Food Security (2023) 15:395–409
https://doi.org/10.1007/s12571-022-01327-3

ORIGINAL PAPER

The effects of safety certification and nutrition messaging on the demand for nutritionally enhanced food in urban Ethiopia

Kaleb S. Jada[1] · **Mequanint B. Melesse**[1,2] · **Marrit van den Berg**[1]

Received: 7 December 2021 / Accepted: 8 October 2022 / Published online: 24 November 2022
© The Author(s) 2022

Abstract
Micronutrient deficiency is among the most significant public health problems in Ethiopia. In this setting, food fortification has been identified as a cost-effective and sustainable strategy to deliver essential micronutrients. Safety certification and nutrition education messages can be used to nudge people to choose fortified foods. However, there is little evidence as to the effectiveness of such interventions in this context. This paper aims to fill this gap. We focus on cooking oil, as it has been identified as an ideal candidate for vitamin A fortification in Ethiopia. To study consumers' willingness to pay (WTP) for safety certification and vitamin A fortification, we implemented a stated choice experiment on 996 randomly selected urban consumers to reveal preferences required to calculate WTP. To estimate the causal effect of messages on consumers' WTP for fortification, a nutrition message on the benefits of vitamin A was provided to 518 randomly selected participants. We found that consumers valued safety certification. This finding holds for certification issued by both government and private parties, with a higher value ascribed to the former. We also found that urban consumers were willing to pay a premium for vitamin A fortification. The nutrition message increased WTP for fortification, albeit only slightly. Finally, we found that the effect of safety certification on consumers' WTP for fortified cooking oil was higher than its effect on WTP for non-fortified oil, indicating that urban consumers value certification even more when fortification is involved.

Keywords Fortification · Food safety · Choice experiment · Consumer · Nutrition message

1 Introduction

In recent years, considerable efforts have been made to reduce micronutrient malnutrition, which contributes substantially to the global burden of disease (Tulchinsky, 2010). While adequately tackling multiple burdens of micronutrient deficiency could require several complementary approaches, food fortification is arguably the most effective, economical and practically feasible method to enhance the availability of the most limiting micronutrients: vitamin A, iron, and zinc (Das et al., 2013; WHO, 2006). Food fortification involves improving the nutritional value of processed staple foods, mostly flours and edible oils, by adding essential vitamins and minerals. It often targets urban people, who are most likely to consume processed foods. While fortification has been a well-established strategy to prevent vitamin and mineral deficiencies in industrialised countries for many decades (Bishai & Nalubola, 2002; WHO, 2006), large-scale fortification has only recently been applied in developing countries (Miller & Welch, 2013; Osendarp et al., 2018).

The success of fortified foods essentially relies on whether they are accepted and consumed by the target population. Fortification programs can be mandatory, whereby producers of specific fortifiable products must comply with national standards, or voluntary, whereby producers may choose whether they fortify or not. When fortification is voluntary, it is important to establish whether there is a demand for fortified food. It is also important to have evidence-based interventions to encourage healthier food choices.

Several studies have shown that African consumers are willing to pay a premium for nutritionally enhanced foods and that the provision of nutrition information is an important lever (Birol et al., 2015; Chege et al., 2019; De Groote et al., 2017; Mabaya et al., 2010; Oni, 2012). Most of these studies focus on rural consumers, while evidence is limited

✉ Kaleb S. Jada
kaleb.jada@wur.nl

[1] Development Economics Group (DEC), Wageningen University and Research, Wageningen, The Netherlands

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

for the urban setting. In addition, these studies do not explicitly examine food safety issues and the role of safety certification. The implicit assumption is that food safety issues are not of great concern. This seems an unrealistic assumption, given the rising concerns in developing countries regarding food fraud, adulteration, and toxic residues from pesticides and feed additives (Ortega & Tschirley, 2017).

One country in which the above-mentioned problems are prevalent is Ethiopia. Diets in Ethiopia are often dominated by starchy staple foods and do not provide the required amounts of important micronutrients (EPHI, 2013; Gebru et al., 2018), making micronutrient deficiencies a widespread public health problem (EPHI, 2016). Nor is the country free of food safety incidents. In mid-2008, there was a major incident of poisonous edible oil in Addis Ababa with 12 confirmed deaths (Alebachew et al., 2013; Assefa et al., 2013), and more recently local media has contained reports of unsafe cooking oil. As a result of such incidents, urban consumers in Ethiopia are more concerned about the safety of their food than about its nutritional content (Melesse et al., 2019). Food fortification has been identified as an important strategy in nutrition programme documents (EPHI, 2016; Head et al., 2014), but it may be a difficult goal to achieve. Given the visibility and acuteness of food safety problems (Drost et al., 2011), people might be prepared to pay only a smaller premium for fortified food than for food that is certified safe. More importantly, poor people may be willing or able to pay only one premium and prioritise safety at the cost of fortification. However, the interaction between food safety concerns and fortification in Ethiopia has not received empirical scrutiny.

This study aims to address this gap in knowledge. We implemented a stated-choice experiment on 996 randomly selected consumers in the city of Addis Ababa in Ethiopia to study consumers' WTP for biofortification and the impacts of food safety certification and nutrition messaging. We focused specifically on WTP for cooking oil because it has been identified as an ideal candidate for vitamin A fortification. The consumption of cooking oil is widespread and consistent throughout the year (EPHI, 2013; Head et al., 2014). Vitamin A is found to be more stable in oils than in any other food, and oil aids vitamin A absorption (Diósady & Venkatesh-Mannar, 2013). Besides, the fortification process does not change the appearance, taste, texture, flavour, or shelf life of edible oils (Chaudhry, 2018). Finally, the risk of excessive intake of micronutrients by young children is lower for cooking oil than for the alternative option wheat flour (EPHI, 2013).

Our study yielded the following findings. First, the urban consumers were willing to pay a premium for food that is certified to be safe for human consumption. Second, they were willing to pay a premium for vitamin A fortification, yet this premium was lower than for safety certification. Third, nutrition messaging increased WTP for fortification, albeit slightly. Finally, we found that the effect of safety certification on WTP was higher for fortified cooking oil than for non-fortified oil, indicating that urban consumers value certification even more when fortification is involved. Taken together, these results suggest that, to support increased consumption of fortified foods, certification and provision of health messages are feasible behavioural change intervention strategies.

The rest of the paper is structured as follows. Section 2 outlines the design of the choice experiment, the sampling strategy and the methods used to analyse the data. Section 3 presents and discusses the results of the paper. Section 4 draws policy implications and Sect. 5 concludes the paper.

2 Material and methods

2.1 Design of the choice experiment and selection of attributes

We used discrete choice experiments to elicit the preferences of consumers for edible oil with different characteristics. Discrete choice experiments are based on Lancasterian consumer theory, which postulates that goods and services are essentially bundles of various attributes and that the value of particular goods or services to a consumer is determined by the relative importance of these attributes (Lancaster, 1966). In choice experiments, choice sets are typically framed in a way that closely reflects the actual purchase decisions of consumers. As a result, choice experiments allow the investigation of the valuation of a new product with one or more new attributes for which there is no revealed preference history. This is the case for our experimental study. In our experiment, participants are asked to choose between hypothetical alternatives, and there are no real consequences associated with the choice. Such responses to hypothetical choices may differ from real-world behaviour (Hensher et al., 2015). Nevertheless, discrete choice experiments have successfully tested theoretical links with real behaviour, and they allow researchers to gain an understanding of how people actually make choices (Louviere et al., 2010).

