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Household Food Insecurity May Predict Underweight and Wasting among Children Aged 24–59 Months

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ABSTRACT
The aim of this study was to examine the association between household food insecurity and nutritional status among children aged 24–59 months in Haromaya District. Children (N = 453) aged 24–59 months were recruited in a community-based cross-sectional survey with a representative sample of households selected by a multistage sampling procedure in Haromaya District. Household Food Insecurity Access Scale and anthropometry were administered. Multinomial logistic regression models were applied to select variables that are candidate for multivariable model. The prevalences of stunting, underweight, and wasting among children aged 24–59 months were 61.1%, 28.1%, and 11.8%, respectively. The mean household food insecurity access scale score was 3.34, and 39.7% of households experienced some degree of food insecurity. By logistic regression analysis and after adjusting for the confounding factors, household food insecurity was significantly predictive of underweight (AOR = 2.48, CI = 1.17–5.24, p = .05) and chronic energy deficiency (AOR = 0.47, CI = 0.23–0.97, p = .04) and marginally significant for wasting (AOR = 0.53, CI = 0.27–1.03, p = .06). It is concluded that household food security improves child growth and nutritional status.

KEYWORDS
Ethiopia; household food insecurity; preschool children; undernutrition

Undernutrition is the leading cause of child death, contributing to more than three million deaths every year (SAVE 2010). Globally, 159 million children under 5 years old were stunted (23.8%), 50 million were wasted (7.5%), and 16 million were severely wasted (2.4%) in 2014 (UNICEF, WHO, and WB 2014). A significant number of the world's undernourished children are living in countries where recurrent food insecurity and prolonged disasters occur, and these aggravate their vulnerability. In these countries, factors such as repeated occurrence of communicable diseases, inadequate caring

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capacity, and social and cultural practices are the major factors that could be addressed to cut undernutrition (UNICEF 2013).

The burden of stunting and wasting in Ethiopia is one of the highest in sub-Saharan Africa (UNICEF 2013). According to the 2014 Ethiopian Mini Demographic Health Survey, 40.1% of children aged below 5 years were stunted, and 18% of children aged below 5 years were severely stunted. This report showed that the prevalence of stunting increases as the age of a child increases, with the highest prevalence of stunting (51.9%) found in children aged 24–35 months. Similarly, prevalence of wasting was around 9%, and 25.3% were underweight (EMDHS 2014).

Food insecurity often forces people to review and reassess their livelihood options as their existing means of addressing food needs are becoming unsustainable. Food security is ultimately about individuals' availability, access, stability, and utilization of safe and nutritious food, but as we are social beings, this cannot be analyzed satisfactorily without placing individuals in contexts. According to the definition of the Food and Agriculture Organization of the United Nations (FAO), food security exists when all people, at all times, have the ability to afford and utilize sufficient, safe, and nutritious food to meet their dietary needs and food choices for an active and healthy life (FAO 1996).

Food insecurity is the result of a complex interplay of factors, and it is the most important factor to cause hunger and malnutrition. It is assumed that household food insecurity can negatively affect the nutritional status of children's food consumption, including reduced quantity and quality of diet varieties and nutrient intakes. According to the UNICEF conceptual framework, the three proximate determinants of child nutritional status include food security, adequate care for mothers and children, and a proper health environment, including access to health services (UNICEF 1990). Each of these is strongly affected by poverty (Black et al. 2008).

Several studies have shown that household food insecurity was associated with the nutritional status of children aged under 5 years (Ali Naser et al. 2014; Gulliford, Mahabir, and Rocke 2003; Saha et al. 2009). However, studies from Nepal, Colombia, Brazil, and Ghana revealed that there were no significant associations between household food insecurity and stunting or underweight in children aged under 5 years (Kac et al. 2012; Osei et al. 2010; Saaka and Osman 2013). In another study conducted in Colombia, food insecurity was associated with child underweight but not related to stunting and overweight (Isanaka et al. 2007).

In summary, earlier studies examined the relationship between household food insecurity and nutritional status, but little was known about the relationship between household food insecurity and nutritional status among children aged 24–59 months in developing countries. The association between household food insecurity and nutritional status among children aged 24–59 months in the Haromaya District of East Hararghe Zone, Ethiopia, was not studied. However, such data are important in providing useful evidence and information on the status of food security and child nutritional status in the study area. In addition, this result can identify areas of intervention to alleviate poverty and child malnutrition in general, and food and nutrition security, in particular. Therefore, this study was initiated with the aim to explore the association between household food insecurity and nutritional status among children aged 24–59 months in the Haromaya District of the East Hararghe Zone, Ethiopia.

