The Effect of Nutrition Knowledge and Women's Empowerment on Nutrition Outcomes of Children in Rural Ethiopia

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By

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Abstract

Child malnutrition in its various forms remains widespread in Ethiopia, and children often consume poor diets characterized by low diversity. Efforts seeking to improve child nutrition have placed a strong emphasis on women's role. Women's nutrition knowledge and empowerment are vital impact pathways for nutrition-sensitive programs and interventions. This paper examines the effects of women's nutrition knowledge and empowerment on child nutrition outcomes using survey data from rural Ethiopia. Using an instrumental variable (IV) approach to address potential endogeneity concerns, women's nutrition knowledge and empowerment are found to have strong and significant effects on reducing child stunting. The interaction between nutrition knowledge and women's empowerment appears to have additional power in explaining child stunting. A disaggregated analysis of empowerment reveals that empowering women in agricultural household decisions and increasing their access to and control of economic resources are more promising for improving child nutrition. Overall, the findings suggest efforts targeting to improve child nutrition in rural Ethiopia need to ensure that they are complemented by efforts to improve women's nutrition knowledge and empowerment.

Keywords: *Child nutrition; child stunting; nutrition knowledge; women's empowerment; Ethiopia*

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1. Introduction

Malnutrition in its various forms (undernutrition, micronutrient deficiencies and overnutrition) continues to be a major global challenge with huge social and economic costs (Gillespie and van den Bold, 2017). It is regarded as the most important risk factor for illness and death globally. Particularly, children constitute the most nutritionally challenged groups due to their special dietary requirements for growth and development. Malnutrition (in some form) is a cause of 45% of all deaths of children under five years of age, amounting to over three million deaths each year globally (Black et al., 2013; Gillespie and van den Bold, 2017). It is estimated that 25% of all children in developing countries are stunted, an indication of sustained episodes of energy and micronutrient deficiencies (Debela et al., 2017). Particularly in Africa, the number of stunted children continues to increase (IFPRI, 2016; UNICEF, WHO, & World Bank, 2015). As a result, ending malnutrition has become a key policy challenge for national and international development efforts (Hawkes et al., 2013; Lim et al., 2013). For so long, improving agricultural production has remained the primary focus of development efforts seeking to end malnutrition. However, the relationship between agriculture and nutrition outcomes is far more complex than popularly assumed (World Bank, 2007). While increased food production is required for food availability, it does not in itself guarantee that poor and vulnerable people have access to enough food. Nor does the gross quantity produced say much about the quality or nutritional value of people's diets. Following this development, the past few years has seen a significant increase in interest in understanding roles of other factors in nutrition outcomes.

One such widely recognized factor is women's role in improving children's nutrition outcomes. Women are particularly important for nutritional outcomes of children and other household members, because in most situations mothers are primarily responsible for dietary choices and food preparation. Women have consistently been found to be more likely than men to invest in their children's health and well-being, and generally the income and resources that women control wield disproportionately strong effects on health and nutrition outcomes (World Bank, 2012; Malapit and Quisumbing, 2015). One of the biggest challenges for the role that women could play in achieving better children's nutrition outcomes is the limited access that they have to productive resources (Sraboni et al., 2014). In developing countries, women do usually not make independent decisions because of the limited access to control

over material and non-material resources. Many times, not poverty per se but the lack of awareness and proper decision power is the most likely cause of food choice and faulty infant feeding practices in Ethiopia (Headey, 2014). Considering this, nutrition knowledge and women's empowerment have been identified as important pathways through which agricultural interventions can enhance nutrition and health outcomes in developing countries (World Bank, 2007; Webb, 2013).

In this paper, we seek to study both independent and interacted impacts of women's nutrition knowledge and empowerment on children's nutrition outcomes in rural Ethiopia. Nutrition knowledge can contribute to better nutrition and health outcomes through facilitating healthful food choices, changing household preferences, improving food allocation within the household by getting it to those who need it most and/or increasing efficiency in food purchases in markets (Hawkes, 2013). Ideas about what is healthy or good can influence food choices and consumption. The quantity, quality, and diversity of the food prepared in the household, as well as the sanitary practices, influence child nutritional outcomes directly. If women do not understand the importance of providing children with certain foods, or if they perceive healthy foods to be harmful, they will not provide these foods to their children even when the foods are available in the household. For example, in rural Ethiopia, low levels of fruit and vegetable consumption are shown to be partially due to a knowledge gap about what a healthy diet entails and wrong beliefs regarding their nutritional value (Demissie et al., 2009). Ethiopian mothers do not feed young children vegetables because vegetables are perceived to be difficult to digest, leading to stomach illnesses (USAID, 2011). They do also not feed pre-school children meat or other animal source foods because they believed that children cannot digest these foods (Alive & Thrive, 2010). To address such nutrition knowledge gaps, improving caregivers' nutrition knowledge through behavioral change communications has gained a lot of attention among policymakers (African Union, 2015; McNulty, 2013). Nutrition education is positively associated with improved nutrition outcomes (e.g Appoh and Krekling, 2005; Penny et al. 2005; Tariku et al., 2015; Debela et al., 2017; Hirvonen et al., 2017).

At the same time, theoretical and empirical research suggests that maternal nutrition knowledge is necessary but not enough for healthy child nutrition and for inducing related behavioral change (Gracey et al., 1996; Worsley, 2002; Webb and Sheeran, 2006; Geaney et al., 2015). Particularly in the context of developing countries, the position of women in the household is likely to be a limiting factor on the effectiveness of nutrition knowledge (Penny et al., 2005; White, 2009). Mothers in many rural areas are frequently not the decision makers, and rarely the sole decision makers, with respect to health and nutrition of their children, which can seriously undermine the impact of nutrition knowledge. Largely, women's empowerment carries special significance both as an important policy goal in its own right and as a policy tool to achieve other important development outcomes, such as improving household nutrition and health outcomes. There is considerable evidence on the link between women's empowerment and nutritional outcomes of households (Park, 2007; Sraboni et al., 2014; Malapit and Quisumbing, 2015).

To this point, however, studies of the impact of nutrition knowledge and the role of women's empowerment in improving children's nutrition outcomes have proceeded in parallel. In this paper, we contribute to the literature by bringing these two relevant concepts of the current development policy agenda together and examining their interaction in shaping children's nutrition outcomes in rural Ethiopia. We use survey data that contain detailed information on diets of children, their mothers' knowledge of good feeding and nutrition practices, and empowerment across several dimensions. Our key nutritional outcome variable of interest is stunting—an anthropometric measure that reflects long-term nutritional outcomes. Using instrumental variable techniques to address the potential endogeneity of mother's nutrition knowledge and empowerment, we find that nutrition knowledge and women's empowerment lead to considerable improvements in children's nutrition outcomes. We also find evidence that the interaction between nutrition knowledge and women's empowerment is equally important for nutrition outcomes of children. The results can help to design more effective food and nutrition policies to improve nutrition outcomes, especially with the already available resources.

2. Problem statement

Ending malnutrition is one of the key policy challenges of national and international development efforts. This challenge is particularly greatest for Sub-Saharan African countries, where chronic undernutrition is widely spread (FAO, 2014). Particularly among children, malnutrition is linked with very serious consequences in growth and development, and predisposition to many health problems, such as infection and chronic disease. In Ethiopia, poor child nutrition is very acute and remains among the highest in the world. Children fare poorly in several household nutrition metrics. Majority of children in the country consume diets that lack most macro and micronutrients essential for growth (Headey, 2014; Herrador et al., 2015). For example, with 38% of children under five years stunted, Ethiopia still has one of the highest levels of chronic undernutrition in the world, despite significant progress showing a reduction in stunting from 58% in 2000 to 38% in 2016 (CSA, 2017). The challenge of malnutrition is specially more pronounced in rural areas, where access to improved food sources, health facilities, and other infrastructure is very limited.

Given the extent of the problem, improving the nutritional status of children in Ethiopia remains one of the major development goals and a high public health priority. The Ethiopian government and other developmental organizations operating in Ethiopia recognize that the state of poor malnutrition in the country is alarmingly high and requires multiple interventions. More specifically, the Ethiopian government has made a remarkable progress in mainstreaming nutrition across all areas of government, including agriculture, health, and rural development. This strong commitment to mainstreaming nutritional outcomes has been expressed in several key government strategies. For example, the National Nutrition Program (2008, 2013), supported by nine national ministries, mobilizes multiple sectors and stakeholders to improve nutritional status and the latest version (2016) aims to address undernutrition, micronutrient deficiencies and the emerging diet-related NCDs, with healthier diets at the center stage of addressing those multiple burdens of malnutrition simultaneously (GFDRE, 2016). It targets to reduce the magnitude of malnutrition and to scale up current nutrition interventions with a greater focus on multi-sectoral approach by clearly defining the roles and responsibilities of Ethiopia's health, agriculture, water, education, and commercial sectors to address chronic undernutrition. Further, the Nutrition-sensitive Agriculture Strategy emphasizes the importance of maximizing the impact of agricultural policies and interventions on

nutrition outcomes through strengthening linkages between agriculture and post-harvest value chains, management and markets for improving nutrition (MOA, 2015). The strategy highlights the opportunities for improving nutrition through several pathways, including improved production, value chains and marketing of nutritious foods, and increased household income.