Our two core attributes are 'fortification' and 'certification'. The 'fortification' attribute refers to whether the cooking oil is fortified with vitamin A or not and therefore has two levels. While certification could in theory reflect fortification status, in the study context, it reflects food safety. More specifically, we are referring to a third-party verification that the food is free of contaminants and has met accepted food safety standards that are set to lower the incidence of foodborne illness. We included three levels: public certification, private certification, and no certification. In Ethiopia, a government agency, namely the Food, Medicine

Table 1 Attributes and attribute levels for the choice experiment

Attributes	Description	Levels considered
Price	The market price of one litre of oil in Ethiopian birr	3 levels (38, 51 and 64 ETB/litre)
Origin	Whether or not the cooking oil is produced domestically	2 levels (Yes and No: reference point)
Fortification status	Whether or not the cooking oil is fortified with Vitamin A	2 levels (fortified and not fortified: reference point)
Certification status	Whether or not the oil is deemed safe for human consumption and who certified it	3 Levels (certified by government entity, certified by the private entity, and not certified: reference point)

and Health Care Administration and Control Authority, is responsible for ensuring the safety and quality of food manufactured, imported, exported, distributed or made available for human consumption (FDRE, 2014). As a response to current contamination and adulteration problems, the Quality and Standards Authority of Ethiopia (QSAE) has started an initiative for testing and certification of edible oil together with development partners (MDG Achievement Fund, 2011), but this has yet to reach the implementation stage. Currently, the involvement of the private sector in food safety inspection and certification is limited. However, as the food chain becomes more complex and the pressure to enhance food safety increases, it is expected that public efforts will need to be supported by engaging the private sector in certification activities. We included private certification as one of the levels of the certification attribute to assess the preference for this approach by consumers.

We included two additional attributes: 'price' and 'origin'. We limited the attributes to four so as to reduce the cognitive burden on respondents and thereby increase the quality of our data. The 'price' attribute is the price of cooking oil per litre in Ethiopian Birr (ETB). This attribute is relevant in the estimation of the utility derived from the other attributes of the product. Based on a realistic average price in the oil market, three levels were proposed: 38, 51, and 64 ETB/litre.[1] The 'origin' attribute describes the place where the cooking oil was produced. The origin attribute has two levels: the oil is either produced domestically, or it is imported. The inclusion of this attribute results from the findings of a relevant study (Sertse et al., 2011) and our understanding of the cooking oil market.

We conducted a pre-test to see whether the attributes included were relevant and whether the levels for each attribute were plausible and understandable. The test results show that respondents paid attention to the proposed attributes and the attribute levels made sense from their perspective. However, we had to revise the levels for the price attribute, as the initial price range was found to be too narrow to trigger relevant trade-offs. Table 1 shows the final set of attributes and their respective levels.

We used the D-optimal approach of fractional factorial to design the experiment with the help of SAS software (Kuhfeld, 2010). This design approach generates choice sets that allow the estimation of all main and key interaction effects. The other advantage of this approach is that it reduces the predicted standard errors of parameter estimates and gives unbiased estimates (Carlsson & Martinsson, 2003; Hoyos, 2010; Rose et al., 2008). Using a D-optimal design, we generated 24 choice sets using random selection without replacement. To promote response efficiency and reduce the cognitive burden on respondents, the choice sets were optimally divided into four equal blocks using SAS macros to ensure orthogonality between the blocking factor and all of the attributes of all alternatives (Kuhfeld, 2010). Each choice set consisted of two cooking oil alternatives (Options 1 and 2) and a no-buy option (Option 3). The design has a maximum between-attributes covariance of 0.04, suggesting a highly optimal and balanced orthogonal design.

2.2 Sampling strategy and data collection

Data collection took place in Addis Ababa in the fall of 2017 using a computer-assisted personal interview (CAPI) method. We used a multi-stage sampling procedure to select respondents. In the first stage, we purposively grouped the ten sub-cities of Addis Ababa into six strata based on location and on food expenditure per capita and total calorie (gross) intake per individual per day (CSA, 2008). Four of the strata consisted of two similar and in most cases neighbouring sub-cities. The remaining two strata consisted of one sub-city each, Bole sub-city and Akaki-Kaliti sub-city. We then randomly selected one sub-city from each of the four strata and included the two other sub-cities, giving us six sub-cities in total.

In the second stage, all the woredas (districts) in each of the study sub-cities were clustered into three development strata, high, medium, and low, based on a qualitative assessment by local experts. From four sub-cities we randomly selected three woredas, one from each stratum. From two sub-cities with a relatively large number of woredas

[1] During the survey period, 1 USD was about 26.81 ETB.

Block1 Question 1	Option 1	Option 2	Option 3
Price (birr/Lt.)	64	51	Neither Option 1 nor Option 2 is preferred
Origin	Gov't	Gov't	
Fortification status	Imported	Imported	
Certification status	Yes	Yes	
I would choose: Please mark only one box	☐	☐	☐

Fig. 1 Example choice set

(Bole and Yeka), we randomly selected four woredas: one woreda from each stratum, and one additional woreda from the stratum that had the highest number of woredas. This process resulted in a total of 20 woredas. In the third stage, two ketanas, or further sub-divisions of the woredas, were randomly chosen from each woreda, giving us in total 40 ketanas or clusters as primary sampling units. We then randomly selected 25 households from a list of residents in each of the ketanas.

Since the number of districts to be sampled was chosen with probability proportional to size, our sample is said to be self-weighting. This simplified the analysis and allowed us to draw precise conclusions about consumers in Addis Ababa by ensuring that sub-groups were properly represented in the sample.

We visited all selected households at their home and conducted a face-to-face interview in the local language. From each household, we interviewed the person who was mainly responsible for household food choice decisions (food purchase and/or preparation). Replacements were randomly drawn from the same list.

Respondents received a short description of the experiment, clear definitions of the product attributes, an explanation of how to respond to questions, and assurance of the confidentiality of their responses. We especially paid attention to the careful explanation of fortification. Fortification is not uncommon in the study area. The government of Ethiopia introduced a mandatory iodised salt programme in 2011 and there has been an intensive campaign to increase awareness about the benefits of consuming salts fortified with iodine. We therefore feel confident in our assumption that our urban research participants were familiar with fortification. We explained the attribute of fortification as addition of vitamin A into the cooking oil, drawing parallels with the iodine in salt when necessary.

Participation was completely voluntary. Moreover, respondents were informed that they could opt out of the experiment at any time with no penalty. They were informed that the cooking oils presented to them differed only in terms of the four attributes described and that all other attributes were identical. In total, responses to 5,976 choice sets were obtained from 996 surveyed household representatives, with each consumer providing responses to six trinary choice sets.

In each choice set, participants were asked to choose their preferred alternative between two cooking oil profiles and a 'no-buy' option. The no-buy option intends to capture consumers' preferences for edible oil alternatives with other attributes in the choice set as well as for a decision not to buy oil altogether. The inclusion of the no-buy option has been recommended by previous literature (Hoefkens et al., 2012; Louviere et al., 2000). This also reflects real market choices, where consumers can decide not to purchase, to purchase something else, or to purchase elsewhere (e.g., Enneking, 2004). Figure 1 presents a sample choice set.

To encourage participants to provide their realistic evaluations of the choices, we informed them prior to the experiment that it was important that they evaluate each alternative as if they were actually facing these exact choices at a shop or supermarket. In addition, we included a consequentiality clause to attenuate the hypothetical bias (the script is provided in Appendix 1). The consequentiality clause indicates that the results of the study may be used by policymakers. Finally, to increase the likelihood that participants understood each attribute, we conducted the experiment in the local language.

To examine the effect of nutrition messaging on participants' WTP for fortified cooking oil, participants (996) were randomly assigned to the treatment ($n=518$) and control ($n=478$) groups. The treatment group listened to a recorded message about the benefits of vitamin A before being asked to evaluate the choice sets. The control group did not hear the message. The message highlighted the benefits of vitamin A for eyesight, the skin, and the immune system. The full script of the nutrition message is provided in Appendix 2. The message was translated into the local language and an audio recording was made by a native speaker. Participants were assigned randomly to the treatment group so that any differences between the treatment and control group as to their WTP for fortified cooking oil could be attributed to the nutrition message.

Finally, ethical approval for research protocols, process, data management and risks related to participation in the research was obtained from the Social Sciences Ethics Committee at Wageningen University. Addis Ababa sub-city administrations

granted permission to conduct the study. All participants provided written informed consent before participation.

2.3 Specification and estimation

The theoretical foundation of discrete choice models is provided by Hendler's (1975) and Lancaster's (1966) consumer theory, and McFadden's (1974) random utility theory. Lancaster argues that utilities are derived not only from the goods as a whole but also from their characteristics or attributes. Technically, consumers are supposed to make choices based not on the simple marginal rate of substitution between goods but on preferences for attributes of the goods. Random utility theory assumes that individuals select the alternative that yields the highest utility given their information set, and that any variation can be treated as random.

