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Received: 9 March 2020 | Revised: 21 January 2021 | Accepted: 9 July 2021

DOI: 10.1111/agec.12668

AGRICULTURAL ECONOMICS
The Journal of the International Association of Agricultural Economists
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ORIGINAL ARTICLE

The effect of women's nutrition knowledge and empowerment on child nutrition outcomes in rural Ethiopia

Mequanint B. Melesse

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Nairobi, Kenya

Correspondence
Mequanint B. Melesse, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), P. O. Box 39063 Nairobi, Kenya.
Email: m.melesse@cgiar.org

Abstract

Child malnutrition remains widespread in Ethiopia. Women's nutrition knowledge and empowerment are emphasized as key impact pathways for nutrition-sensitive programs and interventions. This paper examines effects of women's nutrition knowledge and empowerment on child nutrition outcomes using survey data from rural Ethiopia. Employing econometric strategies that account for potential endogeneity concerns, nutrition knowledge, and empowerment are found to have strong and significant effects on children's dietary diversity and stunting. Their interaction is significantly correlated only with stunting, perhaps suggesting the importance of the interaction between nutrition knowledge and empowerment for long-term nutrition outcomes. A disaggregated analysis of empowerment reveals that empowering women in household agricultural decisions and increasing their access to and control of economic resources are more promising for improving child nutrition. Overall, the findings suggest that efforts targeting to improve child nutrition in Ethiopia need to be complemented by efforts to improve women's nutrition knowledge and empowerment.

KEYWORDS

child nutrition, dietary diversity, Ethiopian, stunting, nutrition knowledge, women's empowerment

JEL CLASSIFICATION

C26, D12, I19, O15, Q12

1 | INTRODUCTION

Malnutrition in its various forms continues to be a global challenge with huge social and economic costs (Gillespie & van den Bold, 2017). Children are the most nutritionally challenged group due to their special dietary requirements for growth and development. Globally, malnutrition in some form is a cause of 45% of all deaths of children under five (Black et al., 2013; Gillespie & van den Bold, 2017). This challenge is more pronounced in developing countries, where chronic undernutrition and sustained micronutrient deficiencies are widespread (FAO, 2014; IFPRI, 2016). The long-standing approach to ending malnutrition in poor countries has had its focus on improving availability and affordability of food (Pinstrup-Andersen, 2007). However, poor nutrition outcomes are not always the result of resource constraints but also of other factors related to food choice behaviors and eating practices (Webb & Sheeran, 2006). As a result, the past few years have seen growing interest in understanding effects of

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other factors on nutrition outcomes (Just & Gabrielyan, 2016; World Bank, 2007).

One such widely recognized factor is women's role. In poor countries, women are champions for improving nutrition outcomes, as they are more likely than men to invest in children's well-being. Generally, income and other resources controlled by women tend to wield strong effects on health and nutrition outcomes (Malapit & Quisumbing, 2015). One of the challenges for rural women in this role is lack of awareness and decision-making power (Sraboni et al., 2014). Calls for leveraging women's nutrition knowledge and empowerment have been a key part of national and International development efforts alike (Black et al., 2013; World Bank, 2007).

This paper studies independent and interacted effects of women's nutrition knowledge and empowerment on children's nutrition outcomes in rural Ethiopia. Nutrition knowledge is a key determinant of nutrition outcomes as ideas about what is healthy or good can influence food choices and consumption (Contento, 2011). If women do not understand the importance of providing children with certain foods, or if they perceive healthy foods to be harmful, they will not provide them to their children, even when they are available. In rural Ethiopia, such misperceptions are widespread. For example, mothers do not feed young children meat and vegetables because they are perceived to be difficult to digest, leading to stomach illnesses (Alive & Thrive, 2010). Studies have shown that nutrition education improves nutrition outcomes (Appoh & Krekling, 2005; Hirvonen et al., 2017).

However, nutrition knowledge is necessary but not sufficient to induce relevant behavioral change (Webb & Sheeran, 2006). In developing countries, the decision power of women is likely to be a limiting factor on the effectiveness of nutrition knowledge. Mothers in many rural areas are frequently not decision makers, and rarely sole decision makers, which can undermine the effect of nutrition knowledge. As result, women's empowerment carries special significance both as an important policy goal in its own right to realize gender equity and as a policy tool to achieve other development goals, such as children's nutrition and health outcomes. There is evidence on the link between women's empowerment and food security outcomes (Malapit & Quisumbing, 2015; Sraboni et al., 2014).

To this point, however, research on the effect of maternal nutrition knowledge and that of women's empowerment on children's nutrition outcomes has progressed in parallel. This paper brings these two strands of current development agenda together and examines their interaction in shaping children's nutrition outcomes in rural Ethiopia. Ethiopia offers a unique opportunity for this study. Children consume poor diets characterized by low diversity and lack nutrients essential for growth (Mason et al., 2015). With 38% of children under 5 years stunted, Ethiopia has one of the highest levels of undernutrition in Africa (CSA, 2017). Malnutrition is more chronic in rural areas, where access to health facilities is very limited.

This study uses primary survey data collected in Ethiopia. The data contain detailed information on diets of children, their mothers' knowledge of good feeding and nutrition practices, and empowerment across several dimensions. The key nutritional outcome variables of interest are child dietary diversity—number of food groups consumed, and stunting—an anthropometric measure. Using an instrumental variables (IV) technique to address the potential endogeneity of mother's nutrition knowledge and empowerment, nutrition knowledge and women's empowerment were found to lead to considerable improvements in children's nutrition outcomes. The interaction between nutrition knowledge and women's empowerment is significantly correlated with stunting, but not with child dietary diversity, perhaps suggesting its relevance for long-term child nutrition outcomes rather than for short-term outcomes. A disaggregated analysis of domains of empowerment reveals that improving child nutrition status may not necessarily require improvements across all domains of women's empowerment. Specially, women's empowerment in agricultural household decisions and access to and control of resources are most promising for improving child nutrition. The results provide important insights for more effective nutrition policies to improve nutrition outcomes.

The remaining part of the paper is organized as follows. Section 2 provides a conceptual framework of the research. Section 3 presents the data and empirical strategy. Section 4 discusses and interprets the results, while Section 5 concludes.

2 | CONCEPTUAL FRAMEWORK

Drawing from previous literature linking women's role with household nutrition (Gillespie & van den Bold, 2017; Herforth & Harris, 2014), a simple conceptual framework is developed to guide our analysis (Figure 1). The conceptual framework presents the adaptation of complex pathways through which interventions that improve mothers' conditions can contribute to better nutrition outcomes of children. Policies and interventions aiming at empowering women target changing household assets and livelihoods, with the ultimate goal of improving women's status. Household's ownership of natural resources, types of resources available, and who has command over resources play an important role in affecting nutrition outcomes.

