Inappropriate child feeding practice and primary health care as major correlates of stunting and underweight among infants and young children 6-23 months of age in food insecure households of Amhara and Oromia Regions, Ethiopia. A community based cross sectional study

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Abstract

Background: Child undernutrition is a major public health problem in Ethiopia. Even though the highest levels of stunting are found in food insecure areas, insufficient evidence limits effective intervention to improve the situation. Therefore, this study aimed to assess undernutrition and associated factors among infants and young children aged 6–23 mo in food insecure households of Amhara and Oromia Regions, Ethiopia. **Method:** A community based cross-sectional study was conducted in productive safety net targeted rural households of Amhara and Oromia Regions from April 25 to June 15, 2018. A total of 464 mother-child dyads were included in the study. Both bivariate and multivariate analyses were used to identify factors associated with stunting, wasting and underweight separately. **Results:** The prevalence of stunting, wasting and underweight among children 6-23mo was 42.6%, 12.4% and 27.3% respectively. Age of the child 12-23vs 6-12mo (AOR = 4.21 95% CI: 2.52, 7.05), female (AOR = 1.84 [1.23, 2.75]), higher number of births (AOR = 1.72[1.10, 2.70]), lack of zinc supplement (AOR = 2.41[1.33, 4.38]), inadequate diet diversity (AOR=1.69[1.02, 2.81]) and lack of iodized salt in complementary food (AOR=1.55[1.03, 2.32]) were significantly associated with stunting. Similarly, age of child 12-23 mo (AOR=1.92[1.14, 3.24]), female gender (AOR = 1.88[1.22, 2.90]), higher number of births (AOR= 1.67[1.05, 2.66]), lack of zinc supplement (AOR=2.29[1.14, 4.61]), lower maternal income (AOR= 2.34[1.18, 4.65]), and inadequate diet diversity (AOR= 2.34[1.27, 4.33]) showed significant association with underweight. **Conclusion:** The magnitude of child undernutrition was found to be very high in the study areas. Child nutrition intervention strategies should take into account nutrition education on appropriate child feeding and iodized salt utilization. In addition, improving zinc supplementation and economic empowerment of women are important to address the high prevalence child undernutrition in the study area. **Key words:** Stunting, zinc, iodized salt, diet diversity, maternal income, food insecurity

Background

Child malnutrition is a continuing problem in developing countries [1]. Globally an estimated 151 million children were stunted in 2017. Stunting is the devastating result of poor nutrition in-utero and in early childhood. The UNICEF, WHO, World Bank global and regional child malnutrition estimates indicate that we are still far from a world without malnutrition [2]. The same report noted more than half of all stunted children under 5 lived in Asia and more than one third lived in Africa.

Previous studies summarized different risk factors for childhood undernutrition. Household food security and healthy household environments play important roles in preventing chronic malnutrition [3-5]. Children under 2 years of age have high nutrient requirements because of their rapid growth and are considered the most at risk age group for undernutrition and increased vulnerability to infectious disease. Taking this age group as a window of opportunity, the World Health Organization (WHO) designed and supports the implementation of Infant and Young Child Feeding (IYCF) strategies [6]. However, poor

feeding and health care in children continue as major determinants of undernutrition in developing countries [4].

Failure to wash hands, failure to dispose of feces hygienically and inadequate food hygiene were associated with a high incidence of diarrheal diseases in Ethiopia [7]. According to WHO, the global cause of death for more than half of under five children is diseases that are preventable and treatable through simple and affordable interventions. Particularly, malnourished children have a higher risk of death from common childhood illness such as diarrhea, pneumonia, and malaria. Therefore, children in sub-Saharan Africa are more than 15 times more likely to die before the age of 5 than children in high income countries [8].

Deficiencies of micronutrients like vitamin A, iron and zinc have global public health importance and represent a major threat to the health and development of populations worldwide [4]. These deficiencies are common in developing countries where a higher prevalence of undernutrition exists. Likewise, deficiencies in key vitamins and minerals are among the major public health problems in Ethiopia [9]. A study from northern Ethiopia reported more than two thirds of school-aged children (79.5%) had at least one micronutrient deficiency and 40.5% had two or more coexisting micronutrient deficiencies. Based on biomarkers determined for 764 children, the most prevalent deficiencies were zinc, folate, vitamin A and vitamin D [10]. One of the main factors responsible for micronutrient deficiency is poor diet quality among children. Dietary diversification is one dimension of diet quality and ample evidence indicates dietary diversity is a proxy indicator of nutrient adequacy in a diet [11, 12].