Materials and methods

The study was conducted in the Haromaya District of the Eastern Hararghe Zone, Oromia Regional State. Haromaya District is located 497 km east of Addis Ababa. According to the 2007 Population and Housing Census results, the total population of Haromaya District was 271,394, of which 138,376 were male and 133,018 were female (CSA 2008).

Study design

Data for this study were collected from a community-based cross-sectional survey designed to test the association between household food insecurity and nutritional status among children aged 24–59 months in Haromaya District from July to September 2015.

The participants of this study were mothers or caretakers and children with the following inclusion criteria: mothers or caretakers of children who had children aged 24–59 months and were accepted to participate in the study; mothers or caretakers of children who had permanent residence (more than 6 months) in the study area.

Sample size

The sample size was based on the previously published Ethiopian Demographic Health Survey (EDHS) report, indicating the prevalence of stunted children aged under 5 years in Oromiya region was 37.5% (EMDHS 2014). Therefore, 37.5% was used in the sample-size calculation using the formula for estimation of single proportion; the sample was multiplied by a design effect of 1.25, and a nonresponse rate of 20%, giving the sample size of 453.

Sampling

A multistage sampling procedure was employed to select the required households. In the first stage, six kebeles (a kebele is the smallest administrative unit of Ethiopia, similar to a ward, a neighborhood, or a localized and delimited group of people) were selected from a total of 33 rural kebeles by using a random-sampling technique. In the second stage, 30 villages were randomly selected with a probability proportional to their population from the six kebeles, according to data from the Haromaya District Health Office. Within each village, households were selected by a systematic random sampling from the list of all the heads of households currently living in the village. Our sampling interval was 1,700 (i.e., cumulative population divided by number of sites). Then, choice of starting point from the households' list was carried out by a random system. If the selected household had more than one child aged 24 to 59 months, only the youngest child was included in the survey to avoid intrahousehold correlation in our data.

Data collection

Data were collected by three field teams with three persons per team through a structured coded questionnaire. All data collectors were trained for 2 days on the study instruments and participated in one round of field testing before the actual work commenced. The performance of the field staffs during data collection was supervised and monitored by the principal investigator.

The mother of the child or other caretaker was requested to give information about sociodemographic characteristics, socioeconomic status (adapted from EDHS), and food insecurity questions.

Household food insecurity

Household food insecurity was measured using the validated Household Food Insecurity Access Scale (HFIAS) for Ethiopia (Coates, Swindale, and Bilinsky 2007; Gebreyesus et al. 2015). The mothers were asked nine questions related to the household's experience of food insecurity in the 30 days preceding the survey. These questions were captured under three main domains of household food insecurity (HFI): (1) anxiety and uncertainty about access (1 question), (2) insufficient quality (3 questions), and (3) insufficient quantity (5 questions). From these questions, two indicators of HFI were constructed: household food insecurity access prevalence and HFIAS score, which ranges from 0 to 27.

Socioeconomic status is an individual's or family's economic and social position relative to others, based on income and owning some properties. It was computed from the property-owning questionnaire (adapted from

EDHS) (CSA 2012). Mean socioeconomic status for each household was computed by summing the value of all assets (durable consumer goods) owned by the household and dividing into three terciles according to the distribution within the sample: lowest, middle, and highest (Doocy and Burnham 2005).

Anthropometric measurements

Children's height, weight, mid-upper-arm circumference (MUAC), and triceps skinfold were measured by following standard recommended procedures (WHO 1995). The nutritional status indicators, weight for height (WHZ), weight for age (WAZ), height for age (HAZ), arm circumference for age (MUACZ), triceps skinfold for age (TSZ), and body mass index for age (BAZ), were compared with reference data from World Health Organization standards (Onis 2006). To assure data quality, at the end of each day the data collected were checked by the supervisor using ENA SMART software (ENA version 2011).

The World Health Organization's (WHO) Anthro Plus software (version 3.2.2, 2011) was used to assess and analyze the nutritional status of the children. Weight for age, height for age, weight for height, arm circumference for age, and triceps skinfold for age less than −3SD is classified as severely underweight, severely stunted, and severely wasted, respectively. Weight for age, height for age, weight for height, arm circumference for age, and triceps skinfold for age between −3SD and −2SD is classified as moderately underweight, moderately stunted, and moderately wasted, respectively. Children with weight for age, height for age, weight for height, mid-arm circumference for age, body mass index for age, or triceps skinfold for age between −2SD and + 2SD were classified as normal weight, normal height, normal skinfold, and normal body mass index, respectively. Weigh for age, height for age, weight for height, and body mass index for age more than +2SD are indicative of overweight, tall stature, and obesity.