Women are central actors in achieving better household nutrition (Nisbett et al., 2017). This interest in the role of women is shown to be based on two considerations. First, women constitute a subgroup of the population who are disproportionately affected by chronic undernutrition. Second, maternal and children's nutritional outcomes are closely linked, not only with the circumstances of the household in general, but also with the status of women in the household, since they are often primary caregivers. Women are more likely to influence health and nutrition outcomes of their children directly through childcare and feeding practices and indirectly through their own nutritional status (Smith et al., 2003; Miller and Cassady, 2015). Aside from being child bearers and caregivers with a more direct influence on fetal and infant health, compared to men, women choose to allocate more resources toward their family's health and nutrition (World Bank, 2012). Recognizing this, the role of women in improving household nutrition outcomes has been stressed in the country's nutrition strategy documents. The National Nutrition Program recognizes that the general lack of control of women over household resources, time, knowledge, and social support networks constitutes a major barrier to improving poor nutritional outcomes in Ethiopia. The Nutrition-sensitive Agriculture Strategy also highlights women's empowerment and knowledge as important impact pathway through which agricultural policies and interventions can yield in better household nutrition outcomes.

However, given persistent gender inequalities in many developing countries, women often lack the autonomy and decision-making power within the household to make key decisions leading to better health and nutritional outcomes, and the resources with which to implement those decisions. To address these problems, the Ethiopian government has long started taking policies measures to improve women's empowerment. Two recent such policies are the joint household land certification and reform in the country's Family Code. Both policies seek to improve the status of women by emphasizing and strengthening gender equality and non-discrimination based on gender. These policies improved women's control over household resources, knowledge about their rights, and participation in social networks and community activities. However, the impact of this improvement on children's welfare has not been explored. Particularly, the evidence backing the effects of women's nutrition knowledge and empowerment on malnutrition is thin and more research is needed.

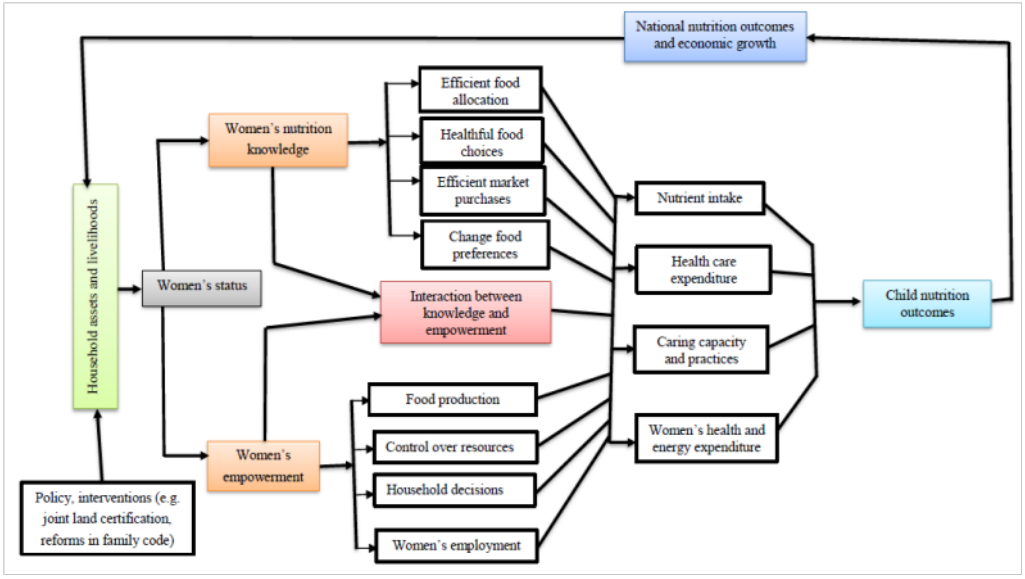
This study seeks to provide rigorous empirical evidence that would assess impacts of women's nutrition knowledge and empowerment and help to facilitate evidence-based decision-making to improve the implementation and effectiveness of policy efforts of the Ethiopian government and beyond. The overarching objective of the study is to examine the independent impacts of women's nutrition knowledge and

empowerment on these nutrition outcomes of children, and the complementarity of nutrition knowledge and empowerment in shaping children's nutrition outcomes. Specifically, we aim to answer the following research questions: (1) What is the impact of women's nutrition knowledge on children's nutrition outcomes in rural Ethiopia? (2) What is the impact of women's empowerment on children's nutrition outcomes? (3) How does the interaction between nutrition knowledge and women's empowerment shape their impacts on children's nutrition outcomes? and (4) Do different dimensions of women's empowerment matter differently for children's nutrition outcomes?

3. Conceptual framework

Following the literature, we develop a simple theoretical conceptual framework to guide our analyses (Fig. 1). It presents our adaptation of the complex pathways and links between women's role and nutrition outcomes. The framework conceptualizes how interventions in mothers can contribute to improved nutrition outcomes of children. Policies and interventions aiming to empower women target changing household assets and livelihoods, with the goal of improving women's status. Household's ownership of natural resources, the types of resources available (e.g., land, labor, etc.), and who has command over the resources play an important role in affecting nutrition outcomes.

Figure. 1: Conceptual framework showing the impacts of women's nutrition knowledge and empowerment on children's nutrition outcomes



The framework depicts how women's nutrition knowledge and empowerment influence children's nutritional outcomes though different channels and interactions. Three main pathways are identified. The women's nutrition knowledge pathway includes healthy food choices, food allocation and food preferences. The women's

empowerment pathway consists of different interrelated components: women's role in food production and use of income, women's control over household resources and other household decisions, and women's employment (Herforth and Harris, 2014). As shown, children nutrition outcomes link directly to women as mothers and how they influence children's nutrition status as caregivers, including affecting nutrition intake and health expenditure, women's ability to care for themselves and children, and women's energy expenditure. Greater bargaining power can benefit nutrition by enabling women to negotiate for access to various health services for themselves and their children (Malapit and Quisumbing, 2015). The last pathway is the interaction between women's nutrition knowledge and empowerment. Finally, good nutrition contributes to cognitive development, bet¬ter opportunities for children to realize their potential, and higher earnings later in life, which in turn support macro¬economic and societal growth.

4. Data and empirical specifications

Data

The study uses cross-sectional data collected by the Institute of Economic Research at Bahir Dar University. The survey was conducted as part of a large food security assessment survey in three districts (Gondar zuria, Dessie zuria and Bahir Dar zuria) of the Amhara regional state, the second most populous region of Ethiopia. The survey took place shortly after the main cropping season (meher) harvest over a six-week period in November and December 2017. The districts have similar agro-climatic conditions and access to relatively large markets. The survey included about 600 randomly sampled rural households in 16 kebeles (sub-districts). Of particular use to our study are 412 households with at least one child between 6 and 60 months of age. As is common in rural Ethiopia, agriculture forms the main source of income for all the households in our sample. The data contained detailed modules on the diets of children, their mothers' knowledge of good feeding and nutrition practices, and different empowerment indicators. Of note is that the module on diets and other information of children was administered at the child level, resulting in 486 relevant observations.

We measure children's nutrition outcome using stunting, which is an anthropometric measure based on height-for-age (HA). Stunting is a standardized indicator useful for assessing the degree to which the physiological needs for growth and development are met during the crucial period of early childhood. This nutrition outcome is based on anthropometric z-scores for children under five that are calculated using the 2006 WHO Child Growth Standards (WHO Multicentre Growth Reference Study Group, 2006). A child is defined as stunted if his or her height-for-age measurement is two or more standard deviations below the median of the reference group. We used different growth references for boys and girls based on the WHO standards to generate Z-scores in our sample.

Mothers' nutrition knowledge is captured in the data through nine statements about appropriate infant and young child feeding practices (WHO, 2008). Women were asked whether they agreed or disagreed with these statements. Agreeing with the statement indicates that the respondent is knowledgeable about the proper infant and young child feeding practices. For our analysis, we reduced the responses to these statements into one index using principal components analysis (see next

section). In our effort to measuring women's nutrition knowledge, our intent is not to examine women's nutrition knowledge in the deeper sense of the term but to assess their nutrition literacy at a basic level, regarding correct infant and child feeding practices about exclusively breastfed, and introduction and increased use of complementary foods for proper growth and development of children between six and 60 months.

Our measure of women's empowerment recognizes that empowerment is a complex multiple dimensional construct (e.g., Mason, 1986; Mahmud et al., 2012). It incorporates three inter-related constructs: (a) resources, (b) agency (the ability to engage in actions), and (c) achievement (whether the desired outcome is really in one's interest) (Kabeer, 1999). While the empirical literature emphasizes economic empowerment indicators, it is well understood that institutions and other social factors, such as kinship networks, social norms and culture, also play central roles in defining perimeters within which women and men interact and negotiate (Agarwal, 1997). Thus, empowerment involves not only decision-making and choice but also resistance, bargaining and negotiation, reflection, freedom of physical mobility and autonomy and attitudes toward verbal and physical abuse. Recently, Alkire et al. (2013) developed an index for women's empowerment in agriculture. While our measurement of women's empowerment captures almost all relevant domains of Alkire et al.'s index, our measurement is slightly different from theirs for two reasons. First, since the survey didn't ask questions of empowerment to male partners, we don't have measurements for some of the Alkire et al.'s indicators (e.g., the gender parity). Second, we have more indicators for some domains and indicators of women's empowerment.

