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Are consumers at the base of the pyramid willing to pay for nutritious foods?

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ABSTRACT

Base of the Pyramid (BoP) consumers living in the urban informal settlements of developing countries spend over 60% of their income on food, yet malnutrition and micronutrient deficiency remain widespread among these populations, pointing to the inadequacy of the foods they consume in terms of quality and quantity. In this paper we examine BoP consumers' willingness to pay (WTP) for nutritious multi-composite porridge flour (improved flour) in the informal settlements of East Africa. The analysis is based on experimental data collected from 600 households in the informal settlements of Kampala, Uganda and Nairobi, Kenya (300 in each country) in 2016. We use Tobit regression models to analyse determinants of WTP for the improved porridge flour. Results show that both Kenyan and Ugandan BoP consumers are willing to pay a premium for the improved porridge flour. In addition, providing nutrition information about the flour, characteristics of household head, economic status of the household, and presence of young children between six and 59 months in the household, influence WTP for the safe and nutritious porridge flour. The paper concludes by providing recommendations for enhancing nutrition among poor consumers in the informal settlements of developing countries.

1. Introduction

Globally, malnutrition is approximated to contribute to more than one third of all annual child deaths (Bain et al., 2013; Bhutta et al., 2013; Black et al., 2013). However, it is rarely shown as the direct cause due to the vicious cycle of diseases and poverty which aggravate the situation (Bain et al., 2013). In addition, maternal and child malnutrition still remain a major health challenge in Africa especially among the resource poor consumers - those at the Base of the Pyramid (BoP), (Black et al., 2013). Malnutrition is attributed to stunted growth, suboptimal breastfeeding and deficiencies of micronutrients like zinc, vitamin A, iodine and iron in children's diets (Bhutta et al., 2013; Black et al., 2013). There have been widespread and different attempts to improve diets in developing countries to reduce malnutrition. Among them are fortification of staple foods with micronutrients such as iron, zinc, and vitamins (e.g. adding vitamins to wheat flour), biofortification (e.g. breeding of iron-rich beans and orange-fleshed sweet potato), supplementation, behaviour change interventions, and dietary diversity (Faber et al., 2005; Candace Jackson et al., 2013; Das et al., 2013; De Groote et al., 2017a, 2017b).

Although biofortication has been underscored as a comparatively inexpensive, cost-effective, long term pathway through which many households can access nutritious foods sustainably (Bouis et al., 2011; Qaim et al., 2007), it is more feasible in rural areas where consumers largely depend on own produced food. Urban consumers would benefit more from biofortication, when production surpluses are achieved and then marketed in the cities (Bouis et al., 2011). The use of fortified foods or diversified/modified diets - which entails consuming a variety of foods so that the consumer benefits from the diverse nutrients (macro and/or micro nutrients) provided by those foods - could be beneficial in urban households. Dietary diversity for instance is considered a reliable source of micro-nutrients like iron, zinc and vitamin A that can potentially reduce deficiency diseases such as anaemia and also help improve nutritional status and growth of infants especially among the poor in developing countries (Faber et al., 2005; Candace Jackson et al., 2013; Das et al., 2013). For instance, composite porridge consisting of cereal and legume ingredients has been recommended as a sustainable and low cost supplementary food source to help improve nutrition and health of the vulnerable poor, the sick and children (Candace Jackson et al., 2013).

When dealing with the resource poor consumers (those at the Base of the Pyramid), it is important to find out whether they are willing to

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pay for the improved and nutritious foods being recommended as potential interventions to reduce micronutrient deficiencies in developing countries. It is also imperative to know the importance of the food products to the consumers, that is, whether they are traditionally accepted basic foods or new relatively luxurious food products.

Several studies have been conducted to assess consumer attitudes and their willingness to pay for foods with improved nutritional quality in developing countries (De Groote et al., 2017a,b, 2014; Birol et al., 2015; Candace Jackson et al., 2013; Jackson et al., 2013; Meenakshi et al., 2012; Chowdhury et al., 2011; Mabaya et al., 2010). Most of these studies have focussed on foods with enhanced nutritional quality through biofortification (Birol et al., 2015; De Groote et al., 2014; Meenakshi et al., 2012; Chowdhury et al., 2011) while a few studies have looked at fortified foods or foods with modified recipes/diversified (De Groote et al., 2017a,b; Candace Jackson et al., 2013; Jackson et al., 2013; Mabaya et al., 2010).

Candace Jackson et al. (2013) for instance showed that consumers in Botswana were more willing to buy multi-composite porridge flour if they perceive that the ingredients will improve their overall nutritional status and health. Moreover, Candace Jackson et al. (2013) found that sensory attributes of composite porridge flour like attractive colour, thickness, taste and smell are more likely to be preferred by children; hence adults are more willing to buy it. De Groote et al. (2017a) in their Senegal study however, found that without providing additional details to potential consumers - for example information on the nutritional benefit of the food products - there may be no difference in WTP for different products among consumers. Also consumers in Senegal were more willing to pay for instant porridge flour with natural food additives like carrot and mango extracts compared to porridge flour with only micronutrient additives (De Groote et al., 2017a).

Although these studies provide interesting insights on consumer attitudes towards nutritious foods, they do not reflect the behaviour of the BoP consumers who are more vulnerable to micronutrient deficiencies and poor health. Most of these studies sampled rural consumers, agricultural households or general consumers across a country without disintergrating into different income groups. The Base of the Pyramid (BoP) consumers living in urban informal settlements spend over 60 percent of their income on food (Banerjee and Duflo, 2007), yet malnutrition and micronutrient deficiencies remain widespread among these populations, pointing to the inadequacy of the foods they purchase and consume in terms of quality and quantity.