The period from 6 to 24 mo of age in children is one of the most critical periods for linear growth [13]. The recent Ethiopian Demographic and Health Survey (EDHS) reported the national prevalence of stunting, wasting and underweight among children under five years as 38%, 10% and 24% respectively. The magnitude of undernutrition in Ethiopia shows variation from region to region with the lowest prevalence of stunting (14.6%) in Addis Ababa. On the other hand, the regional figures for stunting, wasting and underweight were 46.3%, 9.8% and 28.4% respectively in Amhara region and 36.5%, 10.6% and 22.5% in Oromia region [14].

Chronic and acute food insecurity is prevalent, especially among rural populations of Ethiopia, and about 10 percent of citizens are estimated to be chronically food insecure [15, 16]. This situation in Ethiopia is highly linked to severe, recurring food shortage and famine associated with recurrent drought [17]. Being one of three underlying causes of undernutrition, household food insecurity is assumed to affect the nutritional status of children by compromising quantity and quality of dietary intake [18]. But food security cannot be the only determining factor in ensuring adequate nutritional status of children.

Hence, further investigation is needed to explore the most important factors behind the prevalence of undernutrition among children in Ethiopia [19].

Inadequate maternal and child health care and poor child feeding practices are among the main challenges that create a vicious cycle and contribute to long term existence of food insecurity. Often in developing countries, food insecure households are unable to produce enough food, even in times with favorable situations for agriculture, because the effect of chronic nutritional problems makes them unable to work to their full potential [20]. Nutrition program implementers often lack adequate evidence about which interventions would be most successful in reducing undernutrition in specific areas which may cause decisions to be based on assumptions and unjustified conclusions. Inappropriate programs and interventions may be introduced only to discover the consequences after implementation [21]. Hence knowledge of the relative contribution of the predominant risk factors associated with stunting and underweight is an important prerequisite for developing nutrition intervention strategies, particularly in food insecure areas where the prevalence of undernutrition among children is high.

In these areas, identifying the most important factors contributing to undernutrition is important to guide public health planners, policy makers and implementers. Such knowledge assists to plan and design appropriate intervention strategies that will be more likely to enhance nutritional status of children and mitigate the vicious cycle of food insecurity.

Methods

Study setting and design

The study was conducted in five districts, Meket, Lasta and Sekota from Amhara and Chirro and Sirraro from Oromia where the Development Food Security Activity (DFSA) is being implemented. The districts were selected due to high levels of food insecurity. Overall, the program targeted 407,891 productive safety net program (PSNP₄) clients. From the five districts, kebeles (smallest administrative unit in Ethiopia) were selected randomly and a community based cross-sectional study was conducted from April 25 to June 15, 2018. Mother-child dyads were enrolled from households targeted for PSNP₄ if the child was 6–23 months old.

Sample size and sampling procedure

The sample size of 494 mother-child dyads was calculated using Open-Epi analytic software and included an estimate of 5% for non-response rate. The calculated sample was proportionally allocated to the kebeles based on the total number of targeted households

with 6–23 mo children in each kebele; study participants were identified by simple random sampling.

Data collection tools and procedure

The primary outcome variable in this study was the anthropometric status of the index child measured as Z scores using WHO standards [22]. Socio-demographic variables, maternal and child health care and feeding practice were the independent variables. The socio-demographic variables were selected from those used by the Ethiopian Demographic and Health Survey (EDHS) [14] and collected using structured questionnaires via individual interview. Educational status was categorized according to the education levels in Ethiopia. Sixteen data collectors with BSc. degree and two community health workers were involved in the data collection process in each kebele. Two days of intensive training were provided to data collectors. Questionnaires were pretested in 25 households in non-selected kebeles and some modifications were made accordingly. Data were collected under close supervision of the principal investigator. Child weight was measured to the nearest 0.1 kg with a SECA electronic balance with graduation of 0.1 kg and a measuring range of up to 25 kg. Weight was taken with light clothing and no shoes. Instrument calibration was checked before weighing each child. Furthermore, the weighing scale was tested daily against a standard weight for accuracy. Length of the index child (aged 6–23 mo) was measured using a wooden length board in recumbent position, and read to the nearest 0.1 cm.