Considering this, this study adopts a nuanced approach to measuring women's empowerment. In total, 32 survey items were used to capture specific components of women's empowerment. These indicators are then grouped into seven relevant domains of empowerment for rural households. These relevant domains include: (i) household decisions about agricultural production, (ii) power in non-agricultural household decisions, (iii) access to and decision-making power about productive resources, (iv) control of use of income, (v) leadership in the community, (vi) freedom of physical mobility and autonomy (including attitudes toward verbal and physical abuse) and (vii) time allocation. All the domains tend to capture indicators that reflect more the Ethiopian rural context. Five of these domains are included in the Alkire et al.'s empowerment index. The domain household decisions about agricultural production captures the extent to which a woman has a sole or joint decision-making power over various agricultural activities, such as which types of crops to grow, whether to use improved agricultural inputs and technology, household decision over food and cash-crop farming, and livestock raising. The non-agricultural household decisions domain covers various aspects of household decision making that are not directly related to household agricultural activities. These decisions include, for example, decisions on number of offsprings to be born, whether to send children to school, and whether to use contraceptives.

The productive resources domain concerns ownership, access to, and decision-making power over productive resources, such as land, livestock, agricultural equipment, consumer durables, and credit. The relevant decision power indicators are ownership of land and other assets, decisions regarding the purchase, sale, or transfer of land and assets, and access to and decisions about credit. The domain control of use of income concerns sole or joint control over the use of income and expenditures. The important indicators comprise controlling and managing the use of household income, whether to save from household income, and expenditures for large items and daily needs, as well as the extent to which a woman feels she can make her own personal decisions regarding wage or salary employment. The leadership in the community domain reflects women's participation and inclusion in local institutions. Women's institutional inclusion can provide them with opportunities to voice and express their interests. The relevant indicators consist of women's membership in economic or social groups, participation in election and community meetings, and comfort in speaking in public. The freedom of physical mobility and autonomy domain gauges the extent of women's independence within the household in taking certain decisions. This indicator is drawn from women's responses to such questions as whether she can go to the market alone, decide by her own to travel and visit family and friends, and take her children to a health clinic alone. The time allocation domain concerns the allocation of time to productive and domestic tasks and satisfaction with the available time for leisure activities. Thus, the indicators are whether a woman can independently decide on the allocation of her time to productive and domestic tasks, and whether she is subjectively satisfied with her available time for leisure activities. Finally, an overall women's empowerment index is constructed based on all domains of empowerment.

In constructing the indices for each domain, we give the same weight to all indicators when aggregating. Many of the individual items were binary response questions with 'yes' and 'no' answer options. As a result, we could not be able to use other index construction methods, like principal component analysis, to reduce multidimensionality of empowerment and to capture only relevant variables (for a household). This is because binary outcome variables are not suitable for such methods (Krishnakumar and Nagar, 2008). Those items that had more than two response options were recoded to binary dummies to facilitate construction of the respective indices. The main analysis is based on the overall empowerment index.

Finally, the survey contains detailed information on socioeconomic and demographic characteristics of respondents.

Empirical specifications

Our empirical specification is informed by our analytical framework. The conceptual framework highlights three important pathways for the role of women in children's nutrition outcomes: nutrition knowledge, empowerment and their interaction. The following empirical specification is estimated at individual child i level to test for

these pathways and examine the relationship of women's nutrition knowledge and empowerment with nutrition outcomes:

$$S = \beta_0 + \beta_1 K_i + \beta_2 E_i + \beta_3 (K_i x E_i) + \beta_4 I_i + \beta_5 H_i + \beta_6 C_i + \varepsilon \quad (1)$$

where S is an indicator for stunting; K_i is nutrition knowledge; E_i is women's empowerment index; I_i is a vector of individual characteristics; H_i is a vector of household characteristics; C_i is a vector of community level characteristics and $K_i x E_i$ is the interaction between nutrition knowledge and women's empowerment. βs are the parameters to be estimated and ε is the error term of the model. Particularly, β_1,β_2 and β_3 are our estimates of interest and measure the relative importance of the three pathways outlined in the conceptual framework. We expect that nutrition knowledge and women's empowerment are negatively correlated with malnutrition.

We estimate a probit model as our outcome variable is a dummy variable that takes 1 if a nutritional status of a child is identified as stunted, and 0 otherwise. To account for potential confounding factors that may be correlated with both nutrition and nutrition knowledge and women's empowerment, our analysis seeks to control for several household and individual characteristics, as well as community characteristics. Main household characteristics include household family size, land size, per capita income, and asset ownership. Individual characteristics cover mother characteristics (age, years of schooling), household head's age, and child characteristics (age, sex, relationship to the primary care giver and status of sickness over the last two weeks prior to the survey). We include mother characteristics to account for her physical and economic ability to give care for her children. To account for community characteristics, we include district dummies in our estimation of the different models. Further, we include kebele (sub-district) fixed effects in all our regressions to capture observed and unobserved kebele characteristics.

Estimating Eqn. (1) requires addressing the concern of endogeneity. As is likely, nutrition knowledge and women's empowerment could be determined by the same factors affecting children's nutrition outcomes. First, there may be unobservable characteristics deriving both nutrition outcomes and our key explanatory variables beyond the observables that we intend to control in the model. Second, there may be measurement errors in our key explanatory variables. Specifically, nutrition knowledge has not been directly observed in our data. We proxy it through responses to nutrition statements. This approach of measuring the 'true level of nutrition knowledge' will probably result in some degree of measurement error. Such measurement error in the independent variable, if randomly distributed with zero mean, typically leads to a lower bound estimate (e.g., Deaton, 1997).

As a result, our core analysis will consist of instrumental variable (IV) strategy to identify causal relationships. For this purpose, we follow the previous literature and utilize insights drawn from Ethiopia's strategy to combat undernutrition in the country to identify valid instruments for both variables. Many variables in our data can

be used as instruments for both nutrition knowledge and women's empowerment. We instrument nutrition knowledge based on household's access to nutrition and health information. For example, studying the impact of maternal knowledge on malaria prevention measures, Pylypchuk and Norton (2014) use a binary variable indicating whether the mother had heard anything about malaria from the radio as an instrument for knowledge. Burchi (2010) also relies on radio-related instruments to study the impact of nutrition knowledge on child nutrition in Mozambique. Block (2007) instruments maternal nutrition knowledge using distance to the nearest health center (that provide nutrition-related education) to assess the determinants of children's micronutrient status in Central Java. On the other hand, since the start of the 2008 National Nutrition Programme, Ethiopia's nutrition strategy has followed a community-based approach where the community serves as a delivery platform for various health services. The program is widespread, covering nearly all districts (woredas) of the country—all the districts included in the sample are beneficiaries of the program. One key component of the program is the deployment of health extension workers (HEW), whose one of the key tasks is the provision of health education. The National Nutrition Programme also provides nutrition information materials to radio and TV stations (GFDRE, 2016). Radio and TV broadcasts contain nutrition-related messages that promote dietary diversity and discuss the importance of micronutrients. With this guidance, we use three types of instruments for nutrition knowledge: ownership of radio— which enables access to the radio broadcasted nutrition messages, visits by a health extension worker in the past 12 months, and distance from the nearest health center.

We identify several instruments for women's empowerment in a similar way. Traditionally, there are certain factors that favor women to have better bargaining power and access resources within the household. First, assets brought to marriage serve as an important indicator of economic independence within marriage. This is because they are not only retained as individual property during marriage but are also excluded from settlements if the marriage dissolves (Thomas et al., 2002). Second, giving birth to a preferred sex gives women more access to household decision-making. Norms and factors associated with labor market opportunities guide sex preference biased towards male children. In particular, the sex of the first born plays a role in power relations within a household. It is common to see that women whose first born is a son are more respected and have more bargaining power. It is often assumed that girls will eventually become part of another family and take some of her birth family's wealth with her on marriage. In contrast, sons are seen to add to the family wealth and labor by bringing an additional person into the family. Hence, they are considered as protectors of the family name. Third, a woman who lives in her birthplace has more say due to the social support she can rely on in her home village through her parents and relatives. The customary marriage system in Ethiopia—more so in rural areas—is traditionally characterized by patrilineal and virilocal residence. In the gist of the custom, girls move to the home of their husband upon marriage. As

a result, distance from parents is an important factor in women's empowerment. Note that all these factors are relatively exogenous to current intrahousehold bargaining processes. Generally, we particularly use four instruments for women's empowerment: assets brought into the marriage, number of sons, distance to parents, and the average empowerment score in the community excluding the woman of interest. These instruments can help us identify exogenous variation in endogenous variables of interest and create a setting that mimics a randomized experiment.

We use a series of tests to inspect whether our instruments are appropriate. Valid instruments are expected to satisfy two criteria. The first is that these instruments should be good predictors of the endogenous regressors: the relevance criterion. In other words, the instruments should be significantly correlated with the endogenous explanatory variables. The first-stage regression results are given in Table 1. Columns (1) and (2) show regression results for nutrition knowledge without and with control variables, respectively. The excluded instruments appear with expected signs, and all instruments are associated statistically significantly at the one percent level. Columns (3) and (4) indicate similar results for women's empowerment. All the instruments have the expected signs and are significant. The validity of the instruments is further demonstrated by appropriate statistical tests. The associated partial F-statistics for the models including only the instruments (columns (1) and (3)) are greater than the minimum 10 threshold value of the "rule of thumb" for strong instruments (Staiger and Stock, 1997). We also use the "estat fiststage" Stata command to test the joint significance of all the instruments for the two endogenous variables. We find that they are jointly significantly different from zero, with a p=value of 0.000 for both nutrition knowledge and women's empowerment.

