ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENTAL STUDY

CENTER FOR POPULATION STUDIES

Determinants of Chronic Malnutrition among Children aged 6-59 Months in Burayu town, Oromia special zone, Central Ethiopia

By: Negesse Gebissa Dadi

Advisor: Dr. Dula Etana

Master's Thesis Submitted to College of Development Studies,Center for Population Studies in partial Fulfillment of the Requirements for the Degree of Master of Population Studies (RH).

June, 2022

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DECLARATION

This is to certify that the thesis prepared by Negesse Gebissa Dadi entitled 'Determinants of Chronic Malnutrition among Children aged 6-59 Months in Burayu town, Oromia special zone, Central Ethiopia'' *is* the original work of the investigator. The research complies with university norms and satisfies established standards in terms of originality and quality.

Signed by the Examining Board

External examiner (Name)	Signature	Date
Internal examiner (Name)	Signature	Date
Advisor (Name)	Signature	Date

Center Head Graduate Program Coordination

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ACRONYMS AND ABBREVIATIONS

ACC/SCN -Administrative Committee on Coordination/Sub−Committee on Nutrition

ARI- Acute Respiratory Infections

CSA- Central Statistics Agency

CLTS-Community-Led Total Sanitation

EDHS- Ethiopian Demographic Health Survey

EE-Environmental Enteropathy

EED-Environmental Enteric Dysfunction

EMDHS-Ethiopian Mini Demographic and Health Survey

EPHI- Ethiopian Public Health Institute

HAZ -Height-for-age-Z-score

HEW- Health Extension Workers

IYCF-Infant and Young Child Feeding

JMP -Joint Monitoring Programme

LMICs-Low and Middle Income Countries

MUS-Multiple Use Water and Sanitation Services

PPS-probability proportion to size

RANAS- Risk, attitude, norm, ability and self-regulation

SD-Standard Definition

SHINE-Sanitation Hygiene Infant Nutrition Efficacy

UNICEF-United Nations Children's Fund (previously, United Nations International Children's Emergency Fund)

WASH-Water, Sanitation and Hygiene

WHA-World Health Assembly

WHO-World *Health Organization*

ABSTRACT

Under-five malnutrition is a major public health issue contributing to mortality and morbidity, especially in developing countries like Ethiopia where the rates remain unacceptably high. Identification of critical risk factors of malnutrition Among Children Aged 6-59Months using appropriate and advanced statistical methods can help formulate appropriate health programmes and policies aimed at achieving the United Nations SDG Goal.

This study attempts to develop a quantile regression, an in-depth statistical model to identify critical risk factors of Children Aged 6-59Months chronic malnutrition (stunting).
Based on the quantitative cross sectional study design was conducted from march-1/2022 to March-30/2022,height-for-age z-scores(HAZ) was estimated. Multivariable quantile regression model was employed to identify critical risk factors for with the lower cut off height-for-Age-Z-scores (a measure of chronic malnutrition in populations). Quantiles of HAZ with focus on the lower cut off HAZ were modeled and the impact of the risk factors determined. Significant test of the difference between slopes at different selected quantiles of HAZ and other quantiles were performed. Quantile regression plots of slopes were developed to visually examine the impact of the risk factors across these quantiles.

Data on a total of 489 children were analyzed out of which 15 (3.1 %) were stunted and 25% of the children were height-for-age Z-score value <-1. The models identified child level factors such as Child's age, Educational level of mother/caregiver, marital status, household wealth quantile, Latrine/Sanitation status, Disposal of solid wastes, Availability water &soap at hand washing facility, Hygienic practice, Complementary Feeding and Colostrums milk at birth. Highly significant differences exist in the slopes between the lower cut 0.25 and the higher cut 0.97 quantiles. The quantile regression plots for the selected quantiles for the lower cut 0.25 and the higher cut 0.97 showed substantial differences in the impact of the covariates across the quantiles of HAZ considered.

Critical risk factors that can aid formulation of child nutrition and health policies and interventions that will improve child nutritional outcomes and survival were identified. Modelling under-five chronic malnutrition using multivariable quantile regression models could be beneficial to addressing the under-five chronic malnutrition.

Key words: Quantile Regression Model; Child Malnutrition; Burayu Town; Chronic Malnutrition.

CHAPTER ONE

1.INTRODUCTION

1.1. BACKGROUND OF THE STUDY

One of the sustainable development goals (SDGs) is to end all forms of malnutrition by 2030. With specific regard to undernutriton, the WHO refers to 4 broad sub-forms of undernutriton: wasting, stunting, underweight, and deficiencies in vitamins and minerals. Undernutriton makes children in particular much more vulnerable to disease and death (WHO, 2019):Malnutrition links with population studies because it has a series of public health consequences that; diminish the individual quality of life and the prospects for social progress; the Public Health Consequences of malnutrition are; Susceptibility to acute morbidity (disease), Susceptibility to mortality (death), decreased cognitive development, Susceptibility to chronic diseases in later life, decreased economic productivity are the major effects of malnutrition in life course. Poor nutrition often starts in utero and extends, particularly for girls and women, well into adolescent and adult life. It also spans generations; A low-birth weight infant is thus more likely to be underweight or stunted in early life and also have higher mortality rate so the effect of under nutrition affects the popu3lation throughout the life cycle(ACC/ASN, 200).Undernutriton accounts for 33-60% child deaths worldwide where as Malnutrition and diarrhea are the causes of 57% &20% deaths of Ethiopian children respectively (FMOH, 2006).

Stunting is form of undernutriton which increases the risk of child deaths, adversely affects cognitive and motor development, lowers performance at school, increases the risk of over nutrition and non communicable diseases, and reduces productivity in adulthood (Black etal, 2013):Stunting is used as a public health indicator of malnutrition (i.e., insufficient intake of food/nutrients), but it lacks the sensitivity or specificity needed to provide a clear explanation for causality. In 2017, there were 151 million stunted children worldwide. Importantly, about 24% of children younger than five years in low and middle income countries (LMICs) had stunted growth (UNICEF et al., 2018). Stunting is a linear growth failure that has severe short-term and long-term consequences (Aguayo&Menon, 2016; Onis and Branca, 2016). For instance, stunting is associated with increased morbidity and mortality from infections, in particular pneumonia and diarrhea (Black et al., 2008; Mossman et al., 2000; Olefin et al., 2013), and is the cause of about

one million child deaths annually (Aguayo et al., 2016).Stunting is considered as a severe public health problem in the community when its prevalence in children is greater than 40% (*WHO, 1995)*. It is a largely irreversible outcome of inadequate nutrition and repeated bouts of infection during the first 1000 days of the child's life (WHO, 2006).It has long term effects on individuals and societies, including diminished cognitive and physical development, reduced productive capacity, and poor health and increased risk of degenerative diseases such as diabetes((UNICEF, 2017).Furthermore, stunted children experienced rapid weight gain after 2 years have an increased risk of becoming overweight or obese later in life(WHO,2006).Children and women are the most vulnerable group to a wide range of infections unless special attention is given. The highest proportions of infections among children are poor WASH related diarrheal and parasitic diseases. Globally, there are nearly 1.7 billion cases of childhood diarrheal disease every year and diarrhea is responsible for killing around 525,000 children every year (WHO,2018).About 3.5 billion people (the majority of cases were children) in the world were infected with intestinal parasites caused by helminthes and protozoa during 2009(Prüss-Üstün, 2008).Repeated exposure to diarrheal and parasitic infections causes environmental enteropathy (EE) or sometimes called environmental enteric dysfunction (EED). EE is an inflammatory condition of the gut of children which is characterized by villous atrophy, crypt hyperplasia, increased permeability, inflammatory cell infiltrate, and modest malabsorption (Crane,2015).