Standardized seven food groups were used to qualitatively assess the dietary diversity of children [6]. Mothers were asked to recall the food items consumed by the child in the 24-h proceeding the day of the survey. By considering four food groups as the minimum acceptable dietary diversity, a child with less than four was classified as inadequate dietary diversity; otherwise diet diversity was considered to be acceptable. Household food security was classified as recommended by the Food and Nutrition Technical Assistance (FANTA) Guideline [23]. The household wealth index was computed using a composite indicator considering selected household assets and size of agricultural land. Using principal component analysis (PCA), the factor scores were summed and ranked into quintiles. Data were checked for completeness and quality on a daily basis by the supervisors and principal investigator.

Data analysis

Statistical analyses were done using STATA 14 (Stata/SE 14) statistical package. Emergency nutrition assessment for standardized monitoring and assessment of relief and transitions (ENA for SMART) 2011 software was used to convert the anthropometric measures weight and length for age into Z-scores. Descriptive statistics were calculated

and bivariate analyses were done separately for the three outcome variables: stunting, wasting and underweight. Both Crude Odds Ratio (COR) and the Adjusted Odds Ratio (AOR) with a corresponding 95% Confidence Interval (CI) were computed to show the strength of the associations. All independent variables with p-value less than 0.25 during bivariate analysis were included for multivariate analysis. Multivariate logistic regressions were fitted using stepwise backwards elimination technique to identify determinants of stunting, wasting and underweight separately. In the multivariate logistic regression analysis, variables with a p-value <0.05 were considered as statistically significant. Assumptions of the regression model were found to be satisfied [24].

Results

Socio-demographic characteristics

Totally 464 mother child dyads participated in the present study resulting in a response rate of 94%. Of these, 51.7% of children were females (Table 1). The mean ($\pm$ SD) age of the children was 14.6 ($\pm$ 4.6) mo and mean household size was 5.0 ($\pm$ 1.8) persons. Only 12.7% of households had three or more under five children. Nearly 91% percent of the mothers were housewives and 64.7% had no formal education.

Obstetric characteristics of mothers

More than 90% of mothers had their first pregnancy within the age range of 15-26 years (Table 2). Concerning the total number of births (parity), nearly 27% of mothers had five or more live births. A limited number (20.9%) of mothers had four or more antenatal care visits for their most recent pregnancy. Only 3.5% of mothers gave birth to their most recent child at a health facility and 52.4% of mothers did not have postnatal care (PNC) even once after their most recent delivery. Furthermore, 97.2% of mothers did not get a vitamin A supplement after their most recent birth.

Child feeding practice and health characteristics

Only 52.6% of mothers reported initiating complementary food for the child at six mo of age (Table 3). The frequency of meals reported on the 24-h recall was four or more times for only 20.2% of the children and only 21.5% of the children 6-23 mo old met the minimum dietary diversity criteria. Grains, roots and tubers were the most commonly consumed food items in the 24 h preceding the survey. Only 14.2 % of 6-23 mo children fulfilled the minimum acceptable diet criteria. Mothers who used iodized salt with complementary food were 55%; however, 47.1% mothers reported adding the salt during cooking.

Overall, 42 % of mothers reported their children had respiratory infections, 18% had ear infection and nearly 38% experienced diarrhea in the 2 weeks preceding the survey. Treatment from a health care provider was sought for 47.6% of children with diarrhea out of which 53% of children received zinc treatment. Totally 16% of mothers reported their child had zinc supplements at least once in their life.

Prevalence of stunting wasting and underweight

In children 6-23 mo old, 42.6% were stunted, 12.4% were wasted and 27.3% were underweight (Table 4). The children in the 12-23 mo age groups had higher prevalence of stunting and underweight when compared with the 6-11mo age groups.