We address this research gap by analysing the willingness to pay for nutritious foods among consumers at the BoP. We also analyze the effect of providing nutrition information on BoP consumers' willingness to pay for nutritious foods while also controlling for other socioeconomic and demographic factors. We use experimental data collected from the informal settlements of Nairobi and Kampala, the capital cities of Kenya and Uganda respectively. We conducted a willingness to pay experiment using multi-composite porridge flour. For poor households whose diets often lack diversity, multi-composite porridge flour would enhance consumption of different food groups within one product, which would not be possible if these households were to purchase the different foods. In East Africa - and also in most other African countries - porridge is not only consumed as a complementary food for young children and lactating mothers, but also as a meal for all household members especially resource poor households who can not afford complete meals (Wanjala et al., 2016). However, research shows that most of the porridge flour used in these housheolds is often composed of less nutritious starchy cereals (Ndagire et al., 2015). Combining cereals which are usually low in nutrients and low-cost with legumes and vegetables of higher nutritional quality could provide a cheaper and more sustainable source of micronutrients among the vulnerable populations.

2. Methodology

Rational consumers will generally agree to buy a product whose price is set such that the utility generated in the purchase is sufficient. Many methods can be applied to evaluate the impact of commercial products such as food items on consumers' valuation. Despite its extensive application in the valuation of nonmarket goods, the Contingent Valuation Method (CVM) has been recently used to value food safety and design agricultural food marketing (Brugarolas et al., 2009; Anabela et al., 2013). However, experimental auctions are becoming an important alternative to CVM as they overcome the hypothetical nature of the CVM by mimicking closely the choice process and the market in considering a real product and a real exchange of money (Poole et al., 2007; Brugarolas et al., 2009; De Groote et al., 2011).

Under experimental auctions, second price sealed bid auction, which is also known as the Vickrey auction (Vickrey, 1961), and the Becker-DeGroot-Marschak (BDM) mechanism (Becker et al., 1964) are popularly applied. In the Vickrey auction, participants are asked to submit a bid (corresponding to the maximum willingness to pay) for a good. The participant who wins the auction purchases the good at the price stated by the second highest bid among the bidders in the auction. In the BDM, the participants are asked to submit a bid that is compared to a selling price randomly drawn from a distribution of possible prices defined by the researcher/marketer. If the submitted bid exceeds (or equals) the random selling price, the purchase takes place at that price (Becker et al., 1964).

The two experimental approaches are incentive compatible, meaning that they provide participants with the incentive to truthfully undertake the bidding and reveal their true WTP (Lusk et al., 2004). In this paper, the BDM mechanism was used to elicit the level of willingness to pay for improved multi-composite porridge flour among BoP consumers in Kenya and Uganda. The BDM method established by Becker et al. (1964), allows bidding by individuals, so it was possible to conduct this experiment with each respondent at their household. Participants bid against a number from a random distribution mimicking an auction. The random number represents the market price of the product so that respondents whose bids exceed or are equal to the randomly drawn price win the auction and purchase the product at the random price. If the bid is less than the drawn price the participant does not get a chance to buy the product. On the one hand, the BDM mechanism discourages the tendency to overbid, because by bidding more than their WTP, participants risk paying more than what the product is worth to them. On the other hand, they risk losing a valued product, if they bid lower than their WTP. Thus, the method allows participants in the bid to reveal their true WTP for the product.

According to Skuza et al. (2015), BDM has advantages over alternative types of auction mechanisms for application in the field. First, the procedure is relatively easy to implement in a point-of-purchase setting without creating an artificial choice environment, thus increasing external validity of estimates. Second, participants do not bid against each other; rather, the bidding outcome and binding price are determined by drawing from a random distribution. Since participants do not bid against each other, it is possible to allow one or several participants in the experiment at a time, while preventing participants' bids from becoming affiliated (Skuza et al., 2015). This is a particularly attractive feature in the field where researchers have limited ability to control the flow of traffic in the experiment area. Lastly, the procedure maintains the theoretical incentive compatibility of other auction mechanisms (Lusk and Hudson, 2004). Despite the fact that this method is quite convenient in the field, it is said to generate less accurate results in induced value experiments than similar mechanisms such as the Vickrey and n^{th} price auctions (Noussair et al., 2004; Lusk and Rousu, 2006; Skuza et al., 2015). In our study, auction participants were randomly selected for the interviews following a systematic random sampling procedure. We believe this approach lowered the level of sample selection bias.

2.1. The WTP experiment

The WTP experiments were conducted in the informal settlements of Kampala in Uganda and Nairobi in Kenya. Kampala and Nairobi were selected as they are the most urbanized cities in the two countries with an estimated population of 55–60% residing in informal settlements-the slum areas (World Bank, 2017; UN-Habitat, 2007, 2010). We focus on urban areas due to the rapid urbanization taking place in Africa. It is estimated that 66% of the world's population will be residing in urban areas by 2050, and the highest proportion of these will be in Africa and Asia (UNDESAPD, 2014). Increased urbanization means that there will be need to adapt to a shift in consumption patterns especially for the urban population where an increase in demand for nutritious foods may be experienced.

Our study focuses on Kenya and Uganda as the two countries are different in terms of standards of living and other livelihood indicators. The interest in comparing these two countries is to elicit whether there are variations in terms of BoP consumer behaviour and willingness to pay for safe and nutritious products from consumers in two African countries of different social economic status.

