COLLEGE OF DEVELOPMENT STUDIES
CENTER FOR FOOD SECURITY STUDIES

Assessment Of Association Between Under 5 Years Children's Acute Malnutrition And Household Access To Water And Sanitation Service And Hygiene Status:

A Case-Control Study In Yeka , Lemi Kura and Kirkos Sub Cities of Addis Ababa , Ethiopia

By

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ADDIS ABABA, ETHIOPIA

January, 2024

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A Thesis Submitted To The Centre For Food Security Studies, College of Development Studies, Addis Ababa University

Addis Ababa, Ethiopia

March, 2024

DECLARATION

I Bisrat Molla Mekuriaw, do hereby declare to Addis Ababa University School of Graduate Studies that this study product is my original research work, and it has not been submitted to any other university for any academic degree. Materials and information other than my own are dually acknowledged.

Name: Bisrat Molla Mekuriaw
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Date of Submission: 15 March, 2024

Supervisor's approval

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge as an advisor.

Approved by: Abebe Haile (PhD) _____ _____

Thesis Advisor Signature Date

DEDICATION

I dedicated this thesis proposal work to the almighty God, thank you for the guidance, strength, power of the mind, protection, and skills and for giving us a healthy life. I am also dedicated to my wife who has been my source of inspiration and gave me strength when she thought of giving up, she continually provides moral, spiritual, and emotional support.

Approval Sheet

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As members of the Examining Board of the Thesis Open Defense, we certify that we have read and evaluated the thesis prepared by Bisrat Molla, entitled "Assessment Of Association Between Under 5 Years Childrens' Acute Malnutrition And Household Access To Water And Sanitation Service And Hygiene Practice: A Case-Control Study In Yeka , Lemi Kura and Kirkos Sub Cities , Ethiopia ." And we recommend that it is acceptable as a thesis required for the degree of Master of Science in Food Security and Development Studies.

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ABBREVIATIONS AND ACRONYMS

A.A	Addis Ababa
AAU	Addis Ababa University
AM	Acute Malnutrition
ENA	Emergency Nutrition Assessment
EPI	Expanded Program Immunization
FS	Food Security
HH	House Hold
JMP	Joint Monitoring Program
MAM	Moderate Acute Malnutrition
SAM	Severe Acute Malnutrition
SPSS	Statistical Package for the Social Science
U-5	Under Five
UNICEF	United Nation Children's Fund
USAID	United State Agency for International Development
WASH	Water Hygiene and Sanitation
WHZ	Height Z- Score

ACKNOWLEDGMENT

First, I want to thank the Almighty God first and foremost for His kindness during my school time, and in helping me finish my study

I wish to extend my heartfelt gratitude to my thesis work advisor Dr. Abebe Haile for his patience, constant encouragement, guidance, and amazing words of comfort and advice during the whole process starting from content drafting, proposal development to the whole thesis work

My special thanks go to Addis Ababa health bureau and nutrition coordinators in Yeka, Kirkos and Lemi Kura sub cites health office for their cooperation.

I would like to thank my devoted wife Tsehay Mohammed for her encouragement and support to finish this study. I also thank all my lovely children for their patience and gave me enough time for this study at home.

I would like also to thank Dr. Mekuria Alemayehu for valuable comments and encouragement during my thesis work.

I am also grateful to thank my brothers, sisters, relatives, friends, and classmates who shared their words of advice and encouragement to finish this study.

I would also like to acknowledge all the health extension workers in Yeka, Kirkos and Lemi kura sub cities for their contribution during data collection of this thesis work.

Finally, I would like to appreciate the study participants and their relatives for their willingness and participation in the study.

ABSTRACT

The study aims to examine the association between U-5 years children's severe acute malnutrition and household access to water and sanitation service and hygiene practice in Kirkos, Yeka, and Lemi Kura Sub-Cities of Addis Ababa Ethiopia. Community based unmatched case-control study design was deployed to assess the relationship of severe acute malnutrition with water, sanitation, hygiene and other associated factors among under five children. Using systematic random sampling technique, a total of 296 under five children were enrolled from July 3 to August 30, 2023. Bi-variable and multivariable binary logistic regression analysis was done using SPSS version 21 to identify water, sanitation and hygiene factors associated with severe acute nutritional. Statistical significance was declared at P-value<0.05. Water treatment [AOR:1.98,95%CI (1.152-3.413)], child hand washing after defecation [AOR:2.95, 95%CI (1.246-6.973)], marital status of the guardian [AOR: 3.57,95%ci (1.23-10.39)]and adequate breast milk [AOR: 2.05, 95 %CI (1.18-3.56)] were determinant factors significantly associated with child severe acute malnutrition. Thus, water treatment and hand washing after defection were the major water, sanitation, hygiene related factors statically associated with severe acute malnutrition. House hold water handling and treatment, proper child handing and continues behavioral change intervention on hygiene practice are recommended along with nutritional interventions.

The key words: water, hygiene, sanitation, severe acute malnutrition and Addis Ababa.

1. INTRODUCTION

1.1 Background

Under-5 children are the riskiest age group for malnutrition. Malnutrition at the early stages of life can increase risk of diseases, morbidity, and mortality, together with decreased mental and cognitive development. The consequence of child malnutrition is long-lasting and goes beyond childhood (Gizaw et al., 2018).

The world made notable progress in child survival in the past few decades, and high number of children have better survival chances. Though, developing countries are still in challenge of child mortality, mostly from preventable cause of diseases. Above 50 % U-5 deaths are ascribed by malnutrition alone in developing countries. In Africa, one out of three children is stunted (HANISA, 2021).

Globally high number of children who suffer from wasting have only marginally decreased over the years, particularly when compared to progress made in reducing other malnutrition indicators, such as stunting. The worldwide estimated number of children suffering from wasting was decreased by 11% over the course of 21 years, between 1990 and 2011.The immediate causes of malnutrition are insufficient dietary intake and illness; however, the root causes can be complex, often driven by food insecurity, poor care practices, an unsanitary living environment, and poor access to health care (Nassur et al., 2022).

Worldwide, 4.5 billion persons do not have access to better sanitation and 2.3 billion people lacks access to basic sanitation services. People who lack at least basic sanitation often practice open defecation that leaves their living spaces contaminated with harmful pathogens that can lead to diseases and malnutrition. Besides, 2.1 million people do not have access to safe drinking water sources in compounds and 844 million lack access to basic water service. Several of the residents that live in unsanitary living conditions with unsafe drinking water are the same residents (Nassur et al., 2022).

The connection between poverty, household security and children's nutrition and health has been extensively reported. Household (HH) food security level mainly relies on income, family size and purchasing power of HH members. Scientific study has reported that, HH food insecurity can negatively affect food consumption in terms of decreasing dietary, nutrient intake, and nutritional status of HH members (HANISA, 2021).

In Ethiopia, the proportion of malnutrition is high and also have high geographical coverage and socio-economical inequalities. When we compare regions, the stunting rates range from 14% in Gambela to 46% in Amhara. In addition, 2% of children in the highest wealth quintile are stunted whereas 45% of children in the lowest wealth quintile are stunted (USAID, 2018, Ethiopia, Nutrition Profile).

Ensuring food security in Ethiopia is one of the country's greatest challenges. Nearly one out of the five children in Ethiopians needs food support during the 2015/16 drought demonstrates a high level of food insecurity as well as a large segment of the population who are susceptible to become food insecure. The HH food security affected by variety of factors such as access to food, nutrition knowledge, beliefs, access to health care, water and sanitation services and practices (HANISA, 2021).

1.2 Statement of the Problem

Childhood wasting is a worldwide problem and is knowingly pronounced in developing countries. Socio-Economic Status and WASH may be linked with wasting. Most past study is consistent about the role of Socio-Economic Status, but the significance of WASH in the context of wasting remains unclear (Raihan et al., 2017).

Ethiopia is one of the countries with the uppermost U-5 child mortality rates, with malnutrition remaining the foremost cause of death. Overall, 10% of children in Ethiopia are wasted, and 3% are severely wasted(Aye et al., 2023).

According to results from a secondary data analysis of EDHS conducted from 2000 to 2016, the overall prevalence's of wasting and stunting were 10.98% and 47.29% respectively. The result of this study shown that HH sources of drinking water did not predict the occurrence of either wasting or stunting. However, since this study is against to most of the literature, it has recommended to undertake further study to support evidences on the association between WASH and child malnutrition (Sahiledengle etal., 2022).

In AA, where this study was undertaken more than 80% of the city's residents live in slum areas. In these areas, large population share kitchens and toilets, which are unhygienic and unsafe to be around. These unsafe and shared facilities contribute to the spread of illnesses and other health problems. The selected sub cities for this study are among those cities that have poor access to WASH facilities which commonly contributes to child growth failure (Gelet et al., 2023)

Though there are some evidences that shows children with poor access to proper WASH are likely affected by acute malnutrition, there is lack of studies that provide an assessment of WASH factors in Ethiopia, particularly in AA using adequate sample on which to draw conclusions that can inform future intervention. Therefore, this study aimed to assess the association between WASH and SAM among U-5 in AA, Ethiopia

1.3 Objectives

1.3.1 General Objective

The general objective of this study is to assess the association of SAM and HH access to Water, Sanitation and Hygiene practice among U-5 children in AA, Ethiopia.

1.3.2 Specific Objectives

Specific objectives of the study were to:

- Determine association between HH access to water supply and utilization and severe acute malnutrition in study area.
- Identify association between HH access to sanitation facilities and latrine type and child severe acute malnutrition.
- Identify association between child SAM and HH hygiene practice and other factors

1.4 Research Questions

- Is there an association between HHs' access to a basic source of drinking water and severe acute malnutrition?
- Is there an association between HHs' access to sanitation facility and latrine type and severe acute malnutrition?
- Is there an association between HH hygiene practice and other factors and child's SAM?

1.5 Significance of the Study

Apart from the requirement of rewarding MSc in AAU; the study was highlighted the importance of considering WASH along with nutrition interventions. It has recommendations to the concerned sectors and partners about the importance of both community and institutional to prevent acute malnutrition. The study will also be used as baseline for future study. The finding will share to AA Health Bureau, woreda health office, education office and partners working on nutrition, and WASH. This enables to this gov't institution and partners to design problem base intervention and prioritized their intervention for U-5 year of children.

