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College of Natural and Computational Sciences

Center for Food Science and Nutrition

Complementary Feeding, WASH Practice and Nutritional Status of Children 6-23 Months; The Case of Rural Villages in South Wollo

By:

Amanuel Bichaye

Thesis to be Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfilment of the Requirements for Degree of Master of Science in *Community Nutrition.*

December, 2021

Addis Ababa, Ethiopia

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Advisors: - Dr. Kaleab Baye (PhD, Associate Prof)
-Mr. Habtamu Guja (MSc/ MPH)

By: - Amanuel Bichaye

December, 2021

Addis Ababa University

School of Graduate Studies

Center for Food Science and Nutrition

DECLARATION

I, the under signed declare that this is original work and has never been presented in this or any other university and that all source materials used for this thesis have been properly acknowledged.

Name: Amanuel Bichaye Tesfaye

Signature: _____

Place: Addis Ababa University, Addis Ababa, Ethiopia

Date of Submission: December 15, 2021

The thesis has been submitted for examination under approval of university advisors.

Name of Advisor: Dr. Kaleab Baye

Signature: _____

Date: _____

Name of co-Advisor: Mr. Habtamu Guja

Signature: _____

Date: _____

Addis Ababa University

School of Graduate Studies

Center for Food Science and Nutrition

Final Thesis Approval Form

As participants of the board of examiners of the final MSc thesis. Open defense, we declare that we have read and evaluated the thesis prepared by Amanuel Bichaye under the title allowed "**Complementary, Feeding, WASH Practice and Nutritional Status of Children 6-23 Months; The Case of Rural Villages in South Wollo "** and recommend for the degree of Master of Science in Community Nutrition.

Signed by the examining committee:

Name of External Examiner	Signature	Date

Name of Internal Examiner	Signature	Date

Name of Chair Person	Signature	Date

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Abbreviation

AOR	Adjusted Odd Ratio
CF	Complementary Feeding
CI	Confident Intervale
COR	Crude Odds Ratio
EDHS	Ethiopian Demographic and Health Survey
EMDHS	Ethiopian Mini Demographic and Health Survey
HAZ	Height-for-age z-score
JMP	Joint Monitoring Program
MDD	Minimum Diet Diversity
MUAC	Mid-Upper Arm Circumference
SD	Standard Deviation
SDG	Sustainable Development Goals
SPSS	Statistical Package for Social Science
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

Abstract

Background: In addition to the dietary practice, access to improved water, sanitation, and hygiene (WASH) facilities contribute to child growth failure. However, the combined role of dietary practice and access to WASH on child growth outcomes is remains to be studied in rural Ethiopia. The aim of this study was to assess the effect of complementary feeding and WASH practice towards child nutrition outcomes.

Methods: A community-based Cross-section study design was employed among rural households (n=464) having children 6-23months in south Wollo in Apirl 2021, using a multistage sampling technique. Dietary assessment, anthropometric and biochemical (hemoglobin) measurements were done. WASH components were partly assessed through observation. Data were analyzed using Chi-square test, bivariate and multiple logistic regression using SPSS.

Result: Children meeting the minimum dietary diversity was 25%. Proportion of household having access to improved water source (56.3%), improved sanitation (16.6%) and hygiene (54.88). Only 6% of households satisfy for all the three combined WASH components. Regarding nutrition status of children, stunting is more prevalent (44.2%), wasting (5.9%), underweight (14.7%) and anemia (63%). Non-breast children, mother height, fever. Diarrhea was associated with all components of WASH. Having a mother with formal education was an advantage to meet MDD. Being in early age group of 6-11 months (**AOR=2.33, 95% CI 1.49-3.57**), having diarrhea episodes (**AOR=1.59, 1.02-2.47**) and exposing to the unimproved water source **(AOR=1.57, 1.05-2.33)** were associated with anemia. Factors associated with stunting: non-breast feeding (**AOR= 2.6, 95% CI 1.08-6.3**), increasing child age 12-23months (**AOR= 1.56, 95% CI 1.05-2.31**) and maternal height <150cm.

Conclusion: Only quarter of children meet the minimum required dietary diversity. Significant proportion of children are anemic and stunted. Above average the households do not have access to improved water source and hygiene practice. Therefore, in addition to diet-based interventions, the complementary role of WASH through reducing common childhood illness could have significant contribution to the improvements in child nutrition outcomes.

Key words: *Dietary diversity, Stunting, Anemia, Water, Snitation, Hygiene, WASH, Rural, Ethiopia*

Operational and standard definition

- **Adequacy of complementary food:** refers to capacity of complementary food to provide sufficient energy, protein, and micronutrients to meet a growing child's nutritional needs (WHO,2001).
- **Complementary feeding:** refers to the process starting when breast milk is no longer sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids are introduced to the infant, along with breast milk (PAHO/WHO, 2003).
- **Complementary feeding practices: covers:** time of introduction of solid and semi-solid foods or soft foods; frequency of feeding, dietary diversity; consumption of iron-rich foods and continued breastfeeding among children 6-23 months old (PAHO/WHO, 2003).
- **Complementary food:** Any solid, semi-solid or soft food, whether manufactured or locally prepared, suitable as a complement to breast milk or to infant formula, when either becomes insufficient to satisfy the nutritional requirements of the infant (PAHO/WHO, 2003).
- **Introduction of solid, semi-solid or soft foods:** Proportion of infants 6–8 months of age who receive solid, semi-solid or soft foods during the previous day (WHO, 2008b).
- **Minimum acceptable diet:** Proportion of breastfed children 6–23 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day, and non-breastfed children 6–23 months of age who received at least two milk feedings and had at least the minimum dietary diversity not including milk feeds and the minimum meal frequency meal frequency during the previous day (WHO, 2008b).

- **Minimum dietary diversity:** Proportion of children 6–23 months of age who receive foods from four or more food groups during the previous day. The seven food groups used for tabulation of this indicator were: grains, roots and tubers; legumes and nuts; dairy products (milk, yoghurt and cheese); flesh foods (meat, fish, poultry and liver/organ meats); eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables (WHO, 2008b).
- **Minimum meal frequency:** Proportion of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid or soft foods the minimum number of times or more (minimum is defined as: two times for breastfed infants 6–8 months; three times for breastfed children 9–23 months; and four times for non-breastfed children 6–23 months) in the previous day (WHO, 2008b).

- **WASH:** is a combination of different terminologies, that typically refers to activities aiming to improve access to, use of safe drinking water and sanitation as well as promotion of good hygiene practice (WHO/UNICEF/USAID, 2015).

•**Sanitation:** is a broad terminology; it refers to implementation of different techniques and ways for safe and sustainable management of human excreta, including collection, storage, treatment, and disposal of feces and urine (Abdissa & Walelegn, 2016). It is also the provision and utilization of facilities and services that safely dispose human urine and feces, thereby preventing contamination of the environment (WHO/UNICEF/USAID, 2015).

•**Hygiene**: component of WASH refers to practice of hand washing with soap during critical periods (i.e. after defecation and disposal of child feces, prior to preparing and handling of food and before eating) (WHO/UNICEF/USAID, 2015)

•**Malnutrition**; People are malnourished if their diet does not provide adequate calories and protein for growth and maintenance, or if they are unable to fully utilize the food, they eat due to illness (undernutrition). They are also malnourished if they consume too many calories compared to how many they expend. Good nutrition is when the right balances of nutrients enter, leave and are absorbed by the body. In this study the term Malnutrition is used to refer undernutrition (UNICEF, 2006)

•**Undernutrition**; refers the outcome of insufficient food intake and repeated infectious diseases. It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted), and deficient in vitamins and minerals (micronutrient malnutrition). This study will focus only on the stunting, underweight and wasting (UNICEF, 2006, cited by Save the Children, 2016).

•**Stunting**; refers to a child who is too short for his or her age. Stunting is a result of inadequate growth of the fetus and child and results in a failure to achieve expected height compared to a healthy, well-nourished child of the same age. It is the failure to grow both physically and cognitively and the effects of stunting often last a lifetime (UNICEF, WHO, World Bank, 2015, cited by Save the Children, 2016).

•**Wasting;** refers to a child who is too thin for his or her height. Wasting is the result of sudden or acute malnutrition, where the child is not getting enough calories from food and faces an immediate risk of death (UNICEF, WHO, World Bank, 2015, cited by Save the Children, 2016).

•**Underweight**; denotes Weight-for-age Z-score below -2SD from the median of WHO reference population (WHO, 2009).

1. INTRODUCTION

1.1. Background

Malnutrition, mainly undernutrition, is the predominant cause of morbidity and mortality, affecting billions of people in developing regions worldwide. Children are the most vulnerable group of the society significantly affected by the problem. Low- and middle-income countries shoulder almost all undernourished children (Bekele T,2020). According to the joint estimated report of UNICEF, Asia and Africa are the two most affected continents. In 2018, 55% and 68% of Asians were wasted and stunted. Similarly, in Africa, 39% and 28% of the children were estimated to be stunted and wasted (UNICEF 2020a).

Undernutrition has both immediate and long-term effects. Stunting or being underweight is linked to around 20% of childhood mortality in low-income countries (Fenn, 2012). Inadequate diet in the first two years of childhood creates irreversible harm by impeding physical and cognitive growth. A mixture of inadequate and unsafe complementary food and chronic illnesses such as diarrhea due to poor hygiene have been proposed as potential causes for the high prevalence of undernutrition in children under the age of 2-years (Medhin, G. 2010). A recent systematic review and meta-analysis by Abdulahi and other (2017) have identified potential risk factors for child undernutrition in Ethiopia. The same source identified child age, child sex, complementary feeding, diarrheal disease, dietary diversity, maternal education, residential area, and socio-economic status as the main risk factors for stunting, underweight, and wasting.

Approximately 10 million under-five children die each year annually cause related to malnutrition worldwide. From this, 98% of death happen in developed countries (Mekonnen *et al*. 2021), over one-third of mortality is related to inadequate complementary feeding. The introduction of safe and nutritionally enough complementary food at the age of six months is critical for ensuring optimal growth, development, and health. Complementary feeding (CF) is a process that begins when breast milk alone is no longer adequate to fulfill an infant's nutritional needs, and additional foods and liquids are required in addition to breast milk (WHO 2008).

The first two years of a child's existence are crucial for maintaining optimal growth and development (Roba, 2016). Nutritional inadequacies at this time can affect cognitive development, scholastic achievement, and economic production later in life (Grantham-McGregor et al. 2007).

Optimal complementary feeding practice can prevent one-third of child death. Improving the quality of complementary food has been quoted as one of the most cost-effective strategies for improving health and reducing morbidity and mortality of young children (UNICEF 2012).

Various incorrect complementary feeding methods, such as early complementary food introduction, insufficient dietary frequency, and poor dietary diversity of complementary meals, have been proven to have a variety of negative health impacts on children (WHO 2008a). A study done in Norther Wollo shows that over 90% of the children were fed complementary foods at least three times daily; however, less than half met the minimum number of food groups. In addition, many of the children's dietary diversity scores were in the low (0–2) to medium (3–4) range (Baye *et al*. 2013).

Even though suboptimal infant feeding practices, poor quality of complementary foods and micronutrient deficiencies create an undernutrition-infection vicious cycle, a significant proportion of frequent infections among children are also attributed to poor water, sanitation and hygiene (WASH) practices. Among the suggested mechanisms that WASH can reduce malnutrition including (i) reducing diarrheal disease incidence (Prüss-Ustün et al. 2014); (ii) preventing intestinal worm infestation that contributes to inadequate nutrient absorption (Owino et al. 2016) and (iii) reducing the pathogen load in the environments as a result of poor WASH.

Nearly 663 million people lacked access to safe drinking water. from this, more than half population were living in sub-Saharan Africa in 2015 (WHO/UNICEF 2015). One-third of the world population, or nearly 2.4 billion people, lack access to improved sanitation facilities and 13% practice open defecation (Freeman *et al.* 2014). Globally there are nearly 1.7 billion cases of childhood diarrheal disease annually, and diarrhea is responsible for killing around 525,000 children every year (WHO 2017). WASH-related infections are mediated through diarrheal and parasitic diseases.

Furthermore, repeated exposure to environmental pathogens results in an inflammatory condition of the gut of children, characterized by villous entropy, crypt hyperplasia, increased permeability, inflammation cell infiltration, and modest malabsorption (Crane, Jones, and Berkley 2015; Kelly *et al*. 2004). Such environmental enteropathy also leads to chronic child morbidity and disability, including impaired mental development (Black *et al*. 2010). However, studies relating the effect of WASH practices on child nutrition status report inconsistent findings - that is varied from no significant association (Luby *et al*., 2018; Muhoozi *et al*., 2018; Patil *et al*., 2018) to the presence of substantial effect (Lin *et al*., 2013; Pickering *et al*., 2015; Bekele *et al*., 2020; Muche *et al*., 2021). Moreover, those studies presented an

association again showed heterogeneity by age and types of interventions - whether the child received single or combined WASH interventions (Gizaw and Worku, 2019).

Child undernutrition in Ethiopia remains a significant public health problem – contributing to a significant proportion of infant and child mortality (USAID 2014). The relationship between causes and effects of child undernutrition are non-linear/complex. Hence, the complementary roles of both nutrition-specific and sensitive approaches are issues to be addressed. In cognizant of this, this study aims to assess the contribution of complementary feeding and WASH practices to child nutrition outcomes in selected rural villages of the Amhara regional state where the problem is enormous.

1.2 Statement of the problem

Child undernutrition is higher in developing regions of the world. According to the Ethiopian demographic and health survey (EDHS, 2016), 4 out of 10 children under 5 years were stunted (too short for their age) in Ethiopia. Similarly, the stunting prevalence in the Amhara region is 46 %, which exceeds the national figure of 38%. Various conditions have contributed to such unacceptably higher prevalence, including inappropriate complementary feeding practices (such as the untimely introduction of complementary foods, inadequate dietary frequency and low dietary diversity) have been shown to increase the risk of underweight and stunting, particularly in low low-income settings (Tigist.k, *et al*. 2015). Few studies have been conducted in food-insecure areas of the Amhara region. A survey conducted in 2014 in selected woredas/districts of South Wollo by Gebremedhin *et al*. (2017) assessed the status/predictors of dietary diversity and found out that only 7% of children met the recommended dietary diversity, which is by far lower than the national DDS of 14%.

Child malnutrition is multifactorial, and therefore, one-size-fits-all interventions may not hold in every context. For instance, ensuring household food security alone does not always guarantee the improved nutritional status of children. This is portrayed by studies in Nepal (Osei *et al*., 2010) and Western Amhara (Demilew & Alem, 2019) – which highlights the role of other contributing factors than just access to food. Bhutta *et al*. (2013) indicated that up-scaling nutrition-specific interventions could address 20% of the global nutrition problem. Hence, the majority of the problem is expected to be addressed through nutrition-sensitive interventions. Having this fact in mind, existing few studies conducted in south Wollo so far has paid attention to the immediate causes of child malnutrition (Gebremedhin *et al*., 2017; Tessema *et al*., 2020). However, little attention has been given to the underlying determinants, mainly WASH practices and facilities – given that improved WASH has a positive role to play in child health and nutrition outcomes (Null *et al*., 2018; Pickering *et al*., 2015).

Therefore, the present study aims to assess complementary feeding and WASH practice to child nutritional outcome in selected rural villages in the south Wollo zone of Amhara region.

1.3. Significance of the study

Addressing the impact of complementary feeding and WASH practices on children's nutritional status might be a crucial step toward eliminating child malnutrition. This research aims to assess the effect of complementary feeding and WASH practice on child nutritional outcomes in selected rural communities in the Amhara region.

The ultimate goal of this study is to assess the contribution of complementary feeding and WASH practice to the nutritional outcome of children residing in rural settings. The finding of this study is expected to provide additional information and understanding to local conditions through filling data and knowledge gaps for designing the evidence-based future intervention. In doing so, it will play its part for the realization of the UN 2030 sustainable development goals (SDGs) that aspire to achieve universal access to safe and nutritious food to end all forms of malnutrition (SDG-2) and ensure sustainable availability of clean water and sanitation for all (SDG-6).

1.4. Research questions

The present study will answer the following research questions:

- The existing complementary feeding practice provide a diverse diet and age-appropriate meal frequency?
- What proportions of households have access to an improved water source?
- What proportions of households have access to improved sanitation facilities?
- How do households' waste disposal and personal hygiene practices look like?
- What proportion of children under two years of age are wasted, underweight and stunted?

1.5. Objective

1.5.1. General Objective

- To assess the outcome of complementary feeding and WASH practice towards child nutrition outcome

1.5.2. Specific Objectives

- To assess the effect of existing WASH practice on nutritional status.
- To assess the complementary feeding practice and its association to child nutritional status.

- To identify factors that influence optimal complementary feeding and WASH practice among infants and young children aged 6 to 23 months in the study area.

1.6 Scope of the study

The research considered children between 6 and 23 months of age living in rural districts of South Wollo. The main motto for focusing on this age group is that young children are generally at the most significant risk of inadequate complementary feeding and WASH attributed to undernutrition and/or associated health problems.

