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Food Safety and Nutritional Status of Food Insecure Households in North Ethiopia

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Abstract Parts of the northern regions of Ethiopia have suffered from repeated draught and chronic food insecurity for decades. Foodborne diseases and malnutrition, particularly affect infants and young children. This study assessed the extent of food insecurity in low-income households, food safety practices therein and nutritional status of under five children in Adigrat town, Tigray region, Ethiopia. A total of 342 households were selected randomly from the town's six kebeles (districts). A cross-sectional survey was carried out among randomly selected households in the study area. Moreover, Household food insecurity access scale was used to assess food security status of households. Household food safety was assessed regarding food handling, personal hygiene and water sanitation. Nutritional status of under-five children was assessed using anthropometric measurements. Data was analyzed using SPSS version 25. Results were presented using descriptive statistics. Only 2.2% of the households were food secure. All respondents were mothers, and the majority (54%) were older than 45 years. About 97% of them did not have a paid occupation. About 46% of households had four or more members. Most respondents obtained food for the family through daily house-to-house begging or by doing petty jobs for other families. Most households were mildly (26.7%), moderately (27%) or severely food insecure (44.3%). Respondents had poor level of knowledge (37.6%) and practice (37.1%) in food handling, personal hygiene and water sanitation, although positive attitude towards food safety was good (91.7%). Of the under-five children in the study households, 28.8% were thin, 56.6% were stunted, 65.3% were underweight and 48.3% were undernourished. Urgent supply of supplementary nutrients to severely malnourished children is required. Government support to food insecure households through productive safety-net programs is recommended. It is important to give training by health extension workers to food insecure households on food safety and nutrition.

Keywords: *food insecurity, food safety, anthropometry, malnutrition*

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1. Introduction

According to FAO [1], food and nutrition security is achieved when adequate food, in terms of quantity, quality and socio-culturally acceptable is available, accessible and satisfactorily utilized by all individuals at all times to lead healthy and active life. Household food security considers individuals within households as the focus of concern. Households with insufficient access to food often face other challenges related to food insecurity including poor health and a decline in productivity [2].

The use and utilization pillar of food security, in addition, considers biological utilization of food, the ability of the human body to take food and convert it into energy and other substances it requires. The pillar also considers preparation and consumption of safe and nutritious food; other important factors considered therein include water, hygiene and adequate sanitary facilities and understanding of proper health, feeding and care practices [3]. Availability and accessibility of adequate quality of food should correspond to utilization of safe and nutritious food in order to achieve food security [4].

According to WHO [5], millions fall ill and hundreds of thousands die at global level following the consumption of unsafe food each years. These incidents are caused mostly by lack of proper knowledge, attitude and practices (KAP) in food safety by household food handlers. Safety issues in food preparation comprise of components which include personal hygiene of food handlers, sanitation of the food preparation and storage environment, as well as of the equipment being used [6]. Unsafe food creates a vicious cycle of diarrhea and malnutrition, particularly affecting infants, young children, the elderly and the immuno-compromised [7]. Food safety, thus, has a direct impact on people's health and nutritional intake. There is no food security without food safety [8].

Child malnutrition is a serious public health problem in developing countries. It is the major cause of illness and death among under-five children in Ethiopia with a prevalence among the highest in the world and Sub-Saharan Africa [9]. Malnutrition in infants and under-five children can increase morbidity and mortality. The mental and cognitive developments may be hampered. The effect may go beyond childhood and could decrease the educational achievement and labor productivity in later years [9].

The government of Ethiopia developed the Urban Food Security Strategy (UFSS) through Urban Job Creation and Food Security Program (UJCFSP) to alleviate urban food insecurity and tackle the increasing levels of vulnerability by supporting the urban poor. However, this program is not implemented in Adigrat (our study area) so far. According to WFP [10], 35% of food utilization in the study area was affected by poor basic infrastructure and deterioration of basic services such as safe drinking water, sanitation, housing and health facilities. As there is no information available on the nutritional status and food safety KAP of food insecure households in Adigrat town, northern Ethiopia, this study was, aimed at assessing the nutritional status of under-five children and KAP of food safety among mothers in the selected area.

2. Methodology

2.1. Study Area

Adigrat town is the seat of the Zonal administration of Eastern Tigray located 900 Km north of Addis Ababa (Figure 1). According to the WPR [11], the population of Adigrat is estimated at 65,000. Females constitute 50.2 % of the total population.

2.2. Sampling and Sample Size Determination

A retrospective-cross-sectional study design was used to assess nutritional status and food safety KAP of food insecure households, who were registered as being under the poverty line by the Social and Labor Affairs office of Adigrat town. There were a total of 1,826 such households distributed through the six kebeles (the smallest administrative unit) of the town. The kebeles were grouped in three neighborhoods, namely Meda Agame (Kebeles 04 and 05), Mewtsa'e Worki (Kebeles 01 and 02) and Hadish Adi (Kebeles 03 and 06). A sample size of 342 households was determined as in Yamane [12] and about 51 to 62 mothers were randomly selected from each kebele based on proportion.

2.3. Data Collection

A community-based cross-sectional study design was used to collect data on household food insecurity access (HFIA), food safety knowledge, attitude and practice (KAP) of mothers and anthropometric parameters of under-five children in the study households. Information, consisting of household socio-economic and demographic parameters, such as age, sex, educational level, monthly income, and occupation, was also collected.

A structured questionnaire was developed based on Macias and Glasauer [13] to collect data on household socio-demographic characteristics. Household food insecurity was assessed according to Coates et al., [14].