1.6 Scope of the Study

The study is to assess the association of SAM and HH access to WASH services among U-5 children in AA. The study was focus on quantitative method survey using pretested questionnaire to collect children enrolled to the HC for nutritional services starting from Jan 1 to July 30, 2023. All U-5 children in AA have been represented by the study groups in Kirkos, Yeka and Lemi Kura sub cities selected using systematic random sampling technique.

1.7 Limitation of the Study

Because of the time and other challenges only quantitative method was applied to collect the data i.e focus group discussion and key informant interview of experts and heads from stakeholder organizations were not done. The other limitation was lack of similar studies in urban setting to review and compare the results with literatures in similar topics. The study population was selected from the under five children nutrition service data records (nutrition service registration book) in the HCs, i.e Anthropometric measurement was not carried out to identify the current nutritional status of the children.

1.8 Organization of the Paper

This research proposal is divided into eight chapters. The first chapter is about general introduction which includes background of the study; statement of the problem; significance of the study and limitations. Chapter two is about objectives, chapter three covers the literature review and the definition of key concepts related to child malnutrition and WASH. Chapter four is about research methods which includes study area description, study design, period, source of population, study population, eligible criteria, data sources, sample size determination, sampling techniques, data collection tools, data quality management, study variables, independent and dependent variables, data analysis and ethical consideration. Chapter five, six and seven and eight covers results and discussions, conclusion and recommendations, references and appendices respectively.

2. LITERATURE REVIEW

2.1 Definition of Concepts

Stunting is defined by a height-for-age (HAZ) < -2 Z scores. Stunting of a child's growth may be the result of failure to receive adequate nutrition over a long period, or sustained improper feeding practices, or of the effect of repeated episodes of illness.

Mid-upper Arm circumference (MUAC) meter: is a measuring instrument, usually plastic tape used to screen and admit children only by measuring the Mid-upper Arm circumference.

Moderate acute malnutrition (MAM): MUAC) of ≥11.0 cm but <12.5 cm.

Severe acute malnutrition (SAM): MUAC of < 11.0 cm in children

Underweight (low weight for age): is used as a composite indicator to reflect both acute and chronic under nutrition.

Wasting (low weight for height): is an indicator of acute under nutrition, the result of more recent food deprivation or illness.

Improved or unimproved source of water: Using the Joint Monitoring Program's definition ((WHO/UNICEF, 2020). Source of drinking water is classified as **improv**ed if it was obtained from the piped water into a dwelling or plot/yard, protected well or spring, tube

well/borehole, public tab/standpipe and rainwater. Drinking water is categorized as **unimproved** if it's obtained from the following sources; unprotected dug well and spring, cart with small tank/drum, tanker truck, and surface water. Bottled water is classified as improved only if the participant's nondrinking source of water is piped in the dwelling or yard; otherwise, bottle wateris classified as unimproved.

Improved or unimproved source of sanitation: toilet facilities are classified as **"Improved"** sanitation facilities are: flush to toilet, piped sewer system, septic tank, pit latrine with slab, ventilated improved latrines, and composting toilets. However, if any of the sanitation facilities that are considered improved are also shared between two or more households, then they are classified as **unimproved.** Furthermore, other sanitation facilities i.e. Bucket toilets, hanging toilets/latrine, bush/field are grouped as unimproved type of sanitation.

Disposal of feces classified as "Safe" if the child is helped to use a toilet or latrine or fecal matter is disposed into a toilet or latrine.

2.2 Theoretical review

From the Nutriset update of August 17, 2018; contaminated water, insufficient sanitation, and poor hygiene practices are directly linked to undernutrition in children through three main routes: diarrhea, intestinal parasites, and environmental enteric dysfunction (Nutriset,2018)

According to the technical brief of UNICEF; there is evidence connecting safe WASH to health and nutrition. This document has indicated that poor WASH services and practices may impact child undernutrition through four pathways: (1) repeated episodes of diarrhea; (2) frequent and intense enteric infections; (3) poor gut health; and (4) effects from significant time spent accessing services (USAID, 2023)

Action Against Hunger is working more of on nutrition. Recently they have added WASH component to nutrition intervention as they already knew the linkage and believes the positive impacts of WASH intervention to prevent AM.

Stepped activities recommended by Action Against Hunger in 2027 under R4ACT (Research4Action) factsheet -the impact of WASH on acute malnutrition report were:

1. Select the most appropriate HH water treatment method in the area covered by SAM treatment

through a participatory approach

2. Systematically coordinate the delivery of HH water treatment adapted to the context with SAM management
3. Train identified health facilities staff on a) health center water system management and b) building caregivers' capacity on the correct use of HH water treatment products.
4. Improve water system in health facilities– Develop behavior change on water treatment in areas covered by SAM treatment.
5. Ensure information, knowledge and data sharing between the WASH and Nutrition sectors (ACF, 2017)

2.3 Empirical Review

A community-based cross-sectional study design undertaken at Gulele Sub-city in 2020 on HH food security and U-5 children status showed that the prevalence of food insecurity in the HHs among safety net program beneficiaries in the Sub City was 20.8%. According to this study,the magnitude of stunting, underweight, and wasting were 54.6%, 15.6%, and 11.4 %, respectively. This study also tried to assess other factors that affect U-5 children's nutrition. For instance, the study indicated that children who live with illiterate HH heads were 0.24 times (AOR = 0.24, 95% CI: (0.09 - 0.7) less likely to be well nourished compared to those who live with HH heads who completed primary school (HANISA, 2021). However, this study didn't assess the association of between child AM and WASH.

As per the prevalence surveys conducted in 2019; there were 50 million children that suffer from AM, or wasting, of which 14.3 million were severely wasted globally. AM is estimated to account for over one-third of child deaths and 11% of the total worldwide disease burden. South Asia has the highest number of children with wasting, followed by Africa and the Middle East (Patlán-Hernández et al., 2022).

A case-control study design was conducted in December 2018 in Kersa and Omo Nada woreda of the Jimma Zone, Ethiopia on Childhood Malnutrition and its Association with WASH. As this study demonstrates malnutrition was significantly increased among children who delayed breastfeeding initiation(AOR=3.12; 95% CI: 1.62-6.00), had diarrhea (AOR=9.22; 95% CI: 5.25-16.20), were living in HHs indexed as the poorest (AOR=2.50; 95% CI: 1.12-5.62), defecated in a pit latrine without slab (AOR=2.49; 95% CI: 1.17-5.30), fetching water from < 1 km distance (AOR=4.77; 95% CI: 1.01-22.71) and sometimes practiced hand washing at the critical times (AOR=2.58; 95% CI: 1.16-5.74) compared with their counterparts. However, lactating during the survey (AOR=0.35; 95% CI: 0.18-0.67), water collection from unprotected sources (AOR=0.22; 95% CI: 0.05-0.95) and collection and disposal of under-5 children feces elsewhere (AOR=0.06; 95% CI: 0.01-0.49) significantly reduced the likelihood of malnutrition (Soboksa et al., 2021).

From this study, it is possible to conclude that early initiation of exclusive breastfeeding, diarrhea prevention, and the use of improved latrine and hand washing practices at critical times could be important variables to improve the nutritional status of children. However, this study didn't asses effect of the water supply, source and utilization to the children's AM.

Another community-based observational study was conducted in five woredas (Chikwawa, Chiradzulu, Machinga, Mulanji, and Zomba Districts) across the Southern Region in Malawi on HH-level factors associated with relapse following discharge from treatment for MAM. The results showed that HH with fitted lids on water storage containers (P=0·004) was a significant predictor of sustained recovery. According to this study sustained recovery was better among children whose caregivers were observed to have clean hands (P= 0·053) and in HH using an improved sanitation facility (P=0·083). By contrast, socio-economic status and child feeding practices at the time of discharge, and HH FS throughout the follow-up period were not significant. Though there was no adequate evidence that showed a significant association between child nutrition and WASH, the investigator of the above study hypothesized that improved water, sanitation, and hygiene conditions in tandem with the management of MAM through supplemental feeding programs have the possibility to decrease relapse following recovery from MAM (Stobaugh et al., 2018)

The unmatched case-control study was conducted on 451 U-5 children (151 cases and 300 controls) in Gedeo Zone in 2018 on determinants for AM among U-5 Children. The major determinates for AM among U-5 children by this study were; diarrheal diseases (AOR=3.601 CI=(1.36, 9.53)),

complimentary feeding started before 6 months or late after 6 months (AOR=4.4,CI=(1.6, 11.84)), HH monthly income <750 Ethiopian birr , (AOR=4.6 CI=(1.1, 21.6)), maternal illiteracy (AOR=4.18, CI=(1.36, 12.8)), merchant mothers (AOR=7.45 CI=(2.6, 21.2)), care givers' infrequently hand washing (AOR=5.4 CI (1.15, 25.8)) and family size more than four (AOR=5.9, CI (2.1, 16.7)(Abuka et al., 2017). Even though this study assesses socio-demographic and behavioral factors of AM among U-5 children, other associated factors such as water source, latrine utilization and hygiene practice were not well addressed.

A clustered randomized control trial study on the associations between AM and potential drivers in Sila, Chad in 2016 showed HHs who reported not regularly cleaning the container used for transporting water for HH consumption were almost twice as likely to have a malnourished child. HHs living in villages with larger concentrations of cattle and having more livestock sharing the same water source for human consumption were significantly more likely to have malnourished children. Though, cleaning the water container mediated the negative impact of living in a village with a large cattle concentration on wasting (Marshak et al.,2017). This study demonstrated that hygiene practices and livestock water management are correlated with AM. These findings provide a hypothesis for a possible pathogen driving AM as part of a complex water chain, whereby the source of infection may be mitigated by hygiene behaviors with important implications for humanitarian programs.