Data analysis

Statistical analysis was conducted with SPSS 18 software (SPSS Ltd, Quarry bay, Hong Kong, PASW-statistics 18). Chi-square test was used to test the relationship between household food insecurity and dependent variables: nutritional status in normal and undernourished. Then multinomial logistic regression models were applied to select variables that are candidates for multivariable model. The variables that were associated with the nutritional indexes of the child on the bivariate analysis were used in the multivariable ordinal logistic regression model to find their independent effect. The anthropometric results were also presented as proportions and the output of the logistic regression as adjusted odds ratios (AORs) with 95% confidence intervals (CIs). Associations were considered statistically significant at *p* values less than .05 ($p < .05$).

The HFIAS indicator categorizes households into four levels of HFI: food secure, mildly food insecure, moderately food insecure, and severely food insecure. Households are categorized as increasingly food insecure as they respond affirmatively to more severe conditions and/or frequency of experiencing the conditions following steps described in the HFIAS guide (Coates et al. 2007). The HFIAS score was constructed by adding the total values of the nine questions ranging from 0 to 27, with higher numbers representing a greater level of food insecurity.

Ethical consideration

The study obtained ethical approval from Tehran University of Medical Sciences (TUMS) research ethical review board (Ethical Approval code: 9313421008–145687) and Oromiya regional health office (Ethiopia) research and ethical review committee (Ref. No.: BEFO/AHBTH1/1–8/3834). Both oral and written informed consent were obtained from each study participant after thoroughly describing the aim and benefits of the study. All data were collected in complete agreement with the study participants, coded, and entered in an Excel data sheet.

Results

A total sample of 453 households with one child aged 24–59 months was selected from 1,364 eligible households living in the villages of the six kebeles in Eastern Haraghe zone of Haromaya District. In the interviewed households, 453 eligible mothers and caretakers were identified for individual interview; complete interviews were conducted for all, yielding a response rate of 100%.

Demographic and socioeconomic characteristics of sample households

The total number of children included in the survey was 453, with females slightly outnumbering males (232 compared with 221). The result showed an overall sex ratio of 95 boys per 100 girls. The mean age of the children was 34.87 months (SD = 9.17). The average family size of the sample households was 6.36 persons (SD = 2.2). However, this average masks differences in the number of family members among sample households, which ranged from 2 to 13 persons (table 1).

About 93% of the households were male-headed and the rest were female-headed. The median age of the mothers was 32 years (SD = 6.21) and the

Table 1. Demographic and Socioeconomic Characteristics of Study Participants (*N* = 453), Haromaya, 2015.

Variable	*N* (%)	Mean (*SD*)
Sex of household head		
Male	422 (93.2)	
Female	31 (6.8)	
Mother's age (years)		32.12 (6.21)
< 20 years	14 (3.1)	
20–24	30 (6.6)	
25–29	110 (24.3)	
30–34	112 (24.7)	
≥ 35	186 (41.1)	
Mother's current marital status		
Married	419 (92.5)	
Separated	22 (4.9)	
Widowed	12 (2.6)	
Mother's educational status		
None	386 (85.2)	
Primary and secondary (grades 1–12)	67 (14.8)	
Size of the family in the household		6.36 (2.22)
< 5	174 (38.4)	
5–8	206 (45.5)	
> 8	73 (16.1)	
Child's sex		
Male	221 (48.8)	
Female	232 (51.2)	
Child's age (months)		34.87 (9.17)
24–35	195 (43)	
36–47	174 (38.4)	
48–59	84 (18.5)	
Household socioeconomic status		
Lowest	207 (45.7)	
Middle	163 (36)	
Highest	83 (18.3)	

Note. SD = standard deviation.

range is between 17 and 48 years. The current marital status of the mothers indicated 92.5% were married. Only 14.8% of mothers had reported formal education (primary and secondary school). Around 46% of the households were living in the lowest socioeconomic status (table 1).

