.2	0.0	23.5	0.0	0.0	0.0	17(0.4)	
40-44											
Number of Children											
0	55.0	40.2	14.8	23.5	16.7	11.1	2.8	0.6	0.3	3688(64.3)	DF=48
1	53.9	39.7	14.1	22.3	17.5	10.1	3.2	0.5	0.3	1145(20.0)	X^2=54.43
2+	52.1	42.3	9.8	22.5	19.8	8.6	2.0	0.1	0.1	907(15.8)	P=0.2431(NS)
Occupation											
Not Working	55.6	37.8	17.8	20.0	15.8	12.8	3.9	0.8	0.4	3024(64.3)	
Professional	53.3	28.9	24.4	20.0	8.9	18.9	4.4	1.1	0.0	180(3.4)	DF=42
Clerical	57.1	31.0	26.2	20.2	10.7	21.4	3.6	1.2	0.0	84(1.5)	X^2=247.79
Sales	44.4	22.2	22.2	14.4	7.8	17.8	4.4	0.0	0.0	90(1.6)	P<0.0001**
Agriculture	53.1	48.2	4.9	25.6	22.6	4.5	0.3	0.0	0.1	1541(26.9)	

Table.4.1.48.continued

Service	44.0	28.9	18.2	21.7	7.2	11.4	3.0	0.6	0.0	166(2.9)	
Skill & Unskilled	55.2	44.2	11.0	24.8	19.3	9.0	1.4	0.3	0.3	652(11.4)	
DK	0.0	0.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0	02(0.03)	
Educational Level											
No Education	53.6	43.9	9.7	23.9	20.0	8.2	1.2	0.1	0.3	1974(344)	DF=18
Primary	49.7	38.5	11.2	21.0	17.5	8.6	2.4	0.0	0.1	742(12.9)	X^2=125.92
Secondary	63.2	39.5	23.8	23.2	16.3	11.3	11.3	0.9	0.3	2576(44.9)	P<0.0001**
Higher	73.6	33.8	39.8	22.6	11.2	19.2	19.2	1.3	0.0	447(7.8)	
Educational Level of Partner											
No Education	53.5	45.0	8.5	25.2	19.8	7.0	1.1	0.2	0.2	1410(31.7)	DF=24
Primary	51.1	41.9	9.2	22.3	19.6	7.3	1.6	0.0	0.3	628(14.1)	X^2=281.56
Secondary	51.8	32.0	19.8	18.0	14.0	14.0	4.7	0.7	0.3	1880(42.2)	P<0.0001**
Higher	56.8	24.2	32.6	15.4	8.8	25.6	5.1	1.8	0.2	512(11.5)	
DK	77.3	31.8	45.5	18.2	13.6	45.5	0.0	0.0	0.0	22(0.5)	
Wealth Index											
Poorest	55.2	52.6	2.5	28.8	23.9	2.0	0.6	0.0	0.0	511(8.9)	
Poorer	56.4	51.8	4.6	28.3	23.6	4.0	0.3	0.0	0.2	1244(21.7)	DF=24
Middle	51.8	43.1	8.8	23.6	19.5	7.9	0.6	0.1	0.1	1428(24.9)	X^2=643.89
Richer	49.3	33.4	15.9	19.3	14.1	11.6	3.5	0.4	0.3	1365(23.8)	P<0.0001**
Richest	60.6	28.2	32.4	19.0	9.1	22.7	7.4	1.8	0.4	1192(20.8)	
Toilet Facility											
Flush toilet	54.7	32.0	22.7	19.6	12.4	15.7	5.5	1.1	0.3	2117(36.9)	DF=72
Pit latrine	54.6	30.3	24.3	20.3	9.9	18.4	4.5	0.7	0.7	403(7.0)	X^2=508.66
Bush	54.0	48.0	6.0	25.8	22.3	5.3	0.5	0.0	0.1	2903(50.7)	P<0.0001**
Others	62.5	50.0	12.5	29.2	20.8	8.3	4.2	0.0	0.0	24(0.4)	
Not dejure resident	54.0	38.9	15.1	24.9	14.0	14.0	0.0	0.7	0.4	285(5.0)	
Place of delivery											
Home	58.4	54.9	3.6	26.8	28.1	2.7	0.6	0.2	0.0	474(32.9)	DF=60
Gov't facility	50.5	41.6	8.9	24.8	16.8	7.4	1.2	0.4	0.0	517(35.9)	X^2=172.33
Private Facility	51.6	28.9	22.7	16.9	12.0	18.5	3.7	0.5	0.0	432(30.0)	P<0.0001**
Others	38.9	33.3	5.6	22.2	11.1	5.6	0.0	0.0	0.0	18(1.3)	
Who decide how to Spend money											
Respondent Alone	53.6	38.5	15.1	23.6	14.8	12.5	2.0	0.3	0.3	351(25.1)	DF=18
Partner	54.2	48.3	5.8	27.8	20.6	5.3	0.3	0.3	0.0	360(25.7)	X^2=32.22
Jointly	51.7	37.8	13.9	20.0	17.7	10.9	2.3	0.5	0.3	654(46.7)	P=0.02*
Someone Else	55.6	52.8	2.8	30.6	22.2	2.8	0.0	0.0	0.0	36(2.6)	
Jointly Someone											
Allowed to go to hospital											
Respondent Alone	53.1	36.4	16.7	21.0	15.4	12.5	3.4	0.6	0.2	2407(42.0)	DF=12
With someone	55.3	43.2	12.1	24.5	18.8	9.2	2.2	0.4	0.3	3205(55.9)	X^2=32.22
Not at all	53.2	46.8	6.5	28.2	18.5	5.6	0.8	0.0	0.0	124(2.2)	P<0.0001**
TOTAL	**54.3**	**37.9**	**16.4**	**22.3**	**15.6**	**12.7**	**3.0**	**0.5**	**0.2**		

**= 1% Probability Level, *=5%probability level, NS=Not Significant, NA=Not Available, DK=Don't Know, OV=Over Nutrition, UW= Under Weight, OW=Over Weight, Mal-nut= Malnutrition, NA=not available