Women's nutrition knowledge and empowerment can influence children's nutrition outcomes though different

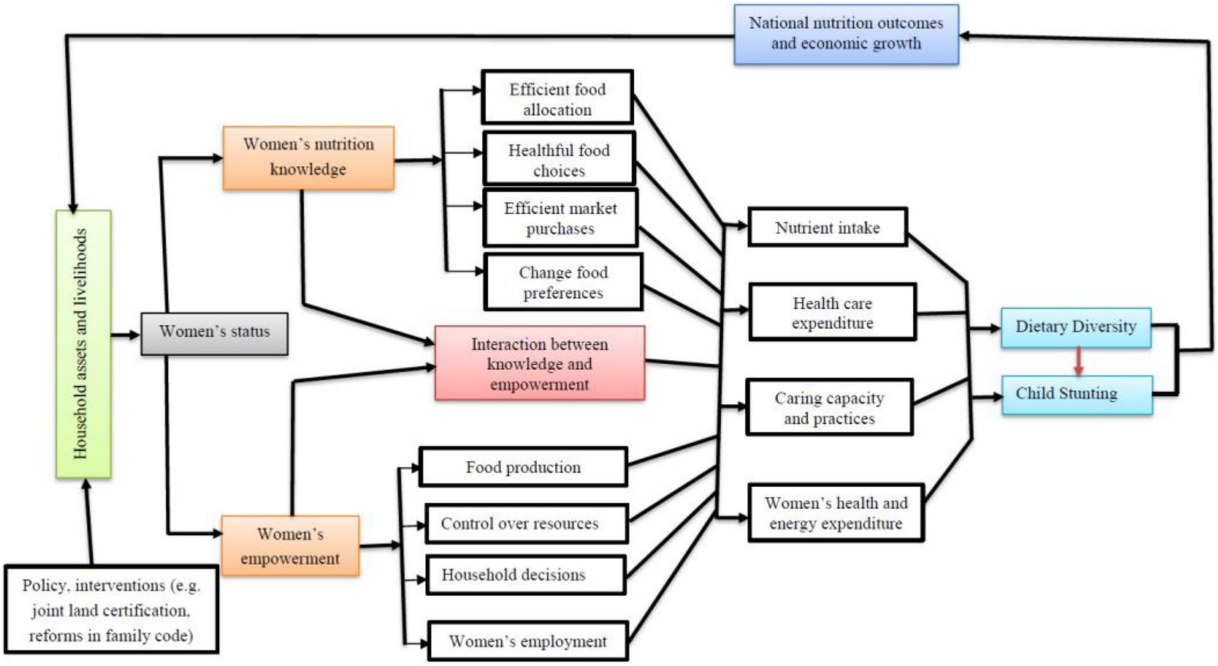

FIGURE 1 Conceptual framework linking women's nutrition knowledge and empowerment with child nutrition
[Color figure can be viewed at wileyonlinelibrary.com]

channels and interactions. Three main pathways are identified. The first pathway consists of nutrition knowledge. The quality of the care mothers provide to family members is largely dependent on their knowledge of nutrition and health practices. In particular, the patterns of feeding and diet are not only the result of household food availability but also caregiver's nutritional knowledge (Appoh & Krekling, 2005; Variyam et al., 1999). Mothers' nutrition knowledge can affect child nutrition in several ways. Mothers with better nutrition knowledge are more likely to make healthful food choices, allocate food efficiently within the household by getting it to those who need it most, and increase efficiency in food purchases. Also, nutrition knowledge may make mothers pay attention to nutrition information and it can also play a role in changing household food preferences (Contento, 2011).

The second pathway is women's empowerment. As part of the quest to achieve gender equality, women's empowerment has increasingly been the focus of many development interventions. Women's empowerment is also considered as an important tool to achieve other development outcomes, like children's health and nutrition. Women's empowerment pathway consists of different interrelated channels: women's role in food production and use of income, women's control over household resources and other household decisions, and women's employment as a source of income (Herforth & Harris, 2014; World Bank, 2007). As shown, children nutrition outcomes link directly to women as mothers and how they influence children's nutrition status as caregivers, including affecting nutrition intake and health expenditure, women's ability to care for themselves and children, and women's energy expenditure. Greater bargaining power can benefit nutrition by enabling women to negotiate for access to resources for themselves and their children (Malapit & Quisumbing, 2015). The last pathway is the interaction between women's nutrition knowledge and empowerment. Ultimately, good nutrition contributes to cognitive development, better opportunities for children to realize their potential, and higher earnings late in life, which support macroeconomic and societal growth.

The conceptual framework depicts two measures of child nutrition outcomes considered in this study: dietary diversity (i.e., food groups) and stunting. Diet quality is a key factor affecting nutritional status, including child linear growth but also micronutrient adequacy and reduced risk of morbidity and mortality (Arimond & Ruel, 2004). Nutrition information around infant and young child feeding (IYCF) practices could affect behavior around breastfeeding and diet quality. Stunting is a marker of chronic undernutrition and is affected by a whole host of individual, household and environmental factors (UNICEF, 1990). It reflects long-term effects of the interplay between diets, health and care practices since and even before birth (WHO, 2010). Thus, in addition to limited decision power of caregivers and resource constraints preventing the translation of nutrition knowledge into outcomes, it is possible that nutrition knowledge on IYCF practices might not simply be enough for improved nutrition outcomes.

3 | DATA AND EMPIRICAL SPECIFICATION

3.1 | Data and descriptive analysis

Data for this study came from the Amhara regional state in Ethiopia. The survey was conducted by the Institute of Economic Research (IER) of Bahir Dar University, Ethiopia, as a part of a large food security assessment survey in three districts: Gondar zuria, Dessie zuria, and Bahir Dar zuria. The data collection took place shortly after the main harvest season in 2017. The survey covered about 600 randomly sampled rural households from 45 villages of 16 randomly selected kebeles (sub-districts)—five kebeles from Gondar zuria and Dessie zuria each, and six kebeles from Bahir Dar zuria. Of particular use to this study are 412 households with at least one child between 6 and 60 months of age. The data contained detailed modules on diets of children, mothers' knowledge of good feeding practices and various empowerment indicators. Modules on diets were administered at child level, resulting in 486 relevant observations.

Table 1 presents detailed summary statistics for households with at least one child between 6 and 60 months of age. The first two rows in the variables list show food groups and stunting, the two children's nutrition outcomes. The information on food groups is based on responses of mothers on children's food consumption in the previous day (24 h). Mothers were asked a series of Yes/No questions about foods consumed by all children between six and 60 months. The questions were asked for each child. Following the recommendations of WHO (2008) for assessing IYCF practices, these foods were grouped into seven groups: (1) grains, roots, and tubers (e.g., barley, maize, teff, and wheat); (2) legumes and nuts; (3) dairy products (milk, yogurt, cheese); (4) flesh foods (meat, poultry, and fish products); (5) eggs; (6) vitamin A rich fruits and vegetables; and (7) other fruits and vegetables. This gives a score ranging from zero to seven. The average child consumed about three food groups. A more diverse diet is necessary if children are to meet both energy and micronutrient needs (Arimond & Ruel, 2004).

The data on individual food groups revealed important patterns. Table A1 in the supplementary material (SM) shows variations in individual food groups. Many children consumed grains, roots, and tubers, and legumes and nuts. About one-third of the children consumed dairy products and eggs. The consumption of flesh foods (17%) and vitamin A rich fruits and vegetables (11%) is strikingly low. But the consumption of other fruits and vegetables is relatively high (75%). About four percent of the children were reported to consume none of these foods during the previous day, either because they were ill or only consumed breastmilk.