Diarrhea, parasitic infections and EE are key mediating pathways linking poor WASH to developmental deficit(Bhutta,2008). A large body of evidence suggests that malnutrition is linked with poor WASH practice(Lin,2013). Poor WASH is associated with under nutrition as a result of diarrhea, nematode infection and EE. Diarrhea and intestinal worms cause nutrient losses and diversion of nutrients from growth to the immune system to fight the infection.EE increases the small intestine’s permeability and reduces nutrient absorption(Korpe,2012).

The link of poor WASH and under nutrition has also socio-economical mechanism. For instance the energy cost of carrying water for long distances from the source to home. The average woman carrying a typical load of 20L on level ground would consume about 39 cal per kg of body weight per hour with an assumption that 1g of maize meal yields 3.5 cal(Cumming,2016).

WASH interventions are the most holistic and effective approaches to prevent stunting and wasting among under two children. However, there is conflicting evidence on the effect of WASH on linear growth. Some studies reported that there is no significant association between WASH and linear growth (Luby, 2018), and some others reported that WASH has significant effect (Fenn , 2012).

Generally, the prevalence of stunting is declining at a slower pace–from 32.5% in 2000 to 21.9% in 2011 worldwide(WHO et al.,1995). The same trend exists in Ethiopia; stunting declined from 51% in 2005 to 37% in 2019.Ethiopia remains to be one of the countries where the prevalence of stunting is "very high" (WHO,2019).

Majority of the studies conducted to examine risk factors of under-five malnutrition in Ethiopia used statistical models which might not be optimal to inform targeted nutrition policies and interventions because they could not give much information about the underlying associations, not robust to statistical outliers and lacks flexibility in analyzing the determinants of nutritional status. For example, modelling the mean as in the ordinary linear regression models could miss critical aspects of the relationship that may exist between the nutritional status and its determinants, especially in the presence of skewed data as is usually the case with anthropometric data (Koenker et al. ,2011):Therefore, the current study was apply quantile regression to examine Chronic malnutrition among children aged 6-59 Months which was guided by vulnerability theory in Burayu town, Oromia special zone, Central Ethiopia.

1.2. STATEMENT OF THE PROBLEM

Chronic malnutrition will result in stunting (low height for age), an irreversible condition that literally stunts the physical and cognitive growth of children (UNICEF, 2020).Stunting is caused by inadequate intake of nutritious food, frequent illnesses such as diarrhea and intestinal worms, poor care practices, and lack of access to health and other essential services, especially in the first 1,000 days of a child's life. Ethiopia, Madagascar, Mozambique, Somalia, and the United Republic of Tanzania are among the countries with a high burden of both stunting and severe acute malnutrition (UNICEF,2020).

In Ethiopia, 59% of infants under 6 months are exclusively breastfed (EPHI, 2019). Results from

the 2019 EMDHS show that 37% of children under 5 are short for their age or stunted (below -2 SD), and 12% are severely stunted (below -3 SD). The prevalence of stunting generally increases steadily with age, from 22% among children 6-8 months up to 44% of children 48-59 months. Notably, the highest proportion of stunting of children (45%) was observed at age 24-35 months, and it is also slightly higher among male than female children (40% versus 33%). Moreover, the use of sanitation facilities in Ethiopia is very poor, with just 7% of public services being used nationwide. The use of basic drinking water facilities is also poor, especially in rural areas, where only 30% of the rural population uses them (UNICEF, 2017).

About half (1/2)of infant and child deaths in Ethiopia are associated with stunting and other forms of undernutriton(Shields,2015). Ethiopia has the intention to contribute to the countrywide goal of dropping stunting among under-five children in selected regions, through provision of intervention to 1.5 million stunted children and to reduce the occurrence of stunting by 40% between 2015 and 2025. According to the current progress report, the recent reduction rate was 2.8% and it needs an average annual reduction rate of 6% to achieve the 2025 targets. However, the occurrence of childhood stunting is still high and it requires massive efforts to achieve the 2025 target(Shields,2015).

Poor sanitation alone was the second leading cause of stunting worldwide (Danaei, 2016).Globally, 2.2 billion (one in three) people lack safe drinking water. Similarly, 4.2 billion people (3 in 5) population lack safe sanitation and about 673 million people around the world still practice open defecation. Also, 3 billion (2 out of 5) people around the world lack basic hand washing facilities. In Ethiopia, the proportion of the population practicing open defecation was 33%. About 90% of people live in communities where one household practices open defecation. There are also significant inequalities in water service levels between urban and rural populations. For instance, in Ethiopia, there is a 67% gap between rural (5%) and urban (72%) (UNICEF/WHO, 2019).

According to FSIN studied about (2019)7% of children aged 6–23 months received early ‘Least Adequate Diet’ for growing and progress; 35% of households lacking access to safe drinking water and 39% of children aged 0–59 months stunted. Additionally, in Ethiopia with high level of malnutrition and poverty, almost one-fourth of the Ethiopian populations are malnourished with

the greater ratio of suffering from severe malnutrition (Jamal and Kim, 2014).). It has been estimated that environmental factors, including no access to water and sanitation and poor hygiene practices, may account for half of all undernutriton (Blusher& de Onis, 2005; Prüss-Üstün &Corvalan, 2006; Victora & Fall, 2008; World Bank, 2008). Further, one study has estimated that approximately 860,000 child deaths attributable to undernutriton could be prevented with improved WASH (Prüss-Üstün et al., 2008).

The estimated water service level of Ethiopia in terms of coverage, quantity, quality, and reliability is among the lowest in the world. Sanitation facilities are also in worst condition. Due to unreliability of safe and inaccessibility of safe and sufficient water supply and adequate sanitation facilities the estimated service level could be in much less situation. These combine effect of the poor water supply and sanitation facilities in the country have high impact on the economic development of the country and the living condition of the town's communities (OWRMB, 2010).

Growing evidence suggests a link between child linear growth and household water, sanitation and hygiene (WASH) practices (Brooker, 2009).It has previously been estimated that as much as 50% of child undernutriton may be attributable to poor WASH practices. Ingestion of high quantities of faecal bacteria from both human and animal sources by infants and young children through mouthing soiled fingers and household items, and the exploratory ingestion of soil and poultry faeces are common in many rural low-income environments. This leads to intestinal infections which affect a child's nutritional status by diminishing appetite, impairing nutrient absorption and increasing nutrient losses(Prüss-Üstün,2008).In both low and middle-income countries, diarrhoeal disease is the second leading cause of morbidity and mortality among children under the age of five (Lim et al., 2012; Walker et al., 2013; Murray et al., 2015), and the leading cause of death in sub-Saharan Africa (Prüss-Üstün et al., 2014). Approximately 1.5 million children under the age of five died of diarrhoeal disease in 2012 (Prüss-Üstün et al., 2014). One multiple country study found that 25% of stunting in children under the age of two could be due to five or more diarrhoeal episodes (Checkley et al., 2008).