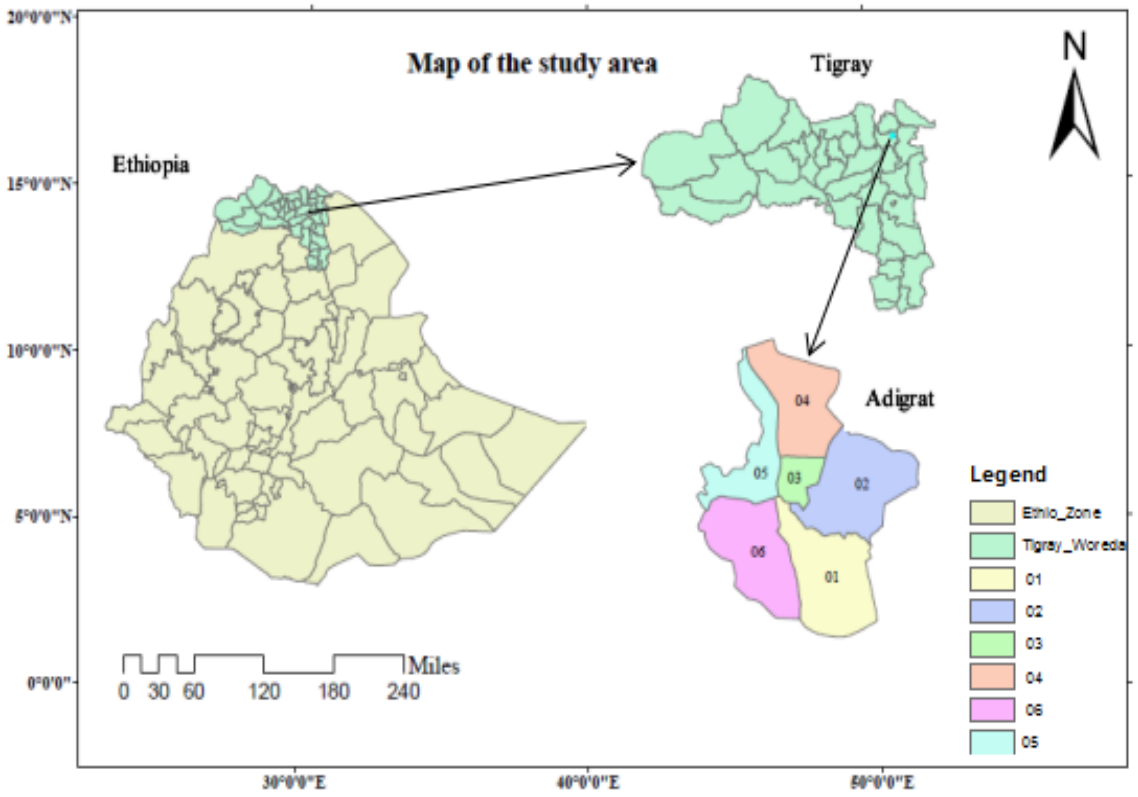

Figure 1. Map of the study area (Adigrat town)

Household food safety KAP was assessed with respect to food handling, personal hygiene and water sanitation. Qualitative data, collected through questionnaires, were converted to percentages and used as indicators for level of KAP on food safety. The KAP of the population was calculated for each question by dividing the total number of correct responses by the number of total responses given by all respondents who answered the question [13] Respondents who did not answer the question, or for whom information was incomplete, were excluded.

Percentage of total knowledge/attitude/practice among population was calculated as:

$$\frac{Sum\ of\ \ correct\ responses\ given\ by\ all\ respondents}{Sum\ of\ \ responses\ given\ by\ all\ respondents} x100$$

Food safety KAP of respondents was classified, using Bloom's cut-off points for KAP studies, as good (≥80%), moderate (60%-79%) and poor (<60%) [15].

Child nutritional status was assessed by measuring child weight, height/length, and age. Using these measurements, height-for-age (HAZ below -2SD) indicated stunting; weight-for-height (WHZ below -2SD) reflected thinness; and weight-for-age (WAZ below -2SD) reflected underweight. Quantitative data was analyzed using SPSS Version 25 software.

2.4. Ethical Consideration

During data collection, ethical issues were taken into considerations to ensure confidentiality of information and anonymity of respondents. An informed consent was obtained from the participants or care takers before being enrolled in the study. Weight, height and MUAC measurements were taken by a qualified health professional.

3. Results and Discussion

3.1. Socio-Demographic Description

All respondents were female and the majority (54%) were older than 45 years. About 81% were single, divorced or widowed. About 60% of the respondents were either illiterate or had elementary level education. Almost all respondents (97%) did not have a paid occupation and only 3% of the respondents worked in governmental or non-governmental organizations (Table 1).

Table 1. Socio-demographic characteristics of respondents (n=342)