Anthropometric status of the study participants

Summary statistics of the nutritional status of children in the study area revealed that the mean weight, height, MUAC, and triceps skinfold were 11.90 kg (SD = 2.26), 85.16 cm (SD = 8.79), 13.78 cm (SD = 1.27), and 8.18 mm (SD = 2.11), respectively. Nevertheless, 2.4% of children had height or weight far out of the range of normal in their age group. The prevalences of stunting, underweight, and wasting were 61.1%, 28.1%, and 11.8%, respectively. Around 10% of the study participants had BMI for age z scores less than –2 SD

Table 2. Anthropometric Characteristics of Sampled Children in Haromaya District, 2015.

			Age (months)			Sex		
Measure		% (95% CI)	24–35	36–47	48–59	Male	Female	*p* value
Weight for height	*N*	450	194	173	83	216	234	.069
	% < -3 *SD*	6.2 (4.4–8.8)	8.2	5.2	3.6	7.4	5.1	
	% < -2 *SD*	11.8 (9.9–13.9)	11.9	10.4	14.5	14.4	9.4	
	% > 2 SD	11.9 (7.8–15.7)	13.9	11.0	4.8	13.4	9	
	% > 3 *SD*	4.0 (1.6–9.5)	5.2	3.5	2.4	5.6	2.6	
	Mean *z* score	0.16	0.33	0.12	−0.15	0.08	0.23	
Height for age	*N*	442	188	171	83	209	233	.179
	% < -3 *SD*	38.2 (32–44.9)	46.3	36.3	24.1	39.7	36.9	
	% < -2 *SD*	61.1 (54.8–67.1)	66	60.8	50.6	64.1	58.4	
	Mean *z* score	−2.49	−2.68	−2.46	−2.13	−2.51	−2.48	
Weight for age	*N*	452	196	173	83	217	235	**.024**
	% < -3 *SD*	12.2 (9.6–15.2)	12.2	13.3	9.6	13.4	11.1	
	% < -2 *SD*	28.1 (24.2–32.3)	28.1	29.5	25.3	32.7	23.8	
	Mean *z* score	−1.31	−1.27	−1.32	−1.36	−1.39	−1.23	
Body mass index for age	*N*	446	191	172	83	214	232	.153
	% < -3 *SD*	5.8 (3.9–8.6)	7.9	4.7	3.6	6.5	5.2	
	% < -2 *SD*	10.8 (8.7–13.2)	11	9.9	12	12.6	9.1	
	% > 2 *SD*	15.9 (12.4–20.3)	21.5	14.5	6	17.3	14.7	
	% > 3 *SD*	6.7 (4.0–11.2)	10.5	4.7	2.4	0.46	5.2	
	Mean *z* score	0.47	0.72	0.41	0.02	0.46	0.48	
Mid-upper-arm circumference for age (%)	*N*	449	195	171	83	214	235	**.002**
	% < -3 *SD*	8.2 (5.3–12.6)	11.3	8.2	1.2	10.3	6.4	
	% < -2 *SD*	30.1 (26.1–34.4)	32.3	30.4	24.1	36	24.7	
	% > 2 *SD*	0.2 (0–2.2)	0.5	0	0	0	0.4	
	% > 3 *SD*	0.2 (0–2.2)	0.5	0	0	0	0.4	
	Mean *z* score	−1.56	−1.55	−1.57	−1.59	−1.61	−1.52	
Triceps skinfold for age (%)	*N*	452	196	173	83	217	235	.090
	% < -3 *SD*	2.2 (1.1–4.4)	3.6	1.7	0	3.2	1.3	
	% < -2 *SD*	8.2 (5.5–12)	11.7	6.4	3.6	10.1	6.4	
	% > 2 *SD*	2 (0.6–5.9)	1	3.5	1.2	2.8	1.3	
	% > 3 *SD*	0 (0–0)	0	0	0	0	0	
	Mean *z* score	−0.08	−0.19	−0.01	0.02	−0.08	−0.09	

Note. SD = standard deviation. Boldface = $p < .05$.

(chronically energy deficient); whereas 16% of the study participants had a BMI for age *z* score greater than 2 SD (overweight) (table 2).

Stunting and underweight were least prevalent in the older age group (48–59 months). The proportion of children who were wasted was lowest in the age group of 36–47 months. The result of the study revealed that the severity of malnutrition as indicated by stunting and wasting was highest in the younger age group (24–35 months) and underweight was highest in the age group of 36–47 months (table 2). Furthermore, the findings of the study revealed the existence of variations in the level of undernutrition depending on the sex of the children. There is a significant difference between the two groups on wasting ($p = .002$) and underweight ($p = .024$). (table 2).