According to the 2014 Ethiopian Mini Demographic and Health Survey (EMDHS) report, 42%, 26.7%, and 9% of U-5 children were stunted, underweight, and wasted, respectively. The problem is even worse in rural areas. For instance, the prevalence of underweight and stunting among rural children was 27% and 42% compared with only 13% and 24% among urban children, respectively (Gizaw et al., 2018)

According to the Secondary data analysis using EDHIS 2011 in 2016 to examine the impact of HH access to Water and Sanitation on Child Malnutrition in Ethiopia, approximately 44%, 10%, and 29% of the children under five years of age were stunted, wasted, and underweight, respectively. About 54% of the study population used unimproved sources of drinking water and about 82% used unimproved sanitation facilities. This study also has shown children in households with an unimproved source of drinking water had higher odds of stunting comparedto children in households with an improved drinking water source (OR: 1.2; 95% CL 1.02-1. As per this study finding stunting was not associated with the unimproved source of drinking water (AOR: 1.0; 95% 0.8-1.2) and not significantly associated with wasting (OR: 1.0; 95% CL 0.8- 1.3) and underweight (OR: 1.2; 95% CL 1.0-1.4).However, adjustment of a child, maternal, and household characteristics showed an inverse association between source of drinking water and wasting iii (AOR: 0.7; 95% CL 0.6-0.9) and access to unimproved sanitation was significantly associated with stunting (OR: 1.3; 95% CL 1.02-1.74) and underweight (OR: 1.5; 95% CL 1.1- 2.1). Compared to children living in homes with access to improved sanitation facilities, children in households with unimproved sanitation facilities had 1.4 increased odds of being stunted (95% CL 1.1-1.9). Also, Children from households with improved water but unimproved sanitation had higher odds of wasting and being underweight compared to

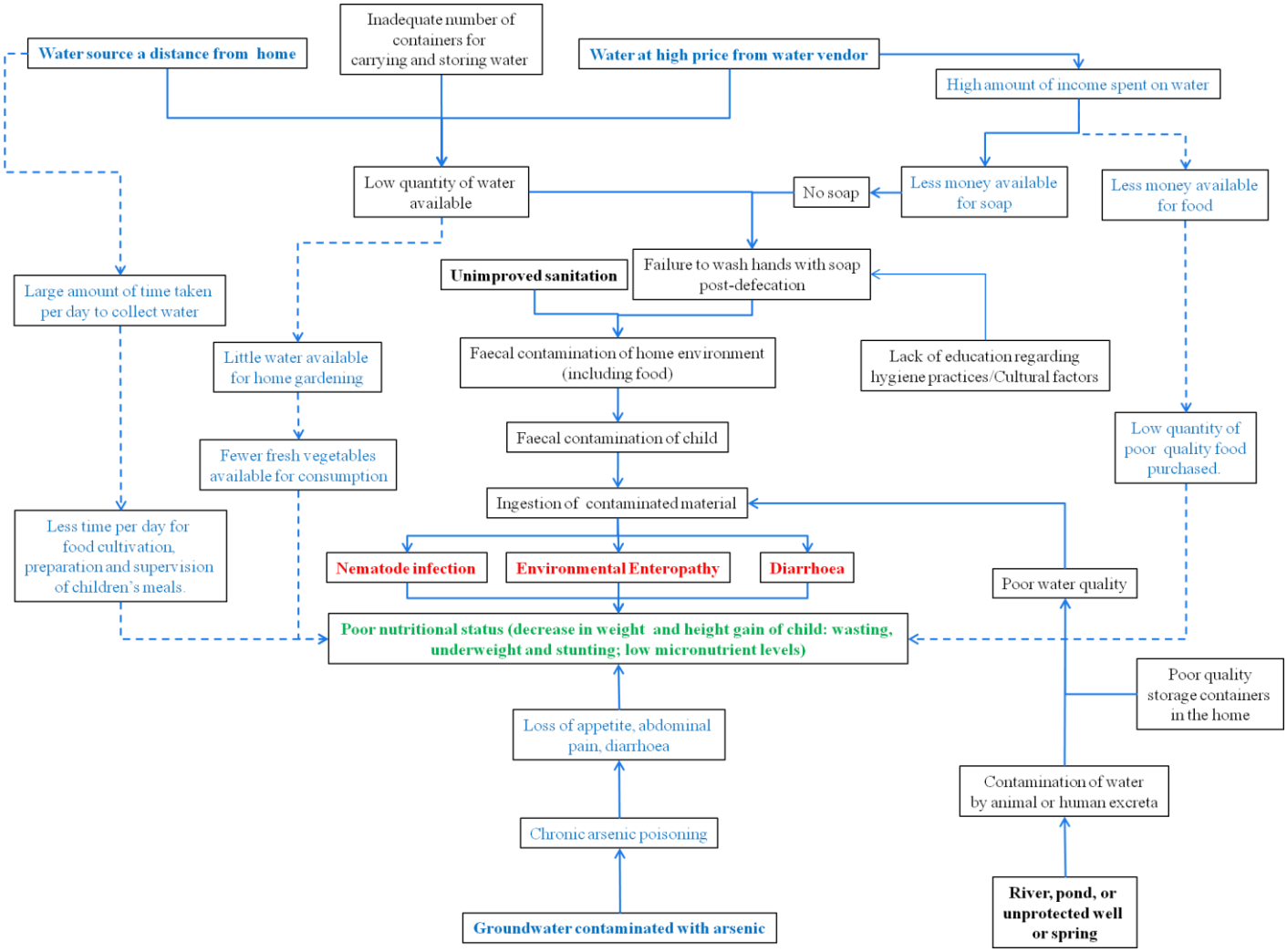
children living in households with both services (Wondimu, 2016). Based on this study finding, the investigator concluded that HH access to an unimproved source of drinking water and sanitation increases the likelihood of malnutrition. However, the association of WASH with MA didn't explicitly investigate in this study which needs further evidence. Also, since this study used secondary data (EDHIS) it didn't assess HH hygiene status by observation and interview which questions the reliability of the results and conclusions.

A cross-sectional study was conducted to assess the magnitude and factors associated with AM among children aged 6–59 months in the Hadaleala Woreda , Afar Region in 2015. The result has shown that the prevalence of acute malnutrition was 11.8% (95% CI = 9.3, 14.8%). The highest prevalence (50%) of acute malnutrition occurred among children aged between 12.0–23.0 months. Childhood acute malnutrition was associated with the presence of two (AOR = 2.49, $p < 0.05$) and three (AOR = 12.87, $p < 0.001$) children in each household, unprotected drinking water sources (AOR = 3.78, $p < 0.05$), absence of the latrine (AOR = 5.24, $p < 0.05$), hand washing with soap (AOR = 0.21, $p < 0.05$), childhood diarrheal disease (AOR =2.72, $p < 0.05$), and child vaccination (AOR = 0.15, $p < 0.001$). Hence this study indicates that drinking safe water, improving hand washing practices, utilization of latrines, preventing diarrheal diseases, and vaccinating children are important factors to improve the nutrition of children of the nomadic people (Gizaw et al., 2018). However, since this study is undertaken in rural and nomadic communities, it may not represent big cities and stable communities likeAddis Ababa. Also, HH members' hygiene status was not investigated in this study which needs to be further strengthened or confirmed by other studies.

Taking into account these sources that provide evidence for the association between WASH and acute malnutrition, there is a lack of studies in the AA context that provide an assessment of WASH factors based on contextual, demographic factors and a relatively large sample on which to draw conclusions that can inform future intervention.

A systematic review by ACF France in 2019 on the impacts of WASH on AM from available scientific evidence has developed conceptual framework which shown a causal pathway between AWASH and child nutrition.

Fig 1: Pathways for how poor WASH impacts child nutritional status, indirectly (ACF France, 2019)



2.4 Conceptual Framework

As evidences from different studies shown; the FS status of HHs is impacted by different factors.

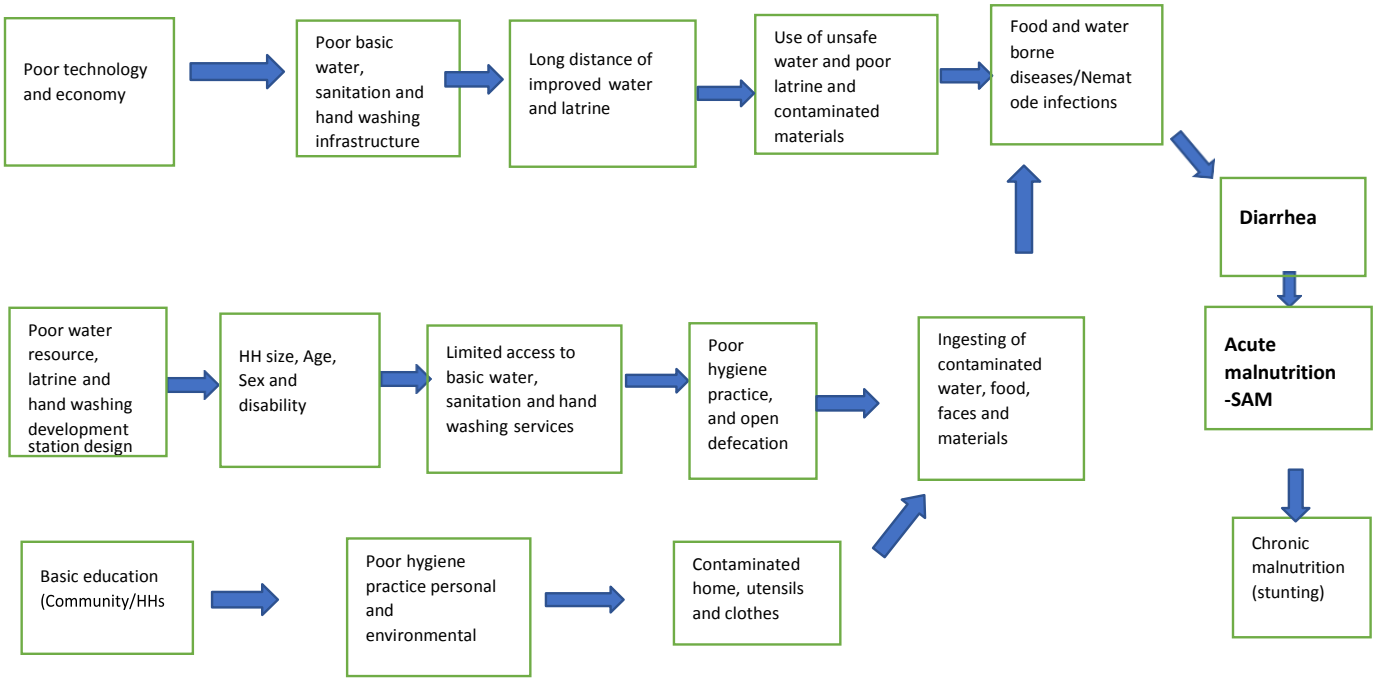
Technologies and economy to build water and sanitation infrastructure are among primary contributing factor for AM. Poor technology and economy unable to build improved community water and latrine facilities. This results unsafe utilization water and latrine which finally causes for diarrhea from ingestion contaminated foods, materials and water. Diarrhea can be the major causes of child MA.