Characteristic	Meda Agame	Mewtsa'e Worqi	Hadish Adi	Total
	No (%)	No (%)	No (%)	N (%)
All female	114 (33.3%)	114 (33.3%)	114 (33.3%)	342 (100%)
Age				
18-29	38 (33.3%)	26 (22.8%)	20 (17.5%)	84 (24.6%)
30-45	24 21%)	26 (22.8%)	24 (21%)	74 (21.6%)
>45	52 (45.6%)	62 (54.4%)	70 (61.4%)	184 (53.8%)
Religion				
Orthodox	96 (84.2%)	108 (94.7%)	110 (96.5%)	314 (91.8%)
Muslim	8 (7%)	4 (3.5%)		12 (3.5%)
Catholic	10 (8.7%)	2 (1.7%)	4 (3.5%)	16 (4.7%)
Marital status				
Married	24 (21%)	16 (14%)	24 (21%)	64 (18.7%)
Single	70 (61.4%)	60 (52.6%)	62 (54.4%)	192 (56.1%)
Divorced	10 (8.7%)	22 (19.3%)	24 (21%)	56 (16.5%)
Windowed	10 (8.7%)	16 (14%)	4 (3.5%)	30 (8.7%)
Occupation				
Governmental	6 (5.3%)	-	2 (1.7%)	8 (2.3%)
Non-governmental	2 (1.7%)	-	-	2 (0.6%)
Others	106 (92.9%)	114 (100%)	112 (98.2%)	332 (97%)
Educational status				
Illiterate	42 (36.8%)	47 (41.2%)	54 (47.4%)	143 (41.8%)
1-8 grade	14 (12.3%)	26 (22.8%)	22 (19.3%)	62 (18.1%)
9-12 grade	38 (33.3%)	27 (23.7%)	24 (21%)	89 (26%)
Diploma	16 (14%)	12 (10.5%)	14 (12.3%)	42 (12.3%)
>diploma	4 (3.5%)	2 (1.7%)		6 (1.8%)
Monthly income (ETB)*				
<800	94 (84.5%)	90 (98.9%)	95 (83.3%)	279 (81.6%)
801-1500	20 (17.5%)	22 (19.3%)	19 (16.7%)	61 (17.8%)
1501-2800		2 (1.7%)		2 (0.6%)
Household size				
One	28 (24.6%)	22 (19.3%)	18 (15.7%)	68 (19.8%)
Two	13 (11.4%)	16 (14%)	33 (28.9%)	62 (18.1%)
Three	21 (18.4%)	22 (19.3%)	18 (15.7%)	61 (17.8%)
Four	27 (7.9%)	24 (21%)	21 (18.4%)	72 (21%)
≥Five	25 (21.9%)	30 (26.3%)	24 (21%)	79 (23%)

*ETB, Ethiopian Birr (1 USD = 30 ETB during the study period).

Most respondents said that they obtained food for the family through house-to-house begging, assisting in flour mills (for a handful of flour per round of milling they assisted), selling home-brewed traditional alcoholic beverage (*Tella*), manually washing clothes or cooking food for other families, selling vegetables in village sheds or earning money as sex workers. About 82% of the respondents had a monthly income of less than ETB 800.00. About 46% of respondents had households consisting of four or more members.

3.2. Households Food Insecurity Access

Most (94%) of the respondents from the three neighborhoods felt anxiety and uncertainty sometimes or often. They worried that the household would not have enough food during the previous four weeks (Table 2). Similarly, about 89% were unable to eat preferred food, or ate limited variety of food or ate food they did not want to eat sometimes or often due to lack of resource in the household. In addition, 91% of the study households sometimes or often reduced the size of a meal or the frequency of meals eaten in a day. A total of 86% of respondents, sometimes or often, had to go to sleep at night hungry, or had to go a whole day and night without eating because there was no food of any kind to eat in the household.

Based on the measure of household food insecurity access scale- HFIAS [14], about 98% of the households considered in this study suffered from some form of food insecurity. The majority (71%) were either moderately or severely food insecure (Table 3).

The extent of food insecurity among the study population was much higher than that reported from other zones in Ethiopia: 72% in Wolaita zone [16], 90.6% in East Shewa Zone [17], 69 % in Jimma zone [18], and 69% in East Wellega zone [19]. Similarly, studies from elsewhere in Africa and Asia showed a relatively lower prevalence of food insecurity than that observed in our study such as 70% in Accra, Ghana [20], 39% in Tongaat, South Africa [21], and 50% in slums in North India [22] and over 54% in Nepal [23],

3.3. Households Food Safety

Food safety was assessed with respect to household food handling, personal hygiene and water sanitation.

3.3.1. Food Safety Knowledge

3.3.1.1. Food Handling Knowledge

Proper food handling, storage and heating are the mainstay of preventing foodborne diseases. Household food handling knowledge was assessed in terms of separation of raw and cooked food, signs of thorough cooking, cold storage of perishable foods, and washing vegetables (Table 4). Average knowledge in food handling (68%) and personal hygiene (64%) among all respondents from the three study sites was moderate although knowledge in water sanitation was very poor (21%). Poor knowledge scores were particularly noted in reason for separation of raw and cooked foods mainly because most respondents had no food for the family and depended on food scraps from other families that they collected by begging. Lower knowledge values were also seen in similar studies reported by Legesse *et al*. [24] in Arba Minch, and Tessma *et al.* [25] in Dangila, both from Ethiopia. However, a study in Malaysia [26] showed that food handling knowledge of food handlers was excellent (90.3%). Even though our study households suffered from severe food shortage, further food safety awareness creation may help them to appropriately handle the food they access.

3.3.1.2. Personal Hygiene Knowledge

Personal hygiene refers to maintaining cleanliness of one's body. In this study, personal hygiene knowledge was assessed in terms of identifying actions to prevent food poisoning from germs fecal origin and pointing out the key moments for handwashing (Table 4). Average knowledge in the required actions that can prevent foodborne illnesses from fecal germs was poor (38%). However, average knowledge in identifying the key moments of handwashing among all respondents was good (90%). Frequent and appropriate handwashing is the single most important action that prevents contamination and cross contamination of food and utensils in the kitchen. In general, knowledge level among all respondents in personal hygiene was moderate (64%) but was slightly lower than that observed among communities of comparable food security status in Nepal [27].

Table 2. Mean values of food insecurity experience among households (n=342)

Household food insecurity experience	Occurrence	Frequency		
		Rarely	Sometimes	Often
Anxiety and uncertainty	303 (88.6%)	18 (5.9%)	73 (24.1%)	212 (70%)
Reduced quality of food	312 (91.2%)	34 (10.9%)	26 (8.3%)	252 (80.8%)
Reduced quantity of food	272 (79.5%)	24 (8.8%)	39 (14.3%)	209 (76.8%)
Hunger	242 (70.8%)	25 (10.3%)	65 (26.9%)	142 (58.7%)

Rarely (1 or 2 times), sometimes (3 to 10 times), Often (more than 10 times).