Since our interest was to estimate consumers' WTP for individual attributes, we specified utility in the WTP space. This re-parametrisation has been found to be convenient (Hess & Train, 2017) and provides more reasonable distributions of WTP than the conventional specification of utility, which is defined on the preference space (Train & Weeks, 2005). Indexing an individual consumer by n, cooking oil type (alternatives) by j, and a choice occasion by t, utility can be written as:

$$U_{njt} = -\lambda_n p_{njt} + \lambda_n wtp_n^{'} x_{njt} + \varepsilon_{njt}, \tag{1}$$

where λ_n is a price-scale coefficient, p_{njt} is price, wtp_n is a vector of WTP for each of the non-price attributes, x_{njt} are non-price attributes, and ε_{njt} is an i.i.d type-one extreme value, with constant variance $\frac{\pi^2}{6}$. WTP can vary randomly among consumers. Consumer n chooses alternative j in the choice set J in choice occasion t if $U_{njt} > U_{nit} \forall j \neq i$. The probability of this occurring conditional on the price-scale coefficients and WTP is given by the following specification:

$$Prob_{njt}|\lambda_{nt} \text{ and } \text{WTP}_{nt} = \frac{e^{-\lambda_n p_{njt} + \lambda_n wtp_n^{'} x_{njt}}}{\sum_{j \in J} e^{-\lambda_n p_{njt} + \lambda_n wtp_n^{'} x_{njt}}}. \tag{2}$$

However, we do not observe the price coefficients and WTP for the individual attributes. Instead, the cumulative distribution function of these coefficients in the population is given by $F(\beta)$. Let F be discrete with a finite support set S and let the probability mass at any $\lambda_r and wtp_r \epsilon S$ be expressed as a logit formula. Using a logit formula as a representation of the mixing distribution allows for easy and flexible specification of relative probabilities (Train, 2016). The unconditional probability of consumer n choosing j is then given by:

$$Prob_{njt} = \sum_{r \epsilon S} \left(\frac{e^{\alpha' Z(\lambda_r, wtp_r)}}{\sum_{s \in S} e^{\alpha' Z(\lambda_s, wtp_s)}} \right) \cdot \left(\frac{e^{-\lambda_r p_{njt} + \lambda_r wtp_r^{'} x_{njt}}}{\sum_{j \in J} e^{-\lambda_r p_{njt} + \lambda_r wtp_r^{'} x_{njt}}} \right), \tag{3}$$

where $Z(\lambda_r, wtp_r)$ is a vector-valued function of $\lambda_r and wtp_r$, and α is a corresponding vector of coefficients. The Z variables are used to specify the shape of the probability distributions of the coefficients. In this paper, we specified the Z variables as orthogonal polynomials and compared the goodness-of-fit of this model with models estimated under the assumption that the coefficients are distributed normally and are uncorrelated.

3 Results and discussion

3.1 Descriptive statistics

Table 2 shows the descriptive statistics for the sample. Most of the respondents (82%) were female and about one in four had not had formal education. By age group, 37% of the sample were between 18 and 35 years, 47% were between 35 and 60 years and 25% were over 60 years of age. The data set only characterises household members who were largely responsible for food shopping and/or food preparation for the household. Table 2 also reports that 848 respondents out of 996 stated the per capita income of their household to be greater than 600 birr per month.[2] The implication is that about 15% of the households earned an income under the national poverty line. This is close to the urban poverty headcount ratio (14.8%) based on the national poverty line reported for urban areas in Ethiopia in 2016 (PDC, 2016). Of the 996 respondents, 406 (41%) reported that they trusted health claims on food packages, and for 285 (29%), nutritional value was an important food choice motive.

3.2 Main results

The estimates for the different models in the WTP space are reported in Table 3. We first estimated the model using the maximum simulated likelihood (MSL) estimation method by applying the command "mixlogitWTP" in Stata. The WTPs are specified to be jointly normal and the price or scale coefficient is lognormal. Following the procedure in Train (2016), we then estimated logit-mixed logit (LML) models. The first column reports the MSL estimates with uncorrelated coefficients. For LML models, two models were estimated by specifying a second- and sixth-order

[2] Ethiopia's national poverty line was 7,184 per capita per year in Ethiopian birr (2015).

Table 2 Summary statistics of the study sample ($N = 996$)

Variable		Frequency	Percent
Gender	Female	815	82
	Male	181	18
Age	Between 18 and 35 years	372	37
	Between 35 and 60 years	471	47
	Over 60 years	153	15
Education	No formal education	255	26
	Primary or secondary	610	61
	Above secondary	131	13
Per capita income	Less than 600 birr per month	148	15
	between 600 and 1455[1] birr per month	458	46
	More than 1455 birr per month	390	39
Trust in health claims on food packages	Yes	406	41
	No	590	59
Nutrient value is one of food choice motives	Yes	285	29
	No	711	71

[1]Upper-middle income class poverty line or 48.5 per day per capita in Ethiopian birr (2015)

polynomial, respectively. The LML models were estimated in MATLAB using the code made available by Train (2016). The respective LML estimates are presented in the second and third columns.

Allowing for full correlation among coefficients increases the simulated log-likelihood (SLL) at convergence from -4420.43 to -4367.34. Specifying a more general LML model further improves the model's fit, as this model attained even higher SLL at convergence (-4297.83, compared to -4367.34 for the model with a second-ordered polynomial). The likelihood ratio test suggests that the hypothesis that the extra parameters in our more general model are zero can be rejected at the 99% confidence level ($\chi^2(36) = 139.02$, $p = 0.000$). In addition, our general model attained lower BIC (8517.39 compared to 8656.42) and AIC (8577.65 compared to 8716.68). Thus, our general specification (Model 3) fits the data better than the alternatives.

The WTP estimates are the premium of the corresponding attribute as compared with the reference point stated in Table 1. Looking at the results of the three specifications (Model 1-Model 3), the estimated means have the same signs and orders of magnitude across models. Overall, the signs are plausible and as expected. In addition, though the stated preferences seem to overestimate WTP, the relative orders are in line with expectations given the context of the study areas.

Focusing on the results of the model that fits our data well (Model 3) the estimated coefficients for the attributes are statistically very significant ($p < 0.01$) indicating that respondents had considered each attribute carefully when choosing among the alternatives. The estimated coefficient for the 'origin' attribute was 1.59 and is statistically significant, indicating that consumers are willing to pay 1.59 more for domestically produced cooking oil than for imported oils. The implication is that respondents preferred domestically produced oil to imported oil, supposedly due to its perceived quality. The safety and quality of imported oils are frequently discussed in the food market by consumers. Most imported oils are palm oils that are often partially solid, an attribute viewed as highly negative consumers. That may partly explain why consumers preferred domestically produced oils, which are mainly produced from niger seeds (FBPIDI & GAIN, 2018) and are in liquid form, even though they are relatively expensive and in limited supply. These preferences may partly explain consumers' WTP for nationally produced cooking oils is higher than their WTP for imported oils, despite the availability of quality imported cooking oils.