2.LITERATURE REVIEW

2.1. Child undernutrition: The theoretical foundation and conceptual framework

Even though nutrition has received more attention in recent decades, nutritional deficiencies continue to be a complicated problem that affects many newborns and young children throughout the world (UNICEF, 2015). More than a quarter of these youngsters (UNICEF/WHO/World Bank, 2017) live in Africa. The causes of undernutrition are multifactorial and interlinked. The widely used UNICEF's conceptual framework describes the immediate, underlying, and primary causes of malnutrition encompassing individual, household, and community-level factors (UNICEF, 2013). Furthermore, nutrition outcomes for infants and young children require a broader framework than nutrition-specific interventions alone (van Cooten*et al*., 2018). With these theoretical foundations, the present study will be guided by the developed conceptual framework (Figure 1) to assess the contribution of WASH and complementary feeding to child nutrition outcomes in rural Ethiopia.

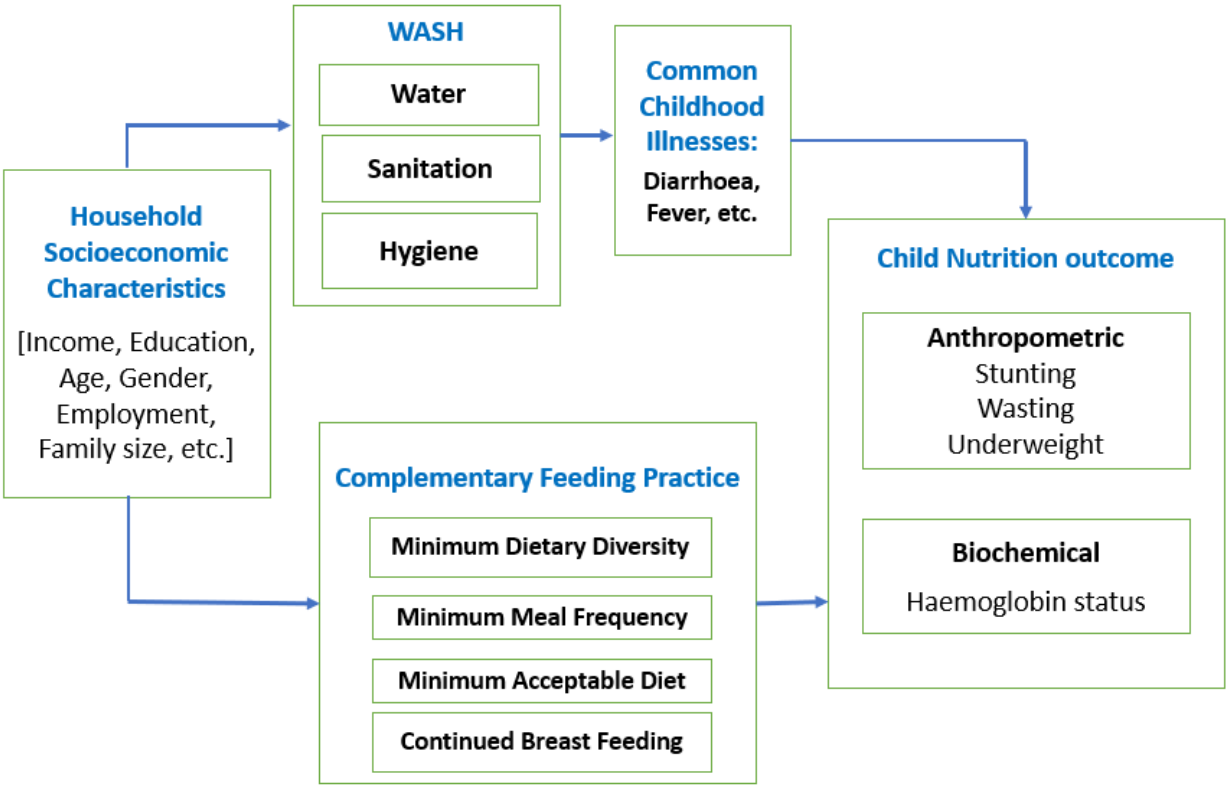

Figure 1: Conceptual framework relating WASH and complementary feeding practice to child nutrition outcome. [Constructed by the author, adapted from UNICEF, 2013; Gebremedhin *et al*., 2017; Bekele *et al*., 2020; Jones *et al*., 2015; Muche *et al*., 2021].

Child undernutrition is linked with poor water, sanitation and hygiene (WASH) conditions. However, existing pieces of evidence were inconsistent. Several studies from low-and-middle-income countries have reported no significant association between WASH and linear growth (SR *et al.*, 2014; Luby *et al.* 2018; Muhoozi *et al.* 2018), and some others reported that WASH has a significant effect (Lin *et al*., 2013; Pickering *et al*. 2015; Mekonnen *et al.*, 2021; Muche *et al*. 2021). Bekele *et al*., (2020) assessed the nutrition status of children concerning access to single or combined WASH facilities in children under five years from the Ethiopian DHS 2016 data for Amhara region. The authors reported that improved water and sanitation separately and combined WASH were not associated with being underweight and wasting. At the same time, children with access to combined improved WASH facilities showed a significant reduction in linear growth failure. Gizaw and Worku et al. (2019) conducted a systematic review and meta-analysis to examine the impact of single and combined water, sanitation, and hygiene (WASH) initiatives on children's nutritional status. They found that the impact of WASH on HAZ varied depending on age and intervention type. The WASH intervention had a greater impact on HAZ in children under two.

Moreover, children who received combined WASH interventions grew better than children who received single interventions. Complementary feeding from 6 to 23 months is critical to help each child achieve its full potential (WHO, 2013). From 6 months onward, the increasing nutrient demand of children cannot be satisfied exclusively by breast milk alone. This period is a remarkably vulnerable time when undernutrition commonly starts to occur. Insufficient quantity and nutrient-poor complementary diet tied with unhygienic feeding practice led to micronutrient deficiencies, common childhood illnesses and growth faltering (Arabi *et al.* 2012).

Although sub-optimal complementary feeding practices unquestionably contribute to child stunting, frequent intercurrent childhood illnesses, such as fever, cough and diarrhoea, may also adversely impact child growth (Jones et al. 2015). Jones et al. (2015) found that intercurrent illnesses restrict the growth hormone axis by lowering insulin-like growth factor 1 levels in Zimbabwean children in a longitudinal cohort study (IGF-1). Acute childhood illness has the potential to affect the growth hormone axis in both direct and indirect ways. Cough and fever had a predominantly indirect effect on suppressing the growth hormone axis through activation of the inflammatory response, and diarrhoea had a predominantly direct effect on the growth hormone axis. It has been documented that both dietary protein restriction and zinc deficiency have been shown to reduce circulating serum IGF-1 concentrations (Cossack, 1991; Fontana *et al*. 2008). In this regard, diarrheal illness is shown to induce moderate protein deficiency through

decreased dietary intake, malabsorption, or catabolic loss (Brown, 2003). Diarrhoea may also induce or intensify zinc deficiency through excess faecal losses of zinc (Jones *et al*., 2015).

2.2. Infant and Young Children Feeding.

2.1.1 Breastfeeding Practices

Breast milk is a natural resource that has a significant impact on a child's health, growth and development. Breast feeding and complementary feeding are two primary care strategies that may have an effect on a child's nutritional status (Alfthan *et al.* 2010). It is recommended that infants should be exclusively breastfed for the first six months of life. Nutritionally adequate and safe complementary foods should be introduced while breastfeeding continues for at least two years (Muchina and Waithaka 2010). For the vast number of children in developed countries, breastfeeding is a life-or-death situation. During the first six months of childhood, only about 35% of children globally are predominantly breastfed (Muchina and Waithaka *et.al* 2010). Scientific literature shows that appropriate breastfeeding has significant physical, social, and economic benefits (Belay 2019). A multi-center cohort study conducted in India, Ghana, and Peru discovered that babies who were not breastfed had a tenfold increased chance of dying from any cause of disease. They also have an increased risk of being treated for any cause compared to those who had been exclusively breastfeeding (Bhutta *et al*. 2013).

According to a study conducted in Chittagong, Bangladesh, children who were predominantly breastfed from 0 to 6 months had a slightly lower incidence of diarrhea and acute respiratory illness than those who were not exclusively breastfed (Kabir, I. 2012). Several studies have shown a correlation between breastfeeding and a host of infectious or noncommunicable diseases such as allergies, obesity, diabetes, asthma, cancer, and Crohn's disease (León-Cava, 2012). An estimated 1.3 million lives are lost attributable to insufficient exclusive breastfeeding annually. Another 600,000 lives were lost due to a lack of continued breastfeeding with proper complementary feeding (Muchina and Waithaka *et al.*, 2010). Breast milk must be supplemented with other foods of adequate quantity and consistency to meet the infant's nutritional requirements during the complementary feeding cycle (WHO 2013).

2.2 Complementary feeding

According to WHO, the first 1000 days of life are critical to promoting optimal growth (WHO 2014b). When breast milk alone is no longer adequate to fulfil an infant's nutritional requirements should initiate complementary feeding. Complementary feeding (CF) refers to a progressive dietary change marked by incorporating solid and semi-solid foods into the infant's diet. Even though breastfeeding can last longer than two years, the recommended age period for complementary feeding is usually 6 to 24 months (WHO 2013).

According to (WHO 2013), the complementary feeding journey starts at six months and lasts for at least 24 months, and it is the most critical period for child growth and development. The dietary inadequacy of the complementary diet, both in terms of consistency and quantities, and the negative impact of pathogens on a child's nutritional status are still significant issues facing infants and young children today (Nti, C.A., and Lartey 2014).

The Ethiopian National Policy on Infant and Young Child Nutrition, based on WHO advise, includes detailed complementary feeding guidelines. The following are some of them: Start complementary feeding at six months, with small quantities of food steadily increasing as the infant grows older. Food quality and variety can be progressively improved as well. Another suggestion is to breastfeed often and on-demand before the child is two years old or older and use responsive nursing, which directs babies to be fed directly and older children to be helped with eating(Belete *et al.,* 2017).

WHO recommendations for infant and young child feeding (IYCF) practices for children aged 6–23 months have been created, with the minimum acceptable diet (MAD) being one of the eight basic indications of supplementary feeding (NNP2 2013). It's the result of a combination of dietary diversity and meal frequency. For breastfed and non-breastfed children aged 6-23 months, nutritional variety is defined as getting four or more food categories out of seven. Two or more solid, semi-solid, or soft food feedings for 6–8 months, three or more feedings for 9–23 months' breast feed, and four times for non-breast feed children are the minimum meal frequency for breastfed and non-breast feed children aged 6–23 months (UNICEF 2012).

2.2.1 Initiation of complementary feeding

Complementary feeding can begin at an early age, with all children consuming foods other than breast milk by six months (WHO, 2006). Early initiation of complementary feeds before the age of six months will cause breast milk displacement and raise the risk of infections like diarrhea, all of which contribute to weight loss and malnutrition (Agedew Getahun 2017). Research done by Agumasies and others in Eastern Ethiopia indicate that, 60% of women timely initiate and 19% were early initiated CF. The early starting of CF (4-6) month were lack of knowledge, inadequate breast milk production and far distance from health institution were associated factor. Also39.5% of mothers were late initiation of CF (Ayalew, 2014).

Ensuring that a child’s nutritional needs are met during the complementary feeding period requires that the foods introduced are;

- **Timely** – meaning introduced when energy and nutrient needs exceed that provided by breast milk.
- **Adequate** – meaning they provide sufficient energy, protein and other essential macronutrients, and micronutrients to meet nutritional needs.
- **Safe** – meaning they are hygienically stored and prepared and fed with clean hands and clean utensils and not bottles and teats,
- **Responsively fed** – meaning they are fed consistently with a child's hunger and satiety signals. (WHO/UNICEF 2003).
- They should also be **fed appropriately** – meaning that meal frequency and feeding method, such as actively encouraging the child, even during illness, to consume sufficient food using fingers, spoon or self-feeding, are suitable for their age.

Other important components of complementary feeding and meals include food consistency that reflects a child's capacity to chew and swallow, meal frequency, energy density, and nutritional content, and the use of vitamin and mineral supplements or fortified products as needed (WHO/UNICEF 2003).

If not handled and kept appropriately, complementary meals might increase an infant's exposure to infectious microorganisms (susin, L. 2005). However, starting complementary feeding too late can be hazardous to children, as children older than 6 months require complementary meals to satisfy their energy and nutritional needs for healthy development (Vlasuk 2007). Late introduction of supplemental meals may limit exposure to microbial pollutants through food and other vehicles in environments where environmental sanitation is low. However, at the age of six months, newborns begin to explore their surroundings and are exposed to a variety of pollutants. As a result, supplementary meals should be introduced from the age of six months. (Gervasoni 2009).

2.2.2 complementary feeding indicators

According to the WHO definitions 2010 (WHO 2010a) defined the complementary feeding indicators as follows:

(a). Early breastfeeding initiation (EBI), the child was breastfed until 1 hour after birth.

(b). Exclusive breastfeeding (EBF), the child was given only breast milk until the age of 6 months.

(c). Continued breastfeeding (CBF), the child is breastfed until 23 months.

(d). A timely introduction to CF, the child was given solid, semi-solid and liquid food at six months

(e). The minimum acceptable diet (MAD) is a combination of the minimum dietary diversity (MDD)and Minimum meal frequency (MMF). Infant and young children should be fed a minimum acceptable diet (MAD) to ensure proper growth and development. Without adequate diversity and meal frequency, infants and young children are vulnerable to undernutrition, especially stunting and micronutrient deficiencies, and increased morbidity and mortality.

(f). Dietary diversity is used as a proxy for dietary micronutrient richness. Minimum dietary variety measures food intake from four food categories in children aged 6 to 23 months. For both breastfed and non-breastfed children, a four-food-group cut-off is linked to higher-quality diets. In addition to a basic food (grains, roots, or tubers), a kid who consumes food from at least four food categories has a high possibility of consuming at least one animal source of food and at least one fruit or vegetable (WHO 2008b). Grains, roots, and tubers; legumes and nuts; dairy products (milk, yoghurt, cheese); flesh foods (meat, fish, poultry, and liver/organ meat); eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables should all be included in the four dietary categories.

(g). Minimum meal frequency, which is a proxy for a child's energy needs, looks at how often youngsters are fed meals other than breast milk. The minimal number is determined by the child's age and breastfeeding status. If breastfed children consume solid, semi-solid, or soft meals at least twice a day for babies aged 6-8 months and at least three times a day for children aged 9-23 months, they are regarded to be consuming minimum meal frequency.

If non-breastfed children aged 6 to 23 months are fed solid, semi-solid, or soft meals at least four times a day, they are considered to be fed with a minimal meal frequency. In Ethiopia, the national data indicates that 72.5 , 65.0 %, 60.7 % and 57.7 % of children are fed the minimum recommended times or more for 6-8months, 9-11 months, 12-17 months and 18-23 months' age sub-categories, respectively (Central Statistical Agency (CSA) 2012). Overall, scientific evidence shows that complementary feeding practices are suitable in terms of minimum meal frequency but are inappropriate in terms of initiation of complementary foods, minimum dietary diversity and minimum acceptable diet.

According to EDHS 2016, 14 % of children had an adequately diverse diet in which they had been given foods from the appropriate number of food groups, and 45% had been fed the minimum number of times suitable for their age. 19 % of children in urban areas are more likely to be fed according to the minimum acceptable dietary standards than 6% in rural areas. A significant regional variation exists in the proportion of children who receive the minimum acceptable diet, with the highest level of 27% in Addis

Ababa and the lowest levels (2-3%) in Afar, Somali, and Amhara (Central Statistical Agency (CSA) 2016).

2.2.3 Prevalence of optimal complementary Feeding

According to (White JM 2017), globally, only 64.5% of infants from 6 months to 8 months are fed solid, semi-solid or soft food. A study done by Awobegeja and Ugwuona 2010(Awogbenja MD 2010) has reported growth faltering due to inadequate complementary food in terms of quality, quantity, and frequency.

According research conducted in Northern Ethiopia, 10.75 % get proper supplemental nutrition. Factors that can enhance effective supplemental feeding practice include educated moms, children aged 18-23 months, and mothers who have received postnatal care. (Mekbib 2014).A study done in India found that mothers' initiation CF at six months was three-fourths, even though 12% of children had delayed starting of CF. The main reason given by mothers for delayed initiation of CF was that mothers felt their breast milk was enough for their baby (Rao S, 2011). A study done in Uganda points out that half of the mothers introduced Complementary food at six months; water, cereal, traditional medicine, and dry tea were the most food given to the infant reach six months (Mokori A 2012).

A study done in China shows 76% of mothers were introduced CF to their infant between 4-6 months of age, and 62.4% of mothers gave formulated food, 21.2% of them introduced cow milk from 6-12 months of age. Timely initiation of CF was 41.6%, the associated factor for early initiation of CF was maternal age, maternal education, employment and infant sex (Liubai L, 2005). In Ethiopia, CF is still not introduced on time. 11% of infants began complementary food by the age of 4–5-month, 17% of the infant were fed other liquids such as water and 5% milk before six months of age. 60% of children are introduced to solid, semi-solid or soft food at 6-8 months, which is an improvement since 2011, which were 49% (EDHS 2016).