Table 3. Food security status of respondents

HFIAS CATEGORY	%
Food secure	2.2%
Mild food insecure	27%
Moderately food insecure	26.6%
Severely food insecure	44.2%

Table 4. Average household food safety knowledge of respondents

Knowledge	Meda-Agame (n=114)	Mewtsa'e Worki (n=114)	Hadish Adi (n=114)
Food handling			
Reason for Separation of raw and cooked foods	58 (50.9%)	34 (29.8%)	41 (36%)
Signs of thorough cooking	98 (86%)	83 (72.8%)	96 (84.2%)
Perishable foods to be stored in a cool place	84 (73.7%)	62 (54.4%)	80 (70.2%)
Reasons to avoid leftovers not kept in a cool place	76 (66.7%)	58 (50.9%)	77 (67.5%)
Washing raw fruits and vegetables before eating	108 (94.7%)	98 (86%)	106 (93%)
Average knowledge	74.4%	58.9%	70.2%
Personal hygiene			
Action to prevent food poisoning from fecal germs	36 (31.6%)	55 (48.2%)	38 (33.3%)
Key moments for hand washing	104 (91.2%)	98 (85.9%)	108 (94.7%)
Average knowledge	61.4%	67.1%	64%
Water sanitation			
Treating unsafe water	27 (23.7%)	18 (15.8%)	27 (23.7%)
Total knowledge of food safety	53.2%	47.3%	52.6%

Details are given in Annex 1a, b and c.

3.3.1.3. Water Sanitation Knowledge

Water sanitation refers to having clean drinking water by treating collected water for safety. Boiling or adding disinfectants in the right concentration are the methods of choice to make water safe for drinking [28]. Among all respondents in this study, knowledge in how to treat water to make it safe for consumption was very poor (21.1%) (Table 4). Very few respondents (21%) knew either to boil or discard unsafe water. None in the households in the three neighborhoods knew about using bleach to disinfect water, though chlorine-based tablets were available in the market. Generally respondents had poor knowledge of treating unsafe water. This is similar to the study of Joshi et al, [29] from India where 78% of the respondents did not treat water for safety.

3.3.2. Households Food Safety Attitude

3.3.2.1. Food Handling Attitude

A good proportion of all respondents believed that children of other members of the household could likely be sick from unsafe food and the sickness could be serious. They also believed that cold storage of foods would help to prevent growth of germs in foods and reheating leftovers or washing vegetables before use was not difficult. The level of positive attitude towards the importance of appropriate food handling among respondents from all neighborhoods was very good (94.2%) (Table 5). The observation in this study was higher than the 50.4% seen in Debark, Ethiopia [30] and the (80%) from Malaysia [26]. Those of our respondents who had negative attitude towards food handling had different explanations of their own, some stemming from perception, and others from lack of resources. The following were the explanations given by various respondents:

"*Sickness from contaminated food is not serious; God protects us from every disease; keeping food in cold places changes its taste; we eat whatever we get from house-to-house begging; we do not have money to buy charcoal for reheating leftovers; we are too old and lack strength to do it*".

Since dangerous microorganisms in foods can cause disease or even death, it is important to reheat cooked food thoroughly because, if contaminated by harmful microorganisms, they can multiply very quickly in it particularly when kept at room temperature. Multiplication of harmful microorganisms in food result either in spoilage of the food or disease to the consumer.

3.3.2.2. Personal Hygiene Attitude

Assessment of attitude towards proper personal hygiene showed that most respondents believed that foodborne illness caused by unwashed hands could be serious to children or parents (Table 5). They also believed that it was good and not difficult to wash hands before preparing food or feeding a child. Most believed that appropriate handwashing could avoid sickness that can be serious and severe. Overall, total positive attitude towards personal hygiene among all respondents was 89.5% in the three neighborhoods. The finding in this study was similar with the 82.8% positive attitude reported from Malaysia [31]. Those very few respondents who showed negative attitude towards handwashing said the following:

"*Diarrhea is not caused by not washing hands; if we have not been sick from unwashed hands until now, we will never be sick hereafter; it is God who keeps us safe, not Science*."

3.3.2.3. Water Sanitation Attitude

Most respondents in the three study sites believed that using unsafe water could result in illness which could be severe. They also believed that boiling water for drinking could prevent illness coming therefrom (Table 5). Positive attitude among all respondents was very good (91.2%) Few respondents manifested negative attitude towards appropriate water sanitation and gave the reasons as:

"*We have always been safe without boiling water; God is keeping us safe; we do not give attention to boiling water; we have no money to buy charcoal for boiling water; we believe that water we collect is clean and safe*".

Similarly, 94% of respondents in the study of Joshi et al, [29] from India felt that water was clean. Most people believe that water that appears clean to the eyes is also safe even though harmful microbes cannot be seen with the naked eye.

Table 5. Average positive attitude of respondents towards food safety in the study area

Attitude	Meda-Agame	Mewtsa'e Worki	Hadish Adi
Food handling			
Perceived susceptibility Likely to get sick from eating contaminated food	110 (96.5%)	107 (93.8%)	102 (89.5%)
Perceived severity Serious to be sick from eating contaminated food.	114 (100%)	104 (91.2%)	100 (87.7%)
Perceived benefits Good to cold store perishable foods, re-heat left-overs, clean wash fruits and vegetables	114 (100%)	106 (93%)	110 (96.5%)
Perceived barriers Not difficult to re-heating left-overs or clean wash fruits and vegetables	112 (98.2%)	102 (89.5%)	108 (94.7%)
Average positive attitude	98.7%	91.9%	92.1%
Personal hygiene			
Perceived susceptibility Likely to get stomach ache or diarrhea, from not washing hands.	110 (96.5%)	107 (93.9%)	102 (89.5%)
Perceived severity Serious to get diarrhea from not washing hands.	114 (100%)	104 (91.2%)	100 (87.7%)
Perceived benefits Good to wash hands before preparing food or before feeding a child/eating.	114 (100%)	106 (93%)	110 (96.5%)
Perceived barriers Not difficult to wash hands before preparing food or before feeding a child/eating	112 (98.2%)	102 (89.5%)	108 (94.7%)
Perceived self-efficacy Have confidence in washing hands properly	82 (71.9%)	77 (67.5%)	82 (71.9%)
Average positive attitude	93.3%	87%	88.1%
Water sanitation			
Perceived susceptibility Likely to get sick from using unsafe water.	110 (96.5%)	105 (92.1%)	109 (95.6%)
Perceived severity Serious to get sick from using unsafe water	110 (96.5%)	110 (96.5%)	114 (100%)
Perceived benefits Good to boil water before drinking or using it.	113 (99.1%)	100 (87.7%)	110 (96.5%)
Perceived barriers Not difficult to boil water before drinking or using it.	100 (87.7%)	88 (77.1%)	94 (82.5%)
Perceived self-efficacy Have confidence in boiling water before drinking or using it.	102 (89.5%)	96 (84.2%)	100 (87.7%)
Average positive attitude	93.9%	87.5%	92.5%
Total positive attitude on food safety	95.3%	88.8%	90.9%