In this study, a multi-stage sampling strategy was used to select respondents. The national statistics (UBOS & ILRI, 2004; KNBS, 2015) and information from the administrative offices were used to identify four urban Base of the Pyramid (BoP) villages with highest poverty levels in each of the two cities. In Nairobi, *Kibera, Mathare, Kawangware*, and *Mukuru-kwa-Njenga* were selected while *Bwaise II, Kamwokya II, Kawaala II,* and *Kawempe II* were selected in Kampala. Households from these villages were randomly selected, using a systematic random sampling technique. In the end, a total of 600 households were interviewed, 300 in each country. In each household, the person responsible for making decisions on porridge flour to be purchased for household consumption – who in most cases was either the household head or the spouse – was identified as the experiment respondent.

To conduct the WTP experiment, the following procedure was followed: Participants were informed that they were required to show how they value different types of porridge flour that would be presented to them. Then the BDM mechanism was explained and a test round was organized using cupcakes to familiarize participants with the mechanism and ensure that they fully understood it before conducting the actual bidding with porridge flour. Participants were given KES 30 (USD 0.30) and UGX 1300 (USD 0.38) for the experiments in Kenya and Uganda respectively, to enable them purchase the cupcakes if they win the bid. Afterwards, they were asked to make a bid for the two different types of cupcakes presented to them. They were then requested to randomly select a number which identified the binding round. Next, they were asked, to draw a number from a basket of numbers generated with a random distribution and, if the bid was greater than or equal to the number, the participant won the auction and bought the cupcake at the random price. Otherwise, they lost the bid. Respondents were given an opportunity to ask questions after the test round to ensure that they fully understood the bidding process.

Once the test round was completed, and questions from respondents answered, the experiment was conducted using variants of porridge flour following steps shown in Fig. 1. First, each participant was given KES 150 (USD 1.49) in Kenya and UGX 5000 (USD 1.47) in Uganda and requested to make a bid for two porridge flour variants presented to them (Step 1). The amount given was set at roughly two and half times the estimated cost of conventional flours in both countries, based on prices at the local shops. In both countries, half kilogram of conventional and improved porridge flours were packed in clear plastic bags and the composition in each flour was indicated.

In Kenya, the conventional flour was composed of maize and millet flour in half proportions while the improved flour composed of maize, beans, bananas, orange-fleshed pumpkin, carrots, and amaranth leaves. In Uganda, two conventional flours were prepared: maize only and millet only, so that each respondent selected the flour they mostly consume in their household which was then used as the conventional flour for the experiment. The improved flour in Uganda composed of maize, soybean, amaranth grain, beans, and moringa leaves. In both countries, each respondent made a bid only on two types of flours: a conventional flour and an improved flour, and each respondent made two rounds of bidding, one for conventional flour and the other for improved flour.

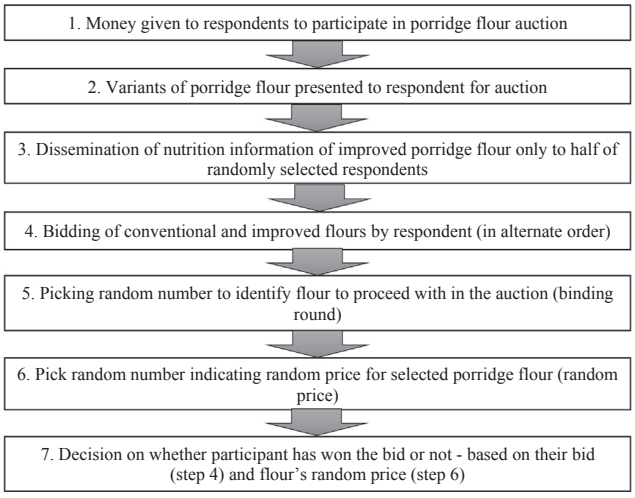

Fig. 1. Steps followed in implementing the willingness to pay experiment using BDM.

About half of the respondents in each country were provided with information on the nutritional benefits of the improved porridge flour based on the flour composition (Step 3 under Fig. 1). This information was written down and translated to local language (*Kiswahili* in Kenya and *Luganda* in Uganda) to ensure that every enumerator read out same information to the selected experiment respondents and also ensure understanding of the message by the respondents. The English version of the nutrition information provided to respondents in each country is presented in the Online Appendix (Appendices 1 and 2). Respondents to receive the nutrition information were randomly selected by the researcher at the time of the experiment, prior to participating in the BDM procedure, by systematically alternating between consecutive respondents. In total, 309 participants received nutrition information on the improved porridge flour (150 from Kenya and 159 from Uganda), while 291 did not receive the information (150 from Kenya and 141 from Uganda). The group of respondents not provided with the nutrition information were only told the ingredients of the conventional and improved porridge flours at the time of bidding. This was done to mimic the usual practice of consumers who go to the market to purchase flour. Usually consumers know the ingredients of the flour or they ask the seller the ingredients but most times they are not given any nutrition information.

After making the two bids (for conventional and improved porridge flour), participants were asked to randomly select a number which identified the bidding round (Step 5). Afterwards, they were requested to draw a number from a random distribution which represented the market price of the flour (Step 6). The random numbers ranged from KES 40 to 92 in Kenya and UGX 350 to 3105 in Uganda for the actual round with improved porridge flour. These numbers were generated from a normal distribution with a mean equal to the average price of the conventional products. If the participant's bid was higher than or equal to the number drawn (the random market price), the participant won the auction and bought the product at the random price (Step 7). Participants were informed of this procedure. In addition, they were informed that numbers presented to them were randomly generated, but they were neither informed of their distribution nor allowed to inspect them.