Household food security status

The mean HFIAS score was 3.34. The HFIAS prevalence showed that more than one-third of households in our sample (39.7%) experienced some degree of food insecurity in the 4 weeks preceding the survey. Around 34% of the households experienced worry or anxiety about food supply, and 40% of mothers reported they were not able to feed their household members the kind of food they preferred, such as nutritious animal-source foods (eggs and meat) because of lack of money for purchasing these foods. Approximately one in every four households ate a smaller meal than was needed, and around 22% of the household members ate fewer meals in a day than usual at some point during the 4 weeks before the survey (table 3).

Association between Household Food Insecurity and Nutritional Indicators

A chi-square test of independence was performed to check the relation between HFIAS and child nutritional status. Accordingly, the relation between household food security and wasting (WHZ) was tested, and the relation was significant ($\chi2$ [$df = 1$, $N = 453$] = 4.27, $p = .04$). Children living in food-secure households were less likely to be wasted than were children living in food-insecure households. Similarly, there was a significant association between body-mass-index-for-age *z* score (BAZ) and HFI ($\chi2$ [$df = 1$, $N = 453$] = 5.53, $p = 0.02$), indicating that chronic energy deficiency was more frequent among children living in food-insecure households (table 4). On the other hand, no significant relation was found between HFI and HAZ ($\chi2$ [$df = 1$, $N = 453$] = 1.69 $p = .19$), WAZ ($\chi2$ [$df = 1$, $N = 453$] = 2.76, $p = .09$), MUACZ ($\chi2$ [$df = 1$, $N = 453$] = 2.62, $p = .11$), and TSZ ($\chi2$ [$df = 1$, $N = 453$] = 2.38, $p = .13$) (data not shown).

Table 3. HFI Access-Related Conditions in the Past 30 Days in Haromaya, 2015.

Condition	*N* = 453
Worried about not having enough food, %	33.6
Not able to eat the kinds of foods he/she preferred, %	36.9
Ate just a few kinds of food day after day, %	32.2
Ate food that he/she preferred not to eat, %	22.5
Ate a smaller meal than he/she felt was needed, %	24.7
Ate fewer meals in a day, %	21.6
No food at all, %	3.1
Went to sleep at night hungry, %	2.9
Spent whole day and night without eating anything, %	0.9
HFIAS score	3.34 ± 4.95
Household Food Insecurity Access Scale	
Food secure, %	60.3
Mildly food insecure, %	7.5
Moderately food insecure, %	23.8
Severely food insecure, %	8.4

Note. HFI = household food insecurity; HFIAS = Household Food Insecurity Access Scale.

Table 4. Distribution of WHZ and BAZ by HFI in Children Aged 24–59 Months in Haromaya District, 2015.

	WHZ [*n* (%)]			BAZ [*n* (%)]		
Variable	Normal	Undernourished (< -2 *SD*)	*p*	Normal	Undernourished (< -2 *SD*)	*p*
HFIAS			.04*			.02*
FSH	255 (93.4)	18 (6.6)		254 (94.4)	15 (5.6)	
FIH	158 (87.8)	22 (12.2)		149 (88.2)	20 (11.8)	
Sex of household head			.50			.06
Male	386 (91.5)	36 (8.5)		380 (92.7)	30 (7.3)	
Female	27 (87.1)	4 (12.9)		23 (82.1)	5 17.9)	
Age of mother (years)			.63			.22
< 20	12 (85.7)	2 (14.3)		10 (76.9)	3 (23.1)	
20–24	26 (86.7)	4 (13.3)		26 (86.7)	4 (13.3)	
25–29	101 (91.8)	9 (8.2)		99 (92.5)	8 (7.5)	
30–34	100 (89.3)	12 (10.7)		99 (92.5)	8 (7.5)	
≥ 35	173 (93.0)	13 (7.0)		168 (93.3)	12 (6.7)	
Maternal educational status			.67			.53
None	351 (90.9)	35 (9.1)		341 (91.7)	31 (8.3)	
Primary/secondary	62 (92.5)	5 (7.5)		62 (93.9)	4 (6.1)	
Child's age (months)			.26			.50
24–35	178 (91.3)	17 (8.7)		173 (92.0)	15 (8.0)	
36–47	162 (93.1)	12 (6.9)		156 (93.4)	11 (6.6)	
48–59	73 (86.9)	11 (13.1)		74 (89.2)	9 (10.8)	
Child's sex			.07			.15
Male	196 (88.7)	25 (11.3)		191 (90.1)	21 (9.9)	
Female	217 (93.5)	15 (6.5)		212 (93.8)	14 (6.2)	
Size of the family			.56			.41
< 5	156 (89.7)	18 (10.3)		155 (90.6)	16 (9.4)	
5–8	191 (92.7)	15 (7.3)		185 (93.9)	12 (6.1)	
> 8	66 (90.4)	7 (9.6)		63 (90.0)	7 (10.0)	
Socioeconomic status			.59			.53
Lowest	188 (90.8)	19 (9.2)		180 (91.4)	17 (8.6)	
Middle	147 (90.2)	16 (9.8)		146 (91.2)	14 (8.8)	
Highest	78 (94.0)	5 (6.0)		77 (95.1)	4 (4.9)	
Size of agricultural land (hectare)			.71			.42
None	36 (87.8)	5 (12.2)		34 (87.2)	5 (12.8)	
< 0.25	20 (87.0)	3 (13.0)		18 (85.7)	3 (14.3)	
0.25–0.50	283 (91.6)	26 (8.4)		277 (92.6)	22 (6.3)	
> 0.50	74 (92.5)	6 (7.5)		74 (93.7)	5 (6.3)	
Total	413 (91.2)	40 (8.8)		403 (92.0)	35 (8.0)	