However, measuring dietary diversity using the 24 h recall approach has its own limitations (FAO, 2018). A major limitation is that a single 24 h recall observation may not describe the overall dietary patterns of children in the sample. As a result, dietary data collected based on 24 h recalls provide a poor estimate of actual nutrient and energy intakes (Alemayehu et al., 2011). It is affected by seasonal variation, which is likely to be important in rural areas with greater reliance on local produce. Additionally, the 24 h recall of dietary diversity is likely to be susceptible to social desirability bias, like other self-reported methods. A specific concern is the so-called "flat slope syndrome", that is, the tendency of respondents to be selective with foods they choose to report during the recall, specifically to overestimate low intakes and underestimate high intakes (FAO, 2018). This remains a concern as prompted-recalls, which are generally more likely to be prone to biases than open-recalls, were used for the dietary data collection. While the survey was conducted in the framework of a broader food security assessment, child dietary diversity was not communicated as a direct purpose of the survey.[1]

Stunting is an anthropometric standardized indicator useful for assessing the degree to which children's physiological needs for growth and development are met during the crucial period of early childhood. Stunting prevents children from reaching their physical and cognitive potential (WHO, 2010). It is based on anthropometric z-scores of height-for-age (HA) for children under 5, calculated using the 2006 WHO Child Growth Standards (WHO Multicentre Growth Reference Study Group, 2006). A child is defined as stunted if his or her height-for-age measurement is two or more standard deviations below the median of the reference group. Different growth references were used for boys and girls to generate z-scores. The data show that about 35% of the children in the sample were stunted.

Next are the key explanatory variables. Nutrition knowledge is assessed using nine statements about IYCF practices (WHO, 2008). Women were asked whether they agreed or disagreed with the statements. Agreeing with a statement indicates that the respondent is knowledgeable about good infant and young child feeding practices.

[1] Another concern is pertaining to day-related behavioral biases (e.g., people eat meat on "special" days, like weekends). The data collection was conducted over a period of continuous 35 days from mid-October to mid-November 2017, a non-fasting period of the Ethiopian Orthodox calendar. There was no systematic deviation from the random distribution of days of the week, that is, no particular day of the week appeared more frequently.

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TABLE 1 Summary statistics of the study sample (N = 486)

Variables	Description	Mean	Std. Dev.	Min	Max
Outcome variables					
Food groups	Number of food groups taken by a child	3.42	1.20	1	7
Stunting	A child is stunted = 1, 0 otherwise	0.35	0.48	0	1
Key explanatory variables					
Nutrition knowledge	Standardized nutrition knowledge index, generated using PCA from nine statements about IYCF practices	0.00	1	−2.57	2.20
Overall empowerment	Standardized women's overall empowerment score	0.00	1	−4.07	2.27
Household and individual level control variables					
Age of caregiver	Age of women in years	33.60	8.57	17	55
Education	Years of education of women	1.18	2.29	0	10
Height	Height of women in centimeters	157.12	7.26	132	175
Household size	Number of people within the household	6.58	2.07	3	12
Religion	Orthodox Christian = 1, 0 otherwise	0.89	0.32	0	1
Age of the head	Age of the household head in years	40.40	8.89	17	59
Land	Land size in timad	6.81	4.27	0	30.5
Livestock	Tropical livestock units of the household	7.07	4.39	0	35.5
Off-farm income	Off-farm income earned by the household = 1, 0 otherwise	0.13	0.33	0	1
Per capita income	Annual per capita income earned by the household in Birr	4106.18	5107.29	55.56	57142.86
Child level control variables					
Boy	Male child = 1, 0 otherwise	0.51	0.50	0	1
Age child	Age of children in months	33.66	16.47	6	60
Mother	Primary care giver is mother to the child = 1, 0 otherwise	0.96	0.19	0	1
Sick	Child suffered from diarrhea or other diseases 2 weeks before survey = 1, 0 otherwise	0.05	0.23	0	1
District dummies					
Gondar Zuria	District is Gondar Zuria = 1, 0 otherwise	0.31	0.46	0	1
Dessie Zuria	District is Dessie Zuria = 1, 0 otherwise	0.32	0.46	0	1
Bahir Dar Zuria (reference group)	District is Bahir Dar Zuria = 1, 0 otherwise	0.37	0.48	0	1
Excluded instruments					
Radio ownership	Household owns a radio = 1, 0 otherwise	0.44	0.50	0	1
Visited by health worker	Household visited by a health worker over the last 12 months = 1, 0 otherwise	0.58	0.49	0	1
Distance from a health center	The nearest health center takes greater than an hour = 1, 0 otherwise	0.23	0.42	0	1
Asset brought to marriage	The woman brought an asset to the current marriage = 1, 0 otherwise	0.37	0.48	0	1
Number of sons	Number of sons from the current woman	2.24	1.62	0	8
Distance from parents	Distance from woman's parents in hours	1.52	1.56	0	7
Community average empowerment	Community average empowerment without the woman of interest	0.59	0.25	0	1

Source: Authors' calculation from the 2017 Food Security Assessment Survey by IER.

Table A2 in the SM provides an overview of the statements and distribution of responses. The intent of our effort to measuring nutrition knowledge was to assess nutrition literacy at a basic level, regarding correct IYCF practices.

For the analysis, responses to these statements were reduced into one index using principal components analysis. The nine statement variables were highly correlated (average correlation coefficient is 0.436) and the principal components analysis attempts to find indicators that account for most of the variation among the variables. Tables A3 and A4 in the SM provide a more detailed description of the principal components analysis and corresponding results. Table A3 shows that the first two components explain about 65 percent of the variation in the data. These two components were retained, following the Kaiser-rule that only components with an eigenvalue larger than one should be retained. Columns 1 and 2 in Table A4 give factor loadings for the two components. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (column 3) supports the factor analysis as all KMO values are close to one, implying that the statements are measuring a common attribute. The end-product of the analysis is a single variable that is considered to represent nutrition knowledge. Moreover, to facilitate interpretation, nutrition knowledge is expressed in units of z-scores (Table 1).[2]

The second key explanatory variable is women's empowerment score. Empowerment is a multidimensional construct that incorporates three inter-related constructs: (a) resources, (b) agency (the ability to engage in actions), and (c) achievement (whether the desired outcome is really in one's interest) (Kabeer, 1999). It involves not only decision-making and choice but also resistance, bargaining and negotiation, reflection, freedom of physical mobility and autonomy, and attitudes toward verbal and physical abuse. While most empirical literature emphasizes economic empowerment indicators, institutional and social factors, such as kinship networks, social norms and culture, also play central roles in defining perimeters within which women and men interact and negotiate (Agarwal, 1997). Alkire et al. (2013) developed an index for women's empowerment in agriculture. Our measurement is slightly different from theirs. Our measurement does not include some of the Alkire et al.'s indicators (e.g., the gender parity) due to lack of data. Yet, ours covers more domains and indicators of empowerment.

Our measurement of empowerment includes seven domains covering various aspects of household decisions: (i) household decisions about agricultural production, (ii) power in non-agricultural household decisions, (iii) access to and decision-making power about productive resources, (iv) control of use of income, (v) leadership in community, (vi) freedom of physical mobility and autonomy and (vii) time allocation.[3] An overall women's empowerment score was constructed based on all domains of 32 survey items. In constructing scores for each domain, the same weight was given to all indicators when aggregating. Many of the items were binary questions with "yes" and "no" answers. As a result, those items that had more than two response options were recoded to binary dummies to facilitate construction of scores. Table A5 in the SM provides information on individual indicators of the seven domains. While the main analysis is based on the overall empowerment score, results are also reported for specific domains. The average value of the overall empowerment score is about 22 out of 32 items. To facilitate interpretation, the empowerment score was again expressed in units of z-scores (see Table 1). Women generally score low in the domains of "Freedom of physical mobility and autonomy", "Control of use of income", and "Access to and decision-making power about productive resources". Strikingly, only about 26% of the women could decide independently whether they should work to earn money from non-farm employment.