2.2. Empirical model

Since participants in the experiment were not allowed to state negative amounts, the WTP data are left-censored (censored from below) (Lusk and Shogren, 2007). As such, any econometric procedure used to estimate an equation using a WTP variable must take this characteristic of the data into account; failure to do so could result in biased estimates (Amemiya, 1973). The Tobit model by Tobin (1958) can be used when left-censored data are encountered. This method explains the relationship between a non-negative latent dependent variable and one or more independent variables. Unlike ordinary least squares, the Tobit model takes explicit account of the limited nature of the dependent variable, yielding unbiased parameter estimates.

Thus, a latent variable y_i^*, representing subject $i's$ bid for porridge flour (conventional or improved) is used in the model. In this case the model was censored at zero. y_i^* is observed for all values since all participants were asked to make bids. In addition, no negative price would be stated by the participants. Hence, these latent variables are related to the observed offers, y_i as follows:

$$y_i = \begin{cases} \infty \\ y_i^* = x\beta + \varepsilon_i \\ 0 \end{cases} \quad (1)$$

The dependent variable y_i refers to the bids made for improved porridge flour in Kenya and Uganda as well as the combined data for the two countries used for comparison purposes. The variable x is a vector of independent variables while β is a vector of estimable parameters and ε_i is a normally and independently distributed error term with mean of 0 and constant variance.

To conduct the experiment, four variants of porridge flours were used: *maize only, millet only, maize and millet mixture, multi-composite flour*. Maize only and millet only were used as the conventional flours in Uganda. In Kenya, porridge flour is mostly composed of a mixture of maize and millet. Therefore, this was taken as the conventional flour in Kenya. The improved flour was a safe and nutritious multi-composite flour both in Kenya and Uganda. In Uganda, most porridge flour consumers consume porridge made of either maize alone or millet alone. The study respondents comprised those who ordinarily consume porridge made of maize only as well as those who consume porridge made of millet only. To mimic reality in porridge consumption, the two porridge variants were taken as the conventional flours, so that each household was first asked what type of porridge they usually consume, and then this would determine whether the experiment would be conducted with maize or millet flour as the conventional flour.

2.3. Control variables

Five groups of explanatory variables were used to explain factors that determine willingness to pay for multi-composite nutritious porridge flour among BoP consumers in the informal settlements of Kampala and Nairobi. These include socio-demographic variables (that is gender, age, education level and income of the household head/breadwinner, household size and number of children aged 6–59 months), access to nutrition information, porridge flour variants, locational variables, and the time of day when the experiment was conducted. Household head characteristics are important as they are often the main decision makers especially on household expenditure. Gender of the household head for example, is likely to have a significant influence on the WTP: women are more involved in food preparation and are more conscious about the nutritional welfare of all the household members. However, most female headed households - especially in the informal settlement - have limited access to lucrative income generating activities (Maxwell et al., 2000), which might limit their purchasing power for more nutritious foods.

Similarly, we expect that education of the household head may have a positive influence on willingness to pay. Higher level of education is likely to enhance ones nutritional knowledge which may then influence their willingness to pay. Also, individuals with higher education are more likely to be engaged in more lucrative employment opportunities and hence have higher income. Income of the household head was used as a proxy for economic status of the household. Monthly income from the main source of income was computed and expressed in international dollar (purchasing power parity, PPP$) for ease of comparison between the two countries. Economic status of the household is an important factor that could determine consumer WTP for more nutritious foods as these foods are often more expensive than the conventional ones. Households with more income have a higher purchasing power and therefore we hypothesize that income will have a positive influence on consumers' willingness to pay.

Previous studies have shown that access to nutrition information has a positive effect on consumers' willingness to pay (Debela et al., 2017; De Groote et al., 2017a; Candace Jackson et al., 2013; Mabaya et al., 2010). This means that individuals who are aware of the nutritional benefits of various foods are more likely to purchase such foods, and perhaps willing to pay more than those who do not have these information. To assess the influence of nutritional information on the willingness to pay for improved porridge flour, half of the respondents in both countries were randomly selected and given information on the nutritional benefits of the flour before starting the porridge flour experiment. Nutrition information was only given about the improved flour (nutritious multi-composite flour), and not the conventional flour (details of nutrition information provided are shown in the Online Appendices 1 and 2). In our analysis, we therefore included a dummy variable on whether the respondent received nutrition information or not. We expect that provision of nutrition information is likely to increase the respondents' WTP for the improved porridge flour.

Young children often have higher nutritional requirements than adults. This means that households with young children may be more conscious about their nutrition and health requirements, and therefore may be more willing to pay for improved flour than those without young children. All the respondents were asked to indicate whether there was at least one child aged 6–59 months in the household. We included a dummy variable in our regressions to capture households with children within this age group.

We also included interaction variables between access to nutrition information with gender and education of the household head. In addition, we control for the time of the day when the interview was conducted namely: morning, afternoon or evening. This was included as it may influence the person's willingness to pay especially when the interview is conducted around the time when porridge is often served. A previous study on consumers' WTP for yellow and fortified maize meal in Kenya showed that time of day when an experiment is conducted has an influence on bidding (Morawetz et al., 2011).

A categorical variable of the type of porridge currently consumed was also included. This variable has three categories: single ingredient (maize), single ingredient (millet) and more than one ingredient. We expect that households that consume more nutritious porridge (with more than one ingredient) may be willing to pay more for improved porridge flour since they may be aware of the nutritional benefits of these types of flours.

Finally, the locational variables used include residence of the respondent in the cities and the country of residence in the country-specific and pooled models, respectively. These are used to control for location or country specific factors.

3. Results and discussion

3.1. Descriptive results

Descriptive statistics of variables used as controls in the regression analysis are presented in Table 1. For quite a number of variables, we find significant differences between the two countries, for example

Table 1
Summary statistics of sample characteristics.