If water and latrine development do not consider disability, sex, age and other factors; it can't be utilized by all HH members. This causes poor personal and food hygiene and contaminated environment and water from open defecations which results infection mainly diarrhea.

The other basic contributing factor for acute malnutrition is illiteracy of the HH members. Less educated and poor aware HHs about important of hygiene practice, proper utilization of water and latrine services results water and food borne diseases which exposes them to parasite infection that causes for diarrhea and malnutrition.

The following conceptual framework shown WASH related factors that contributes to acute child malnutrition. This conceptual framework is adopted from various literatures and modified by the researcher.

Fig 2. Conceptual frameworks -contribution of water, hygiene and sanitation factors to acute child malnutrition, Addis Ababa-2023



3. METHODS AND MATERIALS

3.1 Description of the Study Area

AA is the capital city of Ethiopia and it is also the largest city of the country. The capital city holds 527 square kilometers of area in Ethiopia. It has 11 sub cities named as Arada, Addis Ketema, Yeka, Kirkos, Lideta, Kolfekeranio, Akaki Kaliti, Nifas Silk Lafto, Gulele, Bole and Lemikura. Under each sub city, there are woredas and ketenas which are the lowest units of administrations. Each sub city has an average 9 woredas. AA has highly accelerated population growth, largely owing to the high rates of net in-migration from both rural and urban areas, which leads to urban inequality, a divided city, and an escalated housing crisis. If the current high urbanization trend continues, Ethiopia's level of urbanization will constitute more than one- third of the total population before 2035. Nonetheless, urbanization in Ethiopia does not correspond to economic development, which is challenged by environmental hazards, housing inadequacy, poverty, unemployment, and informal settlements. Thus, inclusive cities and sustainable urbanization can be realized through appropriate regularity instruments and tools that tackle concentrated poverty, social exclusion, and spatial inequality (Gelet et al., 2023).

According to the last quarter of 2022 AA administrative report, the total population of the city is 3,938,772. The number of under five years of children is 286,834 (7.155%), under 2 years of Children 106,826 (2.71%), age b/n 6-59 months children is 250,506 (6.36%), age b/n 24-59 months children is 175,000 (4.443%) and adolescents age b/n 10-24 is 1,315,550 (33.4%). In terms of the economy, Addis Ababa is very diverse. Trade and commerce are the most popular industries, followed by manufacturing and production, homemaking, and civil administration. The city is facing extensive urban poverty, joblessness, inadequate housing, severe overcrowding and congestion and underdeveloped infrastructure.

Many low-resource population in AA have a high prevalence of diseases related to inadequate WASH, such as diarrhea, parasitic worm and skin and eye infection. Schools, particularly those in slums, often have inadequate water, hygiene and sanitation facilities. HHs and women living in Kirkos, Yeka and Lemi Kura sub cities are the most likely to be food insecure and undernourished of comparing to other sub-cities in A.A(HANISA, 2021). The last quarter of 2022 Addis Ababa administrative report also indicated that these sub cities do have higher burden of acute malnutrition and relatively poor WASH service. For this reason, the three sub cities (Yeka, Kirkos and Lemi Kura) were selected for this study.

Study populations in each three-sub city were selected proportionally based on the loads of cases (SAM numbers for the last six months). A total of 10 HCs were selected purposely based on availability of cases. Most of the cases were found in Yeka sub city because of high malnourished under five children in this area. Six health centers in Yeka sub city (Entoto No. 2 HC, Woreda 12 HC, Woreda 10 HC, Woreda 8 HC, Yeka 5 HC ,Ferency Acababi HC), three health centers in Lemukura sub city(Aramsa Hc, Goro HC, Wereda 2 HC) and one health center in Kirkos sub city(Kazanchis HC) were selected).

3.2 Study Design and Approach

Case-control study design was deployed to assess the association of AA with WASH service and other associated factors among U-5 children.

Cases-are those children who are confirmed for SAM in selected. The SAM cases whose MUAC is <11 cm at selected HCs were included to the study.

Control- are those children who are confirmed for not having AM in selected HCs.

3.3 Source Population and Study Population

The source population is all U-5 children in AA. As per recent nutrition report of A.A city, 2022), the total estimated number of U-5 children in AA is 286,834.

The study populations are all under five children in Kirkos, Yeka and Lemi Kura sub-cities. The sampling framework of this particular study is all children aged between 6-59 months live in the area. As per the recent (last quarter of 2022) AA city administrative report; from total 106, 655 U-5 children screened for malnutrition 10,379 and 3,428 were MAM and SAM

respectively.The number of under-five SAM cases in the selected three sub cites were 744 which is 22% of the total cases in A.A.

Table 1: Selected sub cities, health centers and study population, Addis Ababa, Dec 2024

Name of sub city	No of SAM cases	Proportion (%)of cases	No of woreda(HCs)	Proportion of study woreda(40% of the total 26 woreda)	Sampling unit((HHs for interview)	Health center name (cases, control)-purposely selected based on cases available
Kirkos	84	11.29	8	1.17416	34	Kazanchis(17,17)
Lemi kura	197	26.48	9	2.75392	78	Aramsa Hc(12,12) Goro HC (15,15) W2 HC(12,12)
Yeka	463	62.23	9	6.47192	184	Entoto No. 2 HC(10,10) Woreda 12 HC(19,19) Woreda 10 HC(21,21) Woreda 8 HC (17,17)) Yeka 5 HC(15,15) Ferency Acababi HC(10,10)
Total	744	100	26	10.4	296	296(cases+148 control)

3.4 Eligible Criteria.

3.4.1 Inclusion Criteria

Cases: U-5 Children with confirmed SAM at selected HCs

Control: U-5 Children with confirmed for not having SAM at the selected HCs

3.4.2 Exclusion Criteria

Under five guardians who don't give full consent in the study.

3.5 Data Types and Sources

The sources of the data were both secondary and primary data. The secondary data was extracted from the records in Addis Ababa Health Bureau and selected health center of sub-cities. Primary data source was taken from the interview of guardians (mothers/parents) of under-5 children in the selected households. The cases were SAM children who were diagnosed using MUAC measurement from routine health center nutrition service in the last 6 months. The controls are children who were diagnosed as having no nutritional problems from the same sources. Using an unmatched case-control study design and systematic random sampling technique, a total of 296 under-five children were selected at the health center nutrition registration book and then the guardians (mothers/parents) of those 296 children were interviewed at the household level from July 3 to August 30, 2023.

3.6 Data Collection Methods and Procedure

The data was collected using HH questionnaire(surveys) and observation methods. Kobo software was installed to data collectors' smartphones and one-day training was given to them. The enumerators have been selected from the woreda who know the area context. Enumerators with a background including higher secondary and health sciences were recruited for a questionnaire survey. Nutrition is focal in Addis Ababa health bureau and in the sub-cities were consulted during enumeration to make sure about commitment and skill. A total of 16 enumerators who are working in the HC area as HEWs were selected. The questionnaire is

translated from English to the Amharic language for the sake of convenience for data collectors to easily conduct their interviews, as Amharic is an official language of the study area. Data related to HHs hygiene practice were collected using **observation which included h**and washing techniques, waste disposal system, drinking water handling, OPD status of the compound, latrine type and cleanliness were some of the data supported by observation

3.7 Sampling Techniques and Sample Size Determination

3.7.1 Sampling Technique

The sampling procedure is multistage. The study was conducted in 21 woredas in three sub cities of AA city (Kirkos, Yeka and Lemi Kura). The sub-cities were selected based on burden of malnutrition and WASH service availability considering the reported and recorded evidence in AA Health Bureau. The woredas were selected using simple random sampling technique. All health centers under the 21 woreda were included to the study. Simple random sampling technique were employed to recruit cases and controls at the HC. We used the U-5 registration and nutrition screen book of the health centers as a sampling frame. After identification of cases and controls at the health center, the study was conducted at community level.

3.7.2 Sample Size Determination

The sample size was determined using a formula for the double population proportion by assuming estimates of the proportion of well-nourished children (P1) as 43.8 from recent study (Negasa Eshete Soboksa,2019.We assumed an odds ratio of 2(from literature, children living in HHs that had been using unprotected water sources were 2 times more likely to be acutely malnourished than those who had been using protected water sources taking water source as major factor) with a power of 80%, 95% confidence interval, a 1:1 ratio of cases and controls and a 10% non-response rate.

Therefore, the estimated sample sizes for a two-sample proportions test and unmatched case control study is calculated using Pearson's chi-squared test i.e = $\underline{(p_1q_1+p_2q_2)(z_1-\alpha/2+z_1-\beta)^2}$

$(P_2-p_1)^2$

Study parameter alpha = 0.0500

power = 0.8000

delta = 2(odds ratio)

p1 = 0.4380

p2 = 0.6092

Odds ration=2

The standard normal distribution to the significant level of α is 1.96 and the desire level of power (here 80%) β is 0.84. Using STATA version 14 software estimated sample size is 266. After adding 10% for the non-response rate, the final sample 294 for each group (147 cases and 147 for controls)

3.8 Data Quality Management

The quality of data was ensured through training of data collectors and supervisors, close supervision and prompt feedback. The training was consisted of instruction on interviewing techniques, a detailed review of the questionnaire content, instruction and practical demonstration. The collected data was checked for any inconsistencies, coding error, out of range, completeness, accuracy, clarity, missing values and appropriate corrections has made by the principal investigator and supervisors consistently on the daily bias.