Table 1. First-stage regression results

Variables	Nutrition knowledge		Empowerment index	
	(1)	(2)	(3)	(4)
Radio ownership	0.346***	0.305***		
	(0.088)	(0.089)		
Visited by health worker	0.307***	0.279***		
	(0.089)	(0.089)		
Distance from a health center	-0.297***	-0.283**		
	(0.105)	(0.104)		
Asset brought to marriage			0.289***	0.266***
			(0.082)	(0.084)
Number of sons			0.145***	0.137***
			(0.025)	(0.026)
Distance from parents			-0.088***	-0.073**
			(0.026)	(0.031)

continued next page

Table 1 Continued

Variables	Nutrition knowledge		Empowerment index	
	(1)	(2)	(3)	(4)
Community average empowerment without the woman of interest			1.418***	1.352***
			(0.165)	(0.184)
Controlsa	No	Yes	No	Yes
Constant	-0.260***	-1.761*	-1.131***	-0.153
	(0.081)	(1.002)	(0.111)	(0.951)
F statistic (model)	12.00	6.64	42.94	11.36
	(3, 482)	(15, 470)	(4, 481)	(16, 469)
Adj. R2	0.064	0.149	0.257	0.255
N	486	486	486	486

Standard errors in parentheses; *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$; N stands for number of observations.
*The control variables include all the above control variables.

The second criterion for valid instruments is that the respective instruments should not be correlated with our outcome variables, other than through the nutrition knowledge and women's empowerment channels. This is the so-called exclusion restriction and it is more difficult to satisfy and to prove. Many of the instruments can be considered as satisfying this criterion well, while for some it is dubious. For example, regarding our radio instrument, one potential concern is that radio ownership may be motivated by the household's desire to have access to the nutrition information that is being broadcasted. If so, households who care more about their children's nutrition and health may be more likely to own a radio. This possibility raises a concern that radio ownership is correlated with our outcome variables through some unobservable parental traits that affect child nutrition outcomes directly. This would then violate the exclusion restriction. We think that this is unlikely to be the case because of widespread access to radios in rural Ethiopia. This then suggests that parents who are not seeking nutrition information would also be randomly exposed to it through listening to the radio. Another concern is that radio ownership captures some type of wealth effect. We address this issue by including controls for household wealth (per capita income, livestock ownership, and land size). Similarly, the health worker visit instrument could also be problematic. For example, it may well be that the health extension workers are more likely to visit households that have under-nourished children and refer them for 'therapeutic feeding'. While this would obviously violate the exclusion restriction, we believe such practice to be rare.

Assets brought to marriage are primarily determined by the parents of women and are largely exogenous to choices of households. The sex of children is determined largely by a natural process, which is beyond the control of spouses. A potential issue is that spouses who are more concerned with their children's nutrition status may practice family planning that deliberately determines the number of children, affecting the probability of the birth of sons of the household. However, we expect that the

impact of family planning to be minimal as family sizes are already large in our sample. Our distance related instruments—distance to health center and distance to parents—are also relatively exogenous. A potential concern is that households may relocate to areas to be closer to health centers and parents of the female spouse. However, this does not pose a serious threat given the Ethiopian land system. All land in principle is owned by the state. More specifically, individual farmers enjoy all the rights of the owner, but cannot officially sell the land. The Ethiopian Land Proclamation has made enjoying secure and continuous land use rights contingent on permanent physical residence in the community (Deininger and Jin, 2006). Further, as there are no private land markets in Ethiopia, households are restricted in terms of where they can live. Therefore, farmland in Ethiopia is mostly acquired either through inheritance from parents or by community allocation. The absence of private land markets means that households seeking better nutrition outcomes would have considerable difficulties doing so by relocating their farms.

5. Results

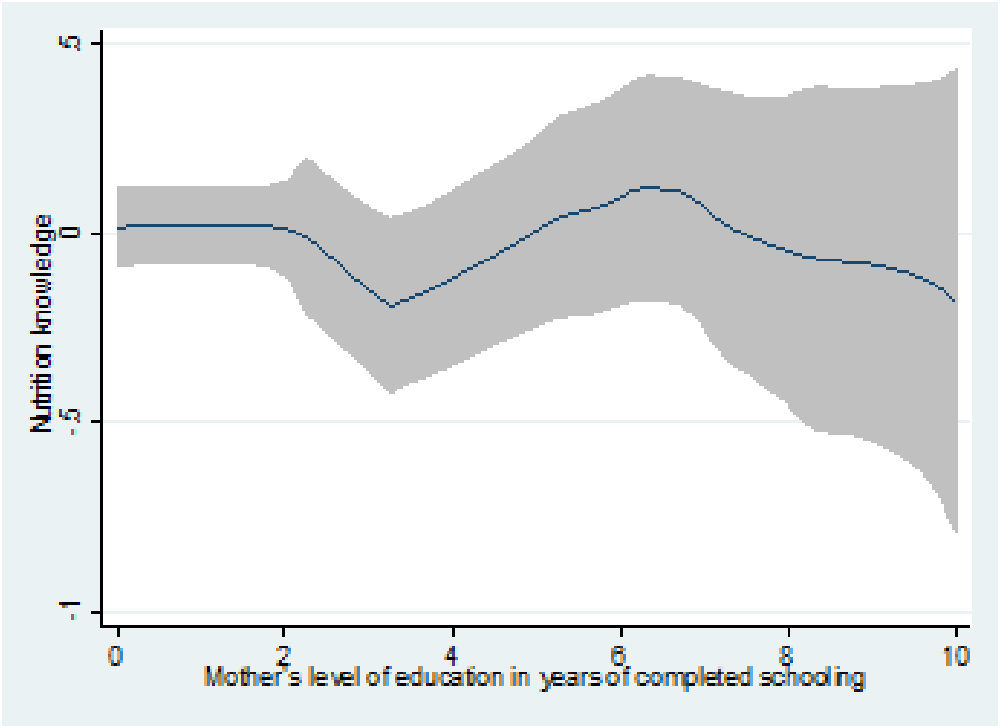
Descriptive analysis

Table 2 shows the detailed summary statistics for households with at least one child between 6 and 60 months of age in our sample. The first row in the variables list presents our outcome variable and shows that 35% of the children were stunted for our sample. As has been discussed, nutrition knowledge is captured through nine statements about appropriate infant and young child feeding practices. Respondents were asked whether they agreed or disagreed with these statements. Table A1 of the Appendix provides an overview of the statements and the distribution of the Likert scale responses to each. We reduce the household responses to these statements into one index using principal components analysis. The nine statement variables are highly correlated (average correlation coefficient is 0.436) and the principal components analysis attempts to find components that account for most of the variation among these variables. Tables A2 and A3 in the Appendix provide a more detailed description of the principal components analysis and the corresponding results. Table A2 shows the eigenvalues for each of the nine components. We see that the first two components explain 65 percent of the variation in the data. Following the Kaiser-rule that states that only components that take an eigenvalue larger than one should be retained, we retained these two components. Columns 1 and 2 in Table A3 provide the principal component loadings based on the first two components. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is displayed in column 3. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy justifies the factor analysis as all KMO values are close to one, implying that the nine statement variables are indeed measuring a common component. The end-product of the principal component analysis is a single variable that we take to represent mother's nutrition knowledge. Moreover, to facilitate interpretation, nutrition knowledge is expressed in units of Z-scores (Table 2).[1]

Since mothers' education has been shown as a significant factor for nutritional outcomes (e.g., Chen & Li, 2009; Alderman & Headey, 2014), we look more closely at this variable. Formal education levels are extremely low in the study area. The average level of education among our respondents is about one year of completed schooling (Table 2) and in our data nearly 70% of the respondents have not attended a formal schooling. Less than 2 percent of the respondents have completed primary

schooling. Figure 2 shows a locally weighted regression of the association between mother's level of education and nutrition knowledge. The relationship is flat throughout the education distribution, implying that education does not explain differences in nutrition knowledge, possibly because of the extremely low maternal education levels in this context. Indeed, recent literature in this area suggests that the nutritional gains from maternal education only appear with secondary education (Alderman & Headey, 2014). In such a context of low formal education levels, gaining nutrition knowledge outside the classroom—for example through media or from frontline health workers—becomes critical (Thomas et al., 1991; Glewwe, 1999; Block, 2007).

Figure 2: Relationships between maternal education and nutrition knowledge.



Note: Local polynomial regressions. Shaded areas refer to 95% confidence intervals.

Our second key explanatory variable is women's empowerment index. In our main analysis, we use an overall women's empowerment index that is constructed by aggregating the 32 items of the seven domains. The average value of the overall empowerment index is about 22 out of the 32 items. To facilitate interpretation, we again express the empowerment index in units of Z-scores and use them in our regressions (see also Table 2). Table A4 in the Appendix gives the averages for individual indicators, for the each of the seven domains and the overall empowerment index (weighted). Of note is that women generally score low in the indices of "Freedom

of physical mobility and autonomy", "Control of use of income" and "Access to and decision-making power about productive resources". Strikingly, only about 26% of the women could decide independently on whether or not they should work to earn money from non-farm employment. Similarly, only about 39% of the women had ever taken out by themselves or been given a credit either in cash or in kind. Later, we will use the seven indicators in our analysis to examine which domains are driving the impacts of women's empowerment.