Variables	Pooled (N = 600)	Kenya (N = 300)	Uganda (N = 300)
Male household head (dummy)	0.69	0.77***	0.62
	(0.46)	(0.42)	(0.49)
Age of the household head (years)	38.53	37.27***	39.78
	(11.70)	(10.04)	(13.04)
Education of household head (years)	9.61	10.54***	8.68
	(3.82)	(3.20)	(4.16)
Household size	4.74	4.65	4.83
	(2.03)	(1.90)	(2.14)
Household with children aged 6–59 months (dummy)	0.35	0.43***	0.28
	(0.48)	(0.50)	(0.45)
Received nutrition information (dummy)	0.52	0.50	0.53
	(0.50)	(0.50)	(0.50)
Monthly income of household head (PPP$)	344.12	371.37**	316.87
	(286.62)	(310.57)	(258.14)
Locations of study			
Kibera		0.25	
		(0.43)	
Embakasi		0.25	
		(0.43)	
Mathare		0.25	
		(0.43)	
Dagoretti		0.25	
		(0.44)	
Kawempe			0.50
			(0.50)
Kampala central			0.25
			(0.43)
Rubaga			0.25
			(0.43)

Notes: PPP, purchasing power parity. *Means difference between Kenya and Uganda is significant at 10% level, **significant at 5% level, and ***significant at 1% level.

gender, age, and education level of household head, and income levels. This is not surprising since we expect that the two countries are different in terms of social and economic status.

From the results, 69% of the sampled households are headed by men who are on average 38.5 years of age with 10 years of schooling. Household heads in Kenya have significantly higher levels of education than those in Uganda. Similarly, household heads in Kenya have significantly higher levels of income than those in Uganda. This is somewhat expected given that the two countries differ in standards of living. In both countries 43% (Kenya) and 28% (Uganda) of households have children aged 6–59 months. To elicit the effect of nutrition information, 50% and 53% of the respondents in Kenya and Uganda were provided with nutrition information. Details of nutrition information provided are shown in the Online Appendices 1 and 2.

Table 2 shows the average willingness to pay levels for different variants of porridge flour in Kenya and Uganda. BoP consumers in Kenya are willing to pay 0.77 US dollars for 500 g (gm) of improved flour and 0.47 US dollars for the same quantity of conventional flour. On the other hand, BoP consumers in Uganda are willing to pay 0.66 US dollars for improved flour compared to 0.34 US dollars for conventional flour. The differences in the willingness to pay for the conventional flours between the two countries could be partly due to the differences in the local prices of the conventional flours in the respective countries. At the time of the survey, the average price of conventional flour in the local shops in Kenya was USD 0.62 for 500 g, which was higher than the price of conventional flour in Uganda (USD 0.40. for 500 g).

A comparison in the WTP for improved flour between the two

Table 2
Willingness to pay for 500 g of different types of porridge flour by BoP consumers in Kenya and Uganda (in US dollars).

Variable	Kenya		Uganda	
	Mean	Std. dev	Mean	Std. dev
Improved flour	0.77	0.30	0.66***	0.25
Maize and millet flour	0.47	0.18	–	
Millet alone	–		0.40	0.11
Maize alone	–		0.28	0.06
Conventional flour	0.47	0.18	0.34***	0.10

Notes: Improved flour is the safe and nutritious multi-composite flour; Conventional flour includes maize and/or millet porridge flour. In Kenya, this is equivalent to maize and millet flour as only one conventional flour was used, whereas in Uganda, it is the mean of WTP for maize alone and millet alone flours; At the time of study, 1 US dollar was equivalent to KES 101 and UGX 3400; ***Mean difference between WTP in Kenya and Uganda is significant at 1% level.

countries shows that BoP consumers in Kenya are generally willing to pay significantly higher for improved porridge flour than those in Uganda. This can be explained in part by the difference in the economic status of the two countries. A further analysis shows that consumers in both countries are generally willing to pay a premium for the improved porridge flour. The results in Table 3 for instance show that 94% of consumers in both countries are willing to pay a premium for improved porridge flour, while 3% of the consumers would require a discount for this flour and another 3% would pay the exact price as the conventional porridge flour.

Looking at the premium, 81% of consumers in Kenya are willing to pay atleast 25% more than the price of conventional flour for improved porridge flour while 57% of consumers are willing to pay atleast 50% more for the improved flour. In Uganda, 86% of consumers are willing to pay atleast 25% more for the improved flour while 64% are willing to pay atleast 50% more for this type of flour. This indicates that in general slightly more consumers in Uganda are willing to pay a greater premium for improved porridge flour than those in Kenya. This may be explained by the importance of porridge in the Ugandan diet - compared to - the Kenyan diet. The findings concurs with Balogh et al. (2016) who argued that consumers are willing to pay a substantial premium for traditionally consumed products.

3.2. Factors influencing willingness to pay for nutritious porridge flour

In this section we present regression results from Tobit model - conducted to understand factors influencing willingness to pay (WTP) for safe and nutritious porridge flour (improved porridge flour) by BoP consumers in Kenya and Uganda. We present the overall results from the pooled data and further separate the analysis by country. Furthermore, in the analysis, we present short models (models 1 and 2) and long models (models 3 and 4) to understand how key variables of interest influence the WTP for the improved porridge flour. Variables were added progressively in models 1, 2, 3 and 4. Prior to analysis, we tested for multicollinearity among control variables and found that the variance inflation factor (VIF) was within the acceptable range. The mean VIF was 1.44 with a range of 1.02–2.56 (see Table A1 in the Online Appendix).