3.9 Study Variables

3.9.1 Dependent Variables

The primary dependent variable for this study is SAM

3.9.2 Independent Variables

The primary independent variables are:

- Source of drinking water (improved/unimproved)
- Water treatment of water at home

- Types of sanitation(latrine) and
- Child stool disposal (safe/unsafe)

Other independent variables which will be explored as potential confounder for this study are: child's age and gender, maternal variables (age and marital), HH variables included household size and number of children < 5 years of age , breast and supplementary feeding

After completion of the data collection, data cleaning was undertaken before data entry is commenced. The data was entered in Epi data version 4 and I was export it to STATA version14 for analysis. Descriptive analysis using percentages, frequencies and mean has made for analyzing the demographic characteristics and hand washing practices. Bi-variable and multivariable binary logistic regression were employed to identify the effect of WASH on SAM and other independent predictors. Crude and Adjusted odds ratio with 95% confidence interval were used to show the effect sizes. Statistical significance was declared at P-value<0.05.

3.10 Descriptive and Inferential Statistics

Data was cleaned and coded for completeness and consistency manually. Data was entered using Kobo and was exported for analysis into SPSS version 21 statistical software. The data was summarized using proportions, percentages, mean/median, standard deviation and Chi-square tests. Bi-variable and multivariable binary logistic regression model was used for analysis. Categorical variables were summarized using frequency and percentages. Factors associated with SAM at bi analysis was identified and the variables with p-value of 0.20 and less was fit to logistic model for multivariable analysis to determine relative prediction level of independent variables to the outcome variable. P-value less than 0.05 at 95% confidence interval was considered as statistically significant. AOR with their 95% confidence intervals were computed to identify the presence and strength of association, and statistical significance was declared if p < 0.05.

3.11 Expected output

Major expected result is having scientific evidence that enables to the gov't institutions and partners to design need base WASH intervention and prioritized their intervention in a way of addressing nutrition problems of children under the age of five.

Specifically, the expected output of study are:

- Capitalized the importance of considering WASH along with nutrition interventions.
- Highlight recommended WASH intervention components that contributed to children'sacute malnutrition.
- Well-articulated and documented finding that can be a baseline for future study and shareit with concerned sectors and partners

4. ETHICAL CONSIDERATION

The health center directors, sub city heads, nutrition focal and parents were informed about the purpose and procedures of the study. Information about the study was given for the participants, including purpose and procedures, potential risk and benefits so that encourage provision of accurate and honest responses. Study subjects were informed that their volunteer and there was no interpretation of a single response (fully confidential). An informed consent was obtained from the study subjects and they have informed that a full right to refuse to response either partly or completely. But participants were also informed their genuine responses are vital importance for the study.

5. RESULTS AND DISCUSSIONS

5.1 Descriptive statistics

Socio- demographic characteristics

A total of 296 HHs who had children less than 5 years were enrolled in the study and all gave response. About 266 (89.9%) of the mother/guardians were married. More than half of the HHs (65%) had four and above family members. About 164(55.4%) and 132(44.6%) were male and female respectively. Other socio demographic data such as educational status are income data were not considered in this study since the searcher mainly focus on WASH factors which are very large to manage.

Table 2. Socio Demographic characteristics of study participants, Addis Ababa, Ethiopia, Dec 2023

Marital status	Frequency	Percent
Married	266	89.9
Widow	11	3.7
Divorced/separated	19	6.4
Total	296	100
Family size		
Two	11	3.7
Three	90	30.4
Four	100	33.8
Five and above	95	32.1
Total	296	100
Sex of children		
M	164	55.4
F	132	44.6
Total	296	100

Water sources, availability and handling

The majority of the HHs were used pipe water in the compound (47%) and public pipe water (46.6%). About 12(4.1% HHs were used protected well. The remaining (2.3%) HHs were used water from unprotected such as unprotected well unprotected spring, surface. water and borehole**.** About 167(56.4%) of the respondents believed that the water is contaminated from the source. The remaining g 127(43.6%) respondents believed that the water not contaminated from the source. More than 50% of HHs didn't used treated the water at home.

Table 3. Water sources, availability and handling of HHs in Addis Ababa, Ethiopia, Dec 2023		
Most used water source	Frequency	Percent
Protected well	12	4.1
Unprotected well	2	0.7
Unprotected spring	1	0.3
Borehole or tube hole	1	0.3
Public stand pipe	138	46.6
Surface water (river, stream, lake, pond)	3	1
Pipe water in the compound	139	47
Total	296	100
Is water sources are free from contaminants?		
Yes	167	56.4
No	129	43.6
Total	296	100
Is drinking water kept away from contamination?		
Yes	267	90.2
No	27	9.1
Total	294	99.3
Missing	2	0.7
Total	296	100
Use of HH water treatment (any methods)		
Yes	135	45.6
No	161	54.4
Total	296	100
Frequency of water storage cleaning		
Everyday	131	44.3
every week	126	42.6
Every month	8	2.7
Rarely	30	10.1
Missed	1	0.3
Total	296	100

Latrine availability and utilization

About 163(55.1%) of the HHs didn't have private ventilated improved latrine. The majority (78.3%) of the HHs that didn't have private latrine were used communal latrine. About 250(84.4%) of the respondents reported that they wash their children's hand after defection. The majority (58.4%) of the HHs had both liquid and solid waste disposal pit. About 15 (8.8%) HHs practiced open reported that they practice open defecation

Table 4. Latrine and waste disposal system availability of the HHs in Addis Ababa, Ethiopia, Feb 2024

Availability of private latrine?	Frequency	Percent
Yes	133	44.9
No	163	55.1
Total	296	100
Where do people in the household defecate if no private latrine?		
Bush	15	8.8
Neighbors' latrine	22	12.9
Communal	133	78.3
Total	170	100
Child handwashing after defecation		
Yes	250	84.5
No	46	15.5
Total	296	100
Type of latrine observed?		
TPL	123	41.6
TPL with san plat	36	12.2
VIP	126	42.6
Total	285	96.3
Missing	11	3.7
Total	296	100
Do you have a liquid waste disposal pit		
Yes	173	58.4
No	122	41.2
Total	295	99.7
Missing	1	0.3

Total	296	100
How do you dispose of liquid wastes if there is no disposal system?		
Ditch	78	45.6
Bush	48	28.1
River	8	4.7
Latrine	37	21.6
Total	171	100
Do you have your Owen solid waste disposal pit?		
Yes	173	58.4
No	123	41.6
Total	296	100

Child Dietary

The majority respondents (81.8%) reported that the staple food for children was Teff Injera with Wet. The least staple food for the children was vegetable and fruit 1(0.3%). About 150 (50.7%) the mothers reported they provide supplementary food for their children an average four times per day. The majority of the mothers 227(76.7%) gave breast milk for their children for at least the first 6 months.

Table 5. Child dietary in Addis Ababa, Ethiopia, Dec 2023

Staple food of the family	Frequency	Percent
Teff injera and wet	242	81.8
Maize and Sorghum	20	6.8
Spagati and Rice	31	10.5
Vegetables/ fruits	1	0.3
Total	294	99.3
Missing	2	0.7
Total	296	100
Frequency of child feeding per day		
Two	15	5.1
Three	84	28.4
Four	150	50.7
more than four	46	15.5
Total	295	99.7
Missing	1	0.3

Total	296	100
Did/do you breastfeed your baby?		
Yes	227	76.7
No	69	23.3
Total	296	100

5.2 Bivariable and Multivariable Analysis

Factors Associated with Severe Acute Malnutrition

Water treatment, child hand washing after toilet, adequacy of breast milk, and marital status are found to be statistically significant associated with acute malnutrition. Private latrine availability, water source, disposal of child faeces, frequency of child feeding, availability of liquid waste disposal and family size were also identified as risk factors for severe acute malnutrition.

Socio demographic factors: among the socio-demographic factors studied only marital status was significantly associated with the occurrence of acute child malnutrition. Children living with /born from mothers who didn't get marriage had about 3.6 times more likely to experience acute malnutrition as compared to those living/born with mothers who got marriage [AOR: 3.57,95%ci (1.23-10.39)]. This result is consistent to the previous study conducted inn Mao, Chad(Dodos et al., 2018). This might be due to the inadequate care and support, inadequate income, activity overload of the mother to care the children, no information and skill transfer from fathers.Children living with family size five and more had about 1.32 times higher risk to SAM as compared to those children who were living with four and less family members [AOR:1.32,95% CI (0.744-2.36)].

Water source, supply and handlings: water treatment at home was found significantly associated with the occurrence of acute child malnutrition. The HH that used untreated water had about 2 times more likely to experience acute malnutrition as compared to the HH that used treated water at home [AOR: 1.98, 95 % CI (1.152-3.413)]**.** This finding was consistent with the secondary data analysis report of EDHIS in 2016 (Wondimu, 2016) and study conducted in Hadaleala district, Afar Region (Gizaw et al., 2018).The possible reasons could be because of the contamination of drinking at different level (source, transport, handling), untreated water causes to the infection including intestinal parasite, diarrheas and others that leads to malnutrition. The HH that used unsafe water sources had about 1.4 times higher risk to SAM as compared to HH that were used water from safe sources [AOR: 1.42,95 %CI

(0.46-4.41)].

Private latrine and waste disposal system availability: The HHs that didn't have private latrine had about 1.3 times higher risk to SAM as compared to HH that did have private latrine [AOR: 1.26, 95% CI (0.73-2.18)]. Again, the HH that didn't have liquid waste disposal had about 1.4 times higher risk to SAM as compared to the HH that had liquid waste disposal [AOR: 1.4, 95% (0.8-2.46)]

House Hold Hygiene Practice: Child hand washing after defecation was significantly associated with acute malnutrition among the HH hygiene practice related factors. The children that didn't practice hand washing after defecation had about 3 times more likely to experience acute malnutrition as compared to the children that were practice hand washing after defecation [AOR: 2.95,95%CI (1.25-6.97). This finding was consistent with the study conducted in Bangladesh and Ethiopia (Musa et al., 2017), (Abuka et al., 2017). This is due to the fact that proper handwashing with soap is crucial for prevention of fecal-oral transmissions of disease. Disease causing germs are spread from hands to foods and HH materials which final ingested by the children that result acute malnutrition due to the diarrhea.