2.2.4 Effect of complementary feeding on nutritional outcome of children

The foundation for good health through life requires appropriate CF(Saaka M,2016). Inappropriate CF practice remains an essential aetiology for childhood undernutrition, in many developing countries, a significant source of disease burden among children under two years of age (Black RE *et.al* 2013; Munuswamy S, 2014)

Appropriate complementary feeding is not only crucial for a child's development, but it also provides the basis for good health throughout their lives (UNICEF. WHO 2017). Malnutrition is one of the leading causes of death for many of the world's youngsters, accounting for more than a third of all deaths of

children under five. Around 178 million children are stunted worldwide, with Africa seeing the highest rates (WHO 2012).

Approximately 10 million under-five children die annually cause related to malnutrition world wild. Over one-third of mortality are related to inadequate complementary feeding. Initiating CF at the age of 6-month of safe and nutritional adequate complementary food is crucial to achieving optimal growth, development and health (Mekonnen *et al*., 2021).

2.3. Water, Sanitation and Hygiene (WASH)

WASH is typically referring to activities aimed at improving access to and use of safe drinking water and sanitation and promoting good hygiene practices e.g., washing hands with soap at all critical times. The water and sanitation system are comprised of the policies, programmers, services, and actors that ensure a population's access to and use of safe drinking water and sanitation. This system is critical to protecting young children's diets. Poor water, sanitation and hygiene can expose children to pathogens that cause diarrhea and other infections and can result in environmental enteropathy, leading to impaired structure and function of the small intestine (UNICEF 2020b).

2.3.1. Component of WASH

WASH is a composite concept comprising individual components each with its own associated unique indicators (Figure 1)

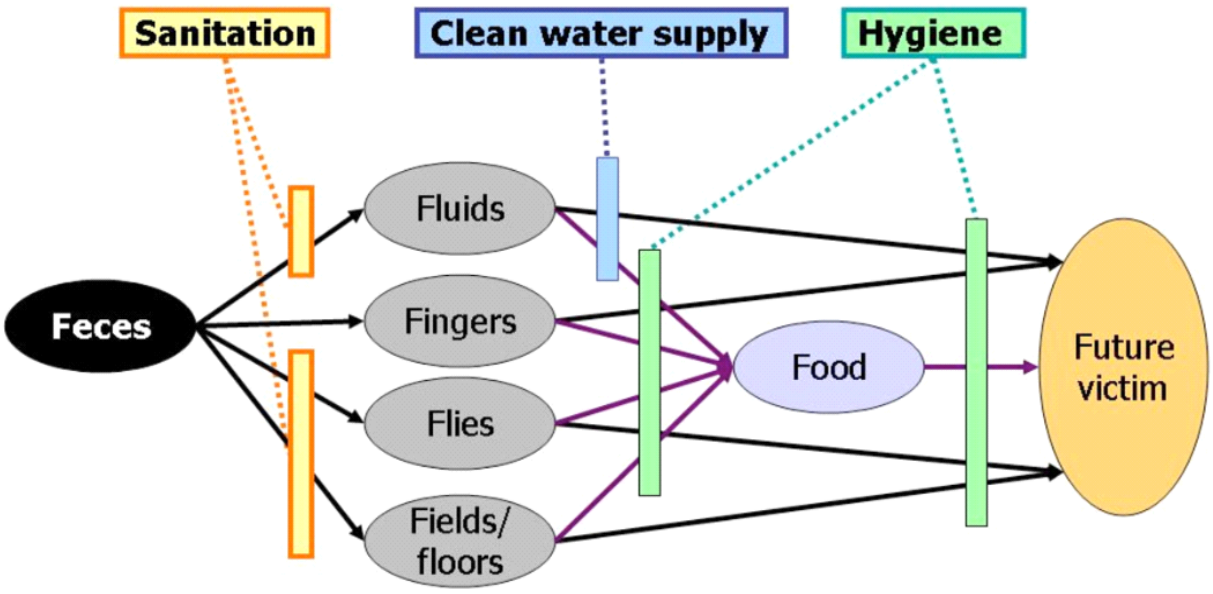

Figure 2: The F diagram above shows the pathways in which fecal matter is ingested by the victim and the barriers that can prevent infection. Source: Padilla, 2012.

Water quantity

provision of facilities and services that increase the amount of water available for drinking, cooking and maintaining good hygiene practice with in house hold, healthcare facilities or schools; and reduce the time and effort required to collect the water (WHO/UNICEF 2015).

Water quality

Improvement and protection of the microbiological (or chemical, such as arsenic) quality of drinking water through water treatment and safe storage or by improving existing water sources to protect them from outside contamination (WHO/UNICEF 2015).

Sanitation

Provision and use of facilities and services that safely dispose of human urine and faces, thereby preventing environment contamination (WHO/UNICEF *et al.* 2015).

Hygiene

The practice of handwashing with soap after defecation and disposal of child faces, before preparing and handling food, before eating, and, in health care facilities, before and after examining patients and conducting medical procedures (WHO/UNICEF *et al.* 2015).

If water quantity is small, the presumption that the individual WASH portion as an independent is likely to be an oversimplification for WASH as, for example, handwashing promotion is unlikely to be successful. (Prüss-Ustün *et.al.* 2019). suggested that the three elements of WASH are also likely to differ at the same time, i.e., improving access to or utilization of water facilities could concurrently enhance hygiene and sanitation behaviors.

2.3.1 Prevalence of WASH access

Regarding the global prevalence of access to WASH, about 663 million people worldwide do not have access to an adequate drinking water supply (UNICEF / WHO et al. 2015). About 1.9 billion people depend on fecally polluted drinking water (Bain et al. 2014). More than one-third of the world's population has also been estimated to have no safe and reliable water service at home (Clasen, T. 2014). Concerning the global estimate of hand washing practice, fewer than one in five people wash their hand with soap after defecation (Freeman et al. 2014).

The join program done by WHO & UNICEF report utilization of safely managed water service increased from 61% in 2000 to 71% in 2017, which means seven people used safely managed drinking water

service out of ten people. About 1.8 billion people gained access to at least essential services. As this report indicates, the population size that lacks basic service decreased from 1.1 billion in 2002 to 785 million in 2017; similarly, the number of people who collected water directly from the surface decreased from 256 million in 2000 to 144 million (WHO and UNICEF 2019).

While access to clean water and sanitation is restricted in countries with low and medium incomes, rural and urban disparities are substantial (Bain *et al*., 2014). According to WHO / UNICEF (2014), 500 million more people in rural areas have no access to clean water than in urban areas, and 1 billion more have no access to sanitation. Access to safe water and sanitation varies between rural and urban communities, with access to water, especially in low- and middle-income countries (LMIC) (Bain *et al.*, 2014).

In Ethiopia, compared to 56.5 % of rural households, 97% of urban households have access to potable water. The three most common sources of drinking water in urban households are water piped into the to a neighbor (12%) household's dwelling, yard, or plot (63%); water piped into a public tap/standpipe (13%); and water piped (EDHS 2016), and also only 6% of Ethiopian households use improved toilet facilities 50% in urban areas and 6% in rural areas). More than half (56%) of rural households use unimproved toilet facilities. One in three households in Ethiopia has no toilet facility (39% in rural areas and 7% in urban areas).

2.3.2 Effect of WASH on the nutritional outcome of children

It is possible to divide the relation between WASH and undernutrition into direct and indirect connections. The direct link between contaminated water, inadequate sanitation and hygiene. Diarrhea, intestinal worm (soil-transmitted helminths), and environmental enteric dysfunction (EED) are caused by the above portion of WASH. The described disease is caused by inadequate WASH and these diseases interact with the digestive and metabolic system by impaired absorption and increased execration.

- **Diarrhea;** is defined as increased stool frequency and decreased stool consistency or going to the toilet more than three times per day (WHO). Diarrhea is one of the leading causes of mortality and morbidity in under-five of age. Under-five children in low-income countries experience diarrhea averagely of 2.9 episodes per year (WHO 2015). Moreover, the effect did not stop there; globally, diarrhea is a cause for 8% of under-five death (UNICEF, WHO 2015). Suffering from the most frequent and severe episode of diarrhea has a high risk for an undernourished child by creating a vicious cycle (Mara, D.2010).

Diarrhea has a significant impact on under-five children causing, malabsorption, loss of appetite and increasing metabolism(Jennings et al. 2015). In children first, 24 months, frequent episode of diarrhea has a significant impact on cognitive development and growth rate (Grantham-McG *et al*.,2007). Being undernourished means having a weak immune system, making them more vulnerable to enteric infection and leading to a more severe prolonged episode of diarrhea (Caulfield *et al*,. 2004).

- **Intestinal worm (soil-transmitted helminths);** Round worm, whip worm and hook worm, soil-borne helminth infection are directly caused by inadequate sanitation and hygiene. They can be transmitted by contact with or ingesting soil infected with human faces containing worm eggs without healthy sanitation and hygiene (WHO 2013). Helminth egg and larva can survive for a month in the soil. Also infect humans when ingestion via contaminated water and food or contact with fomites or by direct contact with the skin when waking bare foot on contaminated soil (hook worm larva) (practical solutions WHO 2015).

  Soil-transmitted helminth infection can affect nutrition status by causing malabsorption of nutrients, loss of appetite and increased blood loss (practical solutions WHO 2015). Whipworms and roundworms can cause severe infection and have impaired growth (Brooker 2010). One of the causes of anima in pregnant women and children is hookworm (Brooker 2008). Recent research has shown that improvement in sanitation can reduce by approximately 50 % the risk of soil-transmitted helminth infection (Soriano, G.P. and Aquino 2019). According to the WHO report, about 24% (1.5 billion) of the world people have been infected with parasitic intestinal infections, mainly hookworms, Ascaris *lumbricoides* and Trichuris *trichiura* (WHO 2017).

  Environmental enteric dysfunction; A subclinical disease triggered by repeated ingestion of pathogen affects both the structure and function of the gut and induces persistent inflammation and damage to the gut, contributing to nutrient malabsorption, also known as environmental entropy (Mbuya and Humphrey 2016). This condition can be a major cause of growth faltering due to the associated malabsorption of nutrients and inflammation of the system (Water aid 2015), even if nutrient status can be impaired in the absence of symptoms.

  Children between the age of 6 to 24 months living in poor sanitation and hygiene are exposed to a high load of pathogen, because at that age, children start crawling on the floor and putting objects into their mouths (Ngure, et.al2014). Reviews suggest that environmental enteric dysfunction may be a major cause for impaired growth and may compromise the effect of nutrition intervention. A

study done in Bangladesh has shown that children living in households with improved WASH are both less likely to have EED, measured by lactulose: mannitol ratios in their urine [a measure of gut permeability and are less likely to be stunted (Lin *et al*. 2013).

Indirect links: the time taken to gather water and the cost of water obtained from retailers because it is not readily accessible at home, the effect on the volumes and quality of water consumed, and on hygiene habits, according to EDHS 2016, more than half of rural households (53%) travel 30 minutes or more extended round trip to fetch drinking water. Which also have a socio-economic mechanism, in turn, influencing nutrition and also nutrition. For example, the energy cost of transporting water for long distances from the source to the home. Additionally, time spent sick with water-borne disease or collecting water impedes educational attainment, significantly impacting health, well-being, and poverty over a lifetime, and potentially over multiple generations (Water aid 2015).

2.4. Child Under nutrition

Malnutrition is a general term that refers to overweight and obesity and is also used to substitute undernutrition. Malnutrition occurs when a person's diet lacks sufficient calories and protein for development and maintenance or cannot properly use the food, they consume due to illness (undernutrition). They are often malnourished if they overeat calories compared to the number of calories expended. When the correct balance of nutrients joins, leaves, and is consumed by the body, good nutrition is called. The word malnutrition is used in this analysis to refer to undernutrition (UNICEF 2012).

Malnutrition, mainly undernutrition, is the highest cause of morbidity and mortality, affecting billions of people globally, especially women and children in the society (WHO/UNICEF 2015). One in every five under-five children are stunted (Waage, J. 2015) . The rate of stunting had declined in some regions of the world including Asia, by one-third from 1990-2015, but not for sub-Saharan Africa (USAID 2015). Children's undernutrition is a serious concern, and the consequences are long-lasting and extend past adolescence. It has short- and long-term ramifications(Abuya BA & Ciera JM 2016). Linear growth retardation (chronic malnutrition or stunting) is also correlated with prolonged exposure to low economic environments, low sanitation, and the interactive consequences of poor ingestion and infection of nutrients. Stunting is regarded as the best marker of child health disparities because of its high prevalence and long-term effects on child development (Grantham-McGregor, *et.al* 2007).

Undernourished children are physically, emotionally, and intellectually less productive than non-undernourished children, and they are more likely to develop chronic illness and impairment later in life. (Jesmin 2011). The causes of malnutrition are various and complex. The diverse dynamics of numerous variables such as socio-demographic, environmental, reproductive, administrative, socio-economic, political, and regional factors all play a role in child malnutrition (Asfaw *et al.* 2015). A mixture of inadequate and unsafe complementary nutrients, as

well as chronic illnesses such as diarrhea due to poor hygiene, have been proposed as potential causes for the high prevalence of undernutrition in the 12–23-month age range (Medhin, *et al*., 2010).

A community based cross-sectional survey was conducted in Mecha and Wenberma Woredas of West Gojam Zone, Between May and June 2006, researchers in Northern Ethiopia looked at the influence of demographic and socioeconomic variables, health-related factors, and nutritional factors on stunting in children under the age of five. The researchers employed bivariate and multivariate analysis (logistic regression model) to find the factors that influence stunting in children under the age of five. The study concluded that the child's sex, age, diarrhea episode, deprivation of colostrums, duration of breastfeeding, prelacteal feeds, type of food, age of introduction of supplemental feeding, and manner of feeding were the key contributing variables for under-five stunting. (Beka Teshome, *et al*.,2009).

Children's malnutrition is a significant public health problem in developed countries like Ethiopia (Black Re *et al. 2008*), In Ethiopia, 44.4 % of children under five are stunted (below -2 SD), and 12 % are significantly stunted (below -3 SD), according to EMDHS (2019). In general, the incidence of stunting proliferates with age, from 22 % of children between 6-8 months to 44 % of children between 48-59 months. In rural areas, stunting among children is more significant (41%) than in urban areas (26%). There are some regional variations in stunting, ranging from a high of 49% in Tigray to a low of 14% in Addis Ababa. In total, 7 % of Ethiopia's children. Regional variations exist, with the highest %ages of children who wasted in Somali (21%), Afar (14%), and Gamble (13%) and the lowest %ages of wasted children in Addis Ababa (2%) and Harari (4%). 21% of all children are underweight (below-2SD), and 6% are severely underweight (below -3 SD). Children in rural areas are more likely than those in urban areas to be underweight (23% versus 14%). The prevalence of stunting, wasting and underweight among under-five kids in Amhara Regional State was 41 %, 8 % and 27 %, respectively. Eliminating undernutrition in Ethiopia would prevent 8–11% per year from the gross national product (IFPRI 2015).

2.4.1. Anemia in children and its prevalence

Anemia can be defined as a reduction in hemoglobin (Hb) concentration below the reference cut-off of 11g/dL in children under five(WHO 2011). Anemia is a composite indicator of nutrition and health status, and hence it is considered as one of the food utilization indicators by the world food and agriculture organization (FAO, 2015). Numerous factors contribute to anemia, and about half of the cause of anemia is due to iron deficiency (Anand et al., 2014) The deficiency may result from inadequate dietary intake, an increased iron demand during rapid growth in children, malabsorption of iron or blood loss(Lopez *et al.* 2016). Other causes of anemia include vitamin A, folate, vitamin B12 and inadequate

intake of dietary protein. Malaria and infestation with intestinal helminths are also contributors (Crawley, 2004; Pickering *et al.* 2015). According to the Ethiopian DHS (2016), more than half of the children 6–59 months (56 %) in Ethiopia were anemic. The prevalence in Amhara region is about 42% which is still unacceptably high and remains a severe public health problem – whose etiology is not well defined

3. METHODOLOGY

3.1 Study area

The study was conducted in the Amhara area, which has a high prevalence of stunting. Stunting affects 41% of children in the region, which is higher than the national average of 37%. (EMDHS 2019).

The South Wollo zones in the Amhara region are one of Ethiopia's most food-insecure locations (Barrett, C.B. and Maxwell 2007). The majority of the zone's population (83 %) lives in rural areas, with a female to male sex ratio of one to one (CSA 2013). The research was carried out in Dessie Zuria and Kutaber, two districts in the south Wollo zone.(Figure 3).