It has been estimated that in 2012 a total of 842,000 diarrhoea deaths were caused by inadequate WASH (502,000 from water, 280,000 from sanitation and 297,000 from hand hygiene). This represents over half of diarrhoeal diseases, or an estimated 1.5% of the total disease burden (Prüss-

Üstün et al., 2014). Given what we know about disease transmission routes and possible barriers to these, the most recent estimate suggests that adequate WASH could prevent the deaths of 361,000 children under the age of five, or 5.5%of deaths in that age group (Prüss-Üstün et al., 2014). A different estimate, which includes WASH in addition to other interventions such as oral rehydration treatment and exclusive breastfeeding, suggests that 95% of diarrhoeal deaths in children under the age of five could be prevented by 2025, as a result of targeted scale-up of such proven interventions (Bhutta et al., 2013).one study has estimated that approximately 860,000 child deaths attributable to undernutriton could be prevented with improved WASH (Prüss-Üstün et al., 2008).Considerations for nutrition and WASH interventions to improve linear growth in infants, is confirmed and consistent with a cross-sectional study in India on household environment and stunted children that identified strong associations between WASH and stunting (Muhoozi,2018).While there is significant research on stunting, the inclusion of WASH facilities and their correlation with stunting has been relatively understudied in the Ethiopian context. Open defecation, when linked to the absence of an actual toilet and/or insufficient use of actual toilets, was noted to be significantly associated with stunting in Ethiopia (Ahmadi et al., 2018). However, randomized controlled trials such as the large-scale Sanitation Hygiene Infant Nutrition Efficacy (SHINE) study identified weak or non-existent linkages between WASH and stunting(Humphrey,2019).However, Most previous studies focus on the impacts of exclusive breast feeding, poor dietary habit and socio-demographic predictors of stunting, Majority of the studies conducted to examine risk factors of under-five malnutrition in Ethiopia used statistical models which might not be optimal to inform targeted nutrition policies and interventions because they could not give much information about the underlying associations, not robust to statistical outliers and lacks flexibility in analyzing the determinants of nutritional status. For example, modelling the mean as in the ordinary linear regression models could miss critical aspects of the relationship that may exist between the nutritional status and its determinants, especially in the presence of skewed data as is usually the case with anthropometric data and also what makes this study different from previous studies is that the present study linked WASH with stunting.

Hence, the current study was apply quantile regression to examine Chronic malnutrition among children aged 6-59 Months which was guided by vulnerability theory in Burayu town, Oromia special zone, Central Ethiopia

1.3.OBJECTIVIES OF THE STUDY

1.3.1. General objective

A. The main aim is to identify critical risk factors of chronic malnutrition among children aged 6–59 Months in Burayu town, Oromia special zone, Central Ethiopia,2022.

1.3.2.Specific objectives

A. The specific objectives of this study were to estimates the prevalence of stunting and Child health consequences in Burayu town, Oromia special zone, Central Ethiopia among children aged 6–59 Months.

B. To examine the effects of risk factors on different quantiles of HAZ to inform appropriate malnutrition Policies and intervention strategies among children aged 6–59 Months in Burayu town, Oromia special zone, Central Ethiopia.

1.4. SIGNIFICANCE OF THE RESEARCH

The research can be used as starting point for next coming researchers. And this study also can be used for policy makers/Health service planner/ based on the findings to give awareness for the health extension programs at primary health care should be revitalized in a way that can enhance the interventional measures by improving knowledge, attitude, and practice on WASH and its contribution for the prevalence of childhood stunting.

The limitation of previous studies can be resolved by analyzing demographic and socioeconomic factors across varied points of the conditional HAZ distribution in Ethiopia. Moreover, the changes in the chronic distribution of children and connections between the key covariates 'patterns and trends in stunting were investigated by using the quantile regression model instead of Traditional regression modelling approaches (linear/logistic regression).

In general, the findings of the study will be used for policy makers, planners, NGOs and other interested researchers to design appropriate interventions in the areas related to childhood stunting and its association with water, sanitation and hygiene.

1.5. SCOPE, STRENGTH AND LIMITATIONS OF THE STUDY

1.5.1. Scope of the study

The study was focused on examining the change in the HAZ distribution of children and examined the relationships between the key co-vitiate trends and patterns in HAZ among children aged 0-59 months. on chronic malnutrition (from children's perspective), and at community level. While Under-nutrition includes; stunting, wasting and under-weight, this study is delimited to assess only childhood stunting. The study will consider only children aged 6–59 Months in the study area during the reference period.

1.5.2. Strength and Limitation of the Study

This study had several strengths. Among these, many variables considered to be risk factors of stunting were assessed and a pre-tested and valid questionnaire was used to collect information. The critical risk factors which is important to develop a relevant policy strategy for efficient prevention of chronic malnutrition was identified.

Strict supervision at the time of data collection was done. In addition to that the study was use expert observations to ensure the validate of the study. Regardless of its strengths, our study had some basic limitations that might be considered while interpreting the results.

The study also used also the Robust model a novel quantile regression approach, permitting the study of covariate effects across different quantiles of HAZ. Thus, providing much more information about the underlying associations between HAZ and the risk factors which could not have been possible using ordinary linear regression approach. In contrast to the OLS and maximum Likelihood linear programming method; such as β_q instead of β identifies the particular beta estimate related to the q quantile. Despite these strengths, the study has a limitation.

The first most limitation of this study was Due to a cross-sectional design, it was difficult to examine any potential temporal relationships. Since the study included children aged 6-59 months there is a potential recall bias among respondents' mothers/caregivers answering questions relating to events happening in the past two years and above for primary data collection from the community; the study is predisposed to errors of anthropometric measurement that might lead to misclassification of children's nutritional status. A result was static and time bound and, therefore, gives no indication of a sequence of events or reveals historical or temporal contexts. Studies

couldn’t been utilized to establish cause and effect relationships. This design only provides a snapshot of analysis so there is always the possibility that a study could have differing results if another time-frame had been chosen. There is no follow up to the finding.

CHAPTER TWO

2.LITERATURE REVIEW

2.1. Theoretical Foundations

1.Vulnerability theory offers an adequate framework to seek explanations for the occurrence of stunting among children (Davis, 2013) Vulnerability is a latent and intrinsic condition that predisposes individuals and groups to varying levels of susceptibility to losses in physical, social, and economic realms (Cutter et al., 2008). In the case of children, individual-level vulnerabilities that characterize their caregivers are likely to have both immediate and ongoing effects on the likelihood of stunting among children. Vulnerability theories of stunting focus on 1.Ecological2.social and 3.cultural aspects of stunting. Of the three, the Ecological aspect has recently emerged as a leading explanation of stunting among children in India.(Spear et al.,2013) find that the lack of toilets, combined with inadequate availability of clean water, facilitates fecal transmission of parasites in the child's nutrients, resulting in stunting.

The social theories of stunting have focused on various aspects of maternal vulnerabilities (Som & Bharati, 2007) with repercussions for children's health. More specifically, the mother's characteristics are grouped into three socioeconomic variables: mother's education, wealth status, and age at motherhood.

Among the three mother's characteristics of substantive interest in the model, the one with the strongest empirical support for its association with stunting level is mother's education. Since women are primarily responsible for children's well-being in Indian households, women's capacity to makeintra-household resource allocation decisions plays a crucial role in preventing child malnutrition. Women's capacity to make nutrition-related decisions is positively associated with their educational level (Imai et al.,2014; Ishwarjiet al.,2018; Menon et al.,2018; Panigrahi, Das, &Sahoo, 2018). Level of stunting is found to decrease with an increase in years of a mother's education.

A second characteristic of interest is mother's age at first birth, which affects young women's opportunities to not only achieve physical maturity but also to learn parenting skills(Finlay et al., 2011; Raj et al., 2010; Reynolds et al.,2006; Tiwari et al., 2014; Villar&Belizdn, 1982).

A third characteristic, wealth status of the household, is also associated with likelihood of stunting. One of the most common explanations of malnutrition in India is poverty and low per capita income. Studies show that stunting levels decrease considerably with increases in mother's wealth (Kumar et al.,2014) on various levels of stunting.

In general The social theories of stunting have focused on various aspects of maternal vulnerabilities (Som et al.,2007) with repercussions for children's health.