Details given in Annex 2a, b, and c.

Table 6. Average appropriate practice of respondents in food safety in the study area

Practice	Meda-Agame	Mewtsa'e Worki	Hadish Adi
Food handling			
Cleaning of kitchen surfaces and utensils after preparing dinner	55 (48.2%)	48 (42.1%)	51 (44.7%)
Proper storing perishable fresh foods	35 (30.7%)	34 (29.8%)	35 (30.7%)
Average appropriate practice	39.5%	36%	37.7%
Personal hygiene			
Ways of washing hands	24 (21.1%)	24 (21.1%)	27 (23.7%)
Water sanitation			
Treating collection item to make it clean	112 (98.2%)	111 (97.4%)	110 (96.5%)
Safe storage of water	52 (45.6%)	50 (43.8%)	49 (43%)
Treatment of water to make it safe to drink	10 (8.8%)	16 (14%)	18 (15.8%)
Average appropriate practice	50.9%	51.7%	51.8%
Total appropriate practice	37.2%	36.3%	37.7%

Details given in Annex 3a, b and c.

3.3.3. Household Food Safety Practice

3.3.3.1. Food Handling Practice

Food handling practices are actions that minimize risk of food contamination, particularly in kitchens (Table 6). Less than half of our respondents cleaned utensils with detergents and about 30% took the correct actions to protect perishable fresh foods from contamination and microbial growth in them. In general, food handling practice among all respondents was poor (39.5%). The finding in this study was similar with that observed by Tessema et al. [25] in Dangla, Ethiopia, but lower than the observation of Fasoro et al. [32] in Nigeria. The good level of positive attitude of respondents in this study was, unfortunately, not translated into appropriate practice.

3.3.3.2. Personal Hygiene Practice

Personal hygiene practice was assessed in terms of step-by-step description of handwashing (Table 6). Very few respondents from all study sites followed appropriate handwashing steps to avoid illness. Although the attitude of our respondents towards handwashing washing was good, total practice of appropriate handwashing among them was very poor (22%). As our respondents were below the poverty line, it might be difficult for them to afford materials to practice appropriate and frequent

handwashing. A higher level of handwashing practice was reported by Dagne et al., [33] from Debark town in northwestern Ethiopia.

3.3.3.3. Water Sanitation Practice

All households collected water for domestic use from public taps (stand pipe) using Jerry cans or buckets. Practice of treating collection item using water and soap to make it clean was good (97%) among all respondents. Practice of storing water in clean and covered jar was, however poor (44%). Similarly, very poor practice was seen in treating the collected water to make it safe either by boiling or adding bleach. According to CDC [28], boiling or adding disinfectants in the right concentration is the methods of choice to make water safe for drinking. Such appropriate practices can be achieved through occasional training given to low income households by health extension workers. Unfortunately, over 87% of respondents said that they did not get training on water sanitation during the study period (Annex 9).

3.4. Anthropometric Assessments

The prevalence of moderate and severe thinness (wasting) among all under-five children was 28.3% (Table 7). Higher prevalence of thinness was seen in boys than in girls (Table 7). The proportion of severely thin boys and girls was higher than the moderate ones. Most of the moderately thin children were found in the age groups 6-17 months and most of the severely thin ones were in the age group 18-29 months (Table 8). Thinness in under-five children in our study (28%) was much higher than that of the 10.1% national average [34] or the 9% reported by Molla [35] both from Ethiopia. It was also much higher than the 5% reported from Uganda [36].

Prevalence of stunting was also high (56.4%) among the study children. The prevalence of severe stunting was much higher (47.3%) than that of moderate stunting (8.3%) (Table 7). In general, boys were more stunted (59.3%) than girls were (53.6%).

None of the households in this study had children in the age group 54 to 59 months. Moderate and severe stunting was distributed through children of ages 6 months to 53 months at varying rates (Table 8). All children within the age group 42-53 months were stunted and underweight. Stunting in under-five children in our study (52.5%) was much higher than the 38.3% and 14% reported as National average in Ethiopia by Kassa et al., [34] and Molla [35], respectively. As stunting is a manifestation of chronic malnutrition, the values indicated that children in such households had been malnourished for a long time. Total prevalence of stunting among under-five children in this study was notably higher than that observed in Nigeria [37] and Uganda [36]. but comparable with the 57% reported by Tsegay et al., [38] from Wukro, Eastern Tigray, a neighbouring town to the study area. In the Democratic Republic of Congo, stunting in under-five children ranged from 44.9% to 76.9% [39].