Factors associated with stunting, wasting and underweight

The results of the multivariate logistic regression model predicting stunting (Table 5) detected significant associations of age, sex and zinc supplement ($p < 0.01$) and total number of births, iodized salt utilization and dietary diversity of the index child ($p < 0.05$). Among these variables remaining in the model, more than four times higher likelihood of stunting was found among children in the 12-23 mo age group [AOR = 4.21; 95%CI: 2.52, 7.05] compared to infants aged 6-11mo. Baby girls showed 1.84 times more likelihood of stunting (AOR = 1.84 [1.23, 2.75]) compared with baby boys. Similarly children who didn't ever have zinc supplement were more than 2.4 times more likely to be stunted (AOR = 2.41 [1.33, 4.38]). Likewise, 1.5 times higher likelihood of stunting was found among children whose mothers didn't utilize iodized salt with complementary food (AOR = 1.55 [1.03, 2.32]) compared to children who received iodized salt. Children whose mothers gave birth five or more times also showed nearly 1.7 times higher likelihood of stunting (AOR = 1.72 [1.10, 2.70]) compared to those whose mothers had less than five births. Finally 1.7 times higher likelihood of stunting was seen among children who consumed fewer than four food groups (AOR = 1.69 [1.02, 2.89]) in the 24 hr prior to the survey. The other factor that showed associations in bivariate analysis but was not significant in the multivariate model was consuming untreated water (AOR = 1.17 [0.69, 1.99]) compared to those who consumed treated water.

The multivariate logistic regression model (Table 6) predicting wasting detected sex, maternal income per month and untreated drinking water to have significant association with wasting at $p < 0.05$. Nearly two times higher likelihood of wasting was found (AOR=1.97[1.10, 3.51]) among girls as compared to boys. Children whose mothers' monthly income was <500 Eth.birr had 3 times higher likelihood of wasting than children of mothers earning ≥ 500 Eth.birr (AOR=3.29[1.14, 9.50]). Likewise, the likelihood of wasting was more than threefold (AOR=3.22[1.24, 8.39]) higher among children from households who consumed untreated water compared to those who used treated water. Other factors

that had significant associations in bivariate analysis but did not remain in the multivariate model were receiving growth monitoring service compared with not receiving the service (AOR=0.60[0.34, 1.08]) and family size of five or more (AOR=1.70[0.94, 3.08]).

Regarding the determinants of underweight, the multivariate logistic regression model (Table 7) detected significant association of sex and diet diversity with underweight at $p < 0.01$ and age of index child, number of births, zinc supplement and monthly maternal income at $p < 0.05$. Children 12-23 mo showed 1.9 times higher likelihood of underweight (AOR = 1.92[1.14, 3.24]) compared with infants 6-11 mo of age. The likelihood of underweight was 1.88 times higher (AOR = 1.88 [1.22, 2.90]) among girls as compared to boys. Likewise children who had never received zinc supplements had more than two times higher likelihood of being underweight (AOR=2.29[1.14, 4.61]) as compared to those who got zinc supplements at least once. Children who got fewer than four food groups showed 2.34 times higher likelihood of underweight (AOR=2.34[1.27,4.33]). Finally, 2.34 times higher odds of underweight were found among children whose mothers' monthly income was less than 500 Eth.birr (AOR: 2.34[1.18, 4.65]) compared to children whose mothers monthly income was 500 Eth.birr or more.

Discussion

The present study revealed that the prevalence's of stunting and underweight among children 6-23mo of age were 42.6% and 27.3% respectively. These high rates suggest the severe public health significance of problems that need intervention. The findings are consistent with previous studies from Uganda and Ethiopia [25, 26]. Compared to this study, higher prevalence of stunting was reported from Central Africa Republic (61.5%) [27] and Kenya (51%) [3]. However, the present finding was much higher than stunting rates reported from Egypt (23.3%) [28] and Sri Lanka (17.1%) [29].

Even though associations of household food insecurity and wealth index with childhood stunting have been reported in previous studies [29-31], our study did not show significant associations of these variables either with stunting or underweight. Perhaps a skewed distribution of households in our study contributed because the study specifically was conducted in poor and food insecure households. Unlike findings in several previous studies [14, 17, 32], the present study revealed baby girls were more stunted than baby boys. A study in food insecure households of Pakistan [31], reported that female children were nearly three times more likely to be stunted than male children. In the context of Ethiopia, where girls have historically experienced discrimination [33], more preference may have been given to boys, especially as the household experienced greater food stress. A previous study from Ethiopia, which reported large gender difference in feeding practices in severely food insecure households [34], supports this idea. Another study noted that girls were more

likely than boys to be stunted in childhood, whereas boys were more likely than girls to be stunted in adolescence [35].