Table 2. Summary statistics of the study sample (N = 486)

Variables	Description	Mean	Std. Dev.	Min	Max
Outcome variable					
Stunting	A child is stunted = 1, 0 otherwise	0.35	0.48	0	1
Key explanatory variables					
Nutrition knowledge		0.00	1	-2.57	2.20
Overall empowerment		0.00	1	-4.07	2.27
Household and individual level control variables					
Age of caregiver	Age of women in years	33.60	8.57	17	55
Education	Years of education of women	1.18	2.29	0	10
Height	Height of women in centimeters	157.12	7.26	132	175
Household size	Number of people within the household	6.58	2.07	3	12
Religion	Orthodox Christian = 1, 0 otherwise	0.89	0.32	0	1
Age of the head	Age of the household head in years	40.40	8.89	17	59
Land	Land size in timad	6.81	4.27	0	30.5
Livestock	Tropical livestock units of the household	7.07	4.39	0	35.5
Off-farm income	Off-farm income earned by the household =1, 0 otherwise	0.13	0.33	0	1
Per capita income	Annual per capita income earned by the household in Birr	4106.18	5107.29	55.56	57142.86
Log per capita income	Log value of annual per capita income earned by the household in Birr	7.82	1.07	4.02	10.95

continued next page

Table 2 Continued

Variables	Description	Mean	Std. Dev.	Min	Max
Child level control variables					
Boy	Male child = 1, 0 otherwise	0.51	0.50	0	1
Age child	Age of children in months	33.66	16.47	6	60
Mother	Primary care giver is mother to the child = 1, 0 otherwise	0.96	0.19	0	1
Food groups	Number of food groups taken by a child	3.42	1.20	1	7
Sick	Child suffered from diarrhea or other diseases two weeks before survey =1, 0 otherwise	0.05	0.23	0	1
District dummies					
Gondar Zuria	District is Gondar Zuria = 1, 0 otherwise	0.31	0.46	0	1
Dessie Zuria	District is Dessie Zuria = 1, 0 otherwise	0.32	0.46	0	1
Bahir Dar Zuria (reference group)	District is Bahir Dar Zuria = 1, 0 otherwise	0.37	0.48	0	1
Excluded instruments					
Radio ownership	Household owns a radio = 1, 0 otherwise	0.44	0.50	0	1
Visited by health worker	Household visited by a health worker over the last 12 months = 1, 0 otherwise	0.58	0.49	0	1
Distance from a health center	The nearest health center takes greater than an hour = 1, 0 otherwise	0.23	0.42	0	1
Asset brought to marriage	The woman brought an asset to the current marriage = 1, 0 otherwise	0.37	0.48	0	1
Number of sons	Number of sons from the current woman	2.24	1.62	0	8
Distance from parents	Distance from woman's parents in hours	1.52	1.56	0	7
Community average empowerment	Community average empowerment without the woman of interest	0.59	0.25	0	1

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

Table 2 also contains information on other explanatory variables. Household size was measured by the number of people living under the same roof, sharing production and consumption activities. Livestock was measured using tropical livestock units.[2] The average respondent was about 34 years old and was about 157 centimeters in height. The highest proportion of the respondents were Orthodox Christians (89%).

The average household had about seven family members. It is headed by a person who was about 40 years of old. The average household works on about seven timads of cultivable land with a livestock herd of seven tropical livestock units. The annual average per capita income for the sampled households was about 4106 Ethiopian Birr. We constructed this variable by adding income from all income sources of the household, valuing all agricultural outputs and livestock products at average local prices. About 13% of the households generates income from off-farm activities.[3]

As to the characteristics of children included in our study, about 51% of the children in our study were boys and their average age was about 34 months. For 96% of the children, the primary care giver respondents were their biological mothers. About 5% of the children in our survey suffered from diarrhea or any other disease in last two weeks prior to the survey. The average child ate from about three food groups out of seven food groups. The information on food groups is based on responses of mothers of children under five years old on children's food consumption in reference to the previous day (24h). Mothers were asked a series of Yes/No questions about foods consumed by all children between six and 60 months who currently resided in the household. The questions were asked for each child of the household. Following the recommendations of WHO (2008) for assessing IYCF practices, these foods are grouped into the following categories: (1) grains, roots, and tubers (e.g., barley, maize, teff, and wheat); (2) legumes and nuts; (3) dairy products (milk, yogurt, cheese); (4) flesh foods (meat, poultry, and fish products); (5) eggs; (6) vitamin A rich fruits and vegetables; and (7) other fruits and vegetables. This yields a score ranging in value from zero to seven. Looking at the consumption of individual food groups revealed important trends. Table A5 in the Appendix shows variations in data on children's consumption of individual food groups. A highest proportion of children consumed grains, roots and tubers, and legumes and nuts. About one-third of the children in our sample consumed dairy products and eggs. The consumption of flesh foods (17%) and vitamin A rich fruits and vegetables (11%) is strikingly low among the surveyed children. But the consumption of other fruits and vegetables is relatively high (75%). Such dietary pattern is not uncommon in Ethiopia; a similar pattern is found, for example, in Hirvonen et al. (2017). There were a few number of children whose mothers reported that they consumed none of these foods during the previous day, either because they were ill or because they only consumed breastmilk.

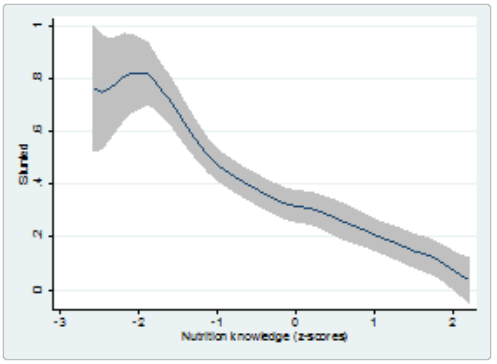
As per the instruments, 44% of the households owned a radio. About 58% of the households were visited by health extension workers. 23% of the respondents resided more than an hour away from the nearest health center. 37% of the respondents had brought an asset to their current marriage. The average respondent had about 2 sons and lived about 1.5 hours away from her parents. The community average empowerment without the woman of interest is about 59%. This variable is computed as a weighting average at a kebele level.

To get a first glimpse of our data, we first carry out a non-parametric statistical analysis. For this purpose, we use local polynomial regression to display the association between our key explanatory variables and our different outcome

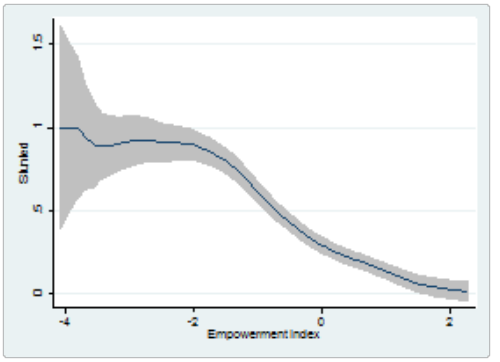
variables. A local polynomial regression uses a polynomial fit to smooth a scatter plot of two variables of interest. The analysis applies a weighted least squares regression with greater weights given to data points closer to the polynomial fit (Cleveland, 1979). Only observations within the smoothing interval are used to estimate the coefficients of the polynomial. Figure 3 depicts results of this non-parametric analysis for the relationship between stunting and nutrition knowledge (panel A) and women's empowerment (panel B).

Figure 3. Relationships between nutrition knowledge, women's empowerment and stunting.

Panel A. Nutrition knowledge and stunting



Panel B. Women's empowerment and stunting



Note: Local polynomial regressions; Shaded areas refer to 95% confidence intervals.

Both polynomial regression plots show the presence of a negative association between nutrition knowledge, women's empowerment, and malnutrition. The plots suggest that there is no non-linear relationships between the key explanatory variables and stunting, motivating the use of linear variables in our subsequent regression models. The subsequent analysis focuses on further examining and formalizing this relationship after controlling for potential confounding factors.

Main results

Table 3 contains estimation results from a series of models. Column (1) shows that nutrition knowledge and women's empowerment are negatively and significantly correlated with malnutrition—stunting. The estimates have the expected signs. The interpretation of the coefficient estimates are relatively straightforward as we used nutrition knowledge and empowerment index in units of Z-scores. For example, on average, a one-standard deviation increase in a mother's nutrition knowledge score decreases the likelihood of stunting by about 0.47 points, all else constant.