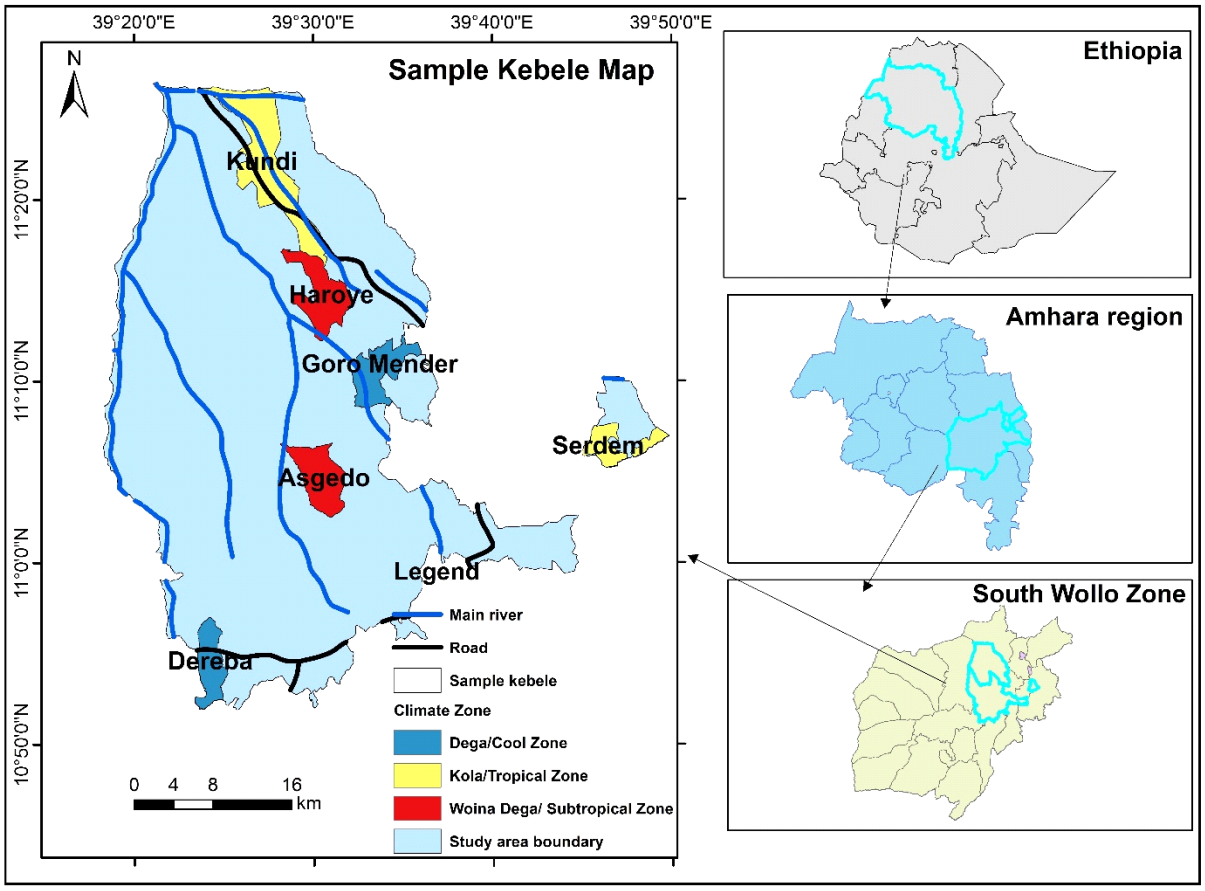

Figure 3: Study area map

3.2 Study Design

A community-based Cross-section study design was employed to collect relevant and sufficient information within a short period. The study design was used a quantitative research approach to assess complementary feeding and WASH practice towards child nutrition outcome of children aged 6 to 23 months in south Wollo; from March to April 2021.

3.3 Data collection

3.3.1 WASH practice

Data were collected by trained data collectors using structured questionnaire to assess child's age, socio-demographic, complementary feeding practice. WASH component data was collected using a structured questionnaire and an observational checklist, *Sanitation facility variables* (sanitation status, number of households sharing one sanitation facility, types of sanitation facility, proximity of sanitation facility to home), *Hygiene variables* (feces/flies observed on the floor and/or around the sanitation facilities, presence of hand washing facility, solid waste and domestic liquid waste management practice of the household), *water* (source, availability, adequacy, and access).

3.3.2. Complementary feeding practice

The following WHO and Pan American Health Organization/WHO/UNICEF recommendations for infant and young child feeding (IYCF) were implemented by CF practices: (WHO 2009, Pan America health organization 2013). The child was breastfed 1 hour after delivery in early breastfeeding initiation (EBI). During Exclusive Breastfeeding (EBF), the child was exclusively fed breast milk until he or she was six months old. The children was still breastfed due to continued breastfeeding (CBF). At the age of six months, the child was offered solid, semi-solid, and liquid meals as a timely introduction to CF. The proportion of breastfed and non-breastfed children aged 6 to 24 months who get solid, semi-solid, or soft meals (but not milk feeds for non-breastfed children) the minimal number of times or more per day was calculated as follows: Breastfed infants 6-9 months should be fed twice; breastfed children 9-24 months should be fed three times; and non-breastfed children 6-24 months should be fed four times. The proportion of children aged 6 to 24 months who eat items from four (4) or more of the seven (7) food categories was considered as minimum dietary variety. The proportion of children aged 6 to 24 months who eat a minimum recommended diet was calculated (apart from breast-milk). The following two fractions are commonly used to create this composite indicator: Breastfed children aged 6 to 24 months who received at least the necessary dietary diversity and meal frequency the day before.

3.3.2. Anthropometric measurements

To assess nutritional status, anthropometry was used. The trained data collector measured anthropometric data (length/height and weight) of the children under study. Using a wooden or Perspex measurement frame, the reclining length of children under. The weight of children was measured by a pediatric weight scale. For children, height-for-age, weight-for-height and weight-for-age was calculated using the WHO growth standard (WHO, 2006); Z-scores below -2.0 will be used generally to classify a child as stunted, wasted or underweight. Whereas Z-scores below -3.0 indicate severely and -3 to

<-2 for moderate forms of the condition. Z-scores for normal (-2 to +2). The anthropometric scores were calculated using WHO Anthro software (v3.2.2) (WHO, 2009).

3.3.3. Hemoglobin concentration

Haemoglobin concentration of children was determined from capillary whole blood after finger prick. All the necessary aseptic procedures were followed. About 2-3 drops from capillary blood was collected in to Hema cue microcuvette through finger pricking. A cutoff values of hemoglobin concentrations less than 11 g/dL was used to classify children as anemic (WHO, 2011).

Haemoglobin (Hgb) measurements were adjusted for altitude (Gonzales *et al*., 2020),

Hgb correction = –0.032 (altitude × 0.0032808) + 0.022(altitude × 0.0032808)^2.

3.4. Data Source and Study Population

Children from 6 to 23 months at the time of the survey in the kebele and their mothers or caregivers were the data source.

3.5. Inclusion and Exclusion criteria

The inclusion criteria for the study were children from 6 to 23 months at the time of the survey. Children above and below 6 to 23 months were excluded from the study.

3.6. Sample Size Determination

The sample size was determined by single proportion sample calculation formula. The prevalence value was taken from 41% of stunting prevalence in Amhara region (EMDHS, 2019).

$$n = \left[Z^2_{\alpha/2}\, P(1-P)\right]/d^2$$

$n=\frac{1.96^2*0.55(1 - 0.45)}{(0.045)^2} = \frac{3.84*0.55\ (0.45)}{0.002025} = 469.33 \approx 517$

Where;

n- The minimum sample size required for very large source population

Z - The critical value for a given confidence interval (95%)

P - Expected proportion of the event to be studied (0.55)

d- Margin of error (4.5%)

Considering non-response rate of 10%, the sample size become 517.

According to the EDHS (2016), rural Ethiopia had 55% unimproved sanitation facility and 43% unimproved water source. In Amhara region, 43% of children were anemic and the prevalence of stunting was 41%. From these prevalence data for the outcome variables of the present study, we have chosen prevalence of 55% (unimproved sanitation facility) as this figure is relatively closer to 50% and able to satisfy the sample sizes required for other specific objectives.

3.7. Sampling technique and procedure

Multistage sampling method was followed where south Wollo zone, particularly, the two districts namely Dessie Zuria and Kutaber were selected purposefully for encompass > 83% of the population are living in rural kebeles. Study kebeles within the two districts were randomly selected and finally, the study subjects (children 6-23 months) were chosen by a systematic random sampling technique from a sampling frame. Sampling frame was developed from household registration book at health posts in those kebeles.

3.8. Study Variables

The independent variables were socioeconomic/demographic and related factors. Socio-economic/demographic variables that were self-reported by the study participants were mother's/caregiver's education level, occupation, age (years), religion, marital status, number of children under five in the household, child's age, child's sex, birth order of child, child's father's education and occupation status, household size and household economic status (wealth status). Wealth status of the study participant household was estimated using principal component analysis (PCA). The intermediate dependent variables for this study WASH, complementary feeding practices and ultimate dependent variable nutrition status of children including: stunting, wasting, underweight and hemoglobin concentration.

3.9. Data Analyses

All data were analyzed using SPSS for windows version 21 (Chicago, IL; SPSS Inc.). Bivariant and Multiple logistic regression models were used to identify factors associated with child nutrition outcomes complementary feeding and WASH. The inclusion of variables in the regression model will be based on scientific plausibility and their level of significance where independent variables that will have *p*-value <0.05 in the bivariate analysis were also be considered as a potential predictor for the multivariate model (Bursac, Gauss *et al*. 2008) Reference categories were defined as those usually associated with the least practice of complementary feeding and WASH in the literature. Similarly, cut-off points for child dietary diversity using seven food groups based on guidelines proposed by the Food and Nutrition Technical

Assistance Project (FANTA, 2006); and anthropometric status will be considered as per WHO growth standard (WHO, 2006).

3.10. Ethical Considerations

The study was conducted after its protocol has been reviewed and approved by the institutional review board of college of natural and computational sciences, Addis Ababa University with Ref No: CNCSDO/650/13/2021 and Dated June 11, 2021, (Annex 3). In addition, permissions to conduct the study was obtained from each of the respective administrative units (health offices of south Wollo zone and study districts). Informed oral consent will also be obtained from all parents/mothers/caregivers for their willingness to participate in the study. Participant's information sheet was included the objective of the study, benefits and possible risks (Annex 1).

4. RESULT

4.1 Sociodemographic Characteristics

The study included 463 children aged 6-23 months; among them 65.2% were in the age group of 12-23 months. The median age of the study children was 15 months, and the female to male sex ratio was nearly one. About two-third of the children were primary children to their parents of the arrangement of member children's 98.5% of them were cared by their mother. Amid the included households (HH), a more significant proportion of them was male-headed, and only 2 % were female-headed and the median age of HH head was 35 years. More than half (57.1%) of the HHs had less than five family members. About (30.5%) HH had greater than 60-year-old people lives; from that (23.1%) HH have at least one greater than 60 people live. The median age of the mother was 35.5 years and 70% of them were housewives. About 62.3% of the mothers were gone to school and 80.2% of them completed primary school. Regarding marital status, 94% of the interview were married, and 3.4 were divorced. More than half of the husbands (63.7%) have attended school.

Table 1: Sociodemographic Characteristics(n=463)

Variables	Frequency (%)
Age of a child (month)	
6-11 month	162(34.7%)
12–23-month	301(65.2%)
Gender	
Female	240(51.7%)
Male	233(48.1%)
Relationship of caregiver to the child	
Mother	457(98.5%)
Father	5(1.1%)
Other	1(0.2%)
Duration of living in the kebele	
0-5 years	82(17.7%)
6-10 years	66(14.3%)
>11 years	285(61.7%)
Marital status	
Married	436(94%)
Religion	
Muslim	451(97.2%)
Orthodox	12(2.6%)
Occupation of the mother	
Housewife	325(70%)
Employed	115(24.8%)
Wealth Status	
Poor	154(33.3%)
Medium	155(33.5%)

Rich	154(33.3%)
Birth order	
First born	146(31.5%)
Second born	94(20.3%)
Third born	95(20.5%)
Number of HH member	
<5	265(57.1%)
≥5	199(42.9%)
School attendance of the mother	
Yes	289(62.3%)
No	174(37.5%)
Education level of the mother	
Primary	232(80.2%)
Secondary and above	57(19.7%)

4.2 Water, sanitation and hygiene (WASH) characteristics of the household

4.2.1 Household Water Source and Availability

More than half, 56.3%, of the households have access to an improved water source for drinking purposes from the survey. Meanwhile, 55% had access to an improved water source for household utilization such as cooking, bathing, and laundry. And also, 88.4% of the house hold were not getting water when it was needed at most.

Table 2: Households Water Source and Availability(n=463)

Variables	Frequency
The household water source for drinking purposes	
Improved	261 (56.3%)
Unimproved	202 (43.5%)
The household water source for cooking, bathing and laundry purpose	
Improved	258 (55.4%)
Unimproved	205(44.2%)
Does drinking water available intermittently	
Yes	54 (11.6%)
No	410 (88.4%)
Water collection time	
≤ 30 minutes	177 (38.1%)
>30 minutes	287 (61.9%)
Do you store drinking water at home	
Yes	122(26.3%)

No	341(73.5%)
For how long is the HH drinking water usually stored at home	
<2 day	336(72.4%)
≥2 day	137(27.6%)

• **Improved water source: -** a piped water source into the home/yard/plot, public stand tap, tube well, borehole, protected well and protected spring, rainwater, and packed water.
• **Unimproved water source: -** unprotected well, unprotected spring, surface water sources like reiver, lake, dam, pond and stream.
• **Water is available when needed**: - when water is available at least 50% of the time (i.e., at least 12 hours per day and four days a week.

4.2.2 Household Water Handling Practice

The study results show that 89.9% of the household utilize water more than 20liter per day. From the total household, 95.3% had knowledge about the transmission of disease through contaminated water. Meanwhile, from the household which applies water treatment technique, more than half, 57.8% of them used chemical to treat water. One quarter (26.3%) of the household's store water for drinking; of them, Jerrican was selected by 56.7% of the household. 53% of the household place their water container on the floor inside the house. 92.2% of the mouse of the container was narrow. Only 17% of the household used water storage for other purposes, and 33.2% cleaned the container once a day.

Table 3: Households Water Handling Practices.

Variables	**Frequency n(%)**
Amount of water consumed per day in the household	
Below 20 lit	47(10.1%)
Above 20 lit	417(89.9%)
Type of storage container	
Clay pot	90(20.5%)
Jerrycan	263(56.7%)
Plastic bucket	64(13.8%)
Iron bucket	41(8.8%)
Drinking water storage container located	
On the floor inside the home	246(53%)
Outside home	18(3.9%)
Inside the home above the floor	199(42.3%)
Containers mouth size	

Narrow	451(97.2%)
Wide	13(2.6%)
Use of drinking water storage container for other purpose	
Yes	79(17%)
No	382(82.9%)
Frequency of storage container cleaning	
Once a day	154(33.2%)
Once every two days	36(7.8%)
Once every three days	93(20%)
Weekly	175(37.7%)

4.2.3 Household Sanitation

During the survey, only 16.6% of the participants used improved toilet facilities, and 5.6% of the survey population had no toilet facility or openly defecated. 6.5% of the household shared their toilet facility with another household member. 17.5% of the household had their toilet facility in the dwelling and 80% of them were located away from the dwelling and family yard. 41.2% of the household had connected sewer for bathing or other waste water to dispose of, as for garbage disposal, more than half 57.3% of the household burn their garbage. As the observational checklist report shows, 19.4% of household have raw sewage in the compound or dwelling and only 22% of them had faces around the hole or on the floor. We also observed 21.3% of the household had uncollected garbage in the compound. More than one-third of 74.6% of the household had a washing facility near the toilet.

More than one-third of the children, 81.7%, spent their time inside their homes in the last two weeks. 30% of the participant children had loos or watery diarrhea two weeks prior to the date of interview, and 87.9% of them reduced their frequency of feeding during the time of illness.

Table 3: Households Water Handling Practices.

Variables	**Frequency n(%)**
Amount of water consumed per day in** the **household	
Below 20 lit	47(10.1%)
Above 20 lit	417(89.9%)
Type of storage container	
Clay pot	90(20.5%)

Jerrycan	263(56.7%)
Plastic bucket	64(13.8%)
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Drinking water storage container located	
On the floor inside the home	246(53%)
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Containers mouth size	
Narrow	451(97.2%)
Wide	13(2.6%)
Use of drinking water storage container for other purpose	
Yes	79(17%)
No	382(82.9%)
Frequency of storage container cleaning	
Once a day	154(33.2%)
Once every two days	36(7.8%)
Once every three days	93(20%)
Weekly	175(37.7%)

Table 4: Households Sanitation Characteristics

Variables	**Frequency (%)**
Toilet facility	
Improved	77(16.6%)
Unimproved	361(77.8%)
No facility (open defecation)	26(5.6%)
Shared toilet facility	
Yes	30(6.5%)
No	434(93.5%)
Toilet facility location	
Inside the family dwelling	81(17.5%)
On the family yard	371(80%)

Elsewhere	12(2.6%)
Current functionality of toilet	
Yes	433(93.3%)
Garbage disposal	
Burning	266(57.3%)
In a pit	124(26.7%)
Present of raw sewage in the compound or dwelling	
Yes	90(19.4%)
Presence of uncollected garbage	
Yes	99(21.3%)
Presence of faces around the pit hole or the floor	
Yes	102(22%)
Presence of hand washing (water & soap) facility near the toilet	
Yes	376(74.6%)
Is there separate area for bathing	
Yes	169(36.4%)
No	295(63.6%)

Improved sanitation is those designed to hygienically separate excreta from human contact. **Unimproved** Use of pit latrines without a slab or platform, hanging latrines or bucket latrines. (UNICEF& WHO).