Note. SD = standard deviation; BAZ = body-mass-index-for-age *z* score; WHZ = weight-for-height *z* score; HFI = household food insecurity; HFIAS = Household Food Insecurity Access Scale; FSH = food-secure household; FIH = food-insecure household.
*$p < .05$ (chi-square test [$\chi 2$]).

A logistic regression was conducted to find the relationship between household food insecurity and undernutrition, as well between other confounding factors (sex of household head, child age, child sex, and size of the family) and nutritional status of the child. HFI was significantly associated with wasting (p = .04). After adjusting for all hypothesized confounding factors, the pooled analysis revealed that household food insecurity was significantly predictive of underweight (AOR = 0.63; 95% CI = 0.40–0.99,

p = .05) and chronic energy deficiency (AOR = 0.47; 95% CI = 0.23–0.97, p = .04) and marginally significant for wasting (AOR = 0.53; 95% CI = 0.27–1.03, p = .06) (table 5). Therefore, children living in food-secure households were less likely to be underweight, chronically energy deficient, and wasted than children living in food-insecure households. However, there was no association between food insecurity and HAZ, MUACZ, and TSZ (data not presented). Furthermore, the analysis of the logistic regression revealed that sex of the household head was significantly associated with BAZ (OR = 0.36; 95% CI = 0.13 to 1.02, p = .05) and TAZ (OR = 0.33; 95% CI = 0.13–0.87, p = .02). Size of the family was significantly associated with WAZ (OR = 1.71; 95% CI = 1.11–2.64, p = .01) and MAUCZ (OR = 0.58; 95% CI = 0.39–0.91, p = .02) (table 6).

Discussion

This study addressed two key areas related to household food insecurity and child nutritional status. It was hypothesized that household food insecurity had a significant effect on the nutritional status of children. This result

Table 5. Logistic Regression Predicting Likelihood of Reporting Undernutrition.

		Crude OR			Adjusted OR		
	Variable	B (*SE*)	*p*	Odds ratio (95% CI)	B (*SE*)	*p*	Odds ratio (95% CI)
WHZ	HFIA (secure)	−0.68 (0.33)	.04*	0.51 (0.26–0.97)	−0.64 (0.34)	.06	0.53 (0.27–1.03)
HAZ	HFIA (secure)	−0.26 (0.20)	.19	0.77 (0.52–1.14)	−0.31 (0.21)	.14	0.74 (0.49–1.10)
WAZ	HFIA (secure)	−0.37 (0.22)	.09	0.69 (0.45–1.07)	−0.46 (0.23)	.05*	0.63 (0.40–0.99)
BAZ	HFIA (secure)	−0.82 (0.36)	.02*	0.44 (0.22–0.88)	−0.75 (0.36)	.04*	0.47 (0.23–0.97)
MUACZ	HFIA (secure)	−0.33 (0.21)	.11	0.72 (0.48–1.07)	−0.28 (0.21)	.19	0.76 (0.50–1.15)
TSZ	HFIA (secure)	−0.51 (0.34)	.13	0.59 (0.31–1.17)	−0.41 (0.35)	.25	0.66 (0.33–1.33)

Note. OR = odds ratio; SE = standard error; CI = confidence interval; HFIA = Household Food Insecurity Access; WHZ = weight-for-height *z* score; HAZ = height-for-age *z* score; WAZ = weight-for-age *z* score; BAZ = body-mass-index-for-age *z* score; MUACZ = mid-upper-arm-circumference-for-age *z* score; TSZ = triceps-skinfold-for-age *z* score. Adjusted for sex of household head, child age, child sex, and size of the family.
*p < .05.