2.2.Empirical Literature

Findings reveal two distinct pathways to childhood stunting, direct and indirect causes, and therefore two stages that present opportunity for intervention in early life. Direct causes comprise the factors that biologically enable growth faltering; namely protozoan and helminthic infections, diarrhoea and EED, a subclinical disease of the small intestine (Dodos et al.,2017).

Malnutrition in the form of undernutriton also presents itself as stunting or wasting, often exacerbated by the causes above (Null et al.,2018).Indirect causes comprise the environmental influences that enable these biological factors to manifest: chronic poverty, the broader political and socio-economic environment, cultural practices and climatic conditions (Dodos et al,2017).

There is evidence that improved water, sanitation and hygiene (WASH) is a central component of achieving global elimination of stunting. Improved WASH can interrupt the faecal–oral transmission pathway, thereby reducing onset of the biological causes of stunting thought to be environmental enteric dysfunction (EED), diarrhoea and subsequent malnutrition(Dodos et al.,2017). WASH infrastructure and improved hygiene behaviours are also linked to socio-economic status and opportunity through the poverty cycle, offering potential for intergenerational economic growth and improved health (Prendergast & Humphrey,2014).Access to water and sanitation aims to address the direct biological causes as well as these indirect socio-economic factors, both with direct impact to child health. Much research exists exploring the relationship between WASH and stunting in children and adults; however, **few** studies are available which specifically explore WASH designed to target maternal and newborn health.

Early literature typically attributes stunting to diarrhea; however, over time studies have found a correlation between stunting and EED, distinguishable due to their symptomatic and asymptomatic natures, respectively(Prendergast et al,2014). Stunting rates have typically been unaffected by

WASH, behavioural and nutritional interventions to reduce diarrhea, which has led to hypothesis of an alternative causal mechanism (Pickering et al,2019).

Additionally, indirect pathways and contextual factors prove significantly influential (Budge et al,2019). The poverty cycle through low income, restricted access to WASH resources and food, and ill health is a fundamental barrier to development (Esreyet al,1992). It is itself influenced by the wider political and economic climate, worsened by political volatility, economic instability and conflict (Antinomy et al,2009). Most removed from control yet significantly influential is the seasonal climate responsible for droughts and floods, straining food and water resources, increasing economic vulnerability and exposure to disease (Hyland &Russ ,2019).

WASH and nutritional interventions have potential to interrupt both direct and indirect causes. Improved water and sanitation have been shown to affect the direct biological causes of stunting by reducing faecal–oral pathogen transmission via any pathway (Wagner &Lanoix,1958; Pickering et al,2019). Indirectly, WASH can interrupt the poverty trap, alleviate the time burden associated with WASH activities and provide more time for income-generating work (Hyland & Russ,2019).

WASH interventions aim to make water and sanitation available, accessible and of an appropriate standard to maintain hygienic practices and reduce opportunity for faecal-oral contamination (WHO &UNICEF ,2019). Feeding and nutritional interventions offer preventative and retrospective measures in response to malnutrition, both independently and in conjunction with WASH.

In a recent analysis of 109 Demographic and Health Surveys conducted between 1991 and 2008 in 54 countries, children under 5 years of age who were born to the shortest mothers (< 145 cm) had a 40 percent increased risk of mortality after adjusting for multiple factors(Ozaltin,2010).

Although the percentage of mothers shorter than 145 cm is low in most countries, the analysis showed an elevated risk of child mortality with each lower category of maternal height, compared to mothers > 160 cm in height (Ozaltin,2010). .The effect of maternal stunting on child mortality was comparable to the effect of having no education or being in the poorest 20 percent of households. The likely explanations for this finding include an elevated risk of prenatal death, for

the reasons explained above, as well as longer-term effects of IUGR on child nutrition and immune function that increase the risk of child mortality

The (WHO, 2017) indicates that an improvement in the quality and availability of water, excreta disposal and general hygiene are all important in reducing faecal–oral disease transmission. The relative contribution of these pathways to spread the disease could vary depending on pathogen, human behavior and other context related factors including access to water, sanitation and hygiene(WASH) infrastructures. The WHO's recent estimate using comparative risk assessment (CRA) indicated a higher proportion of all cases of diarrhoea(34.0%) in LMIC which is linked to inadequate drinking water while sanitation and hygiene are attributed to 19.0% and 20%respectively. In combination, 58% of the diarrhoea morbidity (deaths) is attributed to environmental risks which is primarily WASH (Prüss-Üstun, 2016).

Stunting is both a major cause and an effect in the cycle of poverty triggered by inadequate WASH conditions which determine nutritional status through multiple pathways: social, environmental, health-related and economic (Chase,2016).

Several studies have shown the association between improved WASH conditions, child Growth and stunting reduction(Rah,2015).One study in Peru found a positive association between improved water sources and child growth, demonstrating that this effect was greater when the intervention was combined with improved sanitation facilities(Checkley,2004).

A crossectional analysis of health surveys in India showed that the risk of stunting decreased significantly when caregivers reported, in addition to sanitation improvements, optimal hand washing practices(Rah.,2015). In their meta-analysis, Dangour, found a modest but significant effect of different interventions that aimed to improve water quality and hand washing in the height-for-age Z-score (HAZ) of children under 5; and this effect was greater in children under 2 years of age(Dangour,2013).

UNDER-NUTRITION AMONG CHILDREN

Under- nutrition was the underlying cause of 45% of child deaths each year (Black ,2013) The term mal-nutrition covers three primary anthropometric measures: stunting(which is low height for age); wasting(which is low weight for height) and underweight(which is low weight for age).

Despite targeted and comprehensive nutrition-specific interventions, the persistent presence of mal- nutrition has caused a renewed focus on underlying causes that go beyond lack of nutrients (Bhutta,2008).Inadequate access to clean water and unsafe sanitation and hygiene practices increase the risk of severe infectious diseases that can contribute to under nutrition. There are three key pathways by which lack of WASH access and practice contribute to under nutrition (Humphrey, 2014).

Lack of access to WASH can affect a child's nutritional status in many ways. Existing evidence supports at least three direct pathways: diarrheal diseases, intestinal parasite infections and environmental enteropathy.

DIARRHEA

Diarrhea is a leading cause of mortality and morbidity among children under 5 years of age. Although mortality from diarrhea in this age group has fallen steadily over the past decades from 1.5 million deaths in 1990 to 622 000 deaths in 2012, diarrhea morbidity has remained stable, with 1.7 billion cases occurring annually (Fischer and Walk,2012and Liu,2012). Children under 5 years of age in low-income countries experience on average 2.9 episodes of diarrhea per year, with the highest incidence rates in the first 2 years of life – the critical window for a child's development (Fischer and Walker,2012).Diarrheal diseases continue to be an important public health problem in developing countries, with high morbidity and still significant levels of mortality among children (EHP, 2004). Globally, 1.6 million of children die from diarrhea per year and some 4,500 child deaths every single day. The largest single cause of these deaths is an unsafe and unhygienic environment: over 90 per cent of diarrheal deaths are attributed to poor hygiene, sanitation, and unsafe drinking water (UNICEF, 2006) Water Aid cited (WHO, 2008) agreed o the figure remarked that children deaths due to diarrhea alone surpass the combined child death due to malaria, measles and HIV/AIDS.1.4 millions of these deaths are caused by poor sanitation and drinking water.