Table 4 presents results from the pooled data. Model 1 shows the effect of nutrition information on WTP for improved flour among BoP consumers in Kenya and Uganda. The positive and significant effect coefficient implies that providing nutrition information on improved porridge flour to consumers increases their WTP for that flour. This is plausible because providing nutrition information improves consumers understanding on nutritional benefits of various ingredients contained in the product. This is true even when controlling for income and other factors as show in models 2 and 3. This finding also concurs with De

Table 3
Consumers' willingness to pay a premium or discount for improved flour, by country.

Percentage of consumers						
	Kenya			Uganda		
	Overall	WTP > by 25%	WTP > by 50%	Overall	WTP > by 25%	WTP > by 50%
[a]WTP a premium (%)	94.06	80.86	57.43	94.35	85.71	64.45
[b]WTP a Discount (%)	3.30			2.99		
[c]WTP the same (%)	2.64			2.66		

Notes: [a]WTP for improved is > WTP for conventional (maize and/or millet) porridge flour; [b]WTP for improved is < WTP for conventional (maize and/or millet) porridge flour; [c]WTP for improved is = WTP for conventional (maize and/or millet) porridge flour.

Table 4
Tobit results for determinants of willingness to pay for improved porridge flour: Pooled sample.

Variables	Model 1	Model 2	Model 3	Model 4
Received nutrition information (dummy)	0.047**	0.045*	0.044*	0.078
	(0.023)	(0.023)	(0.023)	(0.066)
Monthly income of household head (PPP$)		0.000**	0.000	0.000
		(0.000)	(0.000)	(0.000)
Male household head (dummy)			0.017	0.015
			(0.025)	(0.035)
Age of the household head (years)			0.003**	0.003**
			(0.001)	(0.001)
Education of household head (years)			−0.003	−0.001
			(0.004)	(0.005)
Male HH head × Received nutrition information				−0.004
				(0.006)
Education of HH × Received nutrition information				0.003
				(0.052)
Household size			−0.001	−0.000
			(0.006)	(0.006)
Household with children aged 6–59 months (dummy)			0.048**	0.048**
			(0.024)	(0.024)
[a]*Current porridge flour mostly consumed in the household*				
Single ingredient (Millet only)			0.074*	0.075*
			(0.039)	(0.039)
More than one ingredient flour			0.115***	0.115***
			(0.035)	(0.035)
[b]*Time of the day*				
Morning			−0.036	−0.036
			(0.028)	(0.028)
Evening			−0.024	−0.025
			(0.032)	(0.032)
[c]Country (Uganda)			−0.105***	−0.106***
			(0.025)	(0.026)
Constant	0.691***	0.667***	0.640***	0.622***
	(0.017)	(0.021)	(0.099)	(0.102)
Sigma	0.284***	0.283***	0.272***	0.272***
	(0.009)	(0.009)	(0.009)	(0.009)
Observations	600	600	600	600

Notes: Robust standard errors in parentheses; ***, **, *, significant at 1%, 5% and 10% respectively; PPP, purchasing power parity; HH, household; [a]Reference is single ingredient flour (maize); [b]Reference is afternoon; [c]Reference is Kenya.

Groote et al. (2017a) who found that consumers in Senegal were willing to pay for fortified pearl millet products when more nutrition information was provided.

In the second model (Model 2), income of household head from the main occupation is included in the model as a proxy for economic status of the household. Both income and nutrition information variables remain significant, implying that economic status is an important factor that determines whether consumers pay for the improved porridge flour or not. This is expected as households with higher incomes are expected to have a higher purchasing power than those with less, and this would increase the probability of purchasing a more expensive product.

In model 3, several other variables are included to analyse their possible effect on WTP for the improved porridge flour. Provision of nutrition information still remains significant in positively influencing WTP. In addition, we find that age of household head has a positive and significant effect on WTP for the improved flour, implying that households with older heads may be willing to pay more for the improved flour than those with younger heads. Households with young children aged between six and 59 months are willing to pay more for the improved nutritious flour than those without young children. This is expected because those with small children are likely to be more conscious about the nutritional status of their children given that more nutrients are required in child development and growth. This is in line with findings elsewhere, such as Haghjou et al. (2013) who found that consumers with young children were more willing to pay for healthy and nutritious foods.

We also find that households that currently consume porridge made of millet alone or with more than one ingredient, are more willing to pay for the improved porridge flour than those who consume porridge flour made of maize alone. This could be because the former category of consumers might already be aware of some nutrition benefits of consuming nutritious porridge unlike those who mostly consume maize flour porridge alone. Maize flour porridge is less nutritious compared to millet and other porridge flours with more than one ingredient.

In Model 4, we also include interaction variables between gender of the household head and nutrition information dummy, and education of the household head and nutrition information dummy. We however do not observe any significant effect from these two variables. Overall, BoP consumers in Uganda are willing to pay less for the improved flour compared to the Kenyan consumers. This is in line with the descriptive findings in Table 2. The difference in WTP across the two countries could be explained by various factors. First is the difference in pricing of commodities between the two countries. Food products and commodities are usually cheaper in Uganda than in Kenya. This could be because Uganda has more arable land for agricultural production than Kenya, which could translate to higher production of agricultural commodities (Kenya is largely a net importer of agricultural produce). Second, the improved products in the two countries have different ingredients. Some of the ingredients used in the Kenyan product may be more expensive than those used in the Uganda product. Finally, the level of nutrition knowledge of consumers' in the two countries may be different. There is likely to be higher nutrition knowledge in Kenya than in Uganda.