Consumers were willing to pay a significant premium for safety certification. The estimated WTP for certification was 7.33 birr per litre if certification was issued by a government entity, but 3.70 birr per litre for a private entity. Because we interact certification with fortification in our model, the WTP for certification depends on the fortification status and the WTPs stated above are for certification of cooking oil that is not fortified with vitamin A. The results suggest that consumers worry about food safety and seek assurance that the food they purchase is safe. This is not surprising as adulteration of cooking oil with an inferior substance is not uncommon in Ethiopia (Gobena et al., 2018), and this has been reported in the media. The results also show that consumers' WTP for government certification is higher than their WTP for private certification and the difference is found to be statistically significant ($p < 0.01$). This is probably because respondents considered government agencies as more trustworthy and capable of assessing the safety of food products than the

Table 3 Statistics of WTPs (birr per litre) and standard errors (in brackets)

		Model 1	Model 2	Model 3
Mean				
	Origin (1 = produced nationally)	1.63***	1.60***	1.59***
		(0.08)	(0.12)	(0.06)
	Certified safe by government entity (1 = Yes)	7.17***	7.03***	7.34***
		(0.13)	(0.18)	(0.20)
	Certified safe by private entity (1 = Yes)	3.26***	3.23***	3.71***
		(0.29)	(0.15)	(0.10)
	Fortification with vitamin A (1 = Yes)	4.53***	4.51***	4.64***
		(0.26)	(0.17)	(0.41)
	Interaction: Fortification x certified by government	4.76***	4.75***	4.89***
		(0.15)	(0.11)	(0.18)
	Interaction: Fortification x certified by private sector	4.38***	4.27***	4.21***
		(0.11)	(0.13)	(0.31)
	Interaction: Fortification x health messaging	0.72***	0.68***	0.56***
		(0.14)	(0.13)	(0.17)
	No purchase	0.08	-0.14	0.19
		(0.05)	(0.14)	(0.13)
	Price/scale	0.28***	0.29***	0.26***
		(0.01)	(0.01)	(0.01)
SD				
	Origin (1 = produced nationally)	0.30***	0.21***	0.32***
		(0.03)	(0.04)	(0.03)
	Certified safe by government entity (1 = Yes)	1.07***	1.11***	1.16***
		(0.20)	(0.15)	(0.13)
	Certified safe by private entity (1 = Yes)	0.37**	0.54***	0.73***
		(0.18)	(0.13)	(0.13)
	Fortification with vitamin A (1 = Yes)	0.64***	0.69***	0.76***
		(0.06)	(0.18)	(0.14)
	Interaction: Fortification x government certification	0.27***	0.24	0.59**
		(0.09)	(0.16)	(0.27)
	Interaction: Fortification x private certification	0.23	0.31***	0.57***
		(0.18)	(0.11)	(0.18)
	Interaction: Fortification x health messaging	0.64***	0.58***	0.61***
		(0.04)	(0.04)	(0.05)
	No purchase	0.88***	0.80***	0.92***
		(0.08)	(0.03)	(0.08)
	Price/scale	0.13***	0.13***	0.12***
		(0.01)	(0.01)	(0.02)
Number of respondents		996	996	996
Log-likelihood value at convergence		-4420.43	-4367.34	-4297.83
Akaike information criterion (AIC)		8822.86	8716.68	8577.65
Bayesian information criterion (BIC)		8762.6	8656.42	8517.39
Correlation among parameters		NO	YES	YES
The order of mixing polynomial		2	2	6

*, ** and *** denote significance at 10%, 5% and 1% level respectively

private sector. At the same time, the results also suggest that respondents recognise the role of the private sector in food certification programs, which is encouraging as this indicates the feasibility of engaging the private sector in addressing the ever-increasing demand for safe foods. Furthermore, food safety issues such as food adulteration were the focus

of media attention prior to the experiment, which partly explains the high willingness to pay for certification. Studies have shown that extensive media coverage of food-related risks can lead to a heightened perception of risk that affects consumer perceptions of products and can consequently influence demand for safer services and products (Frewer et al., 2002; McCluskey & Swinnen, 2011).

The results indicate that urban consumers are willing to pay 4.64 birr per litre on average for vitamin A fortification of cooking oil. Again, because of the interaction term, this refers to an estimated WTP for vitamin A fortification of cooking oil that has not been certified. The results may suggest that the majority of the respondents are aware of the benefits of vitamin A.

Comparing the WTP for certification with the WTP for fortification shows that respondents are more concerned about the safety of the cooking oil than its nutritional value. The difference in WTP for the two attributes is found to be statistically significant ($p < 0.01$), and this holds for both private and government certification.

The interaction between fortification and certification captures the effect of certification on the WTP for vitamin A fortification of cooking oil. The estimated WTPs for certification of fortified cooking oils are positive (4.9 for government and 4.2 for private certification) and statistically significant (p-value < 0.01), suggesting that the effect of safety certification on consumers' WTP for fortified cooking oil is higher than its effect on WTP for non-fortified oil. This indicates that urban consumers value certification even more when fortification is involved.

To calculate the effect of nutrition messaging on WTP for fortified cooking oil, we interacted the treatment status with fortification status so that the coefficient of the interaction term is interpreted as the treatment effect on participant's WTP. The results show that informing respondents about the nutritional benefit of vitamin A increased the WTP for fortification, albeit slightly, and the effect is found to be statistically significant (p-value < 0.01). On average, the information treatment increased WTP by 0.55 birr per litre. Providing nutrition information about vitamin A presumably increased the consumers' awareness level of the product, and awareness plays a crucial role in the decision process. In the field of public health, a number of studies in developing countries have shown that provision of nutrition information is effective in stimulating consumers to make healthier food choices (Barreiro-Hurlé et al., 2010; Bonaccio et al., 2013; Drichoutis et al., 2005; Miller & Cassady, 2015).

The fact that urban consumers are willing to pay a premium for fortification indicates that there may be a market-mediated solution for malnutrition. For such a solution to work, supplying fortified cooking oil should be profitable for the private sector. However, a detailed cost–benefit analysis of supplying fortified cooking oil by the private sector is not available. Such an analysis would help to identify potential constraints which can be acted upon to encourage the participation of the private sector. As fortification is highly cost-effective from a public health perspective (Horton, 2006), both price and non-price incentives should be considered to facilitate private sector action.

3.3 Heterogeneity analysis

The estimated standard deviations of the attributes are statistically different from zero, indicating that there are identifiable differences across respondents in the extent to which they valued each attribute. To further investigate variability in the direction and magnitude of the effect of certification and nutrition messaging on consumers' WTP for vitamin A fortification, we plot the respective distributions. Figure 2 presents the distribution of the relevant WTPs. The first and the second moments of the distribution under Model 3 are similar to those obtained under Model 2, where normal distribution is assumed for random parameters. However, the shape of the distributions of the parameters of interest is different from normal.

The distribution for WTP for fortification as shown in the top left corner of Fig. 2 is bimodal and U-shaped, indicating that people either are willing to pay a considerable amount for fortified cooking oil or are only willing to pay a relatively small amount.

The shape of the distributions of the joint effects of fortification and certification either by a government entity (Fig. 2, top right) or by a private entity (Fig. 2, bottom left) also suggests heterogeneity among respondents. Similarly, the graph in Fig. 2 bottom right suggests that most people are slightly more willing to pay for fortification after having received information about the benefits of consuming fortified cooking oil than they would have without the information treatment. However, for a small group of respondents (14%), the information treatment decreased the premium they were willing to pay for fortified cooking oil. This is an unintended effect of the nutrition messaging which is not uncommon in health communication (Hornik, 2002). Persuasion attempts can pose a threat to people's autonomy and self-determination, triggering a negative reaction, which is termed as psychological reactance (Brehm & Brehm, 1981). This phenomenon can undermine the effectiveness of nutrition messaging (Dillard & Shen, 2007; Quick et al., 2013; Steindl et al., 2015).

Factors that may drive this observed heterogeneity are presented in Table 4. For example, government certification combined with fortification had the highest effect on older people (> 60 years of age) as compared to the other age groups. This is probably because older people have a