Table 3. Impacts of women's nutrition knowledge and empowerment on child stunting

Variables	Dependent variable: Stunting			
	(1)	(2)	(3)	(4)
	Probit	IV Probit	IV Probit	Probit
		Instrumenting for nutrition knowledge	Instrumenting for women's empowerment	Interaction of nutrition knowledge and empowerment
Nutrition knowledge	-0.449***	-1.077***	-0.469***	-0.504***
	(0.097)	(0.335)	(0.097)	(0.105)
Empowerment index	-1.086***	-0.759*	-0.834**	-1.207***
	(0.127)	(0.396)	(0.378)	(0.143)
Nutrition knowledge x Empowerment index				-0.334**
				(0.130)
Food groups	-0.098*	0.086	-0.206	-0.090
	(0.084)	(0.151)	(0.165)	(0.085)
Age of caregiver	-0.032**	-0.010	-0.029*	-0.028*
	(0.016)	(0.024)	(0.017)	(0.017)
Education	-0.065	-0.058	-0.070	-0.065
	(0.045)	(0.040)	(0.044)	(0.044)
Height	0.008	-0.003	-0.007	-0.008
	(0.010)	(0.010)	(0.010)	(0.011)
Household size	0.080*	0.074*	0.086**	0.085**
	(0.042)	(0.041)	(0.042)	(0.042)
Religion	-0.260	-0.674**	-0.248	-0.181
	(0.257)	(0.314)	(0.256)	(0.253)
Age of the head	0.006	-0.007	0.008	0.002
	(0.015)	(0.016)	(0.015)	(0.015)
Land	-0.043**	-0.036*	-0.044**	-0.041**
	(0.020)	(0.021)	(0.020)	(0.020)
Livestock	0.033*	0.026	0.029	0.032*
	(0.018)	(0.018)	(0.019)	(0.019)
Off-farm income	0.022	0.073	-0.061	0.010
	(0.291)	(0.249)	(0.309)	(0.294)
Log per capita income	0.168**	0.128	0.164**	0.186**
	(0.084)	(0.089)	(0.083)	(0.085)
Boy	0.066	0.073	0.075	0.043
	(0.158)	(0.138)	(0.157)	(0.160)

continued next page

Table 3 Continued

Variables	Dependent variable: Stunting			
	(1)	(2)	(3)	(4)
	Probit	IV Probit	IV Probit	Probit
		Instrumenting for nutrition knowledge	Instrumenting for women's empowerment	Interaction of nutrition knowledge and empowerment
	(0.491)	(0.436)	(0.525)	(0.497)
Sick	0.427	0.160	0.438	0.461
	(0.372)	(0.399)	(0.370)	(0.372)
Gondar Zuria	-0.065	0.022	-0.091	-0.042
	(0.505)	(0.438)	(0.501)	(0.514)
Dessie Zuria	-1.303	-0.017	-1.435	-1.215
	(0.935)	(1.302)	(0.941)	(0.984)
Kebele fixed effects	Yes	Yes	Yes	Yes
Constant	-0.013	-0.575	0.393	-0.217
	(1.888)	(1.695)	(1.947)	(1.918)
Pseudo R2	0.428			0.439
Log likelihood	-180.071	-773.457	-671.262	-176.589
Wald test of exogeneity:				
$\chi 2$ (1)		1.34	0.54	
p-value		0.246	0.462	
N	486	486	486	486

Standard errors in parentheses; *p < 0.10, **p < 0.05, ***p < 0.01; N stands for number of observations.

However, as has already been indicated, nutrition knowledge and women's empowerment may be endogenous. To attenuate this concern, we use an instrumental variable (IV) approach to tease out a causal relationship by identifying an exogenous variation in these key variables. As has already indicated, we use radio ownership, visits by a health extension worker and distance from a health center to instrument for nutrition knowledge, and asset brought to marriage, number of sons, distance from parents and community average empowerment without the woman of interest to instrument for women's empowerment. Since we cannot instrument for both nutrition knowledge and women's empowerment at the same time, we estimate the IV models separately. The results are contained in columns (2) and (3) in Table 3. Column (2) gives the results when we instrument for nutrition knowledge. Nutrition knowledge appears with negative and significant coefficient. Column (3) provides results when we instrument for women's empowerment. Women's empowerment again enters significantly and negatively with the expected sign. The coefficient for nutrition knowledge in the IV model appears larger compared to the normal regression estimate for the variable (column (1)). Such differences

are consistent with measurement errors in the nutrition knowledge variable. While measurement errors can bias probit coefficients towards zero (Theil, 1971: p. 608), instrumental variables approach often mitigates such problems (Gujarati, 2003: p. 527).

Another focus of our analysis is examining the effect of the interaction between nutrition knowledge and women's empowerment on child nutrition outcomes. Column (4) in Table 3 presents the result from the basic model by including the interaction between mothers' nutrition knowledge and empowerment as a regressor. The result shows that the interaction between nutrition knowledge and women's empowerment is significant and negative. While we expect the interaction between nutrition knowledge and women's empowerment to be potentially endogenous as are knowledge and empowerment, correcting for it in principle requires using interactions of instruments of nutrition knowledge and women's empowerment to instrument for their interaction. However, the interpretation is not straightforward and, as a result, we don't report these results here.

The coefficient estimates for the other control variables in the basic model (column 1 in Tables 3) also reveal that other control variables are significantly correlated with child malnutrition. Child dietary diversity (number of food groups consumed) is negatively and significantly associated with stunting. Child dietary diversity can be considered as an intermediate outcome of nutrition knowledge and women's empowerment. As a result, it may be potentially endogenous, and the result must be considered as correlation rather than causal effect. Though it is significant, the evidence is weak. This may suggest that, while women's empowerment and nutrition knowledge are important for improving the quality of IYCF practices, the impacts of improvements in the quality of infant and young child feeding practices on ultimate nutrition outcomes is not automatic. First, our measure of food consumption does not capture quantities; only whether different types of foods are consumed. For a maximum effect and for better nutrition outcomes, consumptions of different food groups require to meet certain standard thresholds from a nutrition perspective. This cannot be inferred from our data as our measures of the consumption of different foods are based on Yes/No questions. Second, and equally important, the extent to which diverse diets result in improved nutrition outcomes depends on other underlying household and community-level processes, such as access to health services, water and sanitation, and childcare capacity and feeding practices (UNICEF, 1990; Gillespie, 2013). As a result, diet quality may not necessarily translate to improved nutrition status, owing to the influence of other factors, such as disease, that contribute to poor absorption of nutrients.

Age of the care giver is negatively associated with stunting. This may indicate that caregivers acquire experience and become capable of giving care to their children as they get older. Household size is positively and significantly associated with stunting. Perhaps, this may suggest competition for household resources, such as food, in relatively resource poor rural households. Unexpectedly, per capita income enters

positively and significantly in the model explaining the likelihood of stunting, which may reflect the well know problem of measuring income in poor rural communities who are largely subsistence. The age of children is positively associated with the probability of stunting, which may underlie the long-term impacts of malnutrition. The coefficients of the district dummies are interpreted in relation with the omitted dummy "Bahir Dar Zuria". Compared to Bahir Dara Zuria, Gondar Zuria and Dessie Zuria districts are advantaged in lower stunting levels, though the coefficients are not significant.

Table 4. Results summary: Associations of different domains of empowerment with stunting

Variables	Stunting (Probit)
(A)	
Power in agricultural household decisions	-0.339***
	(0.078)
Nutrition knowledge	-0.424***
	(0.085)
Pseudo R2	0.306
Log likelihood	-218.411
(B)	
Power in non-agricultural household decisions	-0.126
	(0.078)
Nutrition knowledge	-0.425***
	(0.085)
Pseudo R2	0.279
Log likelihood	-226.718
(C)	
Access to and decision-making about productive resources	-0.532***
	(0.088)
Nutrition knowledge	-0.436***
	(0.089)
Pseudo R2	0.339
Log likelihood	-208.089
(D)	
Control of use of income	-0.390***
	(0.079)
Nutrition knowledge	-0.419***
	(0.087)
Pseudo R2	0.316
Log likelihood	-215.100

continued next page

Table 4 Continued

Variables	Stunting (Probit)
(E)	
Leadership in community	-0.337***
	(0.079)
Nutrition knowledge	-0.483***
	(0.088)
Pseudo R2	0.306
Log likelihood	-218.466
(F)	
Freedom of physical mobility and autonomy	-0.305***
	(0.084)
Nutrition knowledge	-0.428***
	(0.086)
Pseudo R2	0.297
Log likelihood	-221.215
(G)	
Time allocation	-0.223***
	(0.073)
Nutrition knowledge	-0.448***
	(0.085)
Pseudo R2	0.290
Log likelihood	-223.306

Standard errors in parentheses; *p < 0.10, **p < 0.05, ***p < 0.01; N =486; N stands for number of observations; the independent regressions include all control variables (see Table 3) and kebele fixed effects.

Finally, women's empowerment is a multidimensional construct. It is thus possible that different domains of empowerment may affect children's nutritional outcomes in different ways and to varying degrees. Here, we use the seven domains of women's empowerment score to identify how specific domains are associated with children's nutrition status. Due to the collinearity between these different domains, we run separate models for each domain, Table 4 displays the summaries of these results. All domains are changed to their corresponding Z-scores and are included in units of Z-scores in the regressions. The regressions also include all the control variables and kebele fixed effects.

Although the different domains of empowerment may be potentially endogenous in our regression models, we believe that suitable instruments for each domain are not available in our data and use probit models and interpret the estimated relationships as associative rather than causal. Results suggest that several components of women's empowerment are significantly associated with stunting. However, all the domains are not important for reducing child malnutrition.

Particularly, power in non-agricultural household decisions is not significantly correlated with stunting. This suggests that improved children nutritional status is not necessarily correlated with empowerment across all domains, and that these domains may have different impacts on nutrition.

Conclusion

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

One such widely recognized factor for improving children's nutrition outcomes is women's role. Emphasis is placed on women's nutrition knowledge and empowerment as key impact pathways for nutrition-sensitive programs and interventions. This paper studies the effects of women's nutrition knowledge and empowerment, and their interaction on child nutrition outcomes using a rich dataset from rural Ethiopia. Accounting for potential endogeneity of nutrition knowledge and empowerment due to potential measurement errors, omitted variables and reverse-causality, the main results show that women's nutrition knowledge and empowerment have strong and significant effects on reducing child stunting. The interaction between nutrition knowledge and women's empowerment has also additional power in explaining stunting. A disaggregating analysis of empowerment reveals that empowering women in agricultural household decisions and increasing their access to and control of economic resources are the most promising domains for improving children's nutrition outcomes.