Consistent with a previous review from Ethiopia [19], the present study showed that the likelihood of being stunted was more than fourfold higher among children aged 12-23 mo compared to infants 6-11mo of age. A plausible explanation might be the effect of malnutrition starting to manifest when the child's nutrient requirement from complementary food increases and breast milk meets less of the needs, particularly at the age of one year and above. This is also an age at which the child is very likely to put everything to his mouth which may increase the risk of infection that negatively impacts the linear growth of the child.

We noted increased risk of stunting among children who did not meet the minimum diet diversity criteria. Previous studies have reported that dietary diversity is a proxy indicator of dietary quality and nutrient adequacy; hence, the overall nutritional quality of the child's diet is improved with a diverse diet [36, 37]. Diversity in the diet is important to meet the requirements for energy and other essential nutrients particularly for those who are at risk of nutrient deficiencies like children in food insecure households. Inadequate diet diversification among children was revealed to be a problem in the present study and lower diet diversity among children was associated with a higher likelihood of stunting. Poor diet diversification in addition to higher nutritional demand related with increased child age may increase the risk of impaired linear growth and be more obvious as these infants and young children grow older.

As one component of diet diversity animal source foods (ASF) have potential to affect linear growth of children. Diets poor in energy, protein and micronutrients can be important contributing factors for stunting [38]. Because ASF are important for improving the dietary quality of children, a more diverse diet is highly correlated with adequate energy, protein, and micronutrients [39-42]. ASF are better than plant source foods for supplying certain micronutrients and high quality protein that are particularly important for bone growth at an early age. Some nutrients also are more bioavailable from ASF. The most important micronutrients contained in ASF are Fe, Zn, Ca, riboflavin, vitamin A and vitamin B₁₂. Hence, relatively small amounts of ASF can substantially increase nutrient adequacy, particularly for young children [41, 42].

The present study also revealed higher likelihood of stunting among children who never received zinc treatment and whose caretakers didn't utilize iodized salt for complementary foods. Previous studies in developing countries have noted that multiple micronutrient deficiencies, particularly deficiencies of vitamin A, zinc, iron and iodine are evident among children [1, 43]. Zinc supplementation in children in endemic areas of zinc deficiency has been reported to enhance linear growth of children [44-46], especially when administered

separately from other micronutrients. Zinc plays an important role in cellular growth, cellular differentiation and metabolism and hence has been recommended by previous researchers from Ethiopia and elsewhere to be included in national strategies to reduce stunting in children < 5 years of age in developing countries [45-47].

Increased demand for zinc can occur due to malnutrition and due to loss from the gut in diarrhea. High prevalence of zinc deficiency in infants has been confirmed in Ethiopia [48], and the effect of zinc on linear growth of children was demonstrated [46]. Even though zinc supplementation is recommended protocol in diarrhea management in Ethiopia, poor compliance has been reported. The most recent EDHS reported that treatment from a health facility or provider for a child with diarrhea was sought for nearly 43% of under five children but zinc supplements were given for only 33% of these children [14]. A study from northern Ethiopia confirmed poor management and inadequate treatment for children with acute diarrhea [49].

The other factor significantly associated with stunting in the present study was iodized salt utilization. Children whose mothers did not utilize iodized salt for complementary food were 1.5 times more likely to be stunted. A low level of iodized salt utilization has been reported in previous studies in Ethiopia [50, 51]. The association of iodized salt with linear growth of children might be explained as iodine is one of the micronutrients that plays an important role in secretion of growth hormone particularly in early life and the deficiency may result in impaired somatic growth [52]. This might have contributed to the prevalence of stunting in the study area. Underweight and stunting in the present study were higher among children 12-23 mo of age as compared to infants 6-11 mo of age. Evidence-based nutrition intervention focused on identified factors in early life would be expected to have a positive effect on stunting reduction.