The children with improper faeces disposal system had about 1.2 times higher risk to SAM as compared to children with proper faeces disposal [AOR: 1.18, 95%CI (0.33-4.19)].

Frequency of Breast Feeding: adequacy and frequency of BF was significantly associated with acute child malnutrition. The children that didn't get adequate breast milk had about 2 times more likely to experience acute malnutrition as compared to the children that had adequate breast milk [AOR: 2.05, 95%CI (1.18-3.56)]. The possible reason might be the fact more frequent and adequate breast feeding helped to the build the body, resistance to the infection and replacing of nutrients loss by diarrhea. Another the possible explanations are: BF milk has antimicrobial effect which prevents the children from infection. The more the child feeding the breast, the less susceptible to the infection including intestinal parasite and disease cause bacterial.

Table 7. Bivariable and multivariant binary logistic regression analysis of factors associated with sever acute malnutrition among U-5 children in Addis Ababa, Ethiopia, Dec 2023

Variable	Case(n=148)	Control(n=148)	COR 95%CI	AOR 95%CI	P value
Marital status					
Married	124	142	1	1	
Not married	24	6	4.6(1.8-11.6)	3.57(1.23-10.39)	0.02
Family size					
≤4	105	93	1	1	
≥5	42	53	0.7(0.43-1.14)	1.32(0.744-2.36)	0.341
HH water source					
Yes	135	142	1	1	
No	13	6	2.3(0.84-6.2)	1.42(0.46-4.41)	0.544
Water treatment at home					
Yes	51	77	1	1	
No	87	67	1.9(1.22-3.16)	1.98(1.152-3.413)	0.013
Private latrine availability					
Yes	58	75	1	1	
No	90	73	1.59(1.015-2.53)	1.26(0.73-2.18)	0.404
Child faces disposal					
Proper disposal	130	141	1	1	
Improper disposal	18	7	2.8(1.13-6.9)	1.18(0.33-4.19)	0.796
Child handwashing after defecation					
Yes	114	136	1	1	

No	34	12	3.4(1.7-6.8)	2.95(1.25-6.97)	0.014
Availability of liquid waste disposal					
Yes	79	94	1	1	
No	68	54	1.5(0.9-2.4)	1.40(0.8-2.46)	0.234
Frequency of feeding					
≤3	61	38	2(1.23-3.3)	1.53(0.85-2.76)	0.156
≥4	87	109	1	1	
Adequacy of BF					
Yes	64	84	1	1	
No	76	55	1.8(1.13-2.92)	2.05(1.18-3.56)	0.011

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Water treatment, child hand washing after defecation and marital status of the guardians were found major factors significantly associated with child SAM.

6.2 Recommendation

a. For Ministry of Health

- Initiate and strengthen integrated WASH and nutrition intervention with more emphasis to the proper house hold water handling and treatment, hand washing after defecation, behavioral change intervention on hygiene practice and breast feeding.

b. For Addis Ababa Health Bureau

- The health bureau needs to give emphasis to HH water treatment and hygiene practice

c. For the Health Centers

- Couple and pre marriage counseling should be integrated to the routine, youth, maternal and child health services at the health center.
- Family planning service and counseling should be also strengthen focusing on the economically poor HHs.

d. For Researchers

- Further study on association SAM and full WASH components in urban setting such as water source and utilization, latrine type and utilization and other nutritional independent factors using both quantitative and qualitative methods.

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APPENDICES

Appendix I. Consent Format

Information Sheet

Greetings, my name is Bisrat Molla. I'm a postgraduate student at Addis Ababa University, College of Food Security and Development Studies and I'm conducting a study on impact of Water and Sanitation service and practice on acute malnutrition of under 5 years children in Kirkos, Yeka and Lemikura sub cities of Addis Ababa city. This study has been approved by Examining Board, to the Council of Graduate Studies (CGS) through the Centre Academic Committee (CAC) of the Centre of Addis Ababa University.

Dear participants, I kindly request you to participate in this study. Here is some important information which helps you decide to participate or not to participate in the study.

1. **Objective of the study:** the objective of this study is to assess the relationship of acute malnutrition with WASH practices and other associated factors among under five children in Kirkos sub city, Addis Ababa, Ethiopia
2. **Risk and discomfort:** you will only be requested to answer some questions relevant to the study. Thus, there is no risk or discomfort associated with the study.
3. **Confidentiality:** the information given by you will serve only for this study not for any other purpose and will be kept confidential.
4. **Involvement in the study:** participation in the study is voluntary, and refusal to participate involves no penalty or loss of benefits to which you are otherwise entitled. You have every right to accept or refuse to participate in this study at any time.

If you have any question about the study, you can reach head of department at:

Centre for Food Security Studies,

College of Development Studies, Addis Ababa

UniversityMob.no: .....

Consent Form

Information about the study has been explained to me by the investigator. I understood that the objective of this study is to assess the willingness to receive cell phone drug reminders and associated factors among epileptic patients. It has also been explained to me that I have the right to quit participation at any time in between and there is nothing I will lose if I refuse to participate.

Thus, I agree to participate in the study and I hereby approve my agreement.
signature..... Date.....

Appendix II. Questionnaires

Table 1: English version Interview Questionnaire for Mothers of Children under 5 years age		
Interview No: ----------		
Interview Date: ----------		
Name of headed of Household----------		
1. Interviewers Name:.....		
2.Gott/village/Name.....	3.Keble/admin	
4. Woreda/district.....	5. Sub city.....	
6. Hell my name is ----------. I am conducting this survey to learn more about current health and nutrition status of your children. To do this, we will measure your children height and weight as usual and we would like to ask you some questions about water, sanitation, hygiene and other socio-economic issues that considered important for the study. This might take about 15 minutes and all answers provided will be kept confidential.		
Would you permit us to ask you some questions about your family?		
CONSENT GRANTED		INTERVIEW DECLINED
GENERAL INFORMATION ABOUT RESPONDENT		Skip
7. What is your marital status?	Married 1----------	
	Widow 2.....	
	Divorced/Separated… 3	
	Other (specify)……	
8. Is your husband living with you?	Yes 1	
	No 0	
9. what is the number of people living in this house (family size)	Two 1	
	Three 2	
	Four 3	
	Five and above 4	
10. How many children less than five years of age do you have?	One 1	
	Two 2	
	Three. 3	
	Four 4	

	Five and above 5	
(***Write the name and sex of thechild in the space provided)***	Sex. ..... M F	
11. Can you remember the date,month and year when **NAME?** Born? (If she can't remember request her the vaccination cardand fill in the space provided)	Date/Month/Year	
12. From which sources do youcollect your drinking water?	1. Protected* well	
Multiple responses accepted	2. Unprotected well	
Read out all responses	3. Protected* spring	
**''Protected'' means that the well has an enclosure with lid ora spring has a spring box and outflow.*	4. Unprotectedspring	
	5. Borehole or tubewell	
	6. Public stand pipe	
	7. Surface water (river, stream, lake,pond)	
	8. other sources	
	(if only one source issited then)	
13. Which of these sources do you use most often? Enter oneresponse only	1. Protected* well	
	2. Unprotected well	
	3. Protected* spring	
	4. Unprotectedspring	
	5. Borehole or tubewell	
	6. Public stand pipe	
	7. Surface water (river, stream, lake,pond)	
	8. other sources	
14. Who generally collect the water from this source? Multipleresponses accepted	1. Mother	
	2. Father	
	3. Adult male of HH(age >15)	
	4. Adult female ofHH (age >15	
	5. Children of	

	Households	
	6. Other	
15. How is the water brought tothe house?	1. Using human Power	
	2. Using car	
	3. Already on premises	
	4. Other (specify).....	
16. In what type of Container isthe water carried?	1. Plastic Jerry can	
	2. Clay pots	
	3. Other ----	
17. What is the approximate volume in litter of the container?(If she doesn't know the exact volume, you can estimate comparing with the standard jerry can)		
18. How many of these containers are carried per day atnormal day?	---------- ----------Litter	
	In No----------	
19. Do you use this water sourceall year round?	1. Yes	
	2. No	25
20. How many months of theyear do you use this water urce?	For Months	
21. How long does it take to fetch water from the water source? (if the respondent knows the time exactly registerhis response. if not as the rangeand tick the number appropriately correspond to hisanswer)	1. Over 1 minute, not more than 5min.	
	2. Over 5min, not more than 10min	
	3. Over 10min, not more than 20min	
	4. Over 20min, not more than 30min	
	5. Over 30min, not more than 40min	
	6. Over 40min, not more than 60min	
	7. Over an hour	
	(If she knows state here the exact hour)	

22. How do you rate the topographical situation of the area to bring water filled container to house? One response only. (Read out all responses and makes the question very clear)	1. Very steep	
	2. Moderate steep	
	3. Too up step	
	4. Moderate up step	
	5.Flat	
23. Do you usually have to wait in line before you can fill your container?	1. Yes	
	2. No	30
24. Approximately how long do you usually have to wait?One response only.(if the respondent knows the time exactly register his response. if not, ask the range and tick the number appropriately correspond to his answer)	1. 5 minutes or less	
	2. 20 minute or less	
	3. 30 minute or less	
	4. 40 minute or less	
	5. One hour or less	
	(If she knows state here the exact hour).....	
25. How long it does usually take to fill a load of water from the source?	1. 5 minutes or less	
	2. 20 minute or less	
	3. 30 minute or less	
	4. 40 minute or less	
	5. One hour or less	
	(If she knows state here the exact hour).....	
26. Do you perceive that our water sources are free from contaminants?	1. Yes	32
	2. No	
27. In your understanding, what are the probable causes of pollution?		
28. Do you make some sort of household treatments to make the water clear and palatable?	1. Yes	
	2. No	
29. What kind/type of household water treatment mechanism do you use?		
(OBSERVATION)		
30. Is drinking water kept in a separate container?	1. Yes	
	2. No	

31. Is drinking water kept above floor level?	1. Yes	
	2. No	
32. Is drinking water kept away from contamination?	1. Yes	
	2. No	
33. Do containers have narrow mouth/openings?	1. Yes	
	2. No	
34. Do containers have lid/cover?	1. Yes	
	2. No	
35. Is this in place at time of visit?	1. Yes	
	2. No	
36. How is water taken from the container?	1. Poured	
	2. Using cup Other(specify).....	
37. Who usually hands out drinking water from the container	1. Children	
	2. Mother	
	3. Maid	
	4. Anyone	
38. Is utensils used to draw water from the container clean?	1. Yes	
	2. No	
39. Is utensil used to draw water the container kept away from surfaces and stored in a hygienic container?	1. Yes	
	2. No	
40. How often is the container cleaned?	1. Every day	
	2. Every week	
	3. Every month	
	4. Rarely	
	5. Never	
41. Is the inside of water container looks clean?	1. Yes	
	2. No	
42. Is the outside of water container clean?	1. Yes	
	2. No	
Now I would like to ask you few questions about household Sanitation and Hygiene. (Interview)		
43. Do you have latrine?	1. Yes	54
	2. No	
44. Where do people in the household defecate?	1. In the bush	55
	2. Neighbors latrine Other(specify).....	
45. How many people use this latrine?	Male.....	