Table 1 also contains information on other explanatory variables. The average respondent was about 34 years old and had 1 year completed schooling. 89% of respondents were Orthodox Christians. The average household had about seven members headed by a person of about 40 years of old. The average household had about seven timads[4] of land with a livestock herd of seven tropical livestock units.[5] As to children, about 51% were boys and their average age was about 34 months. For 96% of the children, the primary caregiver were their biological mothers. About 5% suffered from diarrhea or any other disease in last 2 weeks prior to the survey.

To get a glimpse of the data, a non-parametric statistical analysis is conducted using local polynomial regression, which uses a polynomial fit to smooth a scatter plot of two variables of interest. The analysis applies a weighted least squares regression with greater weights given to data points closer to the polynomial fit (Cleveland, 1979). Figure 2 depicts results of this non-parametric analysis for nutrition knowledge (panel A) and women's empowerment (panel B). The plots show that nutrition knowledge and empowerment are associated positively with food groups, and negatively with stunting. The plots also show the absence of non-linear relationships between the key explanatory and outcome variables, suggesting linear variables in subsequent regression models. The subsequent analysis focuses on further examining and

[2] The z-scores are computed by subtracting the initial knowledge value from the sample mean and then dividing this with the standard deviation of the sample.

[3] Alkire et al. (2013)'s Women's Empowerment in Agriculture Index includes five of these domains:(1) decisions about agricultural production, (2) access to and decision-making power about productive resources, (3) control of use of income, (4) leadership in the community, and (5) time allocation.

[4] One timad is the land area ploughed by a pair of oxen in a day, and approximately equals 0.25 hectare.

[5] Tropical livestock unit is a common unit used to quantify a wide range of livestock species to a single value to get total amount of livestock owned by a household. A tropical livestock unit applicable for SSA is employed.

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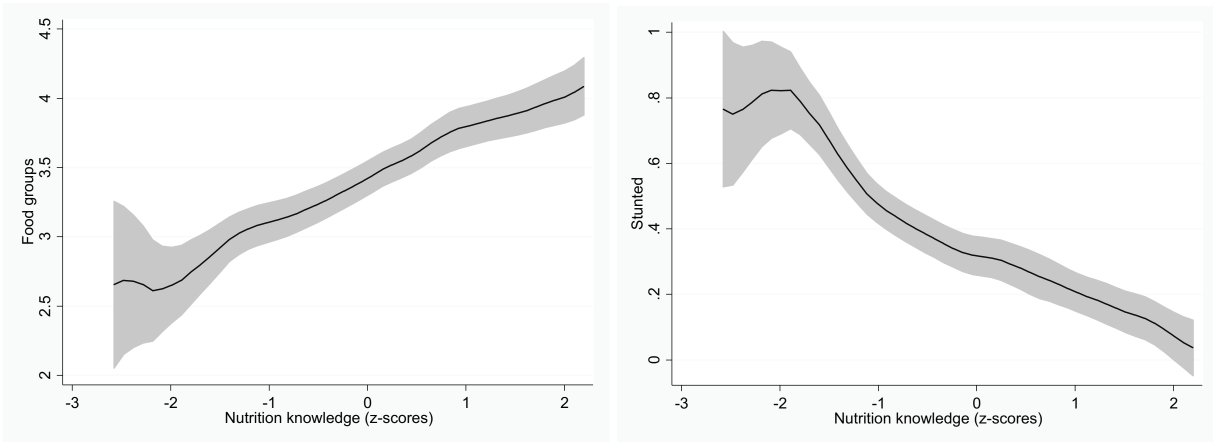
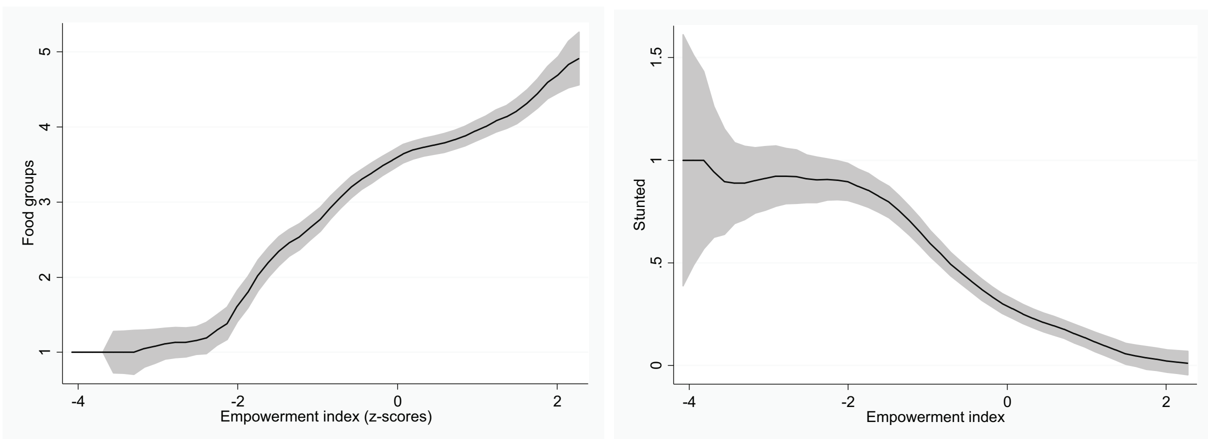


Panel A. Nutrition knowledge and child nutrition outcomes



Panel B. Women's empowerment and child nutrition outcomes

FIGURE 2 Relationships between nutrition knowledge, women's empowerment and child nutrition. Local polynomial regressions; Shaded areas refer to 95% confidence intervals [Color figure can be viewed at wileyonlinelibrary.com]

formalizing these relationships after controlling for potential confounding factors.

Since mothers' education is a significant factor for nutritional outcomes (Alderman & Headey, 2014), we closely probe whether nutrition knowledge has independent effect on child nutrition. Formal education levels are extremely low in the study area. The average level of education among our respondents is about 1 year of completed schooling (Table 1) and in our data nearly 70% of the respondents have not attended a formal schooling. Figure A1 in the SM shows a locally weighted regression of the association between mother's level of schooling and nutrition knowledge. The relationship is flat throughout the education distribution, implying that education does not explain differences in nutrition knowledge, possibly because of the extremely low maternal education levels. Indeed, literature in this area suggests that nutritional gains from maternal education only appear with secondary education (Alderman & Headey, 2014). In such contexts of low formal education, nutrition knowledge gained outside the classroom (e.g., through media or frontline health workers) is critical (Block, 2007).

Finally, to assess how our data are likely to differ from national representative samples, comparisons were made for outcomes and selected covariates with representative data from the Ethiopia Demographic and Health Survey (EDHS, 2016).[6] As our sample is exclusively rural, the comparison is made only for the rural sample of 8667 children below 59 moths from 9096 rural households. The comparisons are presented in Table A6 in the SM. The two samples considerably differ in the outcome variables and certain key covariates, posing a threat to the representativeness of reported results. Generally, respondents in the

[6] EDHS (2016) report provides detailed descriptions of the EDHS data.

study sample had better nutrition outcomes, more livestock and younger household heads, but older children and caregivers. No substantial differences are observed in other characteristics for which data are reported. Unfortunately, the EDHS data do not contain information on women's nutrition knowledge and empowerment, as well as other measures related to the status of women.