Table 5: Household Child feeding Practices

Variable	Frequency
Child breast feeding	
Yes	459(98.9%)
Time of early initiation of breastfeeding	
Within 1 hour after birth	400(86.2%)
After hours	43(9.3%)
After days	11(2.4%)
Time of complementary feeding started	
Before six months	33(7.1%)

At six months	379(81.7%)
After six months	51(11%)
Current status of breastfeeding	
Exclusive	39(8.4%)
Partial breast feeding	398(85.8%)
Not breast feeding	26(5.6%)
The first complementary food served for a child	
Porridge	161(34.7%)
Gruel	292(62.9%)
Other	10(2%)
Had a child begin family food	
Yes	190(40.9%)
No	273(58.8%)
Frequency of feeding during illness	
Less than usual	408(87.9%)
About the same	19(4.1%)
More than usual	21(4.5%)
Direct involvement of husband in IYCF	
Yes	431(92.9%)
Where did a child spent by the las two weeks?	
Inside home	379(81.7%)
Outside home	26(5.6%)
Inside and outside the home	58(12.5%)
Loos or watery stool/ Diarrhea by the past two weeks	
Yes	142(30.6%)
Ever Vaccinated	
Yes	460(99.3%)

4.3 Child feeding practice

4.3.1 Breast feeding

Nealy, all 98.9% of the survey children were breastfed, among them 86.2% of the children breastfed within an hour. Only 5.4% of them had feed colostrum. The majority of the children, 85.8% of the children, were partially breast feed during the data collection period; 89.7% of the participant children were breast feed in the previous 24 hours. The mean age to the cessation of breastfeeding was 13.7 months.

4.3.2 Complementary Feeding Practices

4.3.2.1 Introduction of Solid, Semi-Solid or Soft Foods

Both early and late initiation of complementary feeding was practiced extensively in the study area, but most 81.7% of the mothers started to give complementary food to their children just at six months. Gruel

was the first complementary food consumed by 62.9% of the children. During the data collection time, 40.9% of the children had begun family food.

4.3.2.2 Dietary Diversity of Complementary Feeding Diet

About two-third of the children are able to achieve the diet diversity for the food groups milk, breast feeding legume and grain and other vegetable and fruit. However, children presented with limited intake of the food group like egg (26%), flesh food (4.1%) and vitamin-A rich vegetable and fruits (22.4%).

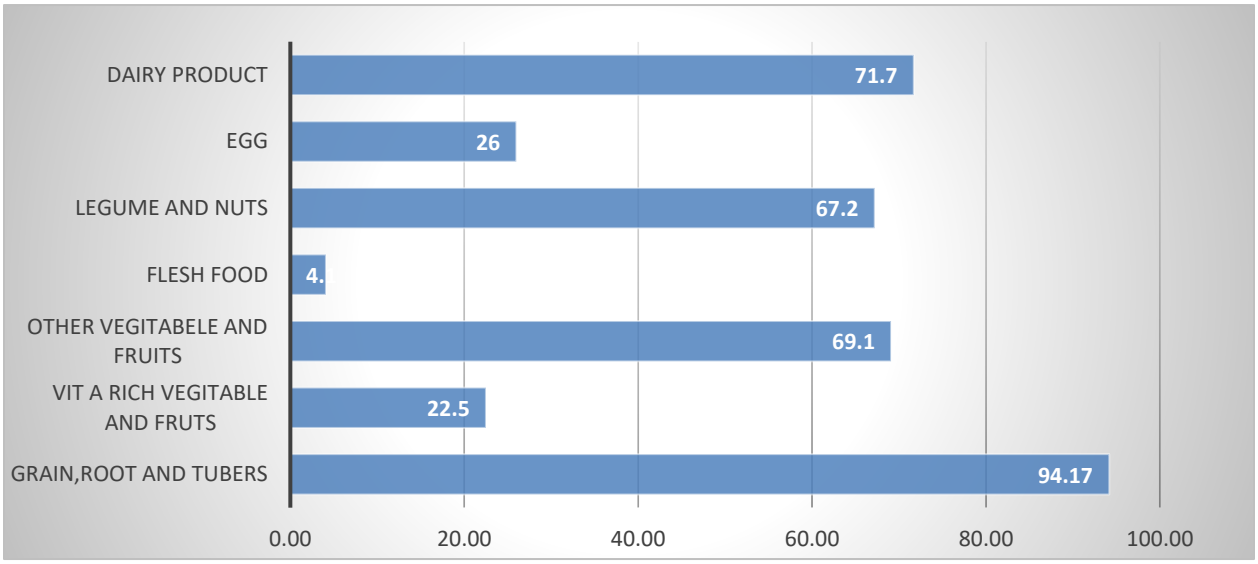

Figure 5: Types of food groups consumed by children 24-Hrs prior to the survey in south Wollo, 2021

According to WHO 2008, dietary diversity score (DDS) was calculated based on food group consumption and classified as low (0-2), medium (3-4) and high (≥5) based on Arimond and Ruel (2004). Majority of the children falling under DDS category of 0-2 and 3-4. (Table 6).

DDS	Frequency	percentage
0-2	114	24.6%
3-4	230	49.7%
≥5	119	25.7%

Table 6: Dietary Diversity score of children 24-Hrs prior to the survey in south Wollo, 2021

Overall, about quarter (25 %) of children aged 6-23 months received 4 or more food groups in the previous 24 hours. In the same age category, 24.3% and 23% of breast fed and non-breastfed children achieved minimum dietary diversity respectively. Minimum dietary diversity

was highest (34%) in 18-23 months old category (36.6% and 26.3% for breast fed and non-breastfed children, respectively). The lowest was the 6-11 months old category (14.9%) (Table 7a an 7b).

Table 7a: Mean Dietary Diversity by age group among children 6-23months in south Wollo, Ethiopia, 2021

Age group	*Mean Dietary Diversity Mean (SD)*
Overall 6-23 months N=463	***2.7 (1.2)***
6-11 months N=160	2.2 (1.2)
12-17 months N=141	2.8 (1.2)
18-23 months N=157	3.0 (1.0)

Table 7a: Minimum Dietary Diversity by age and breastfeeding status among children 6-23months in south wollo, 2021

Age group and breastfeeding status	*Minimum Dietary Diversity*	
	N	***%***
Overall minimum dietary diversity 6-23m	***116***	***25***
Breastfed N=416	105	24.3
Non-breastfed N=47	11	23
6-11 months N=160	***23***	***14.9***
Breastfed N=155	23	14.9
Non-breastfed N=5	0	0
12-17 months N=141	***38***	***27***
Breastfed N=137	37	27
Non-breastfed N=4	1	25
18-23 months N=161	***55***	***34***
Breastfed N=123	45	36.6
Non-breastfed N=38	10	26.3

4.3.2.3 Meal frequency Complementary Feeding Diet

Regarding meal frequency, the overall mean meal frequency for all the aged children 6-23 months old was 3.2 (±1.0). The number of meals consumed by the children in all the age categories ranged from 1 to 6. The minimum meal frequency was achieved by most (86.1%) of the children 6-23 months old with the same increasing trend in the 6-11 months (72.5%), 12-17 months (88.6%) and 18-23 months

(95.1%) old age categories (Table 8a). The percentage of breastfed and non-breastfed children who attained minimum meal frequency in the different age categories was 86.8% and 42.3% (Table 8b). Finally, only about 24% of children have achieved the minimum acceptable diet (Table 8c).

Table 8a: Mean meal frequency by age group among children 6-23months in south Wollo, Ethiopia, 2021

Age group and breastfeeding status	***Mean Meal Frequency Mean (SD)***
Overall Children 6-23 months old N 463	**3.2 (1.0)**
6-8 months Breastfed (N=78)	2.5 (1.2)
9-23 months Breastfed (N=359)	3.3 (0.8)
6-23 months Non-breastfed (N= 26)	3.8 (1.0)

Table 8a: Meal frequency and minimum acceptable diet by age and breastfeeding status

Age group and breastfeeding status	***Minimum meal frequency***	
	N	**%**
Overall 6-23 months N=463	**399**	**86.1**
Breastfed N=447	388	86.8
Non-breastfed N=26	11	42.3
6-11 months N=160	116	72.5
Breastfed N=159	116	72
Non-breastfed N=1	0	0
12-17 months N=141	125	88.6
Breastfed N=138	122	88.4
Non-breastfed N=3	3	100
18-23 months N=161	159	95.1
Breastfed N=139	135	97.1
Non-breastfed N=22	8	36.3

Table 8c: Minimum acceptable diet mong children 6-23months in south Wollo, Ethiopia, 2021

Status of acceptable diet	***Minimum acceptable diet***	
	N	**%**
Achieved	112	24.1
Non-achieved	351	76.6

4.4 Children's Nutritional Status

To assess the nutritional status of children in the study area the anthropometric measurement of 461 children were collected. The most key indicators of nutritional status of children for both chronic and acute malnutrition were considered. Those indicators were height for age (stunting) which resulted from the effects of chronic malnutrition, weight for age (underweight) and weight for height (wasting). Additionally, to strength the result of acute malnutrition MUAC measurement were also collected. The anthropometric measurement was calculated using WHO Antro software according to the WHO (2011) international growth standards. This software produces sex and age specific estimates for the prevalence of undernutrition, mean and SD of the z-scores for each indicator. Indices are expressed as standard deviation from the median reference group. According to this standard the cut point to be stunted, wasted or underweight (<-2SD) while severely stunted, wasted or underweight (<-3SD) from the median of the reference population.

Table 9: Overall Prevalence of undernutrition, Stunting, Underweight and Wasting in South Wollo, 2021

Indicators	< -3SD		< -2SD		Mean	SD
	Number	%	Number	%		
Undernutrition	111	24	298	64.6	-0.94	1.27
Stunting	84	18.2	204	44.2	-1.81	1.41
Underweight	20	4.3	67	14.5	-0.83	1.19
Wasting	7	1.5	27	5.9	-0.19	1.21

The result in table 9 above indicates that the prevalence of overall malnutrition in south Wollo is high. Of the 463 sampled children, 64.6% were malnourished and 24% severely malnourished. Specifically, 44.2% of children were stunted and 18.2 children were severely stunted. While 14.5% of children were underweight and 4.3% were severely underweight. Though the prevalence of wasting among those sampled children were 5.9%, and 1.5% were severely wasted. As indicated in table 10 below, the prevalence of stunting and severe stunting was found higher in the children age group from 12-23 months 45.3% and in male 44.9%.

Table 10: Prevalence of severity of child undernutrition by sex and age in south Wollo, 2021

Variables		Categories	Severe stunting <-3SD		Overall stunting <-2SD	
			Number	%	Number	%
Stunting	***Sex***	Male (n=242)	44	18.4	107	44.9
		Female (n=221)	40	18.1	96	43.4
	Age group	6-11 months (n=161)	27	16.6	67	42
		12-23 months (n=302)	57	19.1	137	45.3
Wasting	***Sex***	Male (n=242)	5	2.1	19	8
		Female (n=221)	2	0.9	8	3
	Age group	6-11 months (n=161)	6	3.8	21	13.1
		12-23 months (n=302)	14	4.7	46	15.3
Under-weight	***Sex***	Male (n=242)	11	4.6	47	19.6
		Female (n=221)	9	4.1	20	9
	Age group	6-11 months (n=161)	6	3.8	21	13.1
		12-23 months (n=302)	14	4.7	46	15.3

As described in Table 10. 302 children belong to 12-23 months. he prevalence of underweight in the study area was higher 15.3% and severe 14 in this age group with a mean value of -1. Though male children, 19.6% were underweight, of the 4.6% were sever underweight.

The prevalence of wasting by age group was higher in the children age 6-11 but children in age group 12-23 1.7% were found sever wasted months. Even though 3.6% of female were wasted 2.1% of male were severely wasted.

	Number	%
Severe acute malnourished (MUACZ<-3SD)	31	6.7
Acute malnourished (MUACZ<-2SD)	111	23.8

Table 13: Prevalence of Acute Malnutrition Result from MUAC for age Z-score in south Wollo in 2021

The MUAC measurement result is also a pointer of direct acute malnutrition for children age 6-59 months. To vigor the results of weight for height Z- score (wasting) MAUC for age Z-score (MUACZ) was estimated. Therefore, children by acute malnutrition were higher than the result observed in the weight for height measurement. This is similar to the result of Emmanuel *et al*. (2016) which suggest that the methods were used complementarily and difference might result from relative leg to body length.

4.5 Anemia

From the 463-sample size more than one-third of 295 (62.9%) were found anemic from those 7(1.5%) were sever animic,142 (30.6%) were moderate anemic.

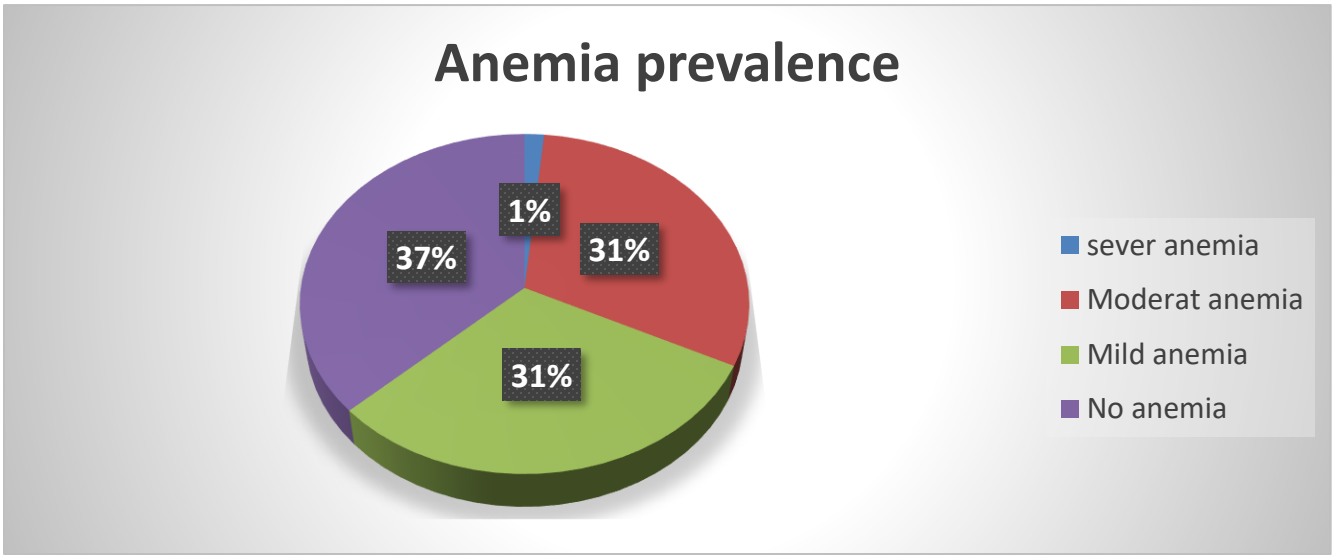

Figure 6; Anemia prevalence in south Wollo 2021

4.6 Factors Associated with WASH, Complementary feeding practice and Nutritional status of children

4.6.1 Factors Associated with WASH

The table below shows factors associated with WASH practice among children aged 6-23 months. Household wealth index in the third quintile is 1.5,13.7 and 1.3 children are more to have improved water source, sanitation facility, and hygiene practice respectively. Also, children who use unimproved hygiene practices are 20% more likely to have diarrheal episodes (AOR=1.;95% CI=1.21-2.79).

Table 14: Factors associated with WASH practice among children aged 6–23-month children.

Water source					
Variables	***Levels***	***Improved***	***Unimproved***	***COR (95% CI)***	***AOR (95% CI)***
Diarrhea	Yes	51(36%)	91(64.1%)	**1.58(1.05-2.38)**	1.49(0.98-2.26)
	No	170 (53%)	151 (47%)	1	1
Wealth Index	Poor	66 (42.9%)	88 (57.1%)	1	1
	Middle	95 (61.3%)	60 (38.7%)	-	-
	Rich	100 (64.9%)	54 (35.1%)	1.57(1.25-1.99)	**1.55(1.23-1.95) ***
Sanitation					
Variables	***Levels***	***Improved***	***Unimproved***	***COR (95% CI)***	***AOR (95% CI)***
Wealth Index	Poor	1 (0.6%)	153 (99.4%)	1	1
	Middle	8 (5.2%)	147 (94.4%)	-	-
	Rich	68 (44.2%)	86 (55.8%)	13.2(6.9-25.6)	**13.17(6.80-25.5) ***
Diarrhea	Yes	33 (23.2%)	109 (76.8%)	**2.13(1.09-4.35)**	1.5(0.83-2.82)
	No	44 (13.7%)	277 (86.3%)	1	1
Fever	Yes	11 (9.8%)	101 (90.25%)	**1.9(1.15-3.15)**	0.50(0.23-1.08)
	No	66 (18.8%)	285 (81.2%)	1	1
Hygiene					
Variables	***Levels***	***Improved***	***Unimproved***	***COR (95% CI)***	***AOR (95% CI)***
Diarrhea	Yes	48 (33.8%)	94 (66.2%)	2 (1.32-3.0)	**1.8(1.21-2.79) ***
	No	159 (49.5%)	162 (50.2%)	1	**1**
Cough	Yes	74 (29.2%)	81 (38.6%)	**0.65(0.44-0.99)**	0.70(0.47-1.04)
	No	179 (70.8%)	129 (61.4%)	1	1
Wealth Index	Poor	70 (45.5%)	84 (54.5%)	1	1
	Middle	89 (57.4%)	66 (42.6%)	-	-
	Rich	94 (61%)	60 (39%)	1.37 (1.09-1.72)	**1.3(1.06-1.66) ***

AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence Interval; *Association are significant at P<0.0

4.6.2 Factors Associated with complementary feeding

The table 15 below shows factors associated with complementary feeding practice among children aged 6-23 months. Children mother who had formal education have twice more to achieved minimum dietary diversity (AOR =2; 95% CI=1.3-3.3**)**. Mothers who have above average about nutritional knowledge were 68% more to achieved minimum dietary diversity (AOR=0.32; 95% CI=0.13-0.78). Mothers who had work are 67% less to achieved minimum dietary diversity (AOR=0.33; 95% CI=0.13-0.81). Children age between 12-23 are 64% and 4.5 times to achieved minimum dietary diversity (AOR=0.36; 95% CI=0.21-0.61) and minimum meal frequency (AOR=4.5 CI 95% 2.5-8.08) respectively.