	Female.....	
	Children.....	
46. How do you dispose of the faces of infants/young children?	1. Al children use latrine	
	2. Put faces in latrine	
	3. Do not dispose of them	
	4. Don't know Other(specify).....	
47. Do the children wash their hands after using the latrine?	1. Yes	
	2. No	
Now I would like to see and ask you few questions about your latrine.		
(Participatory Observation)		
48. Can we look at the latrine?	1. Yes	***Only for those having latrine***
	2. No	
49. Type of latrine?	1. Traditional pit latrine	
	2. TPL with san plat	
	3. Ventilated improved pit latrine Other (specify) … ……...	
50. How far the toilet from the household residence house? (Estimate using pacing)	1. <5meter	
	2. 5 to 10M 3. 10 to 30M 4. 30 to 50M	
	More than 50M	
51. When it built?	1. 0 to 6 Months before	
	2. 6month to 1year	
	3. 1year to 2year	
	4. More than 2years	
	1. Has door	
	2. Has roof	
	3. Has wall	
	4. Child friendly Other(specify).....	
52. Physical appearance you observe during the visit?	....	

53. Lid present and in place?	1. Yes	
	2. No	
54. Does cleaning materials present? (Brush, Cleaning water, ash, soap, etc)	1. Yes	
	2. No	
55. State your overall observation using the following competencies.		
1, Has offensive smel, 2., Lot of flies, 3, Full of spider webs, 4, faeces are seen in the squat hole,	....	
56. Is the compound free of excreta?	1. Yes	
	2. No	
Now I would like to ask you few questions about hygiene.		
(Participatory Observation)		
57. When do you wash your hands? Multiple responses accepted. (Reading the stated answers is not allowed!)	1. After defecation	
	2. After cleaning babies'	
	3. Before food preparation	
	4. before eating	
	5. Before feeding children Other(specify)…… …….....	
58. Would you explain and show me what you do when you wash your hands? Tick on Multiple responses!!	1. Uses water	
	2. Uses soap	
	3. Use ash	
	4. Washes both hands	
	5. Rubs hands together at least three times	
	6. Dries hands hygienically—by aid drying or using a clean cloth	
	Other (specify).....	
59. Where does she wash hands?	1. In the house floor	
	2. In the waste container	

	3. In the compound land Other(specify).....	
60. Do you have liquid waste disposal pit?	1. Yes	
	2. No	
61. What you observe in the liquid waste disposal pit? Please mark and specify things you observe!	1. Far from the residence house	
	2. Has lid	
	3. Properly Infiltrate liquid wastes	
	4. Has no flies	
	Other(specify).....	
62. How do you dispose liquid wastes?	....	
63. Do you have solid waste disposal pit?	1. Yes	
	2. No	
6. What you observe in the solid waste disposal pit? Please mark and specify things you observe!	1. Far from the residence house	
	2. Has sufficient depth (1M)	
	3. Not yet filled	
	4. Has no flies	
	Other(specify).....	
	2. No	

Table 2: Amharic version questionnaire

ሠንጠረዥ 2. ከ 5 ዓመት በታች ለሆኑ ህጻናት እናቶች የቃለ መጠይቅ

የቃለ መጠይቅ ቁጥር፤----------	
የቃለ መጠይቅ ቀን፤	
የቤተሰቡ መሪ ስም፤	
1. የጠያቂዎች ስም፤	
2.የመነደር(የቦታዉ) ልዩ ስም፤-----	3. ቀበሌ/ቀጠና፤----------
4.ወርዳ፤	5. ክፍለ ከተማ፤ .....

6. ሰላም ስሜ ---------- ::ይህንን የዳሰሳ ጥናት እያካሄድኩ ያለሁት ስለ ልጆቻችሁ ወቅታዊ የጤና እና የአመጋገብ ሁኔታ የበለጠ ለማወቅ ነው:: ለጥናቱ አስፈላጊ ናቸው ተብለው በውሃ፣ መጸዳጃ ቤት፤ በንፅህና እና በሌሎች ማህበራዊና ኢኮኖሚያዊ ጉዳዮች ላይ አንዳንድ ጥያቄዎችን ልንጠይቅዎ እፈልጋለዉ:: ይህ ወደ 15 ደቂቃዎች ሊወስድ ይችላል:: ሁሉም የተሰጡ መልሶች በሚስጥር ይቀመጣሉ::

ስለ ቤተሰብህ አንዳንድ ጥያቄዎችን እንድንጠይቅህ ትፈቅዳለህ?

የተሰጠ የፈቃድ ቃለ	አዎ(ከሆኑ ቀጣዮቹን ጥያቄወች ይጠይቁ)	አይ(መጠይቁ ይቁም)
ስለ ምላሽ ሰጪው አጠቃላይ መረጃ		
7. የጋብቻ ሁኔታዎን ይነግሩኛል ?	ያገባ 1----------	
	በሞት ይተለየ 2----------	
	የተፋታ/የተለያየ፤3----------	
	ሌላ (ይግለጹ)	
ባለቤተዎ ከእርስዎ ጋር ይኖራል?	አዎ 1	
	ቁጥር 0	
9. በዚህ ቤት ውስጥ የሚኖሩ ሰዎች ቁጥር ስንት ነው (የቤተሰብ መጠን)?	ሁለት 1	
	ሶስት 2	
	አራት 3	
	አምስት እና ከዚያ በላይ 4	
10. እድሜያቸው ከአምስት ዓመት በታች የሆኑ ስንት ልጆች አሉዎት?	አንድ 1	
	ሁለት 2	
	ሶስት. 3	

	አራት 4	
	አምስት እና ከዚያ በላይ 5	
የልጆቹን ጾታ በተጠቀሰው ቦታ ላይ ፃፉ	ወንድ-------- ሴት--------	
. በቅርቡ የወለዱበት ቀን፣ ወር እና አመት ማስታወስ ይችላሉ? (የማታስታውስ ከሆነ የክትባት ካርዱን ይመልከቱ እና ይሙሉ)	ቀን/ወር/ዓመት	
አሁን ስለ እርስዎ የውሃ ምንጮች እና ሌሎች ተያያዥ ጉዳዮች አንዳንድ ውይይት እናድርግ።		
. የመጠጥ ውሃዎን ከየትኞቹ ምንጮች ይሰበስባሉ? (በርካታ ምላሾች ይቻላል ሁሉንም መልሶች ያንብቡ "የተጠበቀ" ማለት ጉድጓዱ ክዳን ያለው አጥር ያለው ወይም ምንጩ ሳጥን እና መውጫ አለው ማለት ነው)	በጥሩ ሁኔታ የተጠበቀ (Protected well)	
	በደንብ ያልተጠበቀ	
	የተጠበቀ ምነጭ(Protected* spring)	
	4. ያልተጠበቀ ምንጭ	
	5. ጉድጓድ ወይም ቱቦ ጉድጓድ	
	6. የጋራ መጠቀሚያ ቦኖ/ ቧንቧ	
	7. የመሬት ላይ ውሃ (ወንዝ፣ ጅረት፣ ሐይቅ፣ ኩሬ)	
	8. ሌሎች ምንጮች(ይጠቀሱ)	
. ከእነዚህ ምንጮች ውስጥ የትኛውን በብዛት ይጠቀማሉ? (አንድ ምላሽ ብቻ አስገባ)	በጥሩ ሁኔታ የተጠበቀ (Protected well)	
	በደንብ ያልተጠበቀ	
	የተጠበቀ ምነጭ(Protected* spring)	
	4. ያልተጠበቀ ምንጭ	
	5. ጉድጓድ ወይም ቱቦ ጉድጓድ	
	6. የጋራ መጠቀሚያ ቦኖ/ ቧንቧ	
	7. የመሬት ላይ ውሃ (ወንዝ፣ ጅረት፣ ሐይቅ፣ ኩሬ)	
	8. ሌሎች ምንጮች(ይጠቀሱ)	
14. በአጠቃላይ ውሃውን ከዚህ ምንጭ የሚቀዳዉ ማነው? (በርካታ ምልሶች	1. እናት	
	2. አባት	
	3. ጎልማሳ ወንድ (ዕድሜ> 15)	