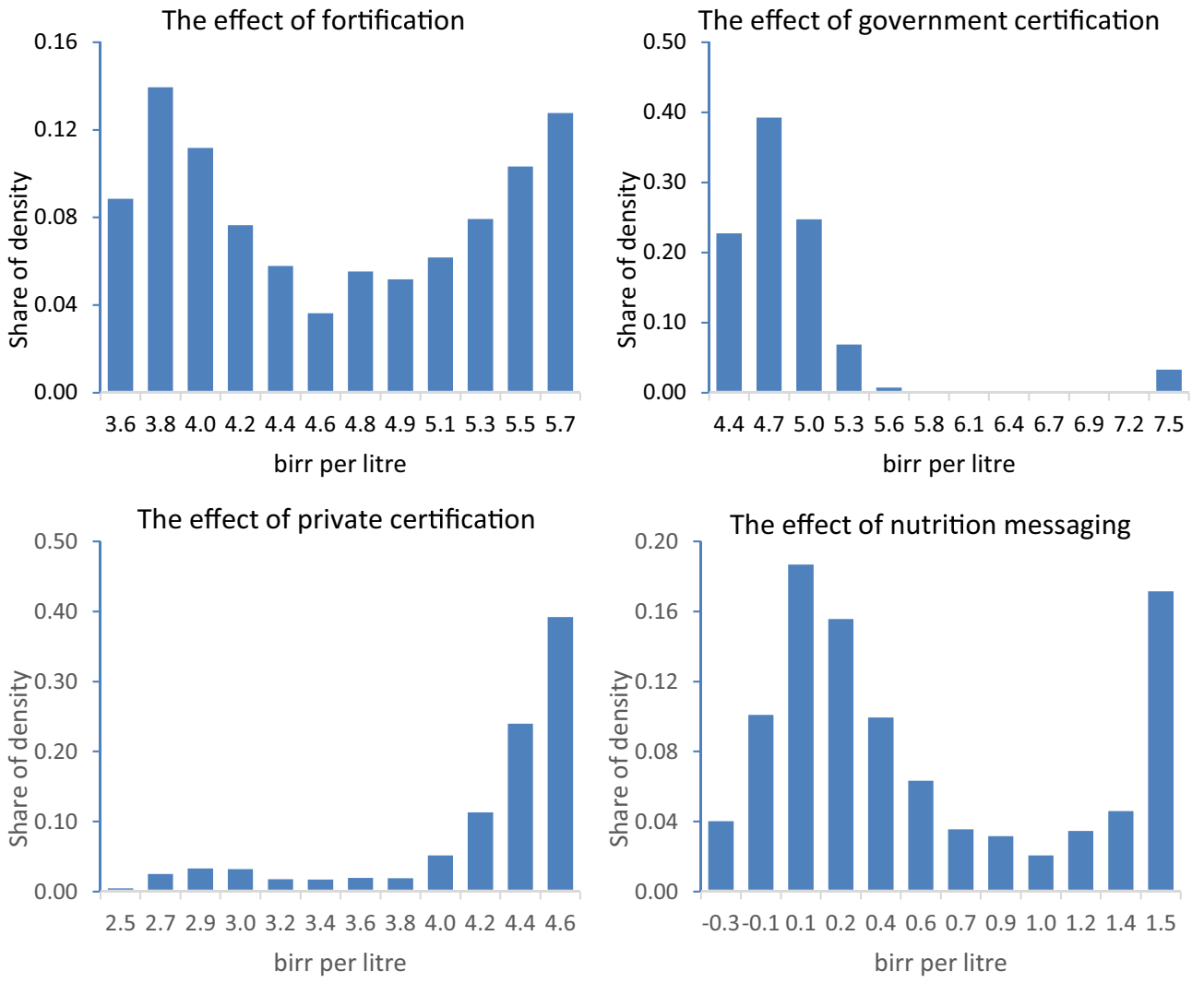

Fig. 2 Distribution of selected WTP parameters

more favourable view of government institutions than the other age groups.

The information treatment, however, was less effective for older people. This may not be surprising because communication is shown to be hindered by the normal ageing process, which may involve a decline in memory and slower processing of information (Halter, 1999). As a result, the older people get, the less likely they may be to incorporate new information in their decision process. This explanation is speculative, as we did not collect information on the cognitive processing speed of our participants. There may be other explanations for the results, such as lack of trust in information.

Fortification has a higher effect on WTP for females than for males. The effect of information on WTP for fortification is twice as strong in females. This is consistent with the growing literature that shows that increasing women's human capital (by filling the nutrition knowledge gap, for example) improves the nutritional outcomes of their household (Kurz & Johnson-Welch, 2016; Madzorera & Fawzi, 2020; Malapit & Quisumbing, 2015).

The certification and the nutrition messaging seem to have the highest effect for those respondents with more than secondary education, presumably because they are more likely to understand the content of the message than those with less than secondary education.

Wealthy respondents–per capita income greater than 1,455 birr –are less likely to increase their WTP for fortified cooking oil and respond weakly to the nutrition messaging. Perhaps this is because they do not necessarily need to consume fortified cooking oil to meet their nutritional requirements, as they may get the necessary nutrients from other food sources to which the poorer respondents may not have access. However, this wealthy group responds more

Table 4 Heterogeneity analysis of certification and information treatments on respondents' WTP (in birr per litre of cooking oil)

Respondent characteristics			Vitamin A fortification	Fortified cooking oil combined with		
				Government certification	Private certification	Nutrition messaging
Respondent age						
	Between 18 and 35[a]		2.2 (0.7)	4.7 (0.6)	4.5 (0.5)	0.6(0.4)
	Between 35 and 60[b]		5.6 (0.8)	5.0 (0.5)	4.3 (0.6)	0.7 (0.6)
	Greater than 60[c]		2.0 (1.2)	5.4 (1.1)	3.8(1.3)	-0.1 (1.3)
Mean differences	b-a		3.4***	0.3	-0.2*	0.1
	c-b		-3.6***	0.4**	-0.5*	-0.8*
	c-a		-0.2*	0.7**	-0.7**	-0.7*
Respondent Sex						
	Male		4.1 (1.3)	5.2 (0.4)	4.3 (0.5)	0.3 (1.2)
	Female		4.6 (0.8)	4.9 (0.6)	4.2 (0.6)	0.6 (0.6)
Mean differences			-0.5*	0.3	0.1	-0.4**
Respondent education level						
		No education[d]	3.9 (2.6)	4.6 (0.6)	4.2 (0.6)	0.4 (0.9)
		Primary and secondary[e]	4.5 (2.7)	4.8 (0.6)	4.1 (0.6)	0.5 (0.9)
		More than secondary[f]	4.7 (2.6)	5.3 (0.7)	4.4 (1.4)	0.8 (1.2)
Mean differences		e-d	0.6*	0.2	-0.1	0.1
		f-e	0.2	0.5*	0.3*	0.3*
		f-d	0.8*	0.7*	0.2**	0.4**
Monthly per capita income						
		Below 600 birr[g]	3.8 (1.3)	4.3 (1.1)	4.1 (0.3)	0.3 (0.1)
		Between 600 and 1,455 birr[h]	4.1 (0.8)	5.1 (0.6)	4.4 (0.7)	0.7 (0.7)
		Above 1,455 birr[i]	4.7 (1.1)	5.3 (0.6)	4.0 (0.9)	0.6 (0.5)
Mean differences		h-g	0.3*	0.8*	0.3	0.4*
		i-h	0.6*	0.2	-0.4	-0.1
		i-g	0.9	1.0**	-0.1	0.3*
Respondent trusts health claims						
		Yes	4.8 (0.6)	4.8 (0.5)	4.4 (0.5)	0.9 (0.5)
		No	4.3 (0.8)	5.1 (0.6)	4.1 (0.3)	0.3 (0.7)
Mean difference			0.5**	-0.3	0.3	0.6**
Nutrient value is one of food choice motives						
		Yes	6.1 (0.5)	5.3 (0.2)	4.1 (0.4)	0.8 (0.4)
		No	4.5 (0.8)	4.8 (0.2)	4.2 (0.6)	0.4 (0.6)
Mean difference			1.6**	0.5*	-0.1	0.4**

This table reports mean (standard deviation) WTP for product attribute stated in the respective column heading. ***, ** and * represents statistical significance at 1%, 5% and 10% level

strongly to certification, but only if it is issued by a government entity. Those with per capita income slightly above the national poverty line respond strongly to fortification as well as to certification. Compared to those with per capita income less than the national poverty line, those who earn between 600 and 1,455 birr per capita per month respond more positively to nutrition information.

Apart from the above socioeconomic characteristics of respondents, respondents' trust in nutrients and health claims and their food choice motives also moderate the effect of the information treatment. Those respondents who indicated high trust in nutrient and health claims also expressed a higher WTP for fortified cooking oil. This group also responded positively to the nutrition messaging: their WTP for fortification increased after they received the information treatment. The implication is that, apart from providing information, it is also important to pay attention to the credibility of the information.