Diarrhea and undernutriton form part of a vicious cycle. Diarrhea can impair nutritional status through loss of appetite, mal-absorption of nutrients and increased metabolism (Caulfield,2004; Petri,2008; Dewey and Meyers, 2011). Frequent episodes of diarrhea in the first 2 years of life increase the risk of stunting and can impair cognitive development (Grantham-McGregor,2007 and

Victoria,2008). At the same time, undernourished children have weakened immune systems, which make them more susceptible to enteric infections and lead to more severe and prolonged episodes of diarrhea(Caulfield,2004).Use of safe water, sanitation facilities, and good hygiene can improve nutritional outcomes by addressing both immediate and underlying causes of malnutrition. Lack of sanitation, in particular, is strongly correlated with acute malnutrition and stunting. Even in the absence of diarrhea, a fecal-contaminated environment is linked to chronic under nutrition, which reduces utilization of essential nutrients. Diarrheal disease reduces the absorption of nutrients by the gut.

Under nutrition remains a significant public health threat that requires both WASH and nutrition interventions. Under nutrition is an underlying cause of 45 percent of child deaths globally, and the lives of nearly 7.4 percent of the world's children are at immediate risk due to severe wasting. Wasting is managed by specialized medical care combined with therapeutic feeding (Black ,2013). In less developed countries, 26 percent of children under 2 years old are stunted and will suffer permanent physical and cognitive effects(Black ,2013).

WASH interventions are important component of programs that target stunting. Simple actions can help prevent diarrhea and under nutrition, even in hygiene-challenged environments.
In general WASH can improve nutritional status in three ways:

Primary WASH reduces the incidence of diarrheal disease. A recent study using the latest burden of disease data estimates that almost 60%of diarrhea is caused by unsafe water, lack of sanitation, and poor hygiene behaviors, and is thus preventable (Prüss-Üstun,2014). Extensive evidence supports the hypothesis that persistent diarrhea increases the risk of under nutrition. A vicious cycle exists between diarrhea and under nutrition, as children with diarrhea eat less and are less able to absorb the nutrients from their food. At the same time, they need additional calories to recover from the infection. Malnourished children have weakened immunity and are more susceptible to diarrhea when exposed to fecal matter from their environment. The World Health Organization (WHO) estimates 1.7 billion cases of diarrheal disease annually, which leads to 9% of child deaths (CHERG, 2013).

A second effect of poor WASH conditions is intestinal worm infection. Severe Whip worm and round worm infections are negatively associated with growth, and intestinal worms may result in

poor absorption of nutrients, thus affecting nutritional status. WASH promotes nutrition status of children.

Third, WASH interventions are able to reduce the pathogen load observed in environments with poor WASH conditions. Some causes of under nutrition are not directly associated with diarrhea, but instead are associated with high pathogen environments and poor WASH conditions (Prüss-Üstun, 2014). Although this cause of under nutrition is not well understood, its association with high pathogen environments suggests that it may be caused by recurring infections in the gut that limit the proper absorption of calories and nutrients. This hypothesis is often referred to as environmental enteropathy or environmental enteric dysfunction.

REFLECTIONS ON WASH AND CHILDHOOD NUTRITIONAL STATUS:

Achieving the goal of global food security – that, "all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life" (as defined by the World Food Summit of, 1996)requires a set of complex and often cross-cutting interventions and programmes. While WASH interventions constitute only part of this broader picture, an appreciation of their influence on nutritional outcomes is of vital importance for the development of comprehensive solutions to this important issue for child health.

It has been estimated that environmental factors, including no access to water and sanitation and poor hygiene practices, may account for half of all undernutriton (Blossner& de Onis, 2005; Prüss-Üstün & Corvalan, 2006; Victora& Fall, 2008; World Bank, 2008). Further, one study has estimated that approximately 860,000 child deaths attributable to undernutriton could be prevented with improved WASH (Prüss-Üstün et al., 2008).

Neither observational studies nor intervention studies included components exploring the role of governance of WASH in their design or described if and how actors in the field of WASH were incorporated into the research process.

Finally, the links between various kinds of malnutrition and environmental factors such as water, sanitation, and hygiene (WASH) may play a role in children's health, growth, and cognitive development. Poor nutrition during pregnancy or early infancy is also linked to the development of

chronic illnesses later in life. Although the state bears main duty for providing water and sanitation as a fundamental service and human right, a variety of parties are involved. The situation is particularly dire in Sub-Saharan Africa (SSA), where 311 million people lacked access to safe drinking water in 2015, and more than 70% of the population lacked sufficient sanitation. Therefore, the links between various kinds of malnutrition and population development are reflected as follows according to studies done in different places are reviewed: Some of the socioeconomic and demographic factors explaining child nutrition for instance;-approximately 10 percent of children born in Ethiopia will die before their first birthday and 17 percent will die before their fifth birthday (CSA and ORC Macro, 2001). According to formulas developed by Pelletier et al. (1994), 57 percent of under-five mortality in Ethiopia is related to severe and mild to moderate malnutrition (ORC Macro, 2001). The consequences of malnutrition in children also include poor physical development and limited intellectual abilities that diminish their working capacity during adulthood.

2.3. Conceptual Framework of the Study

The conceptual framework is drawn from the literature. It assumes that Some of the socioeconomic, demographic and WASH factors explaining child nutrition according to studies done in different places are reviewed variables which might plausibly influence child growth guided by Vulnerability theory.

The immediate causes of child undernutriton include inadequate diet and diseases. Underlying causes are household food insecurity, inadequate maternal and childcare and feeding practices, poor WASH and lack of health services. These underlying factors directly influence nutrients intake and presence of disease. Poor WASH conditions cause infectious disease, especially diarrhea, and consequently undernutriton due to poor appetite and nutrients mal-absorption. Poor nutritional status further increases susceptibility to infectious diseases, thereby creating a *vicious cycle* of worsening illness and deteriorating nutritional status.