Table 7. Nutritional status of under-five children by sex

Status		Prevalence		
		Boys (30)	Girls (30)	Both (60)
Thinness (W/H) or (W/L)	Moderate	5 (16.7%)	3 (10%)	8 (13.3%)
	Severe	5 (16.7%)	4 (13.3%)	9 (15%)
	Total	10 (33.3%)	7 (24.1%)	17 (28.3%)
Stunting (H/A)	Moderate	3 (10%)	2 (6.7%)	5 (8.3%)
	Severe	13 (43.3%)	13 (43.4%)	26 (43.3%)
	Total	16 (59.3%)	15 (53.6%)	31 (56.4%)
Underweight (W/A)	Moderate	15 (50%)	11 (36.7%)	26(43.3%)
	Severe	6 (20%)	7 (24.1%)	13 (22.1%)
	Total	21 (70%)	18 (60%)	39 (65.4%)
Undernourished (MUAC)	Moderate	9 (30%)	4 (13.3%)	13 (21.7%)
	Severe	6 (20%)	10 (33.3%)	16 (26.7%)
	Total	15 (50%)	14 (46.7%)	29 (48.3%)

Total, <-2 z-score; Moderate, <-2 z-score and >=-3 z-score; Severe, <-3 z-score
MUAC: Total, < 125 mm; Moderate, < 125 mm and >= 115 mm; Severe, < 115 mm.

Table 8. Nutritional status of study subjects by age

Age (months)	Total no.	Thinness (W/H <- 2z-score) No. (%)	Stunting (H/A <- 2z-score) No. (%)	Underweight (W/A <-2 z score) No. (%)	Undernourished (MUAC< 125 mm) No. (%)
6-17	21	8 (38.1%)	6 (28.6%)	12 (57.1%)	11 (52.4%)
18-29	25	7 (28%)	17 (68%)	15 (60%)	14 (56%)
30-41	8	2 (25%)	3 (37.5)%	7 (87.5)%	3 (37.5)%
42-53	5	-	5 (100%)	5 (100%)	1 (20%)
54-59	-	-	-	-	-
Total	59	17 (28.8%)	31 (52.5%)	39 (66.1%)	29 (49.2%)

Prevalence of underweight as assessed by weight-for-age measurements was 66% among all children (Table 7 and Table 8). Prevalence of moderate and severe underweight was 43.3% and 21.7%, respectively. Half of the boys were moderately underweight. National average of underweight children in Ethiopia was reported to be at 25% [34]. This is indicative of the serious level of food insecurity the households were facing and the resulting adverse effect on the mental development of the children. Most or all children in the age group 30-41 months and 42-53 months were underweight (Table 8). It appeared that as the children grew older, severity of underweight increased indicating that the children were not getting enough calories commensurate with their increasing activity.

MUAC measurements showed a high prevalence of total malnutrition (48.3%) among all children of which 21.7% were moderately and 26.7% were severely undernourished (Table 7). Higher proportion of boys suffered from total undernourishment. Moderate undernutrition was more conspicuous in boys (30%) than in girls (13.3%). However, more girls (33.3%) were severely undernourished when compared with boys (20%). A higher proportion of children in the age group 6-17 and 18-29 months were undernourished (Table 8). According to MCHET [40], children with MUAC values of <125 mm are considered to suffer from moderate acute malnutrition and should be immediately referred for supplementation. Unfortunately, 27% of the children who suffered from severe acute malnutrition could not afford nutritional supplementation because, due to its chronic nature, mothers considered it as a consequence of fate and had to learn to live with it. In households who lived under such abject poverty and severe food insecurity, child undernutrition was unavoidable.

4. Conclusion and Recommendation

The respondents in this study were, in general, severely food insecure with serious KAP limitations in food safety issues. Their children were also moderately to severely undernourished. Interventions should focus on covering severely food insecure households in public safety net programs and raising their awareness in food safety and nutrition issues.

Conflict of Interest

The authors declare no conflict of interest.

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Supplementary Tables

Annex 1a. Household food handling knowledge of respondents

Food handling knowledge	Meda-Agame	Mewtsa'e Worki	Hadish Adi
1. Reason for separation of raw and cooked food			
Raw animal foods often contain germs	58 (50.9%)	34 (29.8%)	41 (36%)
Others	24 (21%)	14 (12.3%)	24 (21%)
Don't know	32 (28%)	66 (57.9%)	49 (43%)
2. Signs of through cooking of soup and stews for safety and redness to be served			
They are boiling /well cooked	98 (86%)	83 (72.8%)	96 (84.2%)
Others	2 (1.8%)		
Don't know	14 (12.3%)	31 (27%)	18 (5.2%)
3. Kind of perishable foods to be stored In refrigerator on a cool place			
Meat			
Poultry			
Fish			
Milk /dairy products			
All of the above	84(73.7%)	62(54.4%)	80(70%)
Don't know	30(26.3%)	52(45.6%)	34(29.8%)
4. Reason for avoiding eating left over that were not kept in a cool place			
Because food is not safe any more		6(5.3%0	2(1.8%)
Germs multiply very quickly can cause illness	6(5.3%)	2(1.8%)	16(14%)
Higher temperature make germs grow faster	2(1.8%)	2(1.8%)	
All of the above	68(59.6%)	48(42.1%)	59(51.8%)
Don't know	38(33.3%)	56(49.1%)	37(32.5%)
5. Washing raw fruits and vegetables before eating			
Washing with clean water	108(94.7%)	98(86%)	106(93%)
Don't know	6(5.3%)	14(12.3%)	7(6.1%)
Others		2(1.8%)[3]	