Even in places with adequate resources for child feeding, nutritional knowledge and factors such as reducing work overload of mothers are crucial to improve the nutritional status of children [53]. Hence it is important to consider a wide range of information in analyzing the association between feeding practices and child growth [54]. The determinants of stunting are varied and there is no single cause for undernutrition among children. Important pathways for effective interventions to mitigate stunting and promote healthy growth require clarification and consideration of context [55, 56]. However, epidemiological studies have reported repeatedly that suboptimal breastfeeding and complementary feeding practices, recurrent infections and micronutrient deficiencies are important proximal determinants of stunting [29, 57]. Considering a holistic approach, intervention against stunting during the early age of the child should not be overlooked. Also, women who were stunted as children tend to have stunted off spring. This creates an intergenerational cycle of stunting and poverty and of reduced human capital that is difficult to break [58].

We identified that as the number of births increases, so too do the odds of being stunted and underweight. Our finding is supported by another study from Ethiopia which stated that children whose mothers gave birth to more than four children were more likely to be stunted compared to children from mothers who had given birth to only one child[26]. Families with more children may face difficulty in providing the daily nutrition requirements for proper child physical development. As the number of children increases there may be scarcity of resources for the household especially for food and healthcare which ultimately may lead to stunted growth. Furthermore, parents with many children may lack adequate time to pay proper attention to the needs of each child.

The present study is one of only a few studies in Ethiopia that identify the determinants of stunting, wasting and underweight specifically in food insecure households and in one of the most vulnerable population groups, infants and young children aged 6-23mo. Despite the possibility of recall bias and measurement errors, the data revealed factors that could direct important interventions in the study area.

Conclusions

The prevalence's of stunting, wasting and underweight in the study area were higher than the national average. Undernutrition among infants and young children is a severe public health concern that needs critical attention at early ages. Improving zinc treatment, iodized salt utilization in complementary food and diversification of complementary food should be important interventions to mitigate the high burden of undernutrition in the study area. Nutrition education on appropriate feeding practices through existing community-based programs and improving the quality of primary health care to improve micronutrient supplementation and family spacing are critical to accelerate improvement in children's nutritional status. Furthermore economic empowerment of women should be emphasized to address the high prevalence of undernutrition in the study area. Further controlled studies are recommended to evaluate the effect of nutrition interventions on addressing the challenges of undernutrition among infants and young children.

Abbreviations

AOR: Adjusted odds ratio; **ASF:** Animal source food; **CI:** Confidence interval; **COR:** Crude odds ratio; **DDS:** Dietary diversity score; **EDHS:** Ethiopian Demographic and Health Survey; **Eth.birr:** Ethiopian birr; **HEW:** Health extension workers; **Index child:** Child 6-23 mo enrolled for the study; **IYCF:** Infant and young child feeding; **MO:** Months; **PCA:** Principal component analysis; **PSNP₄:** Productive safety net program; **SD:** Standard deviation; **WHO:** World Health Organization

Declarations

Competing interest

The authors declare that they have no competing interests.

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Author's contribution

ZT conceptualized the study, develop proposal and data collection materials, trained the data collection team, involve in data collection, analysis and write up, BJS involve in design, analysis, write up and critically reviewed the manuscript, YB, KB, AA and FR have participated in the planning, analysis and review. All authors read and approved the final manuscript.

Availability of data and materials

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Ethical consideration

Ethical clearance was secured from the Institutional Review Board (IRB) of Hawassa University, College of Medicine and Health Sciences. Data were collected after getting permission from the respective district health offices and taking informed consent from study subjects.

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Tables

Table 1. Socio-economic and demographic characteristics of the respondents from food insecure households in rural communities of Amhara and Oromia Regions, 2018 (n= 464)

Variables		Frequency	Percent
Age of the index child	6-11	124	26.8
	12-23	338	73.2
Sex of the index child	Male	224	48.3
	Female	240	51.7
Marital status	Not married	33	7.1
	Married/living together	396	85.3
	Divorced/Widowed/Separated	35	7.5
Educational status of mother	High school and above	23	5.0
	Primary school(1-8)	140	30.3
	No formal education	301	64.7
Educational status of father	Secondary school and above	66	14.2
	Primary school	164	35.3
	No formal education	234	50.4
Occupation of mother	Housewife	421	90.7
	Farmer	21	4.5
	Other employment	3	0.6
	Merchant	16	3.4
	Daily laborer	3	0.6
Occupation of father	Farmer	137	29.5
	Other employment	20	4.3
	Merchant	301	64.9
	Daily laborer	6	1.3
Wealth quintile	Highest	92	19.9
	Fourth	100	21.6
	Middle	102	21.9
	Second	86	18.5
	Lowest	84	18.1
Mother had own income	Yes	316	68.1
Income of mother /month(in Eth Eth.birr) (1 US dollar=27 Eth Eth.birr)	≥ 500	65	14.1
	< 500	399	85.9
Household food security level	Food secure	154	33.2
	Mild food insecurity	78	16.8
	Moderate and severe food insecurity*	232	50
Head of family	Mother	68	14.6
	Father	396	85.3
Family size	<5	212	45.7
	≥ 5	252	54.3
Number of <5 children	≤ 2	405	87.3
	>2	59	12.7