3.2 | Empirical specification

Our empirical specification is informed by the analytical framework. As has been outlined, the framework highlights three important pathways for the role of women in children's nutrition outcomes: nutrition knowledge, empowerment, and their interaction. The empirical specification to test for these pathways is:

$$\boldsymbol{O} = \beta_0 + \beta_1 \boldsymbol{K} + \beta_2 \boldsymbol{E} + \beta_3 (\boldsymbol{KxE}) + \beta_4 \boldsymbol{I} + \beta_5 \boldsymbol{H} + \beta_6 \boldsymbol{C} + \varepsilon \quad (1)$$

where $\boldsymbol{O}$ is a vector of nutrition outcomes, that is, food groups and stunting; $\boldsymbol{K}$ is nutrition knowledge; $\boldsymbol{E}$ is women's empowerment score; $\boldsymbol{KxE}$ is the interaction between nutrition knowledge and women's empowerment; $\boldsymbol{I}$ is a vector of individual characteristics; $\boldsymbol{H}$ is a vector of household characteristics; and $\boldsymbol{C}$ is a vector of community level characteristics. βs are the parameters to be estimated and ε is the error term. Particularly, β_1, β_2, and β_3 are parameters of interest and measure the relative importance of the three pathways. Food group is a variable that ranges from zero to seven. Stunting is a dummy variable that takes one if a nutritional status of a child is identified as stunted, and 0 otherwise. As a result, ordinary least squares (OLS) regressions for food groups[7] and probit models for stunting are estimated. Regressions control for many household and contextual variables. To account for observed and unobserved community characteristics, district dummies and kebele (sub-district) fixed effects are included in the regressions. Further, when possible, reported standard errors are clustered by village to account for the fact that some households have multiple children in the relevant age range and these observations are not independent.

Estimating Equations (1) requires addressing endogeneity concerns. As is likely, nutrition knowledge and empowerment might be determined by same factors affecting children's nutrition outcomes. First, there may be unobservable characteristics deriving both outcomes and key explanatory variables. Second, there may be measurement errors in the explanatory variables. Specifically, nutrition knowledge is not directly observed in our data. Measurement of "true level of nutrition knowledge" through responses to statements may result in measurement error that could lead to a lower bound estimate (Deaton, 1997). As a result, our core analysis consists of an instrumental variables (IV) approach for causal inference.

We follow the guidance from the literature to identify potentially valid instruments. Nutrition knowledge is instrumented based on household's access to nutrition and health information. For example, Burchi (2010) use radio-related instruments to study effects of maternal education and nutrition knowledge on child nutrition outcomes. Insights from the Ethiopia's strategy to combat undernutrition were also used to identify an additional instrument for nutrition knowledge. Since 2008, the National Nutrition Program of Ethiopia has emphasized a community-based approach. One key aspect of the program is the deployment of health extension workers (HEW), primarily tasked with the provision of health education. The program also provides nutrition information on radio and TV (GFDRE, 2016). The program is widespread, covering nearly all woredas (districts) of the country. With this guidance, three instruments were selected for nutrition knowledge: ownership of radio, distance from the nearest health center, and visits by a health extension worker in the past 12 months.

Four instruments are identified for women's empowerment: assets brought into marriage, number of sons, distance to parents, and the average empowerment in a community excluding the woman of interest. Assets brought to marriage and asset ownership are important for economic independence within marriage (Melesse et al., 2018). Norms and factors linked with labor market opportunities guide sex preference towards male children. Giving birth to a preferred sex is likely to give women more access to resources and decision-making. The customary marriage system in rural Ethiopia is characterized by patrilineal and virilocal residence. In the gist of the custom, girls move to the home of their husband upon marriage. A woman living in her birth place is likely to have more power due to the social support in her home village. Finally, the average empowerment in the community is considered to capture general gender related and other norms defining perimeters within which women and men interact and negotiate (Agarwal, 1997).

The summary statistics for instruments are contained in Table 1. About 44% of the households owned a radio, while about 58% were visited by HEW. About 23% resided more than an hour away from the nearest health center. 37% of women had brought an asset to their current

[7] The food groups outcome is essentially a count variable, calling for using a Poisson model. The results remain robust to estimating Poisson models. As a result, results are reported using linear models as they provide a host of specification tests that can be used to assess the validity of our IV-approach.

TABLE 2 First-stage regression results

Variables	Nutrition knowledge (OLS) (1)	(2)	Empowerment score (OLS) (3)	(4)
Radio ownership	0.346*** (0.102)	0.305*** (0.104)		
Visited by health worker	0.307*** (0.089)	0.279*** (0.088)		
Distance from a health center	−0.297*** (0.089)	−0.283** (0.103)		
Asset brought to marriage			0.289*** (0.076)	0.266*** (0.078)
Number of sons			0.145*** (0.025)	0.137*** (0.026)
Distance from parents			−0.088*** (0.028)	−0.073** (0.033)
Community average empowerment			1.418*** (0.198)	1.352*** (0.223)
Controls[a]	No	Yes	No	Yes
Constant	−0.260*** (0.090)	−1.761(1.191)	−1.131*** (0.138)	−0.153 (0.869)
F statistic (model)	16.77 (3, 44)	12.94 (15, 44)	27.78 (4, 44)	19.07 (16, 44)
R^2	0.070	0.149	0.263	0.279
N	486	486	486	486

Robust standard errors clustered by village in parentheses.
*$p < .10$, **$p < .05$, ***$p < .01$.
[a]Controls include all control variables from Table 1. N stands for number of observations.

marriage. The average respondent had about two sons and lived about 1.5 h away from her parents. The community average empowerment computed as a weighted average at village level without the woman of interest is about 59%.

A series of tests are used to inspect the validity of the instruments. Valid instruments are expected to satisfy two criteria. The first is the relevance criterion that instruments should be good predictors of endogenous regressors. First-stage regression results are contained in Table 2. Columns (1) and (2) show regression results for nutrition knowledge, without and with control variables. Columns (3) and (4) indicate similar results for empowerment. All excluded instruments are significant with expected signs. The partial F-statistics for models including only instruments (columns (1) and (3)) are greater than the minimum 10 threshold value of the “rule of thumb” for strong instruments (Staiger and Stock, 1997).

The second criterion is the exclusion restriction that instruments should not be correlated with outcome variables, other than through the endogenous variables. This is more difficult to compellingly satisfy and prove. Many of the instruments arguably satisfy this criterion, while it is dubious for some others. For example, one potential concern is households who care more about accessing nutrition information may be more likely to own a radio. If so, radio ownership may be correlated with outcome variables through some unobservable parental traits, violating the exclusion restriction. However, this is unlikely because of widespread access to radio in rural Ethiopia. A widespread radio presence means that parents who are not seeking nutrition information would also be exposed to it through listening to the radio. Similarly, the health worker visit instrument could also be problematic. For example, HEW may frequently visit households with undernourished children and refer them for "therapeutic feeding". While this would violate the exclusion restriction, such practice is believed to be rare.

Assets brought to marriage are primarily determined by the parents of women and are mainly exogenous to current households. Sex is determined by a natural process. A potential issue is that spouses who are more concerned with their children’s nutrition status may practice family planning, affecting the probability of birth of sons. The impact of family planning is expected to be minimal as family sizes are already large in our sample. Distance to health center and distance to parents are also relatively exogenous. A potential concern is that households may relocate to be closer to health centers. This should not pose a threat given all land in Ethiopia is owned by the state, and farmers enjoy only user rights conditional on physical presence, which poses difficulties for households seeking to relocate their farms through the market. With these considerations, it can be argued that all instruments are reasonably exogenous.