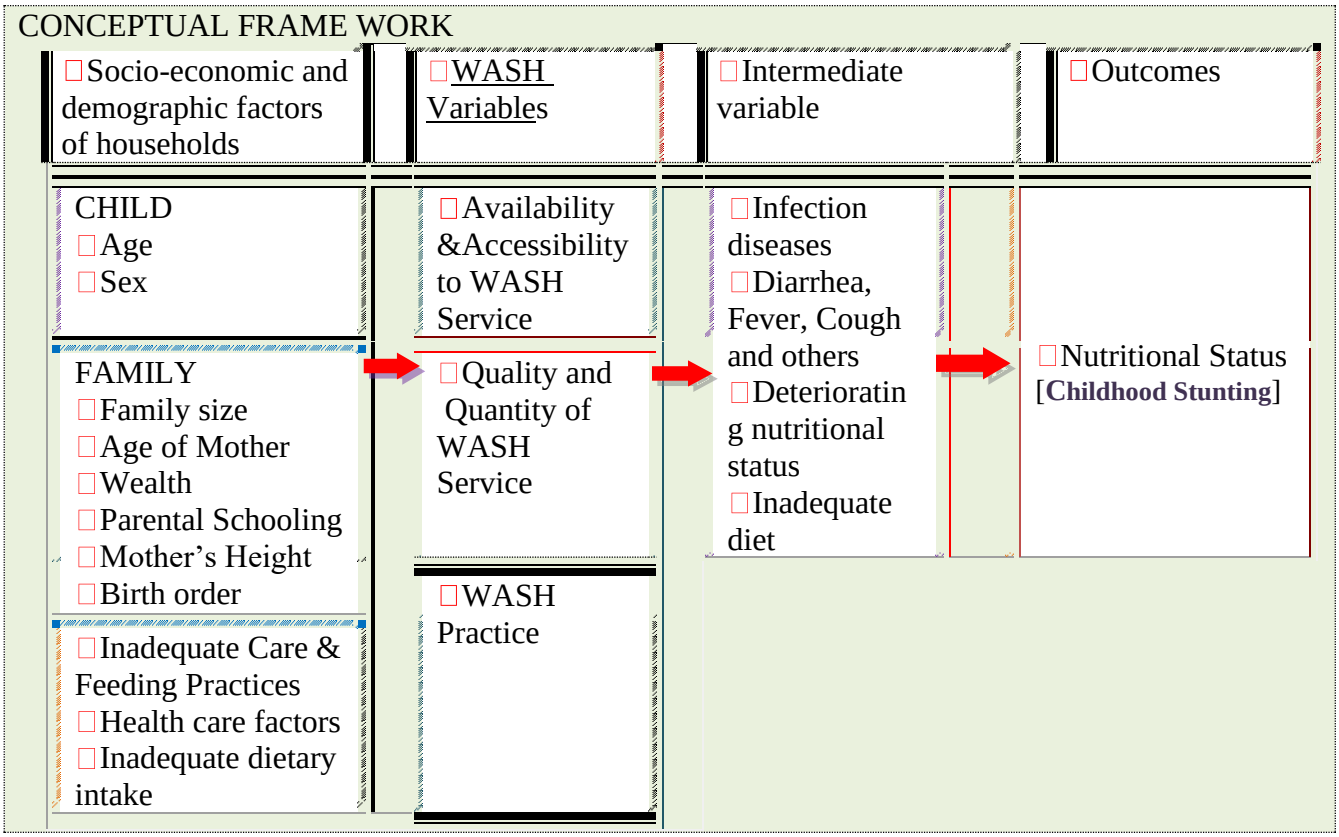

Figure-1: Conceptual frame work of the study

Source: Developed based on review of literature

2.4. Operational Definitions of the Key Study Variables

Stunting (chronic malnutrition): is a form of growth failure, which develops over a long period of time. Inadequate nutrition over long periods of time and/or repeated infections can lead to stunting. In children, it can be measured using the height-for-age nutritional index (UNICEF, 2016).

Improved sanitation: Are sanitation facilities that hygienically separate human excreta from human contact. It includes latrine facilities that have a connection to a public sewer or a septic system, pour-flush latrine, simple pit latrine with cover/slab, and ventilated improved pit latrine.

Un improved water source: is a source that, by nature of its construction, adequately protects the water from outside contamination, from fecal matter. It includes piped household connection, public standpipe, borehole, protected dug well, protected spring and rainwater collection.

Unimproved water sources: are sources that are considered to be at risk from contamination. The WHO/UNICEF Joint Monitoring Programme (JMP) includes unprotected dug wells or springs, vendor-provided water, surface water, tanker-truck supply and bottled water within this category.
Good water handling practice: households that store water with a container and covered at the time of visit.

Improved hygienic practice: households that have hand washing facilities with the availability of soap and other detergents near the toilet facility.
Diarrhea: is defined as the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual.
WASH: typically refers to activities aimed at improving access to and use of safe drinking water and sanitation as well as promoting good hygiene practices (e.g., hand washing with soap at critical times).

Sanitation: Provision and use of facilities and services that safely dispose of human urine and faces, thereby Preventing contamination of the environment. Improved sanitation facilities as defined by the JMP are those that hygienically separate human excreta from human contact and include flush or pour-flush toilets to piped sewer systems, septic tanks or pits, ventilated improved pit latrines, pit latrines with slab, and composting toilets (WHO/UNICEF, 2015).
Hygiene: Practice of hand washing with soap at five critical moments include:1)after defecation, 2) after cleaning a child, 3) before preparing food, 4) before feeding a child, and 5) before eating.
Accessibility of water, in terms of premise level access or not, and availability in terms of regular supply could have linkage with the quality of water. Intermittent supplies, which arecommon in many developing countries, were found to have association with contamination (WHO/UNICEF, 2017).

CHAPTER THREE

3. DESCRIPTION OF THE STUDY AREA AND RESEARCH METHODOLOGY

3.1. Description Of The Study Area

This study was take place in Burayu, an Ethiopian town located in a special zone of the Oromia regional state. The settlement is located in the West, near or adjacent to Addis Ababa (Finfinne), the region's and country's capital, at 9o02'30"North Latitude and 38o03'30"-38o41'30" East Longitude, with an elevation of 1920 meters. It is a part of Oromia State that bordering with the similar Oromia Special Zone towns in the four corners. Sebeta town in the south,Welemera district in the west, Sululta t own in the north and Addis Ababa city in the east.

The special zone, which includes Holeta,Sabata,Galan,Dukam,Lagatafo-Lagadadhi, Sandafa, Sululta, and the peri-urban and rural districts surrounding Addis Ababa, was established in ,2008.

The town was founded in 1953, and its population has steadily grown from 4,138 people in 1984 to 10,027 people in 1994 to 100,200 people in 2010 and 156,463 people in 2016. (data from health office). Because of the large influx of people to the town and the town's progressive expansion, mostly through informal settlement, the present population of the town is unclear. Burayu is organized into clusters and has a town administration, municipality, and six administrative units (kebeles). Burayu town water supply utility is responsible for provision and management of the supply. Gafersa water dam, one of the sources of drinking water supply for the capital, Addis Ababa city, is located in Burayu town administration catchment.

Burayu is a town, directly adjacent to the national capital, Addis Ababa. With capital growth in recent decades and the growth of cities, the city has experienced significant economic and demographic pressure,

The health infrastructure of the District comprises 4 health centers and 2 health posts owned by the government, and 76 health service facilities owned by private organizations. The majority of the town’s populations receive service from government-owned health facilities, no hospital and low

tap water coverage, some villages used unprotected spring water for their consumption. Generally poor sanitation and hygiene practices contributes a lot for the illness which may leads to under nutrition/stunting.

In Ethiopian over half of households in urban areas reported that water had been unavailable at some time during the previous two weeks or insufficient during the preceding month (CSA, 2016).In this research study area (town), these gaps in the service remain applicable and even worsening due to the imbalance in the service delivery in relation to the extensive expansion and growth of the population in the town including informal settlements.

Based on the 2007 census, projected population of the town and estimation by town administration depend on population rapidly growing and rural urban migration, the population size of the town is estimated 280,000 in the year 2025 and population growth rate shows 15.5% annually (Burayu City profile, 2017). Evidences show that, fast demographic
changes pose additional challenges in certain regions for a 40% globally target reduction in the prevalence of stunting among children under the age of five by 2025. For example, in Africa, with the current rate of population increase, stunting prevalence is actually going up (Black et al., 2013).Understanding the intervention needs of informal urban settings: Effect of onsite sanitation on child health in high density/informal urban settings.
The selection of Burayu city as a study area from the other major town of the country is:
1.Regarding to water accessibility, the Oromia National State proclamation number 78/2004 article (5) sub article (1) stated that, the enterprise provides potable and adequate water supply to the urban dwellers in and around the town and ensures that the water supplied is to the standard of the WHO. However, the study result indicated that, the average water consumption of the sample households is 9.5 liters per person per day, which is about less than half of the 20 l/p/d what is recommended by the WHO(Girma,2018).

2.In addition, this rapid industrialization, urbanization and population growth area of the town which leads to complexity to provide better service. Consequently, the need for providing better services for the urbanized community by the local government officials is crucial. Those situations need to be addressed, before the problem increases and the condition becomes go downhill.

3.Due to the proximity of the town's to the national capital and better opportunities of economic activities, there is high immigration of people from different parts of the country causing progressive population growth, urbanization, industrialization and peri-urban expansion in the zone(this situation can bring imbalance between the demand and consumption)(Tadesse&Imana,2019).These put considerable strain in service provision including water supply for the people.