*Only two households (0.43%) were severely food insecure

Table 2. Obstetric characteristics of the respondents from food insecure households from the rural communities of Amhara and Oromia Regions, 2018(n= 464)

Variables		Frequency	Percent
Age of the mother at first pregnancy	<15	28	6.0
	15-26	424	91.4
	27-38	12	2.6
Total number of births	<5	340	73.3
	≥ 5	124	26.7
Number of ANC visits	≥ 4 visits	97	20.9
	3 visits	181	39.0
	1-2 visits	114	24.6
	Not at all	72	15.5
Number of PNC visits	≥ 4 visits	3	0.6
	3 visits	124	26.7
	1-2 visits	94	20.3
	Not at all	243	52.4
Birth order of the index child	First	73	15.7
	Second	112	24.1
	Third	94	20.3
	Fourth	70	15.1
	Fifth and above	115	32.8
Delivery place of the index child	Health facility	16	3.5
	Home with HEW	196	42.2
	Home with family	252	54.3
Mother had vitamin A supplement after birth of the index child	Yes	13	2.8
Mother had iron/folate supplement during pregnancy of the index child	Yes	276	59.5

Table 3. Child feeding practices, sanitation and health characteristics of the index child in rural communities of Amhara and Oromia Regions, 2018 (n=464).

Variable name		Frequency	Percent
Age complementary food started	<4 mo	16	3.5
	4-6mo	21	4.5
	At 6 mo	244	52.6
	Beyond 6mo	183	39.4
Index child's 1st complementary food	Cow's milk	120	25.9
	Formula milk	11	2.4
	Cereal Gruel /porridge	153	33
	Gruel /porridge mixed	154	33.2
Diet diversity of the index child	Family food	26	5.6
	≥ 4 food group	100	21.5
	<4 food group	364	78.5
Index child met minimum acceptable diet	Yes	66	14.2
	No	398	85.8
Meal frequency for children 6-23 mo	≥ 4 times	94	20.2
	<4 times	370	79.8
Frequency of the index child fed animal source foods	Once in a week	233	50.2
	Once in 2week	47	10.2
	Once in a month	41	8.8
	During holidays only	143	30.8
Used iodized salt for complementary food preparation	Yes	255	54.9
Iodized salt added after cooking	Yes	120	25.9
Index child had respiratory illness in the last 2 weeks	Yes	194	41.8
Index child had diarrhea in the last 2 weeks	Yes	174	37.5
Index child had treatment from health facility for this diarrheal episode	Yes	83	47.6
Index child who got zinc among those with diarrhea in the last 2 weeks	Yes	44	53.0
Index child had zinc at least for one prior diarrheal episode	Yes	75	16.2
Index child had ear infection in the last 2 weeks	Yes	85	18.3
Index child immunized for age	Yes	422	90.9
Index child had growth monitoring at least once	Yes	246	46.9
Index child received Vitamin A supplement in last 6 mo	Yes	328	70.7
Main source of water in the household	Piped water	247	53.2
	Protected Spring/well	138	29.7
	Unprotected Spring/well	57	12.7
	River/pond/Rain water	22	4.7
Household used treated drinking water	Yes	93	20.1
Household had latrine	Yes	374	80.6
Mothers washed hands at all critical times	Yes	99	21.3

Table 4. The prevalence of stunting, wasting and underweight among children 6-23 mo by age group in rural communities of Amhara and Oromia Regions, 2018(n=464).