Individuals whose food choices are motivated by the nutritional values of food are more willing to pay for fortification. They will also pay more for certification if the certificate is issued by the government. This is probably

because if individuals take nutritional values in their food choices into account, then they are more likely to take heed of other health considerations in their food choices as well. The information treatment is found to be more effective to those for whom nutrient value was one of the main motives underlying their food choices. These results are consistent with food choice literature that documents the link between food choice motive and food choice behaviour (Konttinen et al., 2013; Naughton et al., 2015). These results highlight the importance of conducting general nutrition campaigns in addition to providing specific nutrition information on fortified foods.

4 Policy implications

Malnutrition is a complex issue, and winning the battle requires multiple interventions within the food system. The specific policy implications of this study are summarised as follows. First, nutrition awareness creation campaigns that aim at raising people's awareness of the nutritive value of foods and their benefits are effective in encouraging healthy food choices. This statement is in line with previous studies which show that making nutritional information accessible helps consumers to make better food choices (Berning et al., 2010; Miller & Welch, 2013). In the case of fortified cooking oil, campaigns should encourage the substitution of regular oil for fortified oil and be cautious not to inadvertently encourage overconsumption, especially in a country like Ethiopia where the dominant cooking oil is palm oil, which is high in saturated fat and thus associated with risk of heart disease (Brouwer, 2016). In addition, increased consumption of refined oils has been associated with the nutrition transitional toward diets rich in sweeteners, fats and highly processed foods (Popkin, 2015).

Second, introducing a safety certification mechanism can be used effectively to promote a healthy diet. Certification allows consumers to easily identify foods that are deemed safe and thereby facilitates the shift to healthy diets. Sanogo and Masters (2002) reported similar findings for Mali, where people showed increased willingness to pay for quality certification.

Third, nutritional messaging and certification have heterogeneous effects depending on the education level, trust in institutions and people's food choice motives. Liu et al (2019) reported similar results, where consumers' degree of trust in food safety inspection and certificate authority affects their willingness to pay for food certified to be safe. Policymakers who wish to encourage healthy food choice behaviour among the community should be aware of the following points: information interventions need to be tailored to the audience's level of education, attention should be given to building consumer trust in institutions, and interventions need to be informed by the targeted population's food choice motives.

5 Conclusion

This study investigated the acceptability of vitamin A fortified cooking oil among urban consumers in Ethiopia and estimated the effect of certification and nutrition messaging on customers' willingness to pay for fortified oil. We conducted a stated choice experiment augmented by nutrition messaging. The experiment was conducted in an urban setting and 996 subjects selected randomly participated. We estimated WTP distributions for key attributes of cooking oil using flexible models parameterised in WTP space. The estimation resulted from the more general LML model in WTP space with correlated terms, which fits the data best.

We found that the average consumer preferred domestically produced cooking oil and was willing to pay for safety certification as well as for fortification. Even though consumers were willing to pay more for nationally produced oil, the magnitude of the WTP for certified and fortified cooking oil indicates that consumers would pay a significant premium for certified and fortified cooking oil even if it were imported. We also find that provision of information about the benefit of vitamin A increased consumer's WTP for fortified cooking oil, albeit slightly. Providing nutrition information is expected to increase the consumers' nutrition knowledge, which in turn allows them to make an informed decision. Finally, we found that the effect of safety certification on consumers' WTP for fortified cooking oil was higher than its effect on WTP for non-fortified oil, indicating that urban consumers value certification even more when fortification is involved. Among the product attributes studied, consumers attached higher importance to safety certification, followed by fortification. This is consistent with the study of Addis Ababa consumers by Melesse et al. (2019), which reported that food safety issues loom larger in people's decisions than nutrition in the study area.

The fact that consumers value fortification and safety certification is encouraging. From a public health perspective, this supports the government's effort to reduce micronutrient deficiency through food fortification. However, in a country like Ethiopia, where market competition and institutional regulations are limited, policymakers need to be aware that producers and traders may use consumer willingness to pay a premium to extract additional surplus from poor consumers. Thus, the distributional aspect is expected to be critical. There could be potential for public–private partnerships to work jointly to mitigate this concern, particularly during the early stage of introducing fortified cooking oil in the market. In addition, there may be a need to establish a regulatory

mechanism to prevent the private sector from exploiting consumers' need for safe and nutritious options. This is particularly important given the recent trend in the Ethiopian cooking oil market, whereby market and non-market shocks seem to give the private sector an excuse to charge an exorbitant price.[3]

Heterogeneity analysis revealed that the effects of certification and nutrition messaging on consumers' willingness to pay for fortified cooking oil are moderated by socioeconomic characteristics, people's level of trust in institutions and their food choice motives.

Appendix 1: Consequentiality clause

Your responses will be used to assist policymakers to determine whether fortified cooking oil is acceptable for consumers like you. Based on your preferences, policymakers could also determine whether foreign oil should be able to enter Ethiopia. Your preferences could also help the policymakers design an effective certification/food safety inspection mechanism that is acceptable to urban consumers like you.

Appendix 2: The script of the nutrition message

Vitamin A is an essential nutrient for humans. It helps people to stay healthy. It is needed for good eyesight, maintaining healthy skin, producing red blood cells and supporting the immune system. Therefore, we all need vitamin A, but young children especially need it because their bodies are at their developmental stage. Pregnant and nursing mothers should have diets rich in vitamin A because they are providing food for growing babies. A study showed that vitamin A deficiency affects 94% of the people in Addis Ababa.

Though vitamin A deficiency may not always have clinical symptoms, inadequate intake of vitamin A can cause blindness, infection, reduced growth and development of our bodies, less healthy skin and even lead to death, particularly in children.

Good sources of vitamin A in the diet include fruits and vegetables, especially those that are deep orange or dark green in colour. Vitamin A can also be found in dairy products, liver and egg yolks. Vitamin A-fortified cooking oil can also be an excellent source for getting the amount of vitamin A that our bodies need.

Acknowledgements We are grateful to the Food Systems for Healthier Diets (FSHD) Flagship of the Agriculture for Nutrition and Health(A4HN) program of the CGIAR for their financial support. We are also deeply grateful to the experiment participants who patiently and willingly responded to our numerous questions. Marrit van den Berg was additionally funded by The Netherlands – CGIAR research programme—Senior Expert Programme, grant number 17226. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Author contributions Kaleb S. Jada: Conceptualisation, Methodology, Investigation, Formal analysis, Software, Writing—Original Draft. Mequanint B. Melesse: Writing—Review & Editing, Marrit van. den Berg: Writing—Review & Editing, Supervision. All authors have approved the final article.

Data availability Upon request to the corresponding author.

Declarations

Conflict of interest statement We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome. We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us. We confirm that the article is our original work, has not received prior publication and is not under consideration for publication elsewhere. We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property. We understand that the Corresponding Author is the sole contact for the editorial process (including Editorial Manager and direct communications with the office). He is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs. We confirm that we have provided a current, correct email address which is accessible by the Corresponding Author and which has been configured to accept email from (kaleb.shifferaw@gmail.com or kaleb.jada@wur.nl).

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

References

Alebachew, A., Aseffa, A., TekleMariam, S., Azazh, A., Tadesse, S., Bane, A., Wondabeku, M., Urga, K., Seboxa, T., Habte, M., Messele, T., Tadesse, Z., Amare, B., Bekele, Y., Assefa, D., Habte, D., & Kebede, A. (2013). Outbreak investigation of epidemic dropsy in Addis Ababa,. *Ethiopian Medical Journal, 2*, 9–20.

Assefa, A., Teka, F., Guta, M., Melaku, D., Naser, E., Tesfaye, B., Messele, T., Kebede, A., Getachew, M., Mudi, K., Alebachew, A.,

[3] https://addisfortune.news/edible-oil-oily-prices-no-respite-for-consumers/. Accessed on 12th April 2022.

Azazh, A., Bane, A., Seboxa, T., Girma, S., Muzein, R., & Urga, K. (2013). Laboratory investigation of epidemic dropsy in Addis Ababa Ethiopia. *Ethiopian Medical Journal, 2*, 21–32.