For robustness check, we also estimated the random effects model given that each household had to indicate the WTP for both conventional and improved flour. The results presented in Table A2 (Online

Table 5
Tobit results for determinants of willingness to pay for improved porridge flour: Kenya country-specific model.

Variables	Model 1	Model 2	Model 3	Model 4
Received nutrition information (dummy)	0.038	0.035	0.033	0.111
	(0.035)	(0.035)	(0.033)	(0.130)
Monthly income of household head (PPP$)		0.000*	0.000**	0.000**
		(0.000)	(0.000)	(0.000)
Male household head (dummy)			0.059	0.031
			(0.037)	(0.054)
Age of the household head (years)			0.004	0.004
			(0.002)	(0.002)
Education of household head (years)			−0.016**	−0.010
			(0.006)	(0.009)
Male HH head × Received nutrition information				−0.011
				(0.011)
Education of HH × Received nutrition information				0.056
				(0.071)
Household size			−0.017	−0.015
			(0.011)	(0.011)
Household with children aged 6–59 months (dummy)			0.102***	0.104***
			(0.036)	(0.035)
[a]Current porridge flour mostly consumed in the household				
Single ingredient (Millet only)			0.133	0.158
			(0.124)	(0.097)
More than one ingredient flour			0.115	0.144
			(0.122)	(0.096)
[b]Time of the day				
Morning			−0.061*	−0.060*
			(0.035)	(0.035)
Evening			0.059	0.058
			(0.066)	(0.066)
[c]Location of study				
Embakasi			−0.140***	−0.142***
			(0.052)	(0.052)
Mathare			−0.013	−0.018
			(0.057)	(0.057)
Dagoretti			−0.168***	−0.171***
			(0.049)	(0.050)
Constant	76.27***	0.727***	0.705***	0.633***
	(2.55)	(0.031)	(0.162)	(0.163)
Sigma	0.302***	0.301***	0.281***	0.280***
	(0.012)	(0.012)	(0.012)	(0.012)
Observations	300	300	300	300

Notes: Robust standard errors in parentheses; ***, **, * is significant at 1%, 5% and 10% respectively; PPP, purchasing power parity; HH, household; [a]Reference is single ingredient flour (maize); [b]Reference is afternoon; [c]Reference is Kibera division.

Table 6
Tobit results for determinants of willingness to pay for improved porridge flour: Uganda country-specific model.

Variables	Model 1	Model 2	Model 3	Model 4
Received nutrition information (dummy)	0.062**	0.062**	0.053*	0.068
	(0.029)	(0.029)	(0.030)	(0.076)
Monthly income of household head (PPP$)		0.000	−0.000	−0.000
		(0.000)	(0.000)	(0.000)
Male household head (dummy)			−0.018	0.006
			(0.036)	(0.048)
Age of the household head (years)			0.002	0.002
			(0.002)	(0.002)
Education of household head (years)			0.003	0.002
			(0.004)	(0.006)
Male HH head × Received nutrition information				0.001
				(0.008)
Education of HH × Received nutrition information				−0.043
				(0.069)
Household size			0.003	0.003
			(0.008)	(0.008)
Household with children aged 6–59 months (dummy)			0.010	0.008
			(0.028)	(0.029)
Current porridge flour mostly consumed in the household[a]				
Single ingredient (Millet only)			0.010	0.011
			(0.038)	(0.038)
More than one ingredient flour			0.123***	0.120***
			(0.035)	(0.036)
Time of the day[b]				
Morning			0.011	0.012
			(0.047)	(0.046)
Evening			−0.057*	−0.057*
			(0.033)	(0.033)
Location of study[c]				
Kampala Central			0.034	0.033
			(0.034)	(0.034)
Rubaga			0.055	0.055
			(0.036)	(0.036)
Constant	0.622***	0.618***	0.438***	0.436***
	(0.021)	(0.026)	(0.099)	(0.105)
Sigma	0.251***	0.251***	0.240***	0.240***
	(0.014)	(0.014)	(0.013)	(0.013)
Observations	300	300	300	300

Notes: Robust standard errors in parentheses; ***, **, *, significant at 1%, 5% and 10% respectively; PPP, purchasing power parity; HH, household; [a]Reference is single ingredient flour (maize); [b]Reference is afternoon; [c]Reference is Kawempe division.

Appendix) are similar to the Tobit regression results.

Since findings from the descriptive and regression analysis show that there is likely to be differences in WTP for improved flour between the two countries, we conduct further analysis separately for each country to find out the specific factors that are likely to determine the WTP for the improved flour. Results of the Kenya and Uganda models are presented in Table 5 and 6 respectively.

Table 5 shows the regression results for Kenya. Looking at model 1, we do not find any significant effect of nutrition information on WTP for improved flour. This could be explained by the fact that most consumers in Kenya, including those in the informal settlements, have some nutrition awareness, so that providing nutrition information about the porridge flour does not make any significant difference in their willingness to pay. Furthermore, most of the respondents in the informal settlement indicated that they consume porridge flour made of more than one ingredient, and therefore may already have some nutrition information on importance of consuming porridge flour with multiple ingredients.

Income of household head, a proxy for economic status of the household, turns out as an important determinant on WTP for the improved porridge flour. The variable is significant even when controlling for other variables as shown in Model 3. Surprisingly, education of the household head has a negative and significant influence on WTP for the improved flour among consumers in Kenya. One would expect that education would increase general nutrition knowledge and hence lead to higher WTP values. De Groote et al. (2017) who studied the willingness to pay for instant fortified pearl millet in Senegal found every extra year of education led to an increase in WTP by 6.5 FCFA. However, this is not the case in our study.