Table 6. Logistic Regression Model Predicting Undernutrition.

Variable	Sex of household head			Family size		
Index	B (*SE*)	*p*	Odds ratio (95% CI)	B (*SE*)	*p*	Odds ratio (95% CI)
WHZ	−0.46 (0.56)	0.41	0.63 (0.21–1.89)	0.29 (0.33)	0.37	1.35 (0.70–2.59)
HAZ	0.48 (0.37)	0.19	1.61 (0.78–3.36)	0.01 (0.20)	0.95	1.01 (0.68–1.49)
WAZ	1.12 (0.61)	0.07	3.06 (0.91–10.32)	0.54 (0.22)	**0.01**	1.71 (1.11–2.64)
BAZ	−1.01 (0.53)	**0.05**	0.36 (0.13–1.02)	0.29 (0.35)	0.40	1.35 (0.65–2.69)
MUACZ	−0.38 (0.38)	0.32	0.68 (0.32–1.45)	−0.52 (0.22)	**0.02**	0.58 (0.39–0.91)
TSZ	−1.11 (0.49)	**0.02**	0.33 (0.13–0.87)	−0.28 (0.37)	0.44	0.75 (0.37–1.54)

Note. SE = standard error; CI = confidence interval; WHZ = weight-for-height *z* score; HAZ = height-for-age *z* score; WAZ = weight-for-age *z* score; BAZ = body-mass-index-for-age *z* score; MUACZ = mid-upper-arm-circumference-for-age *z* score; TSZ = triceps-skinfold-for-age *z* score. Boldface = p < .05.

clearly showed that HFI had an association with WAZ and BAZ and marginally with WHZ, after adjusting for the confounding factors (sex of household head, child age, child sex, and size of the family).

The result of the anthropometric measurement showed that the prevalences of stunting and wasting in the area are 61.1% and 11.8%, respectively. These rates are much higher than those of other regions and higher than those of national-level studies for the same age group (children aged 24–59 months) in Ethiopia (Ali et al. 2013; EMDHS 2014; Nguyen et al. 2014). However, the results of the present study were similar to those of a study conducted in Afar (Fentaw, Bogale, and Abebaw 2013). The rate of underweight (28.1%) was similar to that in a study conducted in Bule Hora (29.2%) (Asfaw et al. 2015) but smaller than in the DHS (32.3%) and Tigray (45.3%) reports (Alemayehu et al. 2015; EMDHS 2014).

The result also revealed that the proportion of undernutrition was higher in males than in females in all nutritional indexes—weight for age, weight for height, and height for age—in agreement with other cross-sectional studies in Ethiopia. Similar to these finding, the EMDHS survey report and studies conducted in Bule Hora and Tigray pointed out higher prevalence rates of stunting and wasting for male children than for female children (Alemayehu et al. 2015; Asfaw et al. 2015; EMDHS 2014). Nutritional requirements for children increase as the child grows older, and the demand is higher in males than in females. If we fail to meet these needs, the child may fail to gain weight in the short term, resulting in small stature in the long run (Taylor 1997). Moreover, boys are more affected by environmental stress than girls. Thus, boys are more likely to show the effects of undernutrition, particularly in environments with recurrent infections (Hien and Hoa 2009). The result showed that the severity of undernutrition, stunting, and wasting was highest in the age group of 24–35 months (Alemayehu et al. 2015). The possible explanation is that this age is a period during which most children would require complementary food rich in protein, energy, and micronutrients.

It was hypothesized that child undernutrition and sex of the head of the household are inversely related. The risk of undernutrition was expected to be lower in male-headed households; children who lived in female-headed households were more vulnerable to undernutrition than those who live in male-headed households (Fentaw, Bogale, and Abebaw 2013; Gurmu and Etana 2013). Our study showed that sex of the household head had a significant effect on the nutritional status of the children. This could be because the over burdening of females results in not having enough time to take care of children and family members, and such households could face limited access to resources and health services and be unable to meet their financial needs.