4 RESULTS

The analyses proceed in several steps. Table 3 provides simple regressions using OLS for food groups and probit for stunting. Columns (1) and (4) present parsimonious specifications with nutrition knowledge and empowerment as the only regressors, and columns (2) and (5) include other controls for full specifications of the models. In the parsimonious specifications, nutrition knowledge, and women's empowerment are positively correlated with food groups and negatively with stunting. Nutrition knowledge and empowerment remain significant when covariates are controlled for in the full specifications.

The coefficient estimates for other control variables from the elaborated specifications reveal that child nutrition outcomes are correlated with a range of other covariates. Consistent with the literature, maternal education enters significantly with expected signs in both food groups and stunting regression models. Age is negatively associated with stunting, perhaps indicating that caregivers acquire experience to give better care as they get older. The age of a child is positively associated with stunting, suggesting that risk of undernourishment increases with age. Household size is positively associated with stunting, possibly indicating competition for resources in poor households. Stunting also decreases with land ownership. Unfortunately, per capita income enters with unexpected sign in the model explaining the likelihood of stunting.

However, as has already been highlighted, nutrition knowledge, and women's empowerment may be endogenous. To attenuate this concern, an IV approach is estimated to tease out a causal relationship. As indicated above, radio ownership, visits by a health extension worker and distance from a health center are used to instrument for nutrition knowledge, as are asset brought to marriage, number of sons, distance from parents, and community average empowerment without the woman of interest for women's empowerment. The results are contained in columns (1) and (3) of Table 4 for food groups and stunting, respectively. Both nutrition knowledge and women's empowerment remain significant with expected signs.

The interpretation of the coefficients is relatively straightforward as the variables are expressed in units of z-scores. For example, on average, a one-standard deviation increase in a mother's nutrition knowledge score increases food groups consumed by about 1.07 points, all else constant. Generally, coefficients for nutrition knowledge in the IV models are greater than corresponding estimates in the simple regressions (Table 3). Such differences are consistent with measurement errors. While measurement errors can bias OLS and probit coefficients towards zero (Deaton, 1997), IV approaches attenuate such problems (Gujarati, 2003: p. 527).

Table 4 provides further qualifications for the instruments. For food groups, the over-identification test is provided. According to the Sargan test, the null of zero correlation between instruments and the error term cannot be rejected. For stunting (IV probit), the Wald test of exogeneity, which tests whether the residuals from the first stage are correlated with those from the final model, is reported. The correlation of an exogenous model is expected to be zero and this hypothesis is not rejected. These results suggest that endogeneity may not in fact pose a serious threat in the data (Wooldridge, 2002), and coefficient estimates from the simple probit models are not inconsistent. Overall, tests suggest that the IV strategy is credible, and results reveal causal effects of nutrition knowledge and women's empowerment on child nutrition.

The coefficients of the district dummies are interpreted in relation to the omitted Bahir Dar district dummy. Compared to Bahir Dara, Dessie district is significantly disadvantaged in food groups. This is not surprising as Dessie district is located in the severely food insecure South Wollo, which was one of the hotspots of the country's worst famine of 1983–1985. Structural factors and key challenges that underlie the chronic food insecurity and malnutrition of the district include rugged topography, erratic, and precarious rainfall, and frequent shocks and stresses (affecting food availability) and poor infant feeding practices (food choice). Finally, reported results are not driven by unobserved and observed community characteristics, as district dummies and kebele fixed effects are controlled for throughout the regressions.

The foregoing analyses focus on investigating how women's nutrition knowledge and empowerment affect child nutrition outcomes. We now turn to examining the effect of their interaction on child nutrition. Columns (3) and (6) of Table 3 provide results from simple OLS regression for food groups and probit model for stunting, respectively. The results reveal that the interaction between nutrition knowledge and empowerment is negatively related to stunting, but not with food groups. However, the interaction between nutrition knowledge and empowerment is expected to be endogenous as are the two variables. To correct for this, the interaction is instrumented for by the instruments for nutrition knowledge and empowerment. The instrumented results are presented in Table 4 (columns (2) and (4)). Note that reported coefficients for nutrition knowledge and empowerment are also instrumented for. The over-identifying restrictions

TABLE 3 Nutrition knowledge, empowerment and their integration significantly correlate with child nutrition outcomes

Variables	Food groups (OLS)			Stunting (Probit)		
	(1)	(2)	(3)	(4)	(5)	(6)
Nutrition knowledge	0.202*** (0.053)	0.239*** (0.051)	0.246*** (0.051)	−0.457*** (0.089)	−0.473*** (0.074)	−0.531*** (0.101)
Empowerment score	0.695*** (0.042)	0.674*** (0.045)	0.669*** (0.046)	−0.932*** (0.109)	−1.146*** (0.116)	−1.267*** (0.136)
Nutrition knowledge *x* Empowerment score			−0.046 (0.040)			−0.340** (0.135)
Age of caregiver		−0.007 (0.008)	−0.007 (0.008)		−0.032* (0.016)	−0.028* (0.016)
Education		0.023* (0.019)	0.025** (0.019)		−0.066** (0.043)	−0.067** (0.041)
Height		−0.002 (0.007)	−0.002 (0.007)		−0.007 (0.012)	−0.007 (0.012)
Household size		−0.008 (0.020)	−0.008 (0.020)		0.080* (0.048)	0.085* (0.082)
Religion		0.015 (0.144)	0.040 (0.107)		−0.261 (0.162)	−0.180 (0.165)
Age of the head		0.015* (0.009)	0.015* (0.009)		0.005 (0.012)	0.001 (0.012)
Land		−0.018 (0.009)	−0.018 (0.009)		−0.042** (0.019)	−0.040** (0.019)
Livestock		−0.016 (0.008)	−0.016 (0.008)		0.034 (0.019)	0.032* (0.019)
Off-farm income		−0.065 (0.122)	−0.060 (0.121)		0.019 (0.279)	0.008 (0.269)
Log per capita income		−0.002 (0.037)	0.002 (0.037)		0.164** (0.071)	0.183** (0.072)
Boy		0.021 (0.059)	0.021 (0.059)		0.073 (0.144)	0.050 (0.145)
Age child		0.001 (0.002)	0.001 (0.002)		0.009* (0.005)	0.010** (0.005)
Mother		0.178 (0.245)	0.137 (0.247)		−0.389 (0.341)	−0.530 (0.379)
Sick		−0.175 (0.180)	−0.171 (0.177)		0.450 (0.347)	0.485 (0.344)
Gondar Zuria		−0.342 (0.104)	−0.343** (0.110)		−0.021 (0.373)	−0.020 (0.401)
Dessie Zuria		−2.308*** (0.228)	−2.293*** (0.233)		−1.083 (0.482)	−1.008 (0.492)
Kebele fixed effects		Yes	Yes		Yes	Yes
Constant	3.418*** (0.041)	3.297*** (1.062)	3.360*** (1.071)	−0.578*** (0.101)	−0.365 (2.096)	−0.551 (2.121)
R^2	0.430	0.485	0.486			
Pseudo R^2				0.341	0.423	0.437
Log likelihood				−207.327	−180.743	−177.152
N	486	486	486	486	486	486

Robust standard errors clustered by village in parentheses.
$^*p < .10$, $^{**}p < .05$, $^{***}p < .01$.
N stands for number of observations.