Annex 1b. Household personal hygiene knowledge of respondents

Personal hygiene knowledge	Meda-Agame	Mewtsa'e Worki	Hadish Adi
1. Action for preventing food poisoning from germs from faces			
Wash hand (after going to the toilet and cleaning the baby's bottom)	4(3.5%)	8(7%)	12(10.5%)
Remove feces from the home and surrounding	2(1.8%)		
Others		4(3.5%)	
One and two are answers	108(94.7%)	102(89.5%)	102(89.5%)
2. Key movements for hand washing			
After going to the toilet or latrine	16(14%)	20(17.5%)	16(14%)
After cleaning the baby 's bottom or changing the babies nappy	19(16.6%)	14(12.3%)	19(16.6%)
Before preparing handling food	17(14.9%)	15(13%)	17(14.9%)
Before feeding a child or eating	18(15.8%)	19(16.6%)	18(15.8%)
After handling row food	16(14%)	15(13%)	20(17.5%)
After handling garbage	18(15.8%)	15(13%)	18(15.8%)
Others		2(1.8%)	
No answer	10(10.5%)	14(12.3%)	6(5.3%)
Total knowledge	218/684= 31.9%	202/684 29.5%	215/684 31.4%
Total knowledge for all	**30.9%**		

Annex 1c. Household water sanitation knowledge of respondents

Water sanitation	**Meda-Agame**	**Mewtsa'e Worki**	**Hadish Adi**	**Total**
Boil it	4(3.5%)		4(3.5%)	8(2.3%)
Add bleach or choline				
Strain it through a cloth			2(1.8%)	2(0.58%)
Use awater filter ,ceramic ,sand composite etc				
Use solar destination				
Let it stand and settle	15 (13.2%)	18 (15.8%)	16 (14%)	49(13.4%)

Annex 2a. Household of food handling attitude of respondents

Personal hygiene attitude	Kebeli	It is	It is not	Not sure
Perceived susceptibility				
Likelihood of one self or child having stomach ace or diarrhea from not washing your hand	Meda Agame	110(96.5%)	2(1.8%)	2(1.8%)
	Mewtsa'e Worki	107(93.8%)	2(1.8%	5(4.4%)
	Hadish Adi	102(89.5%)	4(3.5%)	8 (7%)
Perceived severity				
Seriousness if one or child gets diarrhea from one self not washing one's hand	Meda Agame	114(100%)		
	Mewtsa'e Worki	104(93.8%)	4(3.5%)	6(5.3%)
	Hadish Adi	100(87.7%)		4(3.5%)
Perceived benefits				
Goodness of washing ones hand before preparing food or before feeding a child or eating	Meda Agame	114(100%)		
	Mewtsa'e Worki	106(93%)		8 (7%)
	Hadish Adi	110(96.5%)		4(3.5%)
Perceived barriers				
Difficulty to wash one's hand before preparing food before feeding a child or eating	Meda Agame		112(98.2%)	2(1.8%)
	Mewtsa'e Worki	2(1.8%)	102(89.5%)	10(8.8%)
	Hadish Adi	2(1.8%)	108(94.7%)	4(3.5%)
Perceived self-efficacy				
Confidence in washing one's hand properly	Meda Agame	82(71.9%)	10(8.8%)	24 (21%)
	Mewtsa'e Worki	77(67.5%)	24(21%)	13 (11.4%)
	Hadish Adi	82(71.9%)	16(14%)	16 (14%)
Total positive altitude	Meda Agame 523/570=93.3% Mewtsa'e Worki 496/570=87% Hadish Adi 502/570=88.1%			
Over all positive altitude	1521/1710=88.9%			

Annex 2b. Household personal hygiene attitude of respondents

Personal hygiene attitude	**Kebeli**	**It is**	**It is not**	**Not sure**
Perceived susceptibility				
Likelihood of one self or child having stomach ace or diarrhea from not washing your hand	Meda Agame	110(96.5%)	2(1.8%)	2(1.8%)
	Mewtsa'e Worki	107(93.8%)	2(1.8%	5(4.4%)
	Hadish Adi	102(89.5%)	4(3.5%)	8 (7%)
Perceived severity				
Seriousness if one or child gets diarrhea from one self not washing one's hand	Meda Agame	114(100%)		
	Mewtsa'e Worki	104(93.8%)	4(3.5%)	6(5.3%)
	Hadish Adi	100(87.7%)		4(3.5%)
Perceived benefits				
Goodness of washing ones hand before preparing food or before feeding a child or eating	Meda Agame	114(100%)		
	Mewtsa'e Worki	106(93%)		8 (7%)
	Hadish Adi	110(96.5%)		4(3.5%)
Perceived barriers				
Difficulty to wash one's hand before preparing food before feeding a child or eating	Meda Agame		112(98.2%)	2(1.8%)
	Mewtsa'e Worki	2(1.8%)	102(89.5%)	10(8.8%)
	Hadish Adi	2(1.8%)	108(94.7%)	4(3.5%)
Perceived self-efficacy				
Confidence in washing one's hand properly	Meda Agame	82(71.9%)	10(8.8%)	24 (21%)
	Mewtsa'e Worki	77(67.5%)	24(21%)	13 (11.4%)
	Hadish Adi	82(71.9%)	16(14%)	16 (14%)
Total positive attitude	**=1530/1710=89.8%**			

Annex 2c. Household water sanitation attitude of respondents

Water sanitation practice	Kebele	It is	It is not	Not sure
Perceived susceptibility				
Likelihood of one self or ones child to get diarrhea from using unsafe water	Meda Agame	110(96.5%)	3(2.6%)	1(0.8%)
	Mewtsa'e Worki	105(92.1%)	6(5.3%)	3(2.6%)
	Hadish Adi	109(95.6%)	6(5.3%)	0
Seriousness of getting sick from using unsafe water	Meda Agame	110(96.5%)	0	4(3.5%)
	Mewtsa'e Worki	110(96.5%)	4(3.5%)	0
	Hadish Adi	114(100%)	0	0
Perceived benefits				
Goodness of boiling water before drinking or using it?	Meda Agame	113(99.1%)	0	2(1.8%)
	Mewtsa'e Worki	100(87.7%)	0	14(12.3%)
	Hadish Adi	110(96.5%)	0	4(3.5%)
Perceived barriers				
Difficulty of boiling water before drinking or using it?	Meda Agame	12 (8.3%)	100(87.7%)	2 (1.8%)
	Mewtsa'e Worki	22 (12.3%)	88(77.1%)	4 (3.5%)
	Hadish Adi	18 (15.8%)	94(82.5%)	2(1.8%)
Perceived self-efficacy				
Confidence in boiling water before drinking or using it?	Meda Agame	102(89.5%)	7(6.1%)	5(4.4%)
	Mewtsa'e Worki	96(84.2%)	17(14.9%)	1(0.8%)
	Hadish Adi	100(87.7%)	10(8.8%)	4(3.5%)
Total positive attitude	Meda Agame	535/570 = 93.9%		
	Mewtsa'e Worki	499/570 = 87.5%		
	Hadish Adi	527/570 = 92.5%		
Overall positive attitude	**1561/1710 = 91.3%**			