The number of family members living in a household could affect the nutritional status of children. The presence of more than one child in the family usually leads to resource constraints to fulfill the family's need as well as to feed a nutritious and balanced diet to young children, resulting in deteriorated child nutritional status. The study conducted in Ethiopia revealed that the presence of two or more competing siblings in the family increases the likelihood that children could be undernourished (Gurmu and Etana 2013). Moreover, a related study conducted in Ethiopia revealed that there was an association between size of the family and child nutritional status (Fentaw, Bogale, and Abebaw 2013). The present study was in agreement with these findings.

The study of food security using HFIAS score showed that the prevalence of food insecurity in the area was lower (39.7 %) than findings reported from other parts of the country: Ethiopia (66%), Farta (70.7%), and Tigray (68.8%) (Ali et al. 2013; Asmelash 2014; El-Sayed et al. 2010). However, this result coincided with the results of a study conducted in Jimma (39%) (Anderson et al. 2012). The possible justifications might be seasonality and rainfall variations. Since these data were collected in the middle of July, seasonality and food insecurity might be linked. In most parts of Ethiopia, including this study area, July is the time the main rain will began, and a decrease of stored food is common in this month. Similarly, this difference might be attributable to geographical and rainfall variations in different parts of the country.

The hypothesis that food insecurity and child nutritional status (WHZ and WAZ) are associated was supported in the present study; food insecurity was not associated with HAZ because food insecurity was common at every level of HAZ; there was no association between food insecurity and BAZ, MUACZ, and TSZ after adjusting other confounding variables (sex of household head, child age, child sex, and size of the family). Consistent with these findings, studies done in rural Bangladesh, Colombia, and Ethiopia showed the significant association between household food insecurity and child undernutrition (Hasan, Ahmed, and Chowdhury 2013; Isanaka et al. 2007; Motbainor, Worku, and Kumie 2015; Saha et al. 2009).

The combination of natural and manmade factors have resulted in serious and growing food insecurity in Ethiopia. Recurring droughts and erratic rainfall patterns, environmental degradation, and rapid population growth are among the immediate causes of food insecurity in the country. These factors will result in short-term shocks and variations in food availability and food access including changes in domestic food production, food prices, and household incomes (Ministry of Agriculture and Rural Development 2007). Therefore, food insecurity at the household level is associated with low socioeconomic status, inadequate dietary intake, and poor nutritional status of children (PDR 2011).

The association between household food insecurity and low nutritional status in the present study suggests that food-insecure households are often able to afford and provide only a poorly diversified diet for their children, focusing on foods that give energy but lack essential elements and nutrients that promote growth, that is, low or no intake of animal source foods. Thus, not having enough food and having a poorly diversified diet, along with inadequate breast-feeding, contribute seriously to the complete scope of child undernutrition.

Conclusion

The present study provides a recent and accurate picture of the prevalence of wasting, underweight, and stunting in preschool-age children as well the prevalence of household food insecurity in the Haromaya District, East Hararhge Zone, Ethiopia. The findings of the study reveal that household food insecurity was significantly predictive of underweight and chronic energy deficiency and marginally associated with wasting in preschool-aged children of the Haromaya District. It can be concluded that household food security improves child growth and nutritional status.

This information can be used by health authorities and policy makers in the area to plan health and nutrition interventions, to alleviate poverty and child malnutrition in the country in general, and to promote food and nutrition security in the Haromaya District in particular.

Furthermore, this study revealed that boys are more vulnerable and affected by undernutrition than girls; therefore, further studies should be done to understand the possible reason for this difference and to identify the most effective strategies for reducing child malnutrition in the food-insecure households of the study community.

Limitations of the study

The data for this study were cross sectional; they do not allow causal judgments between food insecurity and child nutrition status; some of the variables believed to affect nutritional status are not addressed by the present study.

Conflict of interest

There are no competing financial interests in relation to the current study.

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Notes on contributor

Ahmed Abdulah wrote the proposal; contacted the authorities involved in the study; supervised the data collection in the fieldwork, data entry, and data analysis; and wrote the initial draft manuscript. Dr. Khadijeh Mirzaei, Dr. Ahmed Dorosty, Dr. A. Rahimiforoushani, and Dr. Haji Kedir advised and participated in the design of the study. All authors participated in the review of the manuscripts and read and approved the final manuscript.

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