TABLE 4 Effects of nutrition knowledge, empowerment and their interaction on child nutrition outcomes

Variables	Food groups (2SLS)		Stunting (IV probit)	
	(1)	(2)	(3)	(4)
Nutrition knowledge	1.071***	1.112***	−1.235***	−1.079***
	(0.291)	(0.323)	(0.058)	(0.321)
Empowerment score	0.488**	0.468**	−0.536**	−0.442**
	(0.199)	(0.212)	(0.347)	(0.260)
Nutrition knowledge x Empowerment score		−0.147		−0.278***
		(0.470)		(0.069)
Age of the caregiver	−0.024*	−0.023*	0.010	0.009
	(0.013)	(0.014)	(0.014)	(0.013)
Education	0.024*	0.030*	−0.044*	−0.020*
	(0.027)	(0.033)	(0.030)	(0.031)
Height	−0.005	−0.005	0.002	−0.003
	(0.007)	(0.007)	(0.008)	(0.007)
Household size	−0.017	−0.018	0.058*	0.019
	(0.028)	(0.029)	(0.031)	(0.032)
Religion	0.630**	0.649**	−0.762***	−0.112*
	(0.236)	(0.246)	(0.180)	(0.286)
Age of the head	0.027**	0.025**	−0.014	−0.017
	(0.011)	(0.013)	(0.011)	(0.011)
Land	−0.010	−0.009	−0.025	−0.007
	(0.014)	(0.014)	(0.016)	(0.015)
Livestock	−0.014	−0.014	0.011	0.009
	(0.012)	(0.012)	(0.015)	(0.013)
Off-farm income	−0.115	−0.102	0.0002	0.119
	(0.175)	(0.182)	(0.206)	(0.179)
Log per capita income	0.002	0.007	0.071	0.092 (0.057)
	(0.052)	(0.056)	(0.065)	
Boy	−0.004	−0.006	0.073	0.018
	(0.106)	(0.107)	(0.110)	(0.104)
Age child	−0.0001	−0.001	0.005*	0.008
	(0.003)	(0.004)	(0.004)	(0.004)
Mother	−0.001	−0.132	−0.290	−0.142*
	(0.325)	(0.534)	(0.352)	(0.416)
Sick	0.105	0.123	−0.057	0.200
	(0.250)	(0.260)	(0.277)	(0.249)
Gondar Zuria	−0.320	−0.324	0.016	−0.033
	(0.307)	(0.311)	(0.333)	(0.303)
Dessie Zuria	−3.036***	−3.006***	0.522	0.176
	(0.690)	(0.705)	(0.717)	(0.682)
Kebele fixed effects	Yes	Yes	Yes	Yes
Constant	3.351***	3.552**	−0.250	1.259
	(1.275)	(1.443)	(1.326)	(1.247)
Over-identification test: Sargan test	2.772	2.695		
p-value	0.151	0.145		
Wald test of exogeneity: χ^2			2.598	0.69
p-value			0.167	0.408
R^2	0.345	0.312		
Log likelihood			−1359.268	−1977.111
N	486	486	486	486

Standard errors in parentheses.

*$p < .10$, **$p < .05$, ***$p < .01$.

N stands for number of observations.

(for food groups) and the Wald exogeneity (for stunting) tests remain valid. The results for the interaction qualitatively corroborate the results of the simple regressions (Table 3). Specifically, the interaction term remains significant with the expected sign in the stunting model but not in the food groups regression. Perhaps, this suggests that the interaction between nutrition knowledge and empowerment is more important for long-term child nutrition outcomes than for current diets. Child dietary diversity (i.e., food groups), measured using the 24 h recall approach, is highly likely to be determined by available resources and choice options in a particular day. However, stunting is a result of chronic undernutrition, usually associated with poverty, inappropriate feeding, and poor care in early life.

As has been highlighted, women's empowerment is multidimensional. It is possible that different domains affect nutrition outcomes in different ways and to varying degrees. Such understanding is informative to identify domains that matter most for good nutrition to inform policy options to empower women and improve nutrition. This is important as gender norms are highly likely to be culture and context specific. Results are reported for the seven domains of women's empowerment. Due to the obvious collinearity among different domains, we run separate models for each domain. The different domains are instrumented for using instruments employed for the overall empowerment index. The "community average empowerment without the woman of interest" was adjusted to capture only the domain of interest. Despite valid tests, other instruments may not equally work for all domains; as such, estimation procedures are admittedly imperfect. Z-scores of all domains are used in the regressions.

Table 5 displays summaries of the results from both simple and IV regressions for food groups and stunting. The regressions include all the control variables (see Table 3) and kebele fixed effects. The results suggest that different domains of empowerment have different degrees of correlations with child nutrition, consistent with previous findings (Malapit & Quisumbing, 2015; Sraboni et al., 2014). The domains of agricultural decisions, access to and decision-making about productive resources, and control of use of income are significantly associated with both food groups and stunting. Agricultural decisions determine the diversity and amount of food available for farm households who largely subsist on what they grow for consumption. Our data also corroborate this, as only 13% of the households reported earning some income from off-farm activities. On the other hand, power in access to and decision-making about productive resources, and control of use of income is likely to be important in the choice, use, and allocation of food among household members. Women's empowerment in non-agricultural household decisions is negatively associated with stunting. This domain covers household decisions, such as whether to send children to school and whether to use contraceptives, that are seemingly not directly correlated to dietary outcomes. Perhaps, women who are powerful in this domain are likely to be powerful in other domains relevant to dietary behavior.

The domains of freedom of physical mobility and autonomy, and time allocation are significantly correlated, respectively, with food groups and stunting in the simple regressions; however, they are not robust when corrected for endogeneity. Perhaps, one may expect the domain of freedom of mobility and autonomy to be correlated with child nutrition outcomes, as it covers women's independence to go market alone and possibly to purchase foods of their choice from the market. However, market transactions of subsistence rural households typically involve selling of agricultural produce to purchase non-food household necessities. Finally, power in leadership is correlated with none of the outcomes in the simple regressions, but becomes correlated with stunting in the IV regression, possibly due to correcting measurement errors. Overall, the results show that the effects of the different domains on nutrition vary considerably, suggesting that improving child nutrition may not necessarily require improvements in all domains of empowerment.

Finally, to what extent can we be certain that reported results are indeed true effects? We are working with two outcomes and several "effect" or treatment variables including various domains of empowerment, leading to multiple hypotheses. A multiple hypothesis testing (MHT) is done to jointly identify effects. The recent stata command provided by Barsbai et al. (2020)[8] is used for this exercise. It improves on the List et al. (2019) procedure (mhtexp) and becomes regression-based and permits for inclusion of control variables, while allowing for multiple outcomes and treatments. As the procedure corrects for only the first regressor in each specification, the MHT is set by repeating the regressions and changing the order of the effect variables in the list. The MHT for the main effect variables and the domains of empowerment has been done separately. Table 6 presents corresponding results of *p*-values adjusted for multiple hypotheses based on different approaches. Overall, the results remain qualitatively similar and quite robust even when the multiplicity of the hypotheses is accounted for. Notable changes are that the new coefficients are different from those of the standard model regressions, and the levels of significant change for some effect variables.

[8] Available at https://sites.google.com/site/andreassteinmayr/mhtreg.