The findings of this study have important implications for programs and interventions geared towards improving children's nutrition outcomes. Overall, policy makers and program implementers need to ensure that efforts to improve children's nutrition in rural Ethiopia are complemented by efforts to improve women's nutrition knowledge and empowerment. Notably, results related to nutrition knowledge point to a role for behavior change communication interventions (BCCI) in improving dietary quality and hence children's nutrition outcomes. Furthermore, while overall

empowerment contributes to considerable improvements in children's nutrition outcomes, it has clearly come out that the domains of power in agricultural household decisions and access to and control of economic resources are the most promising areas for policy intervention. However, the importance of the different domains and indicators of women's empowerment may vary in different settings as dietary choices are deeply embedded in social norms, cultural values and religious beliefs. As a result, the results of this study should not be simply generalized to other contexts—their external validity may be limited.

Notes

1. The Z-scores are computed by subtracting the initial knowledge value from the sample mean and then dividing this with the standard deviation of the sample.

2. Tropical livestock unit is a common unit to quantify a wide range of livestock species to a single figure to get the total amount of livestock owned by a household. We employed a tropical livestock unit applicable for SSA.

3. Theoretically, participation in off-farm income generating activities is expected to impact stunting differently from per capita income because it entails exposure to more information and networks apart from just the quantity of income generated.

4. This item is recorded in the reverse order. Meaning, women who disagreed with the statement were considered as the more empowered ones.

References

African Union. 2015. African Regional Nutrition Strategy 2015-2025. In First meeting of the specialized Technical Committee on Health, Population and Drug Control. Addis Ababa, Ethiopia: African Union.

Agarwal, B. (1997). ''Bargaining'' and Gender Relations: Within and Beyond the Household. *Feminist economics* 3(1): 1–51.

Alderman, H., & Headey, D. (2014). The nutritional returns to parental education. IFPRI Discussion Paper, 01379.

Alive & Thrive. 2010. IYCF Practices, Beliefs and Influences in Tigray Region, Ethiopia. Edited by Alive and Thrive. Addis Ababa, Ethiopia.

Alkire, S., Meinzen-Dick, R., Peterman, A., Quisumbing, A.R., Seymour, G. & Vaz, A. (2013). The Women's Empowerment in Agriculture Index. *World Development* 52: 71–91.

Appoh, L. Y., & Krekling, S. (2005). Maternal nutritional knowledge and child nutritional status in the Volta Region of Ghana. *Maternal & Child Nutrition* 1:100–110.

Black, R. E., Victora, C. G., Walker, S. P., Bhutta, Z. A., Christian, P., de Onis, M., Ezzati, M., et al. (2013). Maternal and Child Undernutrition and Overweight in Low-income and Middle-income Countries. *Lancet* 382, 427.

Block, S. A. (2007). Maternal nutrition knowledge versus schooling as determinants of child micronutrient status. *Oxford Economic Papers*,59(2): 330–353.

Burchi, F. (2010). Child nutrition in Mozambique in 2003: The Role of Mother's Schooling and Nutrition Knowledge. *Economics & Human Biology* 8: 331–345.

Central Statistical Agency of Ethiopia (CSA). 2017. Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia.

Chen, Y., & Li, H. (2009). Mother's education and child health: Is there a nurturing effect? Journal of Health Economics 28(2): 413–426.

Cleveland, W. S. (1979). Robust Locally Weighted Regression and Smoothing Scatterplots. *Journal of the American Statistical Association* 74: 829–836.

Deaton, A. (1997). The analysis of household surveys: A microeconometric approach to development policy. Baltimore, MD: Published for the World Bank by Johns Hopkins University Press.

Debela, B. S., Demmler, K. M., Rischke, R., & Qaim, M. (2017). Maternal Nutrition Knowledge and Child Nutritional Outcomes in Urban Kenya. *Appetite* 116: 518–526.

Deininger, K., & Jin, S. (2006). Tenure security and land-related investment: Evidence from Ethiopia. European Economic Review, 50 (5), 1245–1277.

Demissie, T., Ali, A. & Zerfu, D. (2009). Availability and Consumption of Fruits and Vegetables in Nine Regions of Ethiopia with Special Emphasis to Vitamin A Deficiency. *Ethiop. J. Health Dev.* 23(3):216–222.

Food and Agriculture Organization (FAO) (2014). The State of Food Insecurity in the World: Economic Growth Is Necessary but Not Sufficient to Accelerate Reduction of Hunger and Malnutrition. Rome, Italy.

Geaney, F., Fitzgerald, S., Harrington, J.M., Kelly, C., Greiner, B.A., & Perry I.J. (2015). Nutrition knowledge, diet quality and hypertension in a working population. *Preventive Medicine Reports* 2: 105–113.

Gillespie, S., 2013. Myth and realities of child nutrition. Econ. Polit. Weekly 48 (34), 64–67.

Gillespie, S. & van den Bold, M. (2017). Agriculture, Food Systems, and Nutrition: Meeting the Challenge. *Global Challenges* 1.

Glewwe, P. (1999). Why does mother's schooling raise child health in developing countries? Evidence from Morocco. Journal of Human Resources 124–159.

Government of the Federal Democratic Republic of Ethiopia (GFDRE). (2016). National Nutrition Programme. Addis Ababa, Ethiopia.

Gracey, D., Stanley, N., Burke, V., Corti, B. & Beilin, L. J. (1996). Nutritional Knowledge, Beliefs and Behaviours in Teenage School Students. *Health Education Research* 11(2):187–204.

Gujarati, D., 2003. Basic Econometrics, 4th Edition. New York, NY: McGraw Hill Inc.

Hawkes, C. (2013). Promoting Healthy Diets Through Nutrition Education and Changes in the Food Environment: An International Review of Actions and Their Effectiveness. Food and Agriculture Organization of the United Nations. Rome, Italy.

Hawkes, C., Thow, A. M., Downs, S., Ling, A. L., Ghosh-Jerath, S., Snowdon, W., Morgan, E. H., Thiam, I. & Jewell, J. (2013). Identifying Effective Food Systems Solutions for Nutrition and Noncommunicable Diseases: Creating Policy Coherence in the Fats Supply Chain. *SCN News* 40: 39–47.

Headey, D. (2014). An Analysis of Trends and Determinants of Child Undernutrition in Ethiopia, 2000□2011. IFPRI Ethiopia Strategy Support Program Working Paper 70. Addis Ababa: International Food Policy Research Institute.

Herforth, A. & Harris, J. (2014). Understanding and Applying Primary Pathways and Principles. Improving Nutrition through Agriculture Technical Brief 1. Arlington, VA, US: Strengthening Partnerships, Results, and Innovations in Nutrition Globally.

Herrador, Z., Perez-Formigo, J., Sordo, L., Gadisa, E., Moreno, J., Benito, A., Aseffa, A. & Custodio, E. (2015). Low Dietary Diversity and Intake of Animal Source Foods among School Aged Children in Libo Kemkem and Fogera Districts, Ethiopia. *PLOS ONE* 10(7).

Hirvonen, K., Hoddinott, J., Minten, B. & Stifel, D. (2017). Children's Diets, Nutrition Knowledge and Access to Markets. *World Development* 95: 303–315.

IFPRI (2016). Global Nutrition Report 2016: From Promise to Impact - Ending Malnutrition by 2030. International Food Policy Research Institute, Washington, DC.

Kabeer, N. (1999). Resources, Agency, Achievements: Reflections on the Measurement of Women's Empowerment. *Development and Change* 30(3): 435–464.

Krishnakumar, J., & Nagar, A. (2008). On exact statistical properties of multidimensional indices based on principal components, factor analysis, MIMIC and structural equation models.

Social Indicators Research, 86(3), 481–496.

Lim, S., Vos, T., Flaxman, A. D., Danaei, G., Shibuya, K., Adair-Rohani, H. & Davis, A. (2013). A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors and Risk Factor Clusters in 21 regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010. *The lancet* 380(9859): 2224–2260.

Mahmud, S., Shah, N. M. & Becker, S. (2012). Measurement of women's empowerment in rural Bangladesh. *World Development* 40(3): 610–619.

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.

Mason, K. O. (1986). The status of women: Conceptual and methodological issues in demographic studies. *Sociological Forum* 1(2): 284–300.

McNulty J. (2013). Challenges and Issues in Nutrition Education. Nutrition Education and Consumer Awareness Group, Food and Agriculture Organization of the United Nations. Rome, Italy.

Miller, L. M. & Cassady, D. L. (2015). The Effects of Nutrition Knowledge on Food Label Use: A Review of the Literature. *Appetite* 92: 207–216.

Ministry of Agriculture (MOA). (2015). Nutrition Sensitive Agriculture: Strategic Plan. Addis Ababa, Ethiopia.

Nisbett, N., van den Bold, M., Gillespie, S., Menon, P., Davis, P.,Roopnaraine, T., Kampman, H., Kohli, N., Singh, A. & Warren, a. (2017). Community-Level Perceptions of Drivers of Change in Nutrition: Evidence from South Asia and Sub-Saharan Africa. Global Food Security 13: 74–82.

Park, C. (2007). Marriage Market, Parents' Bargaining Powers, and Children's Nutrition and Education. *Oxford Bulletin of Economics and Statistics* 69(6): 773–793.

Penny, M. E., Creed-Kanashiro, H. M., Robert, R. C., Narro, M. R., Caulfield, L. E. & Black, R. E. (2005). Effectiveness of an Educational Intervention Delivered Through the Health Services to Improve Nutrition in Young Children: A Cluster-Randomised Controlled Trial. *Lancet* 365 (9474):1863–1872.