Table 15: Factors associated with complementary feeding practice among children aged 6-23 months

Variable	Categories	***Minimum diet diversity achieved***		COR (95% CI)	AOR (95% CI)
		Yes	***No***		
Mother formal education	Yes	85(73.3%)	204(58.8%)	1.92(1.2-3.0)	**2(1.3-3.3) ***
	No	31(26.7%)	143(41.2%)	1.92(1.2-3.0)	1
Mother Nutritional Knowledge	Above average	110(94.8%)	292(84.1%)	0.29(0.12-0.69)	**0.32(0.13-0.78) ***
	Below average	6(5.2%)	55(15.9%)	1	1
House Wife mother	Yes	97(84.3%)	228(66.3%)	1	1
	No	18(15.7%)	116(33.3%)	2.74(1.58-4.75)	**0.33(0.13-0.81**) *
Age	6-11	23(19.8%)	136(39.9%)	1	1
	12-23	93(80.2%)	209(60.6%)	0.38(0.22-0.63)	**0.36(0.21-0.61) ***
		Minimum meal frequency achieved			
		Yes	***No***		
Age	6-11	121(30%)	38(65.5%)	1	1
	12-23	282(70%)	20(34.5%)	4.42(2.47-7.92)	**4.5(2.5-8.08) ***

AOR: Adjusted Odds Ratio; COR: Crude Odds Ratio; CI: Confidence Interval; *Association is significant at P<0.05

4.6.3 Factor associated with child nutritional status

The table 16 below shows factors associated with child nutritional status among children aged 6-23 months. Children who are not breast fed are 2.6 times more to be stunted (AOR=2.6; 95% CI=1.08-6.3). Children who had fever are 1.2 times more likely to be stunted (AOR=1.2; 95% CI=0.81-1.95).

Being 12-23 children age group have 57% more to be more Anemic (AOR=0.43;95% CI=0.28-0.67). Children who have diarrhea are 1.6 times to be more anemic (AOR=1.6; 95%CI=1.07-2.57). Children using Unimproved water source are 1.5 more to e anemic (AOR=1.59;95%,CI=1.05-2.33).

Table 16: Factors associated with child nutritional status among children aged 6-23 months.

Variables	Categories	***Stunting***		COR (95% CI)	AOR (95% CI)
		Yes	***No***		
Breast feeding status	Breast fed	190(91.3%)	8(3.1%)	0.34(0.14-0.80)	1
	Non breast fed	18(8.7%)	247(96.9%)	1	**2.6(1.08-6.3) ***
Age	6-11	60(29%)	99(39%)	1	1
	12-23	147(71%)	155(61%)	**1.56(1.05-2.31)**	0.68(0.46-1.01)
Maternal height	<150cm	190(91.3%)	204(80.3%)	**2.63(1.45-4.55)**	0.97(1.08-6.08)
	≥150cm	18(8.7%)	50(19.7%)	1	1
Fever	Yes	45(40.2%)	67(59.8%)	**1.3(1.07-1.95)**	1.2(0.89-1.33)
	No	163(46.2%)	188(53.6%)	1	1
		Wasting			
		Yes	***No***	***COR (95% CI)***	***AOR (95% CI)***
Minimum meal frequency achieved	Yes	13(43.3%)	99(22.9%)	**0.38(0.18-0.82)**	12.32(0.33-4.66)
	No	17(56.7%)	334(77.1%)	1	1
Minimum diet diversity achieved	Yes	14(46.7%)	102(23.6%)	1	1
	No	16(53.3%)	331(76.4%)	**2.8(1.34-6.01)**	2.4(0.64-9.97)
		Anemia			
		Yes	***No***	***COR (95% CI)***	***AOR (95% CI)***
Age	6-11	120(41.1%)	39(23.6%)	**2.27(1.47,3.57)**	**2.33(1.49-3.57) ***
	12-23	172(58.9%)	126(76.4%)	1	1
Diarrhea	Yes	100(34.2%)	41(24.6%)	1.6(1.04-2.45)	**1.59(1.02-2.47) ***
	No	192(65.8%)	126(75.4%)	1	1
Water source	Improved	117(60.6%)	83(49.7%)	1	1
	Unimproved	115(39.4%)	83(50.3%)	1.55(1.06-2.28)	**1.57(1.05-2.33)***

5. Discussion

The study aimed to evaluate WASH, Complementary feeding practice, and Nutritional status in low resource settings during the critical period of growth and development; a factor associated with WASH, Complementary feeding practice, and Nutritional status were assessed and entry points for nutrition intervention were provided. The study used a cross-sectional study design to assess WASH, Complementary feeding practice and Nutritional status of children aged 6-23 months in South Wollo.

The finding of this study shows that the improved source of water for drinking purposes is 56.3%. The study's finding agrees with the report in the Ethiopian Demographic Health Survey in 2016 that rural households have access to an improved source of drinking water was 57% (EDHS 2016). However, this result was lower than in the research done in east India in 2019 and Nepal in 2020 shows that the access to the improved water source of 93% and 75.3% respectively. (Chattopadhyay et al. 2019; Shrestha et al. 2020).

The finding indicates that, children living in the household with unimproved water source, unimproved sanitation facility and unimproved hygiene practice significantly contribute to childhood diarrhea. Access to water is the main component, and it should be addressed effectively for the sanitation and hygiene components of WASH to happen effectively. Without improved access to water, the uptake of hygiene and sanitation practices, and caretaking behaviors, will not be possible for mothers (Chattopadhyay et al. 2019).

Also, this study findings show that more than two-third (81.7%) of the participant children had started complementary feeding at six months. The consumption of vitamin-A rich, Flesh food and egg were low. These findings are comparable with those of studies conducted in Kenya by Chelimo, (2008) and Nepal (Joshi, N.*et al.* 2012). The low consumption of these food groups may have contributed by the high poverty in and limited resource to purchase food.

The finding shows that dietary diversity during complementary feeding was low. Only quarter of the children (25%) have fed four or more food groups in the previous 24 hours. The mean dietary diversity was (2.7 ± 1.2), indicating that many children only ate meals from three of the seven recommended food categories (WHO, 2008b), These findings are in agreement with those from various studies: Sawadogo *et al*. (2011) in Burkina Faso and Joshi *et al.* (2012) in Nepal. One study done in South Wollo where the data was collected in 2014 show that children who meet the minimum dietary diversity was 7% (Gebremedhin *et al*. 2017), this is very low in comparison to the present study during the seven years

gap between the studies, there could be various nutrition intervention efforts, infrastructural changes, etc.

The child dietary diversity result from the present study was lower than what has been reported in Addis Ababa (59.9%) by Solomon D *et al*., (2017), Bench Maji, Southwest Ethiopia (38%) by Edris and Atnafu (2018), and 39.2% from Kenya by Bukania *et al*. (2014). Difference in figure might be due to the variations in study setting (rural/urban), traditional variations in child feeding behaviors, socio-cultural, and, and preparing a few varieties of food for the family, the seasonal differences of data collection, the low obtaining ability of food items and the role of religion aspect in the Ethiopian diet (Hirvonen *et al*., 2015).

Regarding factors associated with minimum dietary diversity practice, there are studies that found infants aged 6–11 months receiving adequate dietary diversity compared with older children (Gatahun and Abyu 2015; Aemro and Mesele, 2013). However, the current study revealed that children aged 12–23 months receive adequate dietary diversity compared to those children at earlier age. This is consistent with several studies conducted before. For instance, studies conducted in Dangila town (Beyene *et al*. 2015), evaluation study in rural Ethiopia (Kuche *et al*., 2020), and ana,lysis of 2016 Nepal Demographic and Health Survey (Chitekwe, 2019) came up with similar finding. This might be attributed to most mothers do not present cereals and legumes for very young children aged 6–11 months till they are 12 months old (Chitekwe, 2019).

In the current study, mothers with formal education were considerably more likely to practice dietary diversification than those without a formal education. This finding agrees with research undertaken in Ethiopian (Aemro *et al*., 2013), Nepal (Khanal and Sauer, 2013) and the Bale Zone (Damtie *et al*. 2020). The explanation for this might be that educated mothers were more likely to have more material access to be aware of educational messages transmitted by various media outlets, to participate in rewarding labor, and to learn about child feeding in their school's education program. This is due to the fact that a mothers' level of education is critical for the health of their children, growth, and development, as well as the practice of excellent child feeding, and it has a beneficial influence on their confidence, family decision-making capacity, and the use of IYCF based on a suggestion (Mekbib *et al*., 2015).

The study established that most children aged 6-23 months old received one to three meals a day with a mean meal frequency of (3.2 ± 1.0). Nevertheless, since more than 85% of the children had consumed more than three times daily, better coverage of energy needs would have been expected. The minimum meal frequency practice was nearly similar with the study conducted in from

Bangladesh (81%), Colombia (72%), Bolivia (74%), and Madagascar (76%) (WHO 2010b), and also result is compatible with the result done in the norther Wollo (Baye *et al.,* 2012). The finding is higher than EDHS 2016 (45%), Assella town South East Ethiopia (53.8%) (Sasie and Oljira, 2017) and northern Ghana (57.3%) (Saaka, 2016), this may be due to the variations in timeline, food security status, nutrition interventions in different contexts, etc.

The minimal meal frequency was shown to be substantially related to the child's age. This suggests that minimal meal frequency is positively related to the age of children, implying that the practice of minimum meal frequency rises as children become older. The findings were consistent with research undertaken in Ethiopia (Beyene, 2015), Ghana (Saaka M, 2016), and India (Knan, 2012). The fact that as a child grows older, meal frequency rises and diets become more diversified attests to this. Furthermore, the eruption of the teeth affects when the kid is introduced to complementary foods, although the process usually results in a loss of appetite and reduces the frequency of meals for the child (Melkam, 2013). Furthermore, it might be linked to the mother's view of the younger kid and the child's intestine's inability to digest and absorb food (Tegegne *et al*., 2017).

Child undernutrition level was found to be significantly higher with prevalence of stunting 64.6(44.2%), underweight (14%), and wasting (5.9%). Compared to the regional, national, and WHO cut-off points of 40% for stunting, this finding of stunting was the highest (WHO 2014a). The present magnitude of stunting was comparable to the 41% in Amhara region (EMDHS, 2019), and lower than the report from North East Ethiopia 49.4% by Geberselassie *et al*. (2018). The finding may vary due to variances in geographic features of the research area, study period, age difference of the study participants (i.e., 6-23 and 6–59 months) and other sociology-economic characteristics of the participants the findings may differ in part from previous ones.

Compared to those children who had no fever, children having fever were more likely to be stunted. This finding agrees with a study done by Muche *et al*. (2021). At the same time, the finding is in contrary to studies done in Kenya and Nepal that showed a negative association between fever and childhood stunting (Bloss *et al*., 2004; Gurung & Sapkota, 2010). It is explained that children become more affected by environmental contamination when they start crawling, walking, exploring and taking objects to their mouth, which increases the risk of infection (Muche *et al*., 2021).

Frequent intercurrent childhood illnesses, such as fever, cough and diarrhoea, may also adversely impact child growth (Jones *et al*., 2015). A longitudinal cohort study of Zimbabwean infants by Jones *et al*. (2015) has presented that intercurrent illnesses suppress the growth hormone axis through reductions in

insulin-like growth factor 1 (IGF-1). Acute childhood illness may therefore impact the growth hormone axis. Cough and fever had a predominantly indirect effect on suppressing growth hormone axis through activation of the inflammatory response. Multiple-continent cohort study by Kosek *et al*. (2017) demonstrate that exposure to enteropathogens results in abnormal gut permeability, inflammation, systemic immune activation, and growth failure. They found stronger evidence for the association between reduced linear growth and systemic inflammation than for local gut inflammation.

The results have shown that children who were breastfeeding were at lower risk for stunting (García Cruz *et al.*, 2017). This association has been mainly explained at the individual level by the breast-milk's immune-protective factors, which help strengthen the child immature immune system, reducing diarrheal episodes and other infectious diseases, which have been identified as leading risk factors for stunting, as well as reduced exposure to non-innocuous complementary liquids or foods, such as unsafe drinking water (Chowdhury and Sinha, 2015; Cruz *et al*., 2017).

The findings of this study also found that Anemia was prevalent in 63 % of the study children. The magnitude is unacceptably high. This finding is comparable to those of studies conducted in Ethiopia 66% by Roba (2016) and 57% in the Ethiopian DHS (2016). Anemia prevalence of the present study significantly higher than the EDHS 2016 report for the Amhara region (i.e., 43% in children under the age of five). Higher magnitudes of anemia were also reported elsewhere from Egypt (66%) (Elalfy, 2012) and India (71.9%) (Muthusamy *et al*., 2017).

Even though the overall prevalence of anaemia is as high as 63% among children under two years old, further disaggregating the data by age group showed a decrease in anemia prevalence as the age of the children increases. Multivariate analysis showed that children in the age group of 6–11 months were 2.33 times (AOR = 2.33; CI 95%: 1.49–3.57) more likely to be anaemic than children in the age range of 12-23 months. This finding is in line with the health-facility based study conducted in south Wollo by Gebreweld *et al*. (2019) where they found out that with increasing age group, the risk of anaemia occurrence among children shown a consistent reduction. Children in the age group of 6–11 and 12–23 months were 4.5 times and 2.8 times more likely to be anaemic than children in the age range of 48–59 months, respectively (Gebreweld *et al*., 2019).

This finding is further supported by other studies conducted in Ethiopia (EDHS, 2016; Guled et al, 2017) and other developing countries (Khan *et al*. 2016; Kuziga *et al.* 2017). This might be due to high iron demand to meet a rapid growth rate in early age and/or low maternal iron reserve during pregnancy

(Tolentino *et al*. 2007). In addition, delayed introduction of complementary foods or early introduced complementary foods that are poor in bio-available iron could also be a contributing factor.

Children from households with unimproved water source were with the odds 1.5 times (AOR = 1.57; 95% CI 1.05-2.33) more likely to be anaemic than households with improved water source. The result is comparable to Baldi *et al.* (2020). Anaemia can be influenced by improved water source through lowering diarrheal illnesses, environmental intestinal dysfunction, and parasite infections (WHO & UNICEF, 2015; Watanabe *et al*., 2016).

Except for child anaemia status, the present study could not find a direct association between any of the WASH components (single/combined) to the anthropometric-based child nutrition status. However, unimproved sanitation showed an indirect association to stunting that was mediated by fever. Children from households with unimproved sanitation facilities were 50% more likely to be presented with fever (COR=0.5, CI 95% 0.23-1.08). Furthermore, children present with fever were 1.2 times more likely to be stunted (COR=1.2, CI 95% 1.01-1.33).

Children having diarrhoeal episode are 1.5 more likely to be anaemic (AOR=1.59; 95% CI 1.02-2.47). Diarrhea is linked to iron loss through the feces and a reduction in nutritional absorption, both of which are important for maintaining adequate hemoglobin levels in the blood (Semedo *et al.* 2014). Diarrheal episodes may suggest the existence of infectious parasites, which are more likely to arise in unhealthy situations, such as those exposed to the worst socio-environmental circumstances. This is supported by studies from Wag-Himra Zone Ethiopia (Woldie *et al.* 2015), Indonesia (Semba *et al.* 2008) and Brazil (Leal *et al*. 2011). This might be due to a loss of appetite and malabsorption caused by diarrhea, which raises the risk of developing anemia.

Limitation of the study

Even though Complementary feeding and WASH activities can better be defined over an extended period of time but the cross-section nature of this analysis did not make it possible to consider seasonal differences in food intakes and WASH practice.

Strength of the study

During the dietary assessment an elaborated list of locally available foods/recipes were used to assist mother recall what they fed their child in the previous 24 Hrs. In addition to the anthropometric-based nutrition status indicators, the present study employed biochemical assessment (hemoglobin concentration) to further strengthen the objectivity of the child nutrition status measurement.

6. CONCLUSION AND RECOMMENDATION

The present study has provided us with the opportunity to explore the effect of WASH, and complementary feeding practice on children's nutritional status in rural South Wollo. From the finding, children meeting the minimum dietary diversity was higher than the national level. Proportion of household having access to improved water source (56.3%), improved sanitation (16.6%) and hygiene (54.88). Only 6% of households satisfy for all the three combined WASH components.

Stunting is still a public health problem in the Amhara region; the prevalence was very alarming. Non-breast children, mother high and fever had associated with stunting. Having a mother with formal education was an advantage to meet MDD. Children who did not achieve minimum meal frequency and minimum dietary diversity are 2.6 and 2.8 times more likely to be wasted, respectively by crude odds ratio.