Barreiro-Hurlé, J., Gracia, A., & de-Magistris, T. (2010). Does nutrition information on food products lead to healthier food choices? *Food Policy, 35*, 221–229. https://doi.org/10.1016/j.foodpol.2009.12.006

Berning, J. P., Chouinard, H. H., Manning, K. C., McCluskey, J. J., & Sprott, D. E. (2010). Identifying consumer preferences for nutrition information on grocery store shelf labels. *Food Policy, 35*, 429–436. https://doi.org/10.1016/j.foodpol.2010.05.009

Birol, E., Meenakshi, J. V., Oparinde, A., Perez, S., & Tomlins, K. (2015). Developing country consumers' acceptance of biofortified foods: A synthesis. *Food Security, 7*, 555–568. https://doi.org/10.1007/s12571-015-0464-7

Bishai, D., & Nalubola, R. (2002). The history of food fortification in the United States: Its relevance for current fortification efforts in developing countries. *Economic Development and Cultural Change, 51*, 37–53. https://doi.org/10.1086/345361

Bonaccio, M., Castelnuovo, A. D., Costanzo, S., Luci, F. D., Olivieri, M., Donati, M. B., de Gaetano, G., Iacoviello, L., & Bonanni, A. (2013). Nutrition knowledge is associated with higher adherence to Mediterranean diet and lower prevalence of obesity. Results from the Moli-sani study. *Appetite, 68*, 139–148. https://doi.org/10.1016/j.appet.2013.04.026

Brehm, J. W., & Brehm, S. S. (1981). *Psychological reactance – a theory of freedom and control* (1st ed.). Academic Press.

Brouwer, I. (2016). *Effect of trans-fatty acid intake on blood lipids and lipoproteins: A systematic review and meta-regression analysis*.

Carlsson, F., & Martinsson, P. (2003). Design techniques for stated preference methods in health economics. *Health Economics, 12*, 281–294. https://doi.org/10.1002/hec.729

Chaudhry, S. A. (2018). Business Considerations for Food Fortification: Cargill India Experience With Oil Fortification. In:V. M. G. Mannar, & R. Hurrell (Eds.), *Food Fortification in a Globalized World*. Academic Press, Haryana, pp. 357–362. https://doi.org/10.1016/B978-0-12-802861-2.00038-9

Chege, C. G. K., Sibiko, K. W., Wanyama, R., Jager, M., & Birachi, E. (2019). Are consumers at the base of the pyramid willing to pay for nutritious foods? *Food Policy*. https://doi.org/10.1016/j.foodpol.2019.101745

CSA. (2008). Summary and Statistical Report of the 2007 Population and Housing Census Results. Addis Ababa.

Das, K., Salam, R., Kumar, R., & Bhutta, Z. (2013). Micronutrient fortification of food and its impact on woman and child health: A systematic review. *Systematic Reviews*, *2*. https://doi.org/10.1186/2046-4053-2-67

De Groote, H., Kariuki, S. W., Traore, D., Taylor, J. R., Ferruzzi, M. G., & Hamaker, B. R. (2017). Measuring consumers' interest in instant fortified pearl millet products: A field experiment in Touba, Senegal. *Journal of the Science of Food and Agriculture, 98*, 2320–2331. https://doi.org/10.1002/jsfa.8722

Dillard, J. P., & Shen, L. (2007). On the nature of reactance and its role in persuasive health communication. *72*, 144–168. https://doi.org/10.1080/03637750500111815

Diósady, L. L., Venkatesh-Mannar, M. g. (2013). Vitamin A fortification of cooking oils. In V. Preedy, R. Srirajaskanthan, & V. B. Patel (Eds.), *Handbook of food fortification and health: From concepts to public health applications* (Vol. 1, pp. 275–290). Springer Science+Business Media, New York. https://doi.org/10.1007/978-1-4614-7076-2_22

Drichoutis, A. C., Lazaridis, P., & Nayga, R. M. (2005). Nutrition knowledge and consumer use of nutritional food labels. *European Review of Agricultural Economics, 32*, 93–118. https://doi.org/10.1093/erae/jbi003

Drost, S, van Wijk, J. C. A. C, & Mandefro, F. (2011). *Multi-stakeholder platform contribution to value chain development.* The Partnerships Resource Centre (PrC). http://hdl.handle.net/1765/77651

Enneking, U. (2004). Willingness-to-pay for safety improvements in the German meat sector: The case of the Q&S label. *European Review of Agricultural Economics, 31*, 205–223.

EPHI. (2013). Ethiopia National Food Consumption Survey Report. Addis Ababa.

EPHI. (2016). Ethiopia National Micronutrient Survey Report. Addis Ababa.

FBPIDI and GAIN. (2018). Ethiopia Edible Oil Industry Mapping. Addis Ababa.

FDRE. (2014). Medicin and Health Care Administration and Control Council of Ministres regulation. Regulation No. 299/2013. Federal Negarit Gazette 20, Ethiopia.

Frewer, L. J., Miles, S., & Marsh, R. (2002). The media and genetically modified foods: Evidence in support of social amplification of risk. *Risk Analysis, 22*, 701–711. https://doi.org/10.1111/0272-4332.00062

Gebru, M., Remans, R., Brouwer, I., Baye, K., Melesse, M., Covic, N., Habtamu, F., et al. (2018). Food Systems for Healthier Diets in Ethiopia:Toward a Research Agenda.

Gobena, W., Girma, S., Legesse, T., Abera, F., Gonfa, A., Muzeyin, R., Fekade, R., & Yohannes, T. (2018). Microbial safety and quality of edible oil examined at Ethiopian public health institute, Addis Ababa, Ethiopia: A retrospective study. *Journal of Microbiology & Experimentation, 6*, 136–139.

Halter, J. B. (1999). The challenge of communicating health information to elderly patients: A view from geriatric medicine. In *Processing of medical information in aging patients: Cognitive and human factors perspectives* (pp. 23–28). Lawrence Erlbaum Associates Publishers.

Head, J., Getachew, B., & Gabrehiwot, M. (2014). Harnessing local technology: Manufacturing small scale mixers for the fortification of edible oils and wheat flours in northern Ethiopia. In *IEEE Global Humanitarian Technology Conference* (GHTC 2014). IEEE, San Jose. https://doi.org/10.1109/GHTC.2014.6970283

Hendler, R. (1975). Lancaster's new approach to consumer demand and its limitations. *The American Economic Review, 65*, 194–199. https://doi.org/10.2307/1806408

Hensher, D. A., Rose, J. M., & Greene, W. H. (2015). *Applied choice analysis* (2nd ed.). Cambridge University Press.

Hess, S., & Train, K. (2017). Correlation and scale in mixed logit models. *Journal of Choice Modeling, 23*, 1–8. https://doi.org/10.1016/J.JOCM.2017.03.001

Hoefkens, C., Pieniak, Z., Camp, J. V., & Verbeke, W. (2012). Explaining the effects of a point-of-purchase nutrition-information intervention in university canteens: A structural equation modelling analysis. *International Journal of Behavioral Nutrition and Physical Activity, 9*, 1–10.

Hornik. (2002). Public health communication: Making sense of the evidence. In Hornik (Ed.), *Public health communication: Evidence for behavior change* (pp. 1–19). Erlbaum.

Horton, S. (2006). The economics of food fortification. *Journal of Nutrition, 136*, 1068–1071. https://doi.org/10.1093/JN/136.4.1068

Hoyos, D. (2010). The state of the art of environmental valuation with discrete choice experiments. *Ecological Economics, 69*, 1595–1603. https://doi.org/10.1016/J.ECOLECON.2010.04.011

Konttinen, H., Sarlio-Lähteenkorva, S., Silventoinen, K., Männistö, S., & Haukkala, A. (2013). Socio-economic disparities in the consumption of vegetables, fruit and energy-dense foods: The role of motive priorities. *Public Health Nutrition, 16*, 873–882. https://doi.org/10.1017/S1368980012003540

Kuhfeld, W. F. (2010). Marketing Research Methods in SAS: Experimental Design, Choice, Conjoint, and Graphical Techniques.