Annex 3a. Household of food handling practices of respondents

Food handling practice	Meda-Agame	Mewtsa'e Worki	Hadish Adi	Total
1. Usual cleaning of kitchen surfaces and utensils after preparing dinner				
Scrape excess food in to rubbish bin				
Wash with hot water	8 (7%)	4 (3.5%)	6 (5.3%)	18 (5.3%)
Wash with detergent	102 (89.5%)	92 (80.7%)	96 (84.2%)	290 (84.8%)
Don't know	4 (3.5%)	18 (15.5%)	12 (10.5%)	34 (9.9%)
2. Storing perishable fresh foods such as raw meat and poultry[1]				
In the refrigerator (below 5 degree cent greed)	10 (8.8%)	14 (12.3%)	23(20.2%)	47(13.7%)
Covered protected from insects rodents pests and dust	74(64.9%)	65(57%)	63 (55.3%)	202(59%)
Separated from cooked or ready to eat foods	22(19.3%)	23 (20.1%)	20(17.5%)	65(19%)
Others	2(1.8%)	2 (1.8%)		4(1.1%)
Don't know	6(5.3%)	10 (8.8%)	8 (7%)	24(7%)
Total appropriate practice	**208/684 30.4%**	**174/684 25.4%**	**202/684 29.5%**	

Annex 3b. Household personal hygiene practice of respondents

Personal hygiene practices	Meda-Agame	Mewtsa'e Worki	Hadish Adi
Could you please describe step by step how you wash your hand			
a) wash hands in a bowl of water sharing with others (poor practice)	42 (36.8%)	32 (28%)	29 (21%)
b) With someone pouring a little clean water from a jug in to one's hand	8(7%)	14(12.3%)	16(14%)
c) under running water (appropriate practice)	6(5.3%)	10 (8.8%)	14(12.3%)
d) washes hand with soap or ashes (appropriate practice	58(49.1%)	48(36.8%)	51(44.7%)
e) don't know		10 (8.8%)	4 (3.5%)
Total appropriate practice	64/114= 56.1%	58/114= 50.9%	65/114= 57%
Overall appropriate practice	**54.7%**		

Annex 3c. Household water sanitation practice of respondents

	Meda-Agame	Mewtsa'e Worki	Hadish Adi	Total
1. Main source of water for drinking, cooking and hand washing				
Piped water				
Public in to dwelling				
Public tap/standpipe	114 (100%)	114 (100%)	114 (100%)	342 (100%)
Piped into yard or plot				
2. Collection of water for domestic use				
Yes	114 (100%)	114 (100%)	114 (100%)	342 (100%)

	Meda-Agame	Mewtsa'e Worki	Hadish Adi	Total
3. Collection item				
Bucket				
Jeri can				
Barrel				
All Bucket ,Jeri can and Barrel	114 (100%)	114 (100%)	114 (100%)	342 (100%)
4. Treating collection item to make it clean				
Yes	114 (100%)	114 (100%)	114 (100%)	342 (100%)
Yes (How)				
5. How you make it clean				
Use of water and soap to clean the container	112 (98.2%)	111 (97.4%)	110 (96.5%)	334 (97.7%)
Others	2 (1.8)%	3 (2.6%)	4 (3.5%)	8 (2.6%)
6. Description of how the water store				
Clean container or jar	32 (28%)	20 (17.5%)	28 (24.6%)	80 (23.4%)
Covered container and jar	28 (25.6%)	32 (28%)	29 (25.4%)	89 (26%)
Clean and covered jar	52 (45.6%)	50 (43.8%)	49 (43%)	151 (44.2%)
Don't know	2 (1.8%)	12 (10.5%)	8 (7%)	22 (6.4%)
7. Treatment of water to make safe to drink				
Yes	10 (8.8%)	8 (7%)	20 (17.5%)	8 (11.1%)
No	104 (91.2%)	106 (92.9%)	94 (82.5%)	304 (88.9%)
8. Practice usually done to the water to make safer to drink				
Boil it	2 (1.8%)	4 (3.5%)	4 (3.5%)	10 (2.9%)
Add bleach or chlorine				
Stain it through a cloth	2 (1.8%)	2 (1.8%)		4 (1.1%)
Use water filtrate (ceramics, sand composite etc	10 (8.8%)	16 (14%)	18 (15.9%)	44 (12.9%)
Let it stand and settle	53 (46.5%)	51 (1.8%)	35 (30.7%)	139 (40.7%)
Don't know /no answer	47 (41.2%)	41 (44.7%)	57 (50%)	145(42.4%)
9.Training of food safety from healthy extensions				
None in this month	100 (87.7%)	105 (92.1%)	102 (89.5%)	307 (89.8%)
1-2 times in this month	14 (12.3%)	9 (7.9%)	12 (10.5%)	35 (10.2%)
Above three times	0	0	0	0
Total appropriate practice	**634/1938 32.7%**	**629/1938 32.5%**	**639/1938 32.9%**	**1881/5814 32.4%**