Furthermore, the findings of this study also revealed that anemia was prevalent in children which is unacceptably large. Child being in 6-11 months of age, having diarrhea episodes and exposing to the unimproved water source was associated with anemia.

Unimproved access to all the three WASH components shown to predispose children to diarrhoea. Particularly, in households with unimproved hygiene practices, children are 1.8 times more likely to have diarrheal episodes, Household wealth index in the richer tercile is 1.5, 13.7 and 1.3 times more likely to have access to improved water source, sanitation facility, and hygiene practice respectively.

Except for child anaemia status, the present study could not find a direct association between any of the WASH components (single/combined) to the anthropometric-based child nutrition status. However, unimproved sanitation showed an indirect association to stunting that was mediated by fever.

According to our findings, initiatives or projects aimed at reducing childhood stunting has to be age and gender appropriate. Improving status of women/caregivers through income generation and education will significantly improve dietary care rendered to the children. Diet-based nutritional interventions alone without complementary improves in environment (WASH) intervention may not be enough to alleviate undernutrition in resource scared situations.

In addition, the higher magnitude of anemia prevalence necessitating a concerted effort to lower it to a point where it is no longer a public health issue. Even though the overall prevalence of anaemia is as high as 63% among children under two years old, further disaggregating the data by age group showed a decrease in anaemia prevalence as the age of the children increases. We suggest intervening the

problem at early infancy along with aggressively working on maternal side (during pregnancy and addressing women of child bearing age).

Designing context-relevant complementary feeding and enormous social mobilization with respect to improving infrastructural aspects of WASH components would contribute to the improved child health nutrition outcomes.

Finally, we suggested that a longitudinal study evaluating intermediate variables related to poor WASH - childhood infections/illnesses including fever, diarrhea, etc. - affecting child nutrition status.

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ANNEX 1: INFORMATION SHEET AND CONSENT FORM

Information sheet

Greetings!

We are conducting a study entitled "Complementary feeding, WASH practice & nutritional status of 6-23month children: The case of rural villages in south Wollo" which is a MSc research project of Centre for Food Science & Nutrition, College of natural and computational sciences, Addis Ababa University.

The study aims to conduct complementary feeding and WASH practice towards child nutrition outcome through gathering data from, household survey and individual's nutritional assessment in selected villages/*kebeles* in Amhara regional state, South Wollo zone, Ethiopia. This will provide potentially useful local level information on how to address among nutritionally vulnerable people residing in rural Ethiopia.

If you and your child participate in the study, you will receive your nutritional status assessment (body measurement) and level of micronutrients for free.

We do not expect any relevant risks in this study. However, the collection of blood samples includes the small risks of bruise, infection and/or superficial inflammation and discomforts during having blood drawn. These risks will be minimized by using sterile equipment and technique and having done the blood collections by experienced medical laboratory technicians or nurses under medical supervision.

Whatever information you provide will be kept confidential and anonymous. The results from this study will only be used for the purpose of further children's health and nutrition.

You have the right to refuse from participating in this research, if you do not wish to. You also have full right to withdraw at any time without explaining the reason why.

Experienced and trained data collectors conduct interviews at your residence. The interview, anthropometric measurement will take about 1 hour.

If you need any further explanation at any point, you can contact Mr. Amanuel Bichaye Tesfaye (Mobile +251912133230). If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact of the Ethics Review board of the College of natural and Computational Sciences, Addis Ababa University that has reviewed & approved this research project (cnsethical@gmail.com).

Do you have any questions?

Do you agree to participate in the study?

If yes, read the consent form to the participant, date and sign it. If no, thank and proceed to the next participant.

ANNEX 2: QUESTIONNAIRE

ENGLISH VERSION QUESTIONNAIRE

Complementary feeding, WASH practice & nutritional status of 6-24 month children.

Questionnaires to assess an overall food system in selected rural kebeles/villages of South Wollo Zone

No.	Questions and filters	Coding categories	Skip pattern
001	Questionnaire Number which includes the woreda code, kebele, cluster number/name & household number **[to be numbered before the interview]**	QUESTIONNAIRE # |_____|_____|_____| WOREDA _____ KEBELE _____ CLUSTER/*GOTE* NAME: _____ HOUSEHOLDE NO: _____ Name of HH head: _____ Name of mother/care giver: _____	
002	Are you the mother or primary caregiver of any of these infants aged 6 – 23 months? ***If the answer is "No" terminate interview and move to next house***	Yes [01] No [02]	> Continue > End survey
003	Look at the age sheet and enter the child's age in months ***[Check that the child is 6.0 – 23.9 months. If so, continue with the interview]***	|_____|_____| **Months**	
004	Geographic coordinate of the household (HH)?	**Longitude (E): _____** **Latitude (N): _____** **Elevation/Altitude (m): _____**	
005	Interviewer's and field supervisor's name & signature.	[A] Interviewer's (name & signature) _____ _____ [B] Supervisor's (name & signature) _____ _____	
006	Number of visits to HH by the interviewer [if household members are not available at home during the survey day]	One visit [01] Repeated visits [02]	
007	Date of interview	|_____|_____|_____| DD MM YYYY	
008	Status of the interview	Completed [01] Incomplete [02] Other _____ [03]	
009	Time of interview	Starting time: _____ Ending time: _____	

Section 1: Background of child, caregiver/mother and size of household			
No.	**Question**	**Choice/Answer/Codes**	**Skip pattern**
101	How many infants aged between 6 and 23 months old live in this household?	_____ Infants	
102	Are you the mother or primary caregiver of any of these infants aged 6 – 23 months? ***If the answer is "No" terminate interview and move to next house***	Yes (01) No (02)	> Continue
If more than one infant is aged 6-23 months, randomly select one of the children, inquire the child's name and conduct the interview about that child. If there is only one infant aged 6-23 months, inquire the child's name and conduct the interview about that child.			
104	Sex of a child	Boy [01] Girl [02]	
105	Date of birth in Ethiopian calendar. [OR age in completed months]	[_____|_____|_____] DD MM YYYY [_____Months]	
106	What is the source of information on birth date?	Health facility record 01 Mother/caregiver's recall 02 Birth certificate 03 Baptism record 04 Recall from local event calendar 05 Others …… 06	
107	What is the child birth order?	First [01] Second [02] Third [03] Fourth [04] Other …….[05]	
108	What is your total household size? [How many people live in this household?]	/___/___/	
109	How many children are there under 15 years in your household?	/___/___/	
110	How many household members aged ≥ 60?	/___/___/	
111	How many under 5 years of age children are there in your household?	/___/___/	
112	What is the relationship of respondent to the index child	Mother [01] Primary caregiver [02] Other specify…… [03]	
113	Who is the head of the household?	Husband/Partner [01] Mother [02] Some other male beside the husband [03] Some other female beside the respondent [04]	
114	What is the Age of Household head (years)?	/___/___/	
115	What is your religion?	Muslim 01 Orthodox 02 Protestant 03 Other (specify) ……. 04	
116	Have you ever attended school?	Yes 01	

		No 02	> 118
117	What is the highest level of education you achieved?	Grade /_____/ [01] Tech/voc. Certificate [02] University/College diploma [03] University/College degree or higher [04]	
118	Age of the respondent/caregiver (years)?	/___/___/	
119	How old were you when you had your first child?	Age in year /___/___/ Don't know 88	
120	What is your current marital status?	Married 01 Single 02 Widowed 03 Divorced 04 Separate 05	> 118
121	Does your husband ever attend school?	Yes 01 No 02	> 18_1
122	What is the highest grade your husband completed?	Grade /_____/ [01] Tech/voc. Certificate [02] University/College diploma [03] University/College degree or higher [04]	
123	How long have you continuously lived in this kebele/woreda?	_____ Years and/or ____ Months Don't know [999]	

Section 2: Household economic status			
No.	**Question**	**Choice/Answer/Codes**	**Skip**
201	What is your husband's profession/what kind of work he does? ***(Multiple answers possible)***	Farmer/Agriculture worker 01 Skilled laborer/wage 02 Unskilled laborer/wage 03 Business/Trader 04 Professional job 05 Jobless 06 Don't have husband 07 Other (specify): …… 08	**> 203**
202	In which of the following land arrangement form do your husband currently working on? ***(Multiple answers possible)***	Own land 01 Family land 02 Rental land 03 Someone else's land 04 Doesn't work on agriculture land 05	
203	In what form your husband is paid for this work?	Paid in cash 01 Paid both in cash & in kind 02 Paid in kind 03 Not paid at all 04	
204	What is your occupation (i.e., what kind of work you mainly do)?	Farmer/Agriculture worker 01 Income generating hand craft 02 Laborer/wage 03 Business/Trader 04 Professional job 05 Work at home 06 Other (specify): …… 07	**> 205**
205	In which of the following land arrangement form do you currently working on? ***(Multiple answers possible)***	Own land 01 Family land 02 Rental land 03 Someone else's land 04	

		Other (specify): …… 05	
206	In what form are you paid for this work?	Paid in cash 01 Paid both in cash & in kind 02 Paid in kind 03 Not paid at all 04	
207	Do your HH currently using have electricity?	Yes/ utility line 01 Yes/ solar or biogas 02 No 03	
208	What type of energy source /fuel/ does your household mainly use for cooking?	Wood 01 Straw/Shrub/Grass 02 Charcoal 03 Biogas 04 Kerosene 05 Electricity 06 Animal dung 07 Packed gases LGP (like Ghion gasses) 08 Other (specify): ……. 09	
209	In this household, is cooking usually done in the house, in a separate room, or outdoors?	In the house [01] In a separate room [02] Outdoors [03] Other …… [04]	
210	Main material of the floor ***(Observation)***	Natural (earth/dung) 01 Rudimentary (wood/bamboo) 02 Finished (concert, tiles, mosaic) 03 Other (specify): …… 04	
211	Main material of the roof ***(Observation)***	Rudimentary (Grass, leaves, straw, plastic sheeting, cardboard, bamboo) 01 Finished (metal, wood, corrugated tin, tile, cement) 02 Other (specify): …… 03	
212	Main material of the wall ***(Observation)***	Rudimentary (Mud, cardboard, bamboo, leaves, straw) 01 Traditional wall made from stone 02 Finished (Concrete, corrugated wood) 03 Other (specify): ……. 04	
213	Any windows ***(Observation) - Record*** "00" if none	/___/___/	
214	Could you tell me from the list that which type of Asset(s) available at your house? ***(Circle all possible responses or underline on each asset to specify it)***	A watch? A bicycle? A television? A non-mobile phone? A mobile phone? A refrigerator? A chair? A kerosene lamps? A motor cycles/Bajaj? A radio? An electric stove? A table? A bed with mattress A car An animal drawn cart?	
215	Do you own the house you live in?	Own house 01 Rent 02 Unpaid/family house 03 Other (specify): …… 04	
216	Does any member of this household own any land that can be used for agriculture?	Yes 01 No 02	> 217
217	How many (local unit) of agriculture land do members of this household own?	Size: _____ Unit: _____ Do not want to tell 88	

		I don't know/not sure 99	
218	How do this household use the agriculture land?	Self-production 01 For rent 02 Fallow land 03 Other (specify): …… 04	
219*	Do you personally own any of the above listed assets/item? [Indicate under **211** & **213**] *Circle All Applicable*	Yes, Solely..…. [01] Yes, Jointly..…. [02] No…..……... [03]	
220	How many of the following animals does this household own?	If none, enter '**00**" Do not want to tell "**888**" If unknown/not sure enter "**999**"	
220A	Milk cows?	Milk cows _____	
220B	Oxen, bulls?	Oxen, bulls _____	
220C	Horses, donkeys, mules?	Horses, donkeys, mules _____	
220D	Camels?	Camels _____	
220E	Goats?	Goats _____	
220F	Sheep?	Sheep _____	
220G	Chicken?	Chicken _____	
220H	Beehives?	Beehives _____	
221*	Do you personally own any of the above listed large and small livestock? *Circle All Applicable*	Yes, Solely..…. [01] Yes, Jointly..…. [02] No…..……... [03]	
222	If your household own milk cow, how much is the usual volume of milk produced per day per cow.	_____ Volume in local unit per day Do not want to tell [88] If unknown/not sure enter [99]	
223	If your household own egg laying chicken, how much is the aggregate number of eggs produced per day?	_____ total number of eggs per day Do not want to tell [88] If unknown/not sure enter [99]	
224	If your household own beehive, how many kg of honey will usually be produced per year?	_____ Kg(s) of honey per year Do not want to tell [88] If unknown/not sure enter [99]	
225	Is any member of your household involved in income generating activities other than working on own farm (like shopkeepers, hand craft, petty trading, services providing activities, off-farm wage labor and non-farm self-employment)	Yes 01 No 02	> 226 > 227
226	What kind of extra-farming work do any of your household member mainly involve?	…… ……	
227	How stable/consistent is this income generating activity/work other than working on own farm by any of your household member?	Throughout the year 01 Seasonally/Part of the year 02 Once in a while 03	
228	What is the mode of payment for this extra-farming activity/work by any of your household member?	Paid cash only 01 Paid in cash and kind 02 Paid in kind only 03 Other …… 04	
229*	Do you personally involved in such extra-farming income generating works/activities?	Yes 01 No 02	 > 231
230*	Who usually decides how the money you earn will be used?	Respondent (wife) 01 Husband 02 Husband & wife jointly 03 Other ……. 04	
231*	Who usually makes decisions about making **major household purchases**? (Expenditures such as land, oxen, etc.)	Respondent (wife) 01 Husband 02 Husband & wife jointly 03	

		Other …… 04	
232*	Who usually makes decisions about making **minor household purchases**? (such as food for daily consumption or other household needs)	Respondent (wife) 01 Husband 02 Husband & wife jointly 03 Other …… 04	
233*	To what extent do you feel you can make your own personal decisions regarding [deciding on how the money you earn is spent or deciding on major household purchases] if you want(ed) to?	Not at all .....1 Small Extent….....2 Medium Extent .....3 To A High Extent ...4	
234	Does any member of this household have a bank account or microfinance savings account?	Yes 01 No 02	
235	Do you have home side garden where you grow vegetables and/or fruits?	Yes 01 No 02	> **225A** > **Section 2.1**
235A	If "Yes", for what purpose do you produce?	Sell all of it 01 Sell most of it 02 Sell less than average of it 03 Exclusively use for own consumption 04 Other (specify): …… 05	
235B	What are the common produces cultivated in the home side garden?	…… ……	

Section 3: Health and health service utilization related information						
No.	**Question**	**Choice/Answer/Codes**				**Skip**
301	Did your child ever have any vaccinations to prevent him/her from getting diseases, including vaccinations received in regular immunization and in a national immunization campaign?	Yes [01] No [02]				
302	Do you have a card where child's vaccinations are written down? If Yes: May I see it please?	Yes (have seen immunization card) [01] Yes (didn't seen) [02] No [03]				
303	Where did your child spend days in the previous 2 weeks?	Inside the home [01] Outside the home [02] Inside and outside the home [03] Other, specify _____ [99]				
304	Has your child been ill with a fever, cough, diarrhea at any time in the last 2 weeks? [***Read out the four conditions of illness***]		***Presented with:***	***Yes***	***No***	
		A	Fever	1	0	
		B	Cough/common cold	1	0	
		C	Breathing difficulty/shortness	1	0	
		D	Diarrhea	1	0	
305	When your child presented with any one or more illness indicated 404, did you seek advice or treatment from any source?	Yes [01] No [02]				> 407
306	From where did you seek advice/treatment?	At health post from HEWs [01] At heath center/ hospital from Nurse/ HO/Drs [02] Traditional medical practitioners [03] Friends/neighbors/Family member [04] Other, specify _____ [05]				
307	Was your child given any drug for intestinal worms in the last **six months**?	Yes [01] No [02]				

Section 4: Child care

Section 8.1: Infant and young child feeding practices			
No.	**Question**	**Choice/Answer/Codes**	**Skip**
401	Did you ever breastfeed your child? ***If the response is 'No' skip to 806***	Yes [01] No [02] Don't know [999]	> 806
402	How many hours or days after birth was [NAME] breastfed for the first time?	Within 1 hour [01] After_____ hours [02] After _____ days [03] I do not remember [04] Other (SPECIFY) _____ [99]	
403	What is your current breast-feeding status?	Exclusive breast feeding [01] Partial breast feeding [02] Not breast feeding [03]	>
404	Presently, if your child is not breast feeding at all, at what age did s/he stop breastfeeding?	_____ Months Don't know/ Don't remember [88]	
405	Did you breast feed your child yesterday day and night?	Yes [01] No [02]	
406	In the previous 6 months, did your child provide with any special formulation (supplementary/therapeutic food)?	Yes [01] No [02]	
407	If your child given any special formulation (supplementary/therapeutic food), what was it? [See if there is an empty package of the formula]	Plump nut [01] F-75/F-100 [02] Other: …… [03]	
408	At what age did you or anyone else give [NAME] something apart from breast milk (including water, herbal infusions or any other kinds of foods)?	_____ Months Don't know/ Don't remember [88]	
409	What was the first food preparation given to the child?	Porridge [01] Gruel [02] Other (SPECIFY) _____ [03] Don't remember [99]	
410	Do you discuss with your husband about what and how to feed your child?	Yes [01] No [02] No husband/partner [03]	 > 413 > 413
411	Has your husband directly involved and support you to feed your child?	Yes [01] No [02]	
412	What kind of direct support do your husband usually do regarding child feeding? [Multiple answers are possible]	He **advises** me to feed special foods (add egg, milk or dried meat) [01] He **reminds** me to feed special foods to our child [02] He gives me **money** to buy egg/milk [03] Himself **buys** some egg/milk [04] **Feeds** the child himself [05] **Prepares** child food [06] Covers other **HH tasks** on my behalf while I fed the child [07] **Reserves some milk/egg** for the child from what he sold [08] Other: _____ [09]	
413	When your child had illness (diarrhea, fever, cough) was s/he given less than usual to eat, about the same **amount/ frequency of feeding**, more than usual, or nothing to eat?	Less than the usual amount [01] About the same amount [02] More than usual [03] Don't know [999]	
414	Has the [NAME] started to eat family food?	Yes [01] No [02]	
415	Have you ever involved in religious fasting that avoid eating animal source food?	Yes [01] No [02]	 > 817
416	In the recent fasting period, did you feed your child any animal source food (if your child started to eat CF)?	Yes [01] No [02	