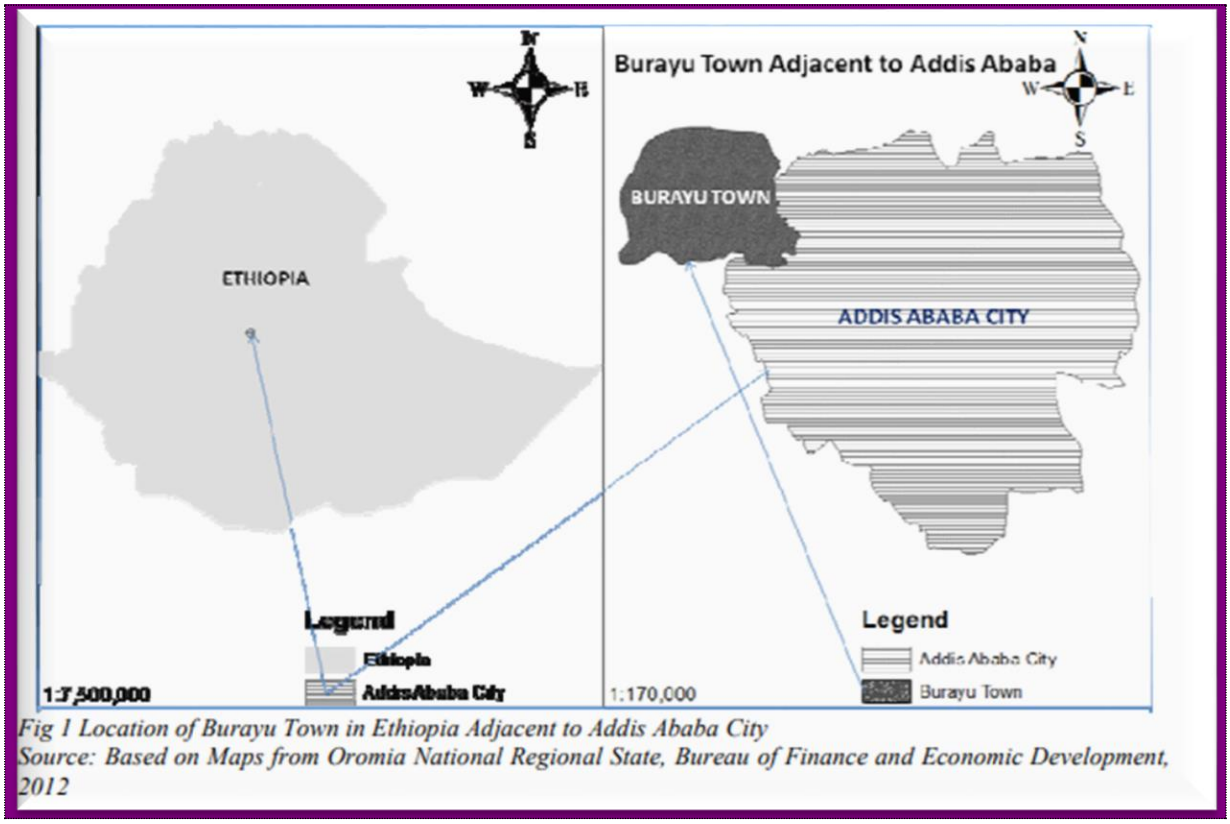

Fig 1 Location of Burayu Town in Ethiopia Adjacent to Addis Ababa City
Source: Based on Maps from Oromia National Regional State, Bureau of Finance and Economic Development, 2012

Figure-2:Location of Burayu town in Ethiopia adjacent to Addis Ababa

3.2. Research Approach and Design

The study was used quantitative research approaches. That was because a quantitative research method was used to apply numerical measurement and analysis of the magnitude and extent of the problem and to see the relationship between the dependent and independent variables.

Research design was used use community-based cross-sectional study design; because this design was better to estimate the prevalence of chronic malnutrition and association with risk factors based on specific nature of the research problem to be studied or the research questions to be answered; So, this study was adopt a quantitative research approach by using primary data source &quantitative cross sectional study design was conducted from march-1/2022 to March-30/2022.

3.3. Source Population and Inclusion Criteria

The source population was all households with children (paired with their mothers/caregivers) between the ages of 6–59 months in all the kebeles of Burayu town. The study populations was households selected in the three randomly selected kebeles. The study unit was all children aged 6-59 months in the selected households. Children aged 6-59 months with mothers/caregivers who lived a minimum of 6 months in the study area was included in the study. Children aged 6-59 months with visible deformity and unknown age was not included in this study.

3.4. Sample Size Determination

The minimum required sample size of this study was determined by using single population proportion formula. The prevalence of stunting in Ethiopia in urban among children under 5years which is 26% will be used (EDHS 2016) to calculate total sample of 489. Adding 10% allowance for non-response and refusal to respond, a total of 489 house hold was selected.

$$\text{n} = \frac{\left(Z_{a/2}\right)^2 \text{ p q}}{d^2} \rightarrow \text{n} = D[\frac{\left(Z_{\frac{a}{2}}\right)^2 \text{ p } (1-\text{p})}{d^2}$$

Where
n=Sample size

$Z\ \alpha/2$= Z value corresponding to a 95% CI= 1.96 /Z=1.96 standard variant at given confidence level/

p = expected stunting in urban among children under 5years = 26% =0.26,q= 1-p=0.74

d = margin of error (5%),D= design effect=1.5

None response rate =10%, therefore, from the above sample size is:

$$\text{n} = D\left(\frac{(1.96)2 \text{ X } 0.26(1-0.26)}{0.0025}\right) + 10\%$$

$$\text{n} = 1.5(296) = 444$$

$$\text{None response rate} = 444 * 10\% = 45$$

$$\text{n} = 444 + 45 = 489 \rightarrow\ n = 489$$

3.5. Sampling Techniques

Multistage sampling technique was used to select the study subjects. First, all the Kebeles/the smallest administrative unit in Ethiopia/ will be clustered in to thee. Then, one Kebeles representing one cluster which covers 16.7% of the total kebele of Burayu town was randomly selected by simple random sampling technique using lottery method prior to data collection. Sample size was allocated proportionally to each randomly selected kebeles. A survey of the sampled three Kebeles was conducted and listing of all households with Children aged 6-59 months with mothers/caregivers a sample frame was prepared.

For selecting the study participant's different sampling intervals was used for each kebele. Whenever more than one eligible respondent found in the same selected household, only one respondent/ the youngest child aged 6-59 months was chosen/. For households with no eligible woman the immediate next household was selected and then, subsequent households was selected according to the already predetermined order. Principal Investigator and in depth interview interviewer (data collector) was explain the purpose of the study and obtain voluntary informed consent prior to conducting the data collection.