ይቻላል)		
	4. ጎልማሳ ሴት (ዕድሜ> 15	
	5. የቤተሰብ ልጆች	
	6. ሌላ(ይለጽ)----------	
15. ዉሃዉ ወደ ቤት የሚመጣዉ እነዴት ነዉ	1. የሰው ኃይል መጠቀም	
	2. ጋሪ ወይም መኪና መጠቀም	
	3. በግቢው ዉሰጥ አለ	
	4. ሌላ(ይግለጹ).....	
16. ውሃው ከምን አይነት ኮንቴይነር ነው የሚቀዱት/የምተሸከሙት? ----	1. የፕላስቲክ ጄሪካን	
	2. የሸክላ ዕቃዎች	
	3. ሌላ (ይግለጹ)	
17. በመያዣው ውስጥ ያለው ግምታዊ የዉሃ መጠን ምን ያህል ነው? (ትክክለኛውን መጠን ካላወቀች፣ ከመደበኛው ጄሪ ጋር ማወዳደር መገመት ትችላለህ)	----------ሊትር	
18. በተለመደው ቀን ከእነዚህ ኮንቴይነሮች ውስጥ ምን ያህሉ በቀን ይሸከማሉ?	በቁጥር፤----------	
19. ዓመቱን ሙሉ ይህንን የውኃ ምንጭ ይጠቀማሉ?	1. አዎ	
	2. አይ	
20. ይህንን የውሃ ምንጭ በዓመት ውስጥ ምን ያህል ወራት ይጠቀማሉ?	የወራት ብዛት፤----------	
21. ከውኃው ምንጭ ውኃ ለማግኘት ምን ያህል ጊዜ ይወስዳል? (መልስ ሰጪው ሰዓቱን በትክክል ካወቀ ምላሹን ያስምሩ፤ካልሆነ ግምቱን ያሰቀመጡ፤(ትክክለኛውን ሰዓት እዚህ ላይ መግለፅን ካወቀች)	ከ 1 ደቂቃ በላይ, ከ 5 ደቂቃዎች ያልበለጠ.	
	ከ 5 ደቂቃዎች በላይ, ከ 10 ደቂቃዎች ያልበለጠ	
	ከ10 ደቂቃ በላይ፣ ከ20 ደቂቃ ያልበለጠ	
	ከ 20 ደቂቃዎች በላይ, ከ 30 ደቂቃዎች ያልበለጠ	
	ከ 30 ደቂቃዎች በላይ, ከ 40 ደቂቃዎች ያልበለጠ	
	ከ 40 ደቂቃዎች በላይ, ከ 60 ደቂቃዎች ያልበለጠ	
	ከአንድ ሰአት በላይ	

22. ውሃ የተሞላ መያዣ ወደ ቤት ለማምጣት በአካባቢው ያለውን የመሬት አቀማመጥ ሁኔታ እንዴት ይገመግማሉ? (አንድ ምላሽ ብቻ;ሁሉንም ምላሾች ያንብቡ)	1.በጣም ቁልቁል 2.በመጠኑ ቁልቁል 3. በጣም ዳገት 4. በመጠኑ ዳገት 5. ሜዳ(Flat)	
23. ዉሃ ለመቅዳት ብዙውን ጊዜ ወረፋ መጠበቅ አለብዎት?	1. አዎ 2. አይ	 25
24. በግምት ለምን ያህል ጊዜ መጠበቅ አለብዎት? አንድ ምላሽ ብቻ (መልስ ሰጪዋ ሰዓቱን በትክክል ካወቀች ምላሹን ያስምሩ፣ካልሆነ ግምቱን ያስምሩ)	1. 5 ደቂቃዎች ወይም ከዚያ ያነሰ 2. 20 ደቂቃ ወይም ከዚያ ያነሰ 3. 30 ደቂቃ ወይም ከዚያ በታች 4. 40 ደቂቃ ወይም ከዚያ በታች 5. አንድ ሰዓት ወይም ከዚያ ያነሰ (ትክክለኛውን ሰአት እዚህ ላይ መግለፅን ካወቀች)---------	
25. ብዙውን ጊዜ ጀሪካኑን ለመሙላት ምን ያህል ጊዜ ይወስዳል?	1. 5 ደቂቃዎች ወይም ከዚያ ያነሰ 2. 20 ደቂቃ ወይም ከዚያ ያነሰ 3. 30 ደቂቃ ወይም ከዚያ በታች 4. 40 ደቂቃ ወይም ከዚያ በታች 5. አንድ ሰዓት ወይም ከዚያ ያነሰ (ትክክለኛውን ሰአት እዚህ ላይ መግለፅን ካወቀች)	
26. የውሃ ምንጩ/ቹ ከብክለት ነጻ ነቸዉን?	1. አዎ 2. አይ	30
27. በእርሰዎ ግንዛቤ፣ የብክለት መንስኤዎች ምንድናቸው?	----------	
28. ውሃውን ንጹህ ለማድረግ አንዳንድ የቤት ውስጥ ህክምናዎችን ያደርጋሉ?	1. አዎ 2. አይ	
29. ምን ዓይነት የቤት ውስጥ ውሃ ማከሚያ ዘዴ ይጠቀማሉ?	----------	
ምልከታ		
30. የመጠጥ ውሃ በተለየ መያዣ ውስጥ ይቀመጣል?	1. አዎ 2. አይ	
31. የመጠጥ ውሃ ከወለል በላይ	1. አዎ 2. አይ	

32. የመጠጥ ውሃ ከብክለት ይርቃል?	1. አዎ	
	2. አይ	
33. ኮንቴይነሮች ጠባብ አፍ/መከፈቻዎች አሏቸው?	1. አዎ	
	2. አይ	
34. ኮንቴይነሮች ክዳን / ሽፋንአላቸው?	1. አዎ	
	2. አይ	
35. ይህ በጉብኝት ጊዜ በቦታው ላይ ነው?	1. አዎ	
	2. አይ	
36. ከመያዣው ውስጥ ውሃ እንዴት ይወሰዳል/ይቀነሳል?	1. በማፈሰስ	
	2. በኩባያ	
	3.ሌላ መጠቀም (ይግለጹ).	
37. ብዙውን ጊዜ የመጠጥ ውሃ ከእቃ መያዣው ውስጥ የሚሰጠውን/የሚቀንሰዉ ማን ነዉ	1. ልጆች	
	2. እናት	
	3. ሰራተኛ	
	4. ማንኛውም ሰው	
38. ከመያዣው ውስጥ ውሃ ለመቅዳት የሚያገለግሉ ዕቃዎች ንጹህ ናቸው?	1. አዎ	
	2. አይ	
39. እቃው ውሃ ለመቅዳት ይጠቅማል?	1. አዎ	
	2. አይ	
40. እቃው በምን ያህል ጊዜ ይጸዳል?	1. በየቀኑ	
	2. በየሳምንቱ	
	3. በየወሩ	
	4. አልፎ አልፎ	
	5. በጭራሽ	
41. የውኃ ማጠራቀሚያው ውስጠኛ ክፍል ንጹህ ይመስላል?	1. አዎ	
	2. አይ	
42. የውሀ መያዣው ውጫዊ ክፍል ንጹህ ነው?	1. አዎ	
	2. አይ	
አሁን ስለ ቤት ጽዳትና ንፅህና አጠባበቅ ጥቂት ጥያቄወች ልጠይቀዎ እፈልጋለሁ::		
43. መጸዳጃ ቤት አዎት?	1. አዎ	
	2. አይ	46
44. በቤት ውስጥ ያሉ ሰዎች የሚፀዳዱበት የት ነው?	1. በጫካ ውስጥ/ማዳ ላይ	46
	2. የጎረቤቶች መጸዳጃ ቤት ሌላ (ይግለጹ).....	

45. ይህን መጸዳጃ ቤት ስንት ሰዎች ይጠቀማሉ?	ወንድ..... ሴት..... ልጆች.....	
46. የጨቅላ / ትናንሽ ልጆችን ፊት እንዴት ማስወገድ እንደሚቻል?	1. ልጆች መጸዳጃ ቤት ይጠቀማሉ 2. ፊቶችን በመጸዳጃ ቤት ውስጥ ያስቀምጡ 3. አታስወግዷቸው 4. ሌላ አታውቁም (ይግለጹ).	
47. ልጆቹ መጸዳጃውን ከተጠቀሙ በኋላ እጃቸውን ይታጠባሉ?	1. አዎ 2. አይ	
አሁን ስለ መጸዳጃ ቤት ቤትዎ ጥቂት ጥያቄዎችን ማየት እና ልጠይቅዎት እፈልጋለሁ።		
አሳታፊ ምልከታ(Participatory Observation)		
48. ሽንት ቤቱን ማየት እንችላለን?	1. አዎ 2. አይ	መጸዳጃ ቤት ላላቸዉ ብቻ
49. የመጸዳጃ ቤት አይነት?	1. ባህላዊ ጉድጓድ መጸዳጃ ቤት 2. ዘመናዊ(ፈላሽ) 3. የተሻሻለ ጉድጓድ መጸዳጃ ቤት 4. ሌላ (ይግለጹ).....	
50. መጸዳጃ ቤቱ ከቤተሰብ መኖሪያ ቤት ምን ያህል ይርቃል? (ይገምቱ)	1. <5ሜትር 2. 5 እስከ 10 ሜ 3. 10 እስከ 30 ሜ 4. 30 እስከ 50 ሜ ከ 50 ሚሜበላይ	
51. መጸዳጃ ቤቱ ሲገነባ?	1. ከ 1.0 እስከ 6 ወራት በፊት 2. ከ 6 ወር እስከ 1 ዓመት 3. ከ 1 ዓመት እስከ 2 ዓመት 4. ከ 2 ዓመት በላይ	
52. በጉብኝቱ ወቅት የሚመለከቱት አካላዊ ገጽታ?	1. በር አለው 2. ጣሪያ አለው 3. ግድግዳ አለው 4. ለልጆች ተስማሚ 5. ሌላ (ይግለጹ)----------	

60. ፈሳሽ ቆሻሻ ማጠራቀሚያ ጉድጓድ አለዎት?	1. አዎ	
	2. አይ	62
61. በፈሳሽ ቆሻሻ ማጠራቀሚያ ጉድጓድ ውስጥ ምን ይመለከታሉ? (ምልክት ያድርጉ እና የሚመለከቷቸውን ነገሮች ይግለጹ!	1. ከመኖሪያ ቤት ርቆ	
	2. ክዳን አለው	
	3. ፈሳሽ ቆሻሻዎችን በትክክል አስገባ	
	4. ዝንቦች የሉትም።	
	ሌላ (ይግለጹ).	
62. ፈሳሽ ቆሻሻዎችን እንዴት እንደሚያስወግዱ?	....	
63. ደረቅ የቆሻሻ ማስወገጃ ጉድጓድ አለዎት?	1. አዎ	
	2. አይ	end
64. በደረቅ ቆሻሻ ማጠራቀሚያ ጉድጓድ ውስጥ ምን ይመለከታሉ? (ምልክት ያድርጉ እና የሚመለከቷቸውን ነገሮች ይግለጹ)	1. ከመኖሪያ ቤት ርቆ	
	2. በቂ ጥልቀት አለው (1ሚ)	
	3. ገና አልተሞላም	
	4. ዝንቦች የሉትም	
	5. ሌላ (ይግለጹ)----------	