Section 4.2: Mother's/caregiver's IYCF knowledge

	Question	Choice/Answer/Codes	Skip
417	At what age should a baby first start to receive liquid (including water) other than breast milk?	[_____] Months Don't know [88]	
418	At what age should a baby first start to eat animal source foods such as meat, chicken and fish?	[_____] Months Don't know [88]	
419	At what age should a baby first start to eat fruits?	[_____] Months Don't know [88]	
420	At what age should a baby first start to eat vegetables?	[_____] Months Don't know [88]	
421	What is the common problem with gruels given as first foods, as they are traditionally prepared?	Too thin [01] Too thick [02] No problem [03] Other specify: _____ [04] Don't know [05]	
422	At what age should a family food be introduced to a baby?	Before 9 months [01] 9-11 months [02] 12 months [03] 13-23 months [04] After 2 years [05]	
423	How often should a baby eat animal source foods such as meat, eggs and milk?	Once per day [01] Several times per week [02] Once per week [03] Once per month [04] Never [05]	
424	How often should a baby eat fruits?	Once per day [01] Several times per week [02] Once per week [03] Once per month [04] Never [05]	
425	How often should a baby eat vegetables?	Once per day [01] Several times per week [02] Once per week [03] Once per month [04] Never [05]	
426	What are some of the foods that that contain vitamin A – a nutrient necessary to protect the body from illness?	Orange colored fruits/vegetables [01] Green leaves [02] Eggs [03] Liver [04] Breast milk [05] Cow's milk [06] Others, specify _____ [07] Don't know [88]	
427	When should you wash your hands? [Multiple answers are possible]	Before eating [01] After visiting toilet [02] Before feeding the child [03] After cleaning a child who has defecated/changing child's diaper [04] Before starting food preparation [05] After having a meal/feeding a child [06] Other, specify _____ [07]	

		Don't know [88]	

Section 4.3: Communication media, practices of HH and community-based nutrition education			
	Question	**Choice/Answer/Codes**	**Skip**
428	Do you read a newspaper or magazine at least once a week, less than once a week or not at all?	At least once a week [01] 1 - 2 times per month [02] Not at all [03]	
429	Do you listen to the radio at least once a week, less than once a week or not at all?	At least once a week [01] 1 - 2 times per month [02] Not at all [03]	
430	Do you watch television at least once a week, less than once a week or not at all?	At least once a week [01] 1 - 2 times per month [02] Not at all [03]	
431	In the previous 3 months, have you heard/seen any message about nutrition and appropriate feeding of infants and young children on any of the following?		
431_A	Newspaper/magazine	Yes [01] No [02]	
431_B	Radio	Yes [01] No [02]	
431_C	TV	Yes [01] No [02]	
431_D	Poster/banner/board	Yes [01] No [02]	
431_E	Role play	Yes [01] No [02]	
431_F	Local loudspeaker	Yes [01] No [02]	
431_G	Community event/village gathering (*Edir, Equb*, coffee ceremony)	Yes [01] No [02]	
431_H	Healthcare providers (HEWs, Nurses, Dr)	Yes [01] No [02]	
431_I	Husband, friends/neighbors	Yes [01] No [02]	
431_J	Others (specify)	……	
432	What do you remember from these messages? [**Do not read out** the list. Select that all apply to the response]	Giving colostrum to the baby [01] Putting baby on breast within the 1st Hr. [02] Pre-lacteal feeding is NOT necessary [03] Feeding only breast-milk for the first 6m [04] During illness increase frequency of BF/CF [05] When to introduce complementary food [06] Enriching porridge with oil, meat, egg, veg [07] Increasing meal frequency during/immediately after illness [08] Hand washing before preparing food [09] Give children animal source foods even on fasting days [10] Other (specify)_____ [11]	
433	In the previous 1 month, how many times have you prepared your child's complementary food/porridge added with egg, milk, vegetables, dried meat or thicken the porridge? ***(Write the number of times in the box)***	☐ …… Mix an egg [01] ☐ …….. Mix milk [02] ☐ ……. Mix vegetables [03] ☐ ……. Mix dried meat [04] ☐ …… Thicken the porridge [05] ☐ … Other, specify _____	
434	If the frequency of the preparation is <4 times, why didn't you prepare more frequently? ***[Don't read out the list - Multiple answers possible]***	The blended CF created some discomfort to the child [01] The child didn't like it [02] Confusing to do/difficult to prepare [03] Since those food items are not available at HH [04] Expensive [05] Time consuming to prepare [06] Other, specify _____ [07]	
435	Have you been visited by a HEW at your home anytime in the last three months?	Yes [01] No [02] Can't remember [03]	

436	How many times did a HEW visit you at your home in the last three months?	One time [01] Two times [02] Three times [03] Four or more times [04] Do not remember [88]	
437	The last time when a HEW visit you at home, did she speak with you about breastfeeding or child feeding?	Yes [01] No [02]	> 438
438	Could you tell me what the HEW told you about child feeding when she visited you last time at your home? ***(DO NOT READ THE OPTIONS)*** ***(Probe to find out more about this information; Multiple responses possible)***	Giving colostrum to the baby [01] Putting baby on breast within the 1st Hr. [02] Pre-lacteal feeding is NOT necessary [03] Feeding only breast-milk for the first 6m [04] During illness increase frequency of BF/CF [05] When to introduce complementary food [06] Enriching porridge with oil, meat, egg, veg [07] Increasing meal frequency during/immediately after illness [08] Hand washing before preparing food [09] Give children animal source foods even on fasting days [10] Other (specify)_____ [11]	

Section 5: Water, Sanitation and Hygiene			
5.1: Water source and handling			
No.	**Question**	**Choice/Answer/Codes**	**Skip**
501	What is the main source of drinking water for members of your household?	**Piped (Tap) water** Piped in to dwelling [01] Piped in to compound [02] Piped outside compound [03] **Well water** Protected well [05] Unprotected well [06] **Spring water** Protected spring [07] Unprotected spring [08] **Surface water** River/stream [09] Pond/Lake/Dam [10] Rain water [11] Other (specify): …… [12]	
502	How long does it take to go to the drinking water source, get water and come back? ***(Time to go to fetch water & return don't include waiting time)***	/___/___/ Hrs./Minutes _____ meters Don't know 99	
503	Is drinking water available intermittently?	Yes [01] No [02]	> 507
504	In the previous 1-month, how many days was there no water available at all?	_____ Days	
505	Do you purchase water when you are unable to get it from your usual source?	Yes [01] No [02]	

506	Does this household use water from the same source for drinking, cooking, bathing and washing clothes?	Yes [01] No [02]	
507	What is the main source of water for cooking, bathing and washing clothes in your household? [Non-drinking water source]	**Piped (Tap) water** Piped in to dwelling [01] Piped in to compound [02] Piped outside compound [03] **Well water** Protected well [05] Unprotected well [06] **Spring water** Protected spring [07] Unprotected spring [08] **Surface water** River/stream [09] Pond/Lake/Dam [10] Rain water [11] Other (specify): …… [12]	
508A	How much water does this household use in a day?	_____ Liters Don't know [999]	
508B	Do you think that the water your household using for different purpose is safe?	Yes [01] No [02] Don't know [999]	
509	Do you think that disease can be transmitted through contaminated water?	Yes [01] No [02] Don't know [999]	
510	What did your household do to make the drinking water safer?	Boil [01] Add Bleach/Chlorine/Water Guard/Pur/Bishan Gari/Aqua Tabs [02] Strain through a clothe/ Filter [03] Let it stand and settle [04] Solar Disinfection [05] Other (SPECIFY) _____ [06] Don't know [99]	
511	Do you store drinking water at home?	Yes [01] No [02]	
512	What type of storage container does this household use for drinking water?	Clay pot [01] Jerrycan [02] Plastic bucket [03] Iron bucket [04] Other (SPECIFY) _____ [99]	
513	What is the capacity of your household drinking water storage container?	_____ Liters Don't know [999]	
514	Where is the household drinking water storage container located?	On the floor inside the home [01] Outside [02] Inside the home above the floor (at least 40cm) [03] Other (SPECIFY)_____ [99]	
515	Is the household drinking water storage container always covered?	Yes [01] No [02] Don't know [999]	
516	Is the household drinking water storage container wide or narrow mouthed?	Wide mouthed [01] Narrow mouthed [02]	

		Don't know [999]	
517	Is the drinking water storage container used for any other purpose?	Yes [01] No [02] Don't know [999]	
518	How often is the household drinking water storage container cleaned?	Once a day [01] Once every 2 days [02] Once every 3 days [03] Weekly [04] Other (SPECIFY)_____ [99]	
519	How do you retrieve water from the drinking storage container?	Pouring [01] Using dipping utensil/container [02] Other (SPECIFY) _____ [99]	
520	For how long is the household drinking water usually stored at home?	Less than two days [01] Two days [02] Three days [03] Other (SPECIFY) _____ [99]	
521	If this household does not have a piped water, what type of container is used to fetch water?	Clay pot [01] Jerrycan [02] Plastic bucket [03] Iron bucket [04] Other (SPECIFY)_____ [05]	
522	What is the capacity of your water collection container?	_____ Liters Don't know [999]	
523	How often the container that is used to fetch water cleaned?	Once a day [01] Once every 2 days [02] Once every 3 days [03] Weekly [04] Other (SPECIFY)_____ [99]	
	5.2: Household Sanitation Component		
524	What kind of toilet facility do members of your household usually use when at home? **Ask to observe the toilet facility if possible**	Pit latrine/traditional pit toilet [01] Ventilated improved pit latrine [02] Flush toilet [03] No facility/Bush/Field [04] Other (specify): …… [05]	> 1131
525	Do you share this toilet facility with other households?	Yes [01] No [02]	> 1127
526	How many households use the shared latrine?	_____ Households(s)	
527	Where is this toilet facility located?	Inside the family dwelling [01] On the family yard/plot [02] Elsewhere [03]	> 1129
528	How far away from the household is the toilet facility?	Facility is _____ m away 999 = Don't know	
529	Is the toilet facility functioning now?	Yes [01] No [02]	
530	How far away is your toilet facility with reference to the closest drinking water source?	Facility is _____ m away 999 = Don't know	
531	Do you wash your hands with soap after cleaning your yard or house?	No [01] Yes [02] Sometimes [03]	
532	Is there a garbage receptacle for the household?	No [01] Yes [02]	
533	Is there house-to-house collection of solid waste in your village?	No [01] Yes [02]	

534	How do you dispose of garbage?	In a pit [01] Burning [02] Through in an open field [03] In a garbage container [04] Other (SPECIFY) _____ [99]	
535	Is there a separate area for bathing?	No [01] Yes [02]	
536	If your HH has pets, do pets ever visited by local vet health professionals?	Yes [01] No [02]	
537	How is the bathing or waste water disposed?	Disposed off inside the compound [01] Disposed off outside the compound [02] In the latrine [03] Flows to a connected sewer [04] Flows into an open sewer [05]	
538	Was there open sewer or raw sewage in the compound/ dwelling during data collection? **Record observation**	Yes [01] No [02]	
539	Was there raw sewage in the compound/ dwelling during data collection? **Record observation**	Yes [01] No [02]	
540	Are any feces seen around the pit hole or on the floor? **Record observation**	Yes [01] No [02]	
541	Is there a hand washing facility (water & soap) inside or outside of the toilet? [**Record observation**]	Yes [01] No [02]	

Section 6A: Child 24 Hrs. Dietary Intake (Semi-quantitative)

I would like you to tell me what your child had eat/drunk after woke-up yesterday morning. Did s/he eat that food at home? What did s/he have next and at what time?

[Proceed through the day, repeating these questions as necessary, and record each food or drink including water consumed (as indicated in 3rd column). Remember to probe any snack or dink consumed between meals]

Time	Place eaten	Food/drink	Description of ingredients

1201_1: Day of the week (circle the day): [**Mon**-01], [**Tue**-02], [**Wed**-03], [**Thu**-04], [**Fri**-05], [**Sat**-06], [**Sun**-07]

1201_2: Probe for sickness; is your child sick in the previous one week? ☐ Yes ☐ No

1201_3: If "yes", how did the sickness affected his/her appetite? ☐ Decreased ☐ Increased

1201_4: Was the food intake unusual? ☐ Yes ☐ No

1201_5: Was it a fasting day?	☐ Yes	☐ No
1201_6: Was it a market day?	☐ Yes	☐ No
1201_7: Is s/he taking medication or supplement?	☐ Yes	☐ No

Section 6B: To confirm the responses on the previous page, fill in the table below once again with the respondent to make sure that nothing was missed		
#	**Food Type**	**Did your child consume this food or type of food yesterday?** **1 for Yes & 0 for No**
Liquids:		
1	Plain water	
2	Infant formula	
3	Milk such as tinned, powdered or fresh animal milk	
4	Juice or juice drinks	
5	Clear broth	
6	Yoghurt	
7	Thin porridge	
8	Any other liquids	
Foods:		
9	Any porridge made from maize, barely, teff or other grains	
10	Any gruel (thin or watery made from rice, oats, wheat, or other grains)	
11	Any commercially fortified food (Cerifam, Fafa, mother's choice, etc.)	
12	Bread pasta, rice, or any other solid foods made from oats, maize, barely, wheat, sorghum, millet or any other grains	
13	Injera or *kita*	
14	*Enset*, white potatoes, white yams, bulla, *kocho*, cassava, or any other food made from roots.	
15	Pumpkin, carrot, squash, or sweet potatoes that are yellow or orange inside	
16	Dark green leafy vegetables (kale, spinach, amaranth leaves)	
17	Other vegetables (onion, cabbage, mushroom, starchy vegetables such as plantain)	
18	Ripe papaya or ripe mangos (other local vit A rich fruits)	
19	Other fruits (banana, apple, citrus fruits)	
20	Liver, kidney, heart – organ meats	
21	Any meat such as beef, pork, goat or lamb (excluding organ meat and chicken)	
22	Chicken, ducks, or other birds	
23	Eggs	
24	Fresh or dried fish or shellfish	
25	Legumes such as peas, lentils, beans, or pulses	
26	Nuts or seeds such as peanuts, groundnuts, sesame, or sunflower seeds	
27	Milk products such as cheese or yogurt	
28	Any food made from oil, fat, or butter	
29	Ready to use therapeutic foods (Plumpy Nut, F100)	
30	*Kolo*, chips, crisps, popcorn	
31	Candies, chocolates, cakes, cookies, or biscuits	
32	Spices or condiments	

Section 7: Anthropometric measurements and hemoglobin				
7.1: Child anthropometric and hemoglobin measurements				
701	Weight (grams)		1st Measurement 2nd Measurement Average	Wt measured [01] Wt not measured [02]
702	Height/Length (cm)		1st Measurement 2nd Measurement Average	Ht measured [01] Ht not measured [02]
703	MUAC (mm)		Measure	MUAC measured [01] MU not measured [02]
704	Head Circumference (cm)		1st Measurement 2nd Measurement	HC measured [01] HC not measured [02]
705	Hemoglobin (g/dL)		Measure 	Hb measured [01] Hb not measured [02]

I have finished my questions, if you have any questions or additional information to share… you are welcome!
Time of finalizing the interview: [____/____] [HH/MM]

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ANNEX 3: Ethical Clearance

COLLEGE OF NATURAL & COMPUTATIONAL SCIENCES

Addis Ababa University

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OFFICE OF THE DEAN

Ref. No. CNCSDO/650/13/2021
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Date June 11, 2021
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To Whom It May Concern

The College of Natural & Computational Sciences Institutional Review Board (CNS-IRB) Committee in its meeting held on **May 28, 2021 Minutes No. IRB/03/13/2021** has examined the project proposal entitled **"Complementary feeding, WASH practice & nutritional status of 6-24 month children: The case of rural villages in South Wollo'' by Amanuel Bichaye** from the Addis Ababa University.

The proposal is **conditionally approved** for implementation.

With regards,

Addisalem Abathun (PhD)
Dean, College of Natural & Computational Sciences
Addis Ababa University

Dean's Office
Addis Ababa University
College of Natural Sciences

ሥልክ/Tel.+251-11-123-94-72
ፖ.ሣ.ቁ/P.O.Box 1176 Addis Ababa, Ethiopia
ፋክስ/Fax: +251-11-123-94-69
ኢ.ሜል/Email: dean_cns@aau.edu.et

Please Quote our reference number in you correspondence