TABLE 5 Results summary: Effects of different domains of empowerment on child nutrition outcomes

Variables	Food groups (1)OLS	(2)2SLS	Stunting (3)Probit	(4)IV Probit[a]
Power in agricultural household decisions Nutrition knowledgeR^2Pseudo R^2Log likelihood	**0.431***(0.049) 0.356***(0.059)0.364**	**1.383***(0.396) 0.133**(0.122)0.321**	**−0.453***(0.079)−0.526*** (0.068)0.264-231.615**	**−1.084***(0.042)− 0.258***(0.057)-859.928**
Power in non-agricultural household decisions Nutrition knowledge R^2 Pseudo R^2 Log likelihood	0.283 (0.057) 0.397*** (0.061) 0.300	0.362 (0.292) 0.381*** (0.086) 0.297	−0.233** (0.073) −0.560*** (0.067) 0.216 −246.797	−0.617** (0.063) −0.298** (0.091) −872.267
Access to and decision-making about productive resources Nutrition knowledge Adj. R^2 Pseudo R^2 Log likelihood	0.386*** (0.055) 0.369*** (0.060) 0.337	1.976** (0.577) 0.187** (0.177) 0.196	−0.629*** (0.078) −0.545*** (0.072) 0.301 −220.004	−1.166*** (0.081) −0.214** (0.088) −833.548
Control of use of income Nutrition knowledge R^2 Pseudo R^2 Log likelihood	0.365** (0.061) 0.366*** (0.058) 0.334	2.783*** (0.972) 0.230** (0.260) 0.446	−0.478** (0.072) −0.531*** (0.066) 0.271 −229.444	−1.150*** (0.053) −0.166* (0.088) −863.011
Leadership in the community Nutrition knowledge R^2 Pseudo R^2 Log likelihood	0.285 (0.044) 0.445*** (0.063) 0.301	0.237 (0.128) 0.438*** (0.060) 0.282	−0.423 (0.083) −0.625*** (0.069) 0.251 −235.499	−0.585* (0.217) −0.610** (0.87) −840.234
Freedom of physical mobility and autonomy Nutrition knowledge R^2 Pseudo R^2 Log likelihood	0.310** (0.055) 0.399*** (0.061) 0.303	0.203 (0.054) 0.401*** (0.058) 0.302	−0.391 (0.070) −0.559*** (0.066) 0.239 −239.527	−0.121 (0.138) −0.228** (0.189) −357.028
Time allocation Nutrition knowledge R^2 Pseudo R^2 Log likelihood	0.207 (0.057) 0.443*** (0.064) 0.279	0.198 (0.042) 0.376*** (0.080) 0.254	−0.277** (0.060) −0.593*** (0.066) 0.224 −244.044	−0.190 (0.053) −0.201** (0.097) −874.358

Robust standard errors clustered by village in parentheses.

*$p < .10$, **$p < .05$, ***$p < .01$.

N = 486; N stands for number of observations.

[a]IV probit does not allow for clustering of standard errors.

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TABLE 6 Multiple hypothesis testing for multiple outcomes and 'treatments'

'Treatments'	Food groups					Stunting				
		p-values					*p*-values			
		Multiplicity unadjusted	Multiplicity adjusted				Multiplicity unadjusted	Multiplicity adjusted		
	Coeff.	(Model *p*-values)	List et al. (Thm3_1)	Bonferroni	Holm	Coeff.	(Model *p*-values)	List et al. (Thm3_1)	Bonferroni	Holm
i) ***Main effect variables***										
Nutrition knowledge	0.214	0.0003***	0.0003***	0.002***	0.001***	−0.182	0.0003***	0.0003***	0.002***	0.001***
Empowerment score	0.684	0.0003***	0.0003***	0.002***	0.002***	−0.236	0.0003***	0.0003***	0.002***	0.002**
Nutrition knowledge *x* Empowerment score	−0.071	0.0613*	0.1203	0.368	0.123	−0.163	0.002***	0.030**	0.031**	0.032**
ii) ***Domains of empowerment***										
Power in agricultural household decisions	0.253	0.0003***	0.0003***	0.005***	0.003***	−0.081	0.0003***	0.0003***	0.005***	0.005***
Power in non-agricultural household decisions	0.191	0.304	0.304	1.000	0.304	−0.020	0.003***	0.003***	0.053*	0.054*
Access to and decision-making about productive resources	0.220	0.004***	0.004***	0.024**	0.023**	−0.084	0.003***	0.003***	0.013**	0.013**
Control of use of income	0.186	0.007***	0.007***	0.009***	0.008***	−0.082	0.003***	0.003***	0.005***	0.004***
Leadership in the community	0.143	0.357	0.312	0.903	0.877	−0.049	0.073*	0. 243	0. 493	0.524
Freedom of physical mobility and autonomy	0.273	0.064*	0.069*	0.381	0.381	−0.124	0.179	0.151	0.381	0.516
Time allocation	0.104	0.193	0.377	0.271	0.395	−0.053	0.091*	0.333	0.126	0.368

*, ** and *** indicate that the corresponding *p*-values less than 10%, 5%, and 1%, respectively.

5 CONCLUSION

There has been growing interest to improve nutritional status of children in sub-Saharan Africa over the past few years. For so long, improving household agricultural production has remained the primary focus of development efforts seeking to end child malnutrition. However, the relationship between food availability and nutrition outcomes is far more complex than popularly assumed (World Bank, 2007). Increased food availability does not in itself guarantee access to adequate food. Nor does the gross quantity produced say much about the quality or nutritional value of children's diets. Furthermore, nutritional deficiencies are not always the result of low food availability but also of poor nutrition knowledge and behavior (Webb & Sheeran, 2006). These considerations have spurred renewed interest in understanding the role of other factors in children's nutrition outcomes. One such widely recognized factor is women's role. Special emphasis has been placed on improving women's nutrition knowledge and empowerment as key impact pathways for nutrition-sensitive programs and interventions.

This paper studies effects of women's nutrition knowledge and empowerment, and their interaction on child nutrition outcomes in rural Ethiopia. Accounting for potential endogeneity, the main results show that women's nutrition knowledge and empowerment have strong and significant effects on child dietary diversity and stunting. The interaction between nutrition knowledge and women's empowerment is significantly associated with stunting, but not with food groups. Perhaps, this implies that the interaction between nutrition knowledge and women's empowerment is more important for long-term nutrition outcomes. A disaggregating analysis of empowerment reveals that the domains of agricultural household decisions and increasing their access to and control of economic resources are most promising for improving child nutrition outcomes. Yet, the analyses in this paper are based on (nonexperimental) cross-section data. Despite our attempt to address potentially endogeneity using IV approaches, reservations remain about whether the exclusion restriction is satisfied for all instruments. Thus, results should be interpreted with care.

The findings of this study have important implications for programs and interventions geared towards improving children's nutrition outcomes. Overall, policy makers and program implementers need to ensure that efforts to improve children's nutrition in rural Ethiopia are complemented by efforts to improve women's nutrition knowledge and empowerment. Notably, results related to nutrition knowledge point to a role for behavior change communication interventions (BCCI) in improving dietary quality and nutrition outcomes. While overall empowerment contributes to considerable improvements in children's nutrition outcomes, domains of power in agricultural household decisions and access to and control of economic resources are the most promising for policy intervention. However, the importance of the different domains of women's empowerment may vary in different settings as dietary choices are deeply embedded in social norms, cultural values, and religious beliefs. Further, our sample drawn from three districts is not representative of national data. Thus, the results should not be simply generalized to other contexts—their external validity may be limited.

ACKNOWLEDGMENTS

The author thanks the African Economic Research Consortium (AERC) for financial support, and College of Business and Economics of Bahir Dar University for sharing data for this research. He is also grateful to the resource persons and members of AERC's thematic research group four for their useful comments and suggestions. The usual disclaimer applies.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

How to cite this article: Melesse, M. B. The effect of women's nutrition knowledge and empowerment on child nutrition outcomes in rural Ethiopia. *Agricultural Economics*. (2021); 1–17. https://doi.org/10.1111/agec.12668