Kurz, K. M., & Johnson-Welch, C. (2016). Enhancing women's contributions to improving family food consumption and nutrition. *22*, 443–453. https://doi.org/10.1177/156482650102200418

Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of Political Economy, 74*, 132–157. https://doi.org/10.1086/259131

Liu, R., Gao, Z., Nayga, R. M., Snell, H. A., & Ma, H. (2019). Consumers' valuation for food traceability in China: Does trust matter? *Food Policy, 88*, 101768. https://doi.org/10.1016/j.foodpol.2019.101768

Louviere, J. J., Flynn, T. N., & Carson, R. T. (2010). Discrete choice experiments are not conjoint analysis. *Journal of Choice Modeling, 3*, 57–72. https://doi.org/10.1016/S1755-5345(13)70014-9

Louviere, J. J., Hensher, D. A., & Swait, J. (2000). *Stated choice methods: Analysis and application*. Cambridge University Press.

Mabaya, E., Jordaan, D., Malope, P., Monkhei, M., & Jackson, J. (2010). Attribute preferences and willingness to pay for fortified cereal foods in Botswana. *Agrekon, 49*, 459–483. https://doi.org/10.1080/03031853.2010.526692

Madzorera, I., & Fawzi, W. (2020). Women empowerment is central to addressing the double burden of malnutrition. *eClinicalMedicine, 20*, 100286. https://doi.org/10.1016/J.ECLINM.2020.100286

Malapit, H. J. L., & Quisumbing, A. R. (2015). What dimensions of women's empowerment in agriculture matter for nutrition in Ghana? *Food Policy, 52*, 54–63. https://doi.org/10.1016/J.FOODPOL.2015.02.003

McCluskey, J., & Swinnen, J. (2011). The media and food-risk perceptions. *EMBO Reports, 12*, 624–629. https://doi.org/10.1038/embor.2011.118

McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. *Frontiers of Theoretical Economics, 1*, 105–142. https://doi.org/10.1108/eb028592

MDG Achievement Fund. (2011). Improving the efficiency of the Ethiopian edible oil value chain. Addis Ababa.

Melesse, M. B., Van den Berg, M., de Brauw, A., & Abate, G. T. (2019). Understanding urban consumers' food choice behavior in Ethiopia: Promoting demand for healthy foods. ESSP Working Paper 131. Washington, DC and Addis Ababa, Ethiopia: International Food Policy Research Institute (IFPRI) and Ethiopian Development Research Institute (EDRI). https://doi.org/10.2499/p15738coll2.133202

Miller, D. D., & Welch, R. M. (2013). Food system strategies for preventing micronutrient malnutrition. *Food Policy, 42*, 115–128. https://doi.org/10.1016/j.foodpol.2013.06.008

Miller, L. M. S., & Cassady, D. L. (2015). The effects of nutrition knowledge on food label use. A review of the literature. *Appetite, 92*, 207–216. https://doi.org/10.1016/j.appet.2015.05.029

Naughton, P., McCarthy, S. N., & McCarthy, M. B. (2015). The creation of a healthy eating motivation score and its association with food choice and physical activity in a cross sectional sample of Irish adults. *International Journal of Behavioral Nutrition and Physical Activity, 12*, 1–10. https://doi.org/10.1186/S12966-015-0234-0/TABLES/7

Oni, O. A. (2012). Consumer willingness to pay for vitamin A fortification in vegetable oil in South Western Nigeria: A contingent valuation approach. *Nigerian Journal of Agriculture, Food and Environment, 8*, 66–73.

Ortega, D. L., & Tschirley, D. L. (2017). Demand for food safety in emerging and developing countries: A research agenda for Asia and Sub-Saharan Africa. *Journal of Agribusiness in Developing and Emerging Economies*. https://doi.org/10.1108/JADEE-12-2014-0045

Osendarp, S., Martinez, H., Garrett, G., Neufeld, L., De-Regil, L., Vossenaar, M., & Darnton-Hill, I. (2018). Large-scale food fortification and biofortification in low- and middle-income countries: A review of programs, trends, challenges, and evidence gaps. *Food and Nutrition Bulletin, 39*, 315–331. https://doi.org/10.1177/0379572118774229

PDC. (2016). Poverty and Economic Growth in Ethiopia (1995/96–2015/16). Addis Ababa.

Popkin, B. M. (2015). Nutrition transition and the global diabetes epidemic. *Current Diabetes Reports*, *15*. https://doi.org/10.1007/S11892-015-0631-4

Quick, B. L., Shen, L., Dillard, J. P. (2013). Reactance. In: J. Dillard, & M. Pfau (Eds.), *The Persuasion Handbook: Developments in Theory and Practice*. SAGE Publications, Inc., pp. 167–183. https://doi.org/10.4135/9781412976046

Rose, J. M., Bliemer, M. C. J., Hensher, D. A., & Collins, A. T. (2008). Designing efficient stated choice experiments in the presence of reference alternatives. *Transportation Research Part B: Methodological, 42*, 395–406. https://doi.org/10.1016/J.TRB.2007.09.002

Sanogo, D., & Masters, W. A. (2002). A market-based approach to child nutrition: Mothers' demand for quality certification of infant foods in Bamako, Mali. *Food Policy, 27*, 251–268. https://doi.org/10.1016/S0306-9192(02)00016-7

Sertse, Y., De Ruyter de Wildt, M., Dijkxhoorn, Y., & Danse, M. (2011). Small-scale edible oil milling operations: Alternative business models for Ethiopia. The Hague. LEI Memorandum 11–005.

Steindl, C., Jonas, E., Sittenthaler, S., Traut-Mattausch, E., & Greenberg, J. (2015). Understanding psychological reactance: New developments and findings. *Zeitschrift fur Psychologie, 223*, 205. https://doi.org/10.1027/2151-2604/A000222

Train, K., & Weeks, M. (2005). Discrete Choice Models in Preference Space and Willingness-to-Pay Space. In R. Scarpa, & A. Alberini (Eds.), *Applications of simulation methods in environmental and resource economics* (pp. 1–16). Springer Netherlands. https://doi.org/10.1007/1-4020-3684-1_1

Train, K. (2016). Mixed logit with a flexible mixing distribution. *Journal of Choice Modeling, 19*, 40–53. https://doi.org/10.1016/J.JOCM.2016.07.004

Tulchinsky, H. T. (2010). Micronutrient deficiency conditions: Global health issues. *Public Health Reviews, 32*, 243–255.

WHO. (2006). Guidelines on food fortification with micronutrients.

Kaleb S. Jada earned his PhD in Development Economics at Wageningen University & Research, the Netherlands. He also holds master's and B.A. (with distinction) degrees in economics from Addis Ababa University, Ethiopia. He previously worked as a Research Officer at Internal Livestock Research Institute (ILRI). He also has an extensive experience as a consultant, economist and principal investigator in project evaluation, impact assessment, consumer satisfaction studies, household surveys, field experiments, willingness to pay studies, structural and economic transformation studies, economic policy analysis and market opportunities studies. His research cuts across consumer behaviour, agricultural technology adoption and behavioural economics. His current research focuses on incorporating methods and insights from phycology or social psychology into economic research and identifying leverage points along the food system to bring about better food and nutrition outcomes. He is currently working as a post-doctoral researcher at the Environmental Economics and Natural Resources Group, Wageningen University.

Mequanint B. Melesse obtained his PhD in Development Economics from Wageningen University and a research master (MSc, *cum laude*) degree in Economics and Business from the University of Groningen (both in Netherlands). He is currently working at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) as a Senior Scientist based in Nairobi, Kenya. His main research interests are in the fields of agricultural and development economics, causal impact analysis, sustainable food systems and consumer behavior and market research. He previously worked as post-doctoral researcher at the Development Economics Group, Wageningen University.

Marrit van den Berg Associate Professor at Wageningen University & Research, Development Economic group, the Netherlands. She holds a PhD in Development Economics from Wageningen University. Over the last 20 25 years, Marrit has researched broadly the livelihood of rural households in areas with imperfect markets with special attention to technology adoption and food and nutrition security. She has also been teaching microeconomics of development and methods, techniques and data analysis for field research. She co-leads the cluster of activities on Food System Innovations under the Food Systems for Healthier Diets Flagship Program of the CGIAR Research Program Agriculture for Nutrition and Health. Within this programIn addition, she is engaged in several research programs focusing onstudies innovations targeting consumers and the food environment aiming to improve diets of vulnerable groups. She has research experience in Africa, Central America, Asia, and Central America Africa. She has also been teachinges microeconomics of development and methods, techniques and data analysis formethodology of field research.