Age(mo)	Freq.	Stunting		Wasting		Underweight	
		Moderate	Severe	Moderate	Severe	Moderate	Severe
		Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)	Freq. (%)
		(HAZ <-2 to ≥3)	(HAZ<-3)	(WHZ <-2 to ≥3)	(WHZ<-3)	(WAZ <-2 to ≥3)	(WAZ<-3)
6-11	126	11 (8.7)	15 (11.9)	5 (4)	9 (7.1)	20 (15.9)	4 (3.2)
12-23	338	92 (27.2)	82 (24.3)	24 (7.1)	19 (5.6)	72 (21.3)	31 (9.2)
Total	464	103 (22.1)	97 (20.5)	29 (6.25)	28 (6.1)	92 (19.8)	35 (7.5)

Table 5. Factors associated with stunting among children aged 6-23mo, Amhara and Oromia Regions, Ethiopia, 2018 (n=464)

Variables	Number stunted		COR [95% CI]	AOR [95% CI]
	Yes	No		
Age of index child				
12-23mo.	173	167	4.31 [2.67,7.07] * *	4.21[2.52,7.05] *
6-11mo.	24	100	1	1
Sex of index child				
Female	111	113	1.72 [1.19,2.50] * *	1.84 [1.23,2.75] * *
Male	87	153	1	1
Total number of births				
≥5	64	60	1.63 [1.08,2.48] *	1.72 [1.10,2.70] *
<5	134	206	1	1
Child treated with zinc at least once				
No	179	210	2.51 [1.43,4.38] * *	2.41 [1.33,4.38] **
Yes	19	56	1	1
Child utilized iodized salt				
No	106	103	1.82 [1.25,2.64] * *	1.55 [1.03,2.32] *
Yes	92	163	1	1
Diet diversity of index child				
<4 food groups	164	200	1.59 [1.0,2.52] *	1.69 [1.02,2.81] *
≥ 4 food groups	34	66	1	1
Treated drinking water				
No	167	204	1.63 [1.01,2.63] *	1.17 [0.69,1.99]
Yes	31	62	1	1

*Significant at a P-value of <0.05

* *Significant at a P-value of <0.01

Table 6. Factors associated with wasting among children aged 6–23 mo, Amhara and Oromia Regions, Ethiopia, 2018 (n=464)

Variables	Number wasted		COR [95% CI]	AOR [95% CI]
	Yes	No		
Sex of the index child				
Female	35	189	1.83 [1.04,3.23] *	1.97 [1.10,3.51] *
Male	22	218	1	1
Received growth monitoring at least once				
Yes	23	223	0.55 [0.31,0.98] *	0.60 [0.34,1.08]
No	34	184	1	1
Family size				
≥5	38	214	1.80 [1.00,3.23] *	1.70 [0.94,3.08]
<5	19	193	1	1
Maternal income per month				
<500Eth.birr	53	338	2.73 [0.94,7.71]	3.29 [1.14,9.50] *
≥500Eth.birr	4	69	1	1
Treated drinking water				
No	52	319	2.86 [1.11,7.40] *	3.22 [1.24,8.39] *
Yes	5	88	1	1

*Significant at P-value of <0.05

Table 7. Factors associated with underweight among children aged 6–23mo, Amhara and Oromia Regions, Ethiopia, 2018 (n=464)

Variables	Under weight		COR [95% CI]	AOR [95% CI]
	Yes	No		
Age of index child				
12-23 month	101	237	1.77 [1.07,2.93] *	1.92 [1.14,3.24] *
6-11 month	24	101	1	1
Sex of index child				
Female	73	151	1.70 [1.12,2.57] *	1.88 [1.22,2.90] **
Male	53	187	1	1
Total number of births				
≥ 5	43	81	1.64 [1.05,2.56]	1.67 [1.05,2.66] *
< 5	83	257	1	1
Child treated with zinc at least once				
No	114	275	2.44 [1.24,4.79] *	2.29 [1.14,4.61] *
Yes	12	63	1	1
Diet diversity of the index child				
<4 food groups	110	254	2.27 [1.27,4.05] **	2.34 [1.27,4.33] * *
≥ 4 food groups	16	84	1	1
Maternal income per month				
<500Eth.birr	114	277	2.09 [1.08,4.03]*	2.34 [1.18,4.65]*
≥500 Eth.birr	12	61	1	1

*Significant at a P-value of <0.05

** Significant at a P-value of<0.01