Pylypchuk, Y., & Norton, S. W. (2014). Preventing malaria among children in Zambia: The role of mother's knowledge. *Health Economics* 24(11): 1389–1402.

Smith, L. C., Ramakrishnan, U., Ndiaye, A., Haddad, L. J. & Martorell, R. (2003). The Importance of Women's Status for Child Nutrition in Developing Countries. Washington, DC: International Food Policy Research Institute.

Sraboni, E, Malapit, H. J., Quisumbing A. R. & Ahmed, A. U. (2014). Women's Empowerment in Agriculture: What Role for Food Security in Bangladesh? *World Development* 61: 11–52.

Staiger, D., & Stock, J. (1997). Instrumental variables regression with weak instruments. Econometrica, 65(3), 557–586.

Tariku, B., Whiting, S. J., Mulualem, D. & Singh, P. (2015). Application of the Health Belief Model to Teach Complementary Feeding Messages in Ethiopia. *Ecology of Food and Nutrition:* 1–11.

Theil, H., 1971. Principles of Econometrics. New York, NY: John Wiley & Sons, Inc.

Thomas, D., Strauss, J., & Henriques, M.-H. (1991). How does mother's education affect child height? Journal of Human Resources, 183–211.

Thomas, D., Elizabeth, F., and Dante C. (2002). Distribution of power within the household and child health. Mimeo, UCLA.

UNICEF, 1990. Strategy for Improved Nutrition of Women and Children in Developing Countries. United Nations Children's Fund, New York.

UNICEF, WHO, & World Bank Group (2015). Joint Child Malnutrition Estimates 2016 Edition. United Nations Children's Fund, the World Health Organization and World Bank Group, New York, N.Y; Geneva, Switzerland and Washington, D.C.

USAID. 2011. Integration of Nutrition Education into the Ethiopia Urban Gardens Program: Results of Recipe Trials and Focus Group Discussions. Edited by USAID: Infant & Young Child Nutrition Project. Washington DC.

Webb, P. (2013). Impact Pathways from Agricultural Research to Improved Nutrition and Health: Literature Analysis and Research Priorities. FAO and WHO, Rome.

Webb, T.L., Sheeran, P., 2006. Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychol*. *Bull*. 132(2).

White, H. (2009). Theory-Based Impact Evaluation: Principles and Practice. Working Paper 3, International Initiative for Impact Evaluation (3ie).

World Bank (2007). From Agriculture to Nutrition: Pathways, Synergies and Outcomes. Washington, DC.

World Bank (2012). World Development Report 2012. Washington, DC.

World Health Organization (WHO), 2008. Indicators for Assessing Infant and Young Child Feeding Practices: Part I Definitions, Geneva.

WHO Multicentre Growth Reference Study Group, 2006. WHO Child Growth Standards: Length/height-for-age, Weight-for-age, Weight-for-length, Weight-for-height and Body Mass Index-for-age: Methods and Development, World Health Organization, Geneva.

Worsley, A. (2002). Nutrition knowledge and food consumption: can nutrition knowledge change food behaviour? *Asia Pacific J Clin Nutr* 11(Suppl): S579–S585.

Appendix

Table A1. Nutrition knowledge statements and the distribution of the responses, %

Statements	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Breast milk is by far the best food for a newborn baby	4.73	6.58	17.08	46.5	25.10
Colostrum should be given to the baby	10.08	25.10	13.99	40.12	10.70
Babies should be put to the breast within one hour of birth.	9.26	18.11	19.34	44.03	9.26
Give only breast milk for the first six months of life	7.82	11.73	14.20	44.65	21.60
Babies should eat thick porridge once they stop breastfeeding	5.76	8.64	16.26	45.06	24.28
Very young children (6-24 months) should eat eggs and meat	4.94	18.52	22.63	38.48	15.43
Porridge for young children (6-24 months) should be made by adding vegetables, eggs, milk	5.76	18.11	22.22	39.30	14.61
Give a variety of foods to very young children (6-24 months)	9.05	11.52	21.81	40.74	16.87
Give your sick children (6-24 months) more food than usual	5.35	16.67	20.16	42.39	15.43

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

Table A2: Principal components and eigenvalues

Components	Eigenvalue	Proportion
component 1	4.57	0.51
component 2	1.25	0.14
component 3	0.76	0.08
component 4	0.60	0.07
component 5	0.49	0.06
component 6	0.47	0.05
component 7	0.38	0.04
component 8	0.34	0.04
component 9	0.12	0.01

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

Table A3: Principal component loadings and measure of sampling adequacy

Statement	1	2	3
	Comp1	Comp2	Kaiser-Meyer-Olkin measure
Breast milk is by far the best food for a newborn baby	0.35	-0.15	0.91
Colostrum should be given to the baby	0.25	0.61	0.78
Babies should be put to the breast within one hour of birth.	0.25	0.61	0.75
Give only breast milk for the first six months of life	0.30	0.22	0.90
Babies should eat thick porridge once they stop breastfeeding	0.36	-0.24	0.92
Very young children (6-24 months) should eat eggs and meat	0.39	-0.23	0.80
Porridge for young children (6-24 months) should be made by adding vegetables, eggs, milk	0.40	-0.20	0.80
Give a variety of foods to very young children (6-24 months)	0.36	-0.03	0.90
Give your sick children (6-24 months) more food than usual	0.31	-0.19	0.95
Overall			0.85

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

Table A4: Women's empowerment domains and indicators (N = 486)

Variable	Mean	Std. Dev.	Min	Max
(i) Household decisions about agricultural production	**0.74**	**0.21**	**0**	**1**
Decisions on crop choice	0.86	0.35	0	1
Decisions on food and cash-crop farming and livestock	0.76	0.43	0	1
Decisions on land investment and management such as tree planting or soil conservation	0.81	0.39	0	1
Decisions on whether to use agricultural technology (e.g., fertilizer and hybrid seeds)	0.75	0.43	0	1
Decisions on whether to sell or buy animals	0.46	0.50	0	1
Decisions on agricultural labor supplies	0.83	0.38	0	1
(ii) Power in non-agricultural household decisions	**0.78**	**0.25**	**0**	**1**
Decisions on number of offspring to be born	0.73	0.44	0	1
Decisions on whether to send children to school	0.65	0.48	0	1
Decisions on whether to use contraceptives	0.85	0.36	0	1
Decisions on whether a sick household member must go to health center	0.89	0.31	0	1
(iii) Access to and decision-making power about productive resources	**0.64**	**0.26**	**0**	**1**
Decisions on land allocation to different uses	0.73	0.45	0	1
Decisions to give land to children or relatives (inheritance)	0.69	0.46	0	1
Decisions on whether the household to access and borrow credit	0.68	0.46	0	1
Whether a woman has ever taken out by herself or been given a credit either in cash or in kind	0.39	0.49	0	1
Decisions whether to buy, sell or transfer to somebody her owned assets	0.72	0.45	0	1
(iv) Control of use of income	**0.64**	**0.23**	**0**	**1**
A woman can decide independently on whether or not she should work to earn money from non-farm employment	0.26	0.44	0	1
Decisions on controlling and managing the use of your household income	0.80	0.40	0	1
Decisions on whether to save from household income	0.64	0.48	0	1
Decisions on expenditure in large items	0.68	0.46	0	1
Decisions on making household purchases for daily needs	0.85	0.36	0	1

continued next page

Table A4 Continued

Variable	Mean	Std. Dev.	Min	Max
(v) Leadership in the community	**0.70**	**0.26**	**0**	**1**
A woman is by herself an active member of any economic or social group (e.g., agricultural marketing, women's association, Eqqub, Idir, water users' group, etc.)	0.72	0.45	0	1
A woman participated in contributing money or labor to community activities over the last 12 months	0.84	0.37	0	1
A woman can comfortably speak in public concerning various community issues	0.67	0.47	0	1
A woman attends most community meetings in her village	0.73	0.44	0	1
A woman votes in local or national election of any kind	0.55	0.50	0	1
(vi) Freedom of physical mobility and autonomy	**0.58**	**0.25**	**0**	**1**
A woman can go to the marketplace alone	0.73	0.44	0	1
A woman can decide by her own to travel to visit your family and friends	0.44	0.50	0	1
A woman can take her children to a health clinic alone	0.74	0.44	0	1
Wife beating is justified if wife goes out without telling husband, neglects children, argues with husband, and refuses to have sex with him[4]	0.43	0.49	0	1
A woman can decide alone how to use her own income or physical asset (e.g. land, livestock, other assets)	0.59	0.49	0	1
(vii) Time allocation	**0.74**	**0.33**	**0**	**1**
A woman can independently decide on the allocation of her time to productive and domestic tasks	0.79	0.41	0	1
A woman is satisfied with the available time for her leisure activities (e.g., visiting friends, families, etc.)	0.69	0.46	0	1
Overall empowerment index (weighted)	0.69	0.14	0.13	1

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

Table A5. Summary statistics for consumption of individual food groups

Food groups	Mean	Std. Dev.	Min	Max
Grains, roots, and tubers	0.95	0.213	0	1
Legumes and nuts	0.87	0.338	0	1
Dairy products	0.36	0.480	0	1
Flesh foods	0.17	0.373	0	1
Eggs	0.34	0.475	0	1
Vitamin A rich fruits and vegetables	0.11	0.317	0	1
Other fruits and vegetables	0.75	0.434	0	1

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

Mission

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