As was the case for the pooled model in Table 4, households in Kenya with young children are more willing to pay for the nutritious porridge flour than those without young children. Finally, we find

location differences in the WTP. Compared to the residents of *Kibera*, those residing in *Embakasi* and *Dagoreti* were willing to pay less for improved flour. Perhaps these latter households do not entirely depend on porridge for nutrient supply unlike those residing in *Kibera* who are extremely income deficient. In addition, residents in *Embakasi* and *Dagoreti* may be having other food alternatives given that the two locations are a bit out of the city and next to agricultural producers, which is not the case for *Kibera* residents. In Model 5, we do not find significant effect of the interaction terms on the WTP. For robustness check, we also analysed the data using the random effects model and the results are similar to those from Tobit model (see Table A3 in the Online Appendix).

Results of the Uganda model are presented in Table 6. Unlike in Kenya, providing nutrition information has a positive and significant effect on WTP for the improved flour among BoP consumers in Uganda as shown in Model 1. The coefficient remains significant even when controlling for other factors (Models 2 and 3). Other socioeconomic characteristics do not seem to significantly influence consumers' WTP in Uganda. However, households that currently consume porridge made of more than one ingredient are more likely to pay for the improved porridge flour compared to those who consume porridge made of maize flour only. This could be explained by the fact that these consumers could already be aware of some nutrition benefits of consuming a multi-composite porridge and therefore they would be more willing to pay for the nutritious porridge flour.

Those interviewed in the morning are likely to have a lower willingness to pay for the nutritious porridge flour compared to those interviewed in the afternoon. This could be interpreted in relation to the hunger levels. Possibly the morning respondents had just taken breakfast and therefore this influenced their willingness to pay for the flour, unlike the afternoon respondents who may not have taken lunch and were still hungry. Robustness check analysis using the random effects model show similar results as the Tobit model (see Table A4 in the Online Appendix).

4. Conclusions and policy recommendations

Micronutrient deficiency remains a public health challenge in many developing countries. The effect of such deficiencies are more evident in poor households given their resource constraints. The urban poor, who mainly reside in impoverished settlements (slums), are more vulnerable to micronutrient deficiencies given their low purchasing power as a result of limited income. Efforts to reduce these deficiencies range from fortification, biofortification of staple crops, supplementation, behaviour change and dietary diversity. Dietary diversity - which entails consuming a diversity of food items with different macro and micro-nutrients, is seen as a convenient strategy especially for urban households. The use of multi-composite porridge flour containing cereal and legume ingredients has been recommended as a low-cost intervention among the resource poor consumers. However, when dealing with resource poor consumers, like those at the Base of the Pyramid (BOP), it is important to know whether they are willing to pay for such nutritious products and the factors that influence their willingness to pay (WTP). In this paper we use experimental data from BoP consumers in Kampala (Uganda) and Nairobi (Kenya) to elicit the willingness to pay for improved nutritious porridge flour by the BoP consumers. In addition, we analyse factors influencing WTP for improved flour using Tobit regression models.

Our results show that BoP consumers in the two countries are willing to pay a premium for the improved porridge flour compared to conventional porridge flour. Consumers in Kenya did not seem to prefer the porridge flour with maize as the main starch ingredient. However, consumers in Uganda are willing to spend, although less, for the maize-based porridge flour. On average however, majority of consumers in Kenya are willing to pay higher for the improved porridge flour than those in Uganda. We associate this with the differences between consumers in the two countries in terms of nutrition awareness, the difference in composition of the improved flours used in the experiment, and the differences in the economic status of the two countries. All these could play a role in the differences in WTP for the products in the two countries.

Only three percent of consumers in both countries would require a discount to buy improved porridge flour. This implies that improved porridge flour could possibly fetch a premium when marketed within the two broad markets. The study findings also reveal the importance of availing nutrition information of the improved flour. Overall, providing nutrition information had a positive and significant influence on WTP for the improved porridge flour. In Uganda, consumers who were informed about the nutritional value of the flour were also willing to pay a premium compared to those who did not receive any nutrition information. However, the WTP for improved flour among consumers in Kenya does not seem to be influenced by provision of nutrition information. This could be because consumers in Kenya are relatively more informed on the nutritional benefits of various ingredients used to make the improved flour and therefore, providing nutrition information of the flour does not make a significant difference in their willingness to pay. Our findings also show that households with children aged six to 59 months are willing to pay more for the improved porridge flour compared to the households without such children.

Three key policy implications can be drawn from our results. First, given that BoP consumers are willing to pay a premium for multi-composite improved porridge flour, it implies that the consumers know the importance of nutritious foods in their diets. Therefore, promoting consumption of diverse nutritious foods among the BoP consumers could be a viable entry point to reducing micronutrient deficiencies in developing countries, especially among the urban poor. Specifically targeting households with children under five years would yield better results. Second, rising demand for multi-composite products could trigger increased production of individual ingredients thereby increasing production and income among farming households. Increased production of nutritious foods by the producers could have positive implications to the rural producers in terms of improving their nutrition (through consuming nutritious commodities that they produce), but also improved incomes (through sale of the produced commodities). Third, it is evident that providing nutrition information to consumers possibly through proper labelling and marketing and market segmentation could enhance the demand of nutritious foods among BoP consumers. However, this will depend on the level of nutrition knowledge already available among the target population as we may not observe any significant effect if the target population already has exposure to such information. While these are useful for policy, further research could be useful to understand the cost benefit analysis for nutritionally enhanced foods including multicomposite products. This may provide further insights on whether private processing companies could sustainably produce such products while being conscious of final consumer prices especially for products targeting low income markets.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodpol.2019.101745.

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