3.6. Schematic Diagram of Sampling Techniques

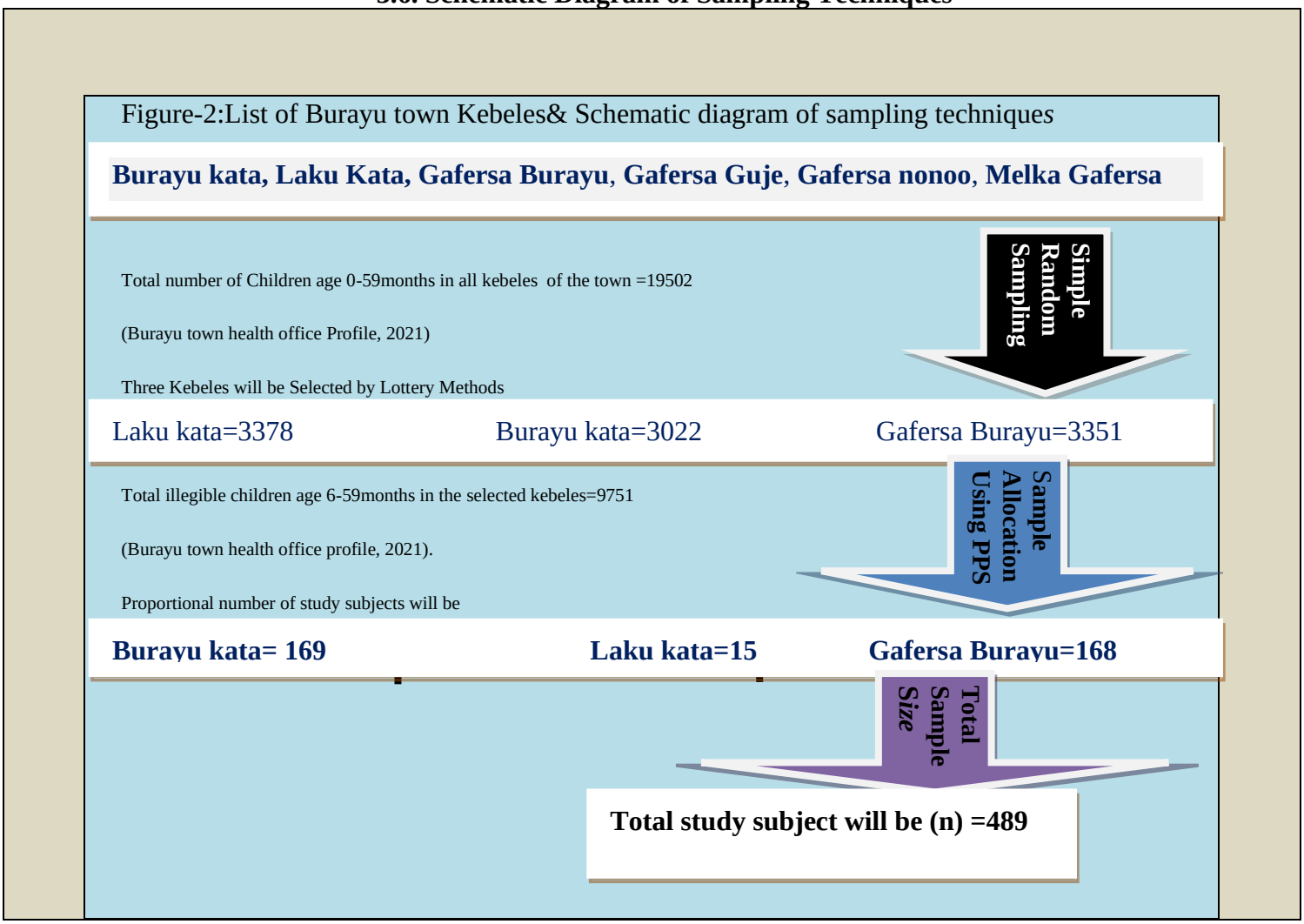

Figure-3: Schematic Diagram of Sampling Techniques

2.5. Description of the Study Variables

2.5.1. Dependent variables

- Nutritional status (height-for-age Z-score) among children aged 6-59 months.

In this analysis, only HAZ was used as a dependent variable to find the independent variables distribution on different quantiles. To estimate the HAZ marker, the reference population of WHO 2006 was considered. As per the WHO, the child is classified as stunted if the height-for-age Z-score is <-2 standard deviations (SDs). If the child's Z -score value is <-1 it was classified as Lower cut off nutritional status (quantile =25th) and the height-for-age Z-score>2 was classified the higher cut off HAZ-score.

2.5.2. Independent variables

Socio-demographic, WASH, health care, and dietary factors

Table-1: Description of the Study Variables

Dependent variable	Independent variables	Categories	
A) Height-for-age-Z-score.	1)Socio-Demographic		
	➢ Sex of child	1-Male	2-Female
	➢ Parental Educational status	0- No Education 1-PrimaryEducation	2.Secondary education and above
	➢ Marital status of a mother	1-Married 2-Divorced	3-Separated
	➢ Age of mother	1-15-24 2-.25-34 3-.35 and above	
	➢ Parity	1- 1-2 2- 3-4 3- >5	
	➢ Stature of mother	1.<145 2.<145	
	➢ Birth order	1-First 2-Second 3-Third and above	
	➢ Wealth quantile	1-Lowest/ Second 2-Third 3- Fourth/ Highest	
	➢ Under >5children in the HH	1-1 child 2-2 and above	
	➢ Death of a child U5,the last five years Religion	1-Yes 2-No	
	2)WASH		
	• Drinking water source status	1-Unimproved 2-Improved	
	• Household Water storage container cover	1-Yes 2-No	
	• Water source location	1- In own dwelling 2-In own yard / compound 3- Elsewhere	
	• Distance to fetch water from the source	1->30Minutes 2-<30 minutes	
	• Latrine /Sanitation status	1-Unimproved 2-Improved	
	• The hygienic practice of households	Poor Good	
	• Solid waste disposal	Open filed Dump into pit Burning Communal waste disposal Containers	

3) Health Care	
▪ Deworming status	1-Yes 2-No
▪ Diarrhea in the past two weeks	1-Yes 2-No
▪ ANC visit of the mother	1-1-3 TIMES 2-4 and above
▪ PNC visit of the mother	1-Yes 2-No
▪ Sickness episode within 2 wks	1-Yes 2-No
4)Dietary Factors	
✓ Complementary Feeding	1-Before 6 and after 8 month 2- At 6–8 month
✓ The First time offer child to breast feed	1-Within 1hrs 2-After 1hrs
✓ Colostrums feeding	1-Yes 2-No
✓ Method of feeding children	Spoon Bottle Cup Hand Hand
✓ Age at introduction of complementary feeding started	1-Before 6 and after 8 month 2-At 6–8 month
✓ Frequency of feeding per day	1-two times 2-Three times 3-Four times 4- and above times

The conceptual variables have been broken down into measurable variables as below:-

WASH: typically refers to activities aimed at improving access to and use of safe drinking water and sanitation as well as Promoting good hygiene practices (e.g., hand washing with soap at critical times).

Improved (good) hygienic practice: households that have hand washing facilities with the availability of soap and other detergents near the toilet facility (Fixed observed (Sink / Tap) or Mobile object observed (Bucket / Jug / Kettle) and practices hand washing with soap at five critical moments include:1)after defecation, 2) after cleaning a child, 3) before preparing food, 4) before feeding a child, and 5) before eating.

Diarrhoea: Prevalence is the number of cases that exist at a given moment (Krickeberg et al., 2012). This study refers to diarrhoea occurrence among children of age 6-59Months during the last two-week period of the data collection.

The socio-demographic variables: include the sex of child, educational status of a mother,

educational status of the father, marital status of a mother, age of mother, family size, and stature of mother and birth order.
A water sanitation and hygiene factor includes: Drinking water source status, Household Water storage container cover, Distance to fetch water from the source, Latrine/Sanitation status, the hygienic practice of households and Solid waste disposal.

Health care factors: Was Deworming status, Diarrhea in the past two weeks, ANC visit of the mother and PNC visit of the mother.

Dietary factors: includes; time of initiation of breastfeeding, Pre lacteal feeding, Colostrums' feeding, Method of feeding children, Age at introduction of complementary feeding started and Frequency of feeding per day.

WASH is often divided into four rather than three categories, with 'water' interventions divided into two subcategories:
'Water quantity' and 'water quality'. The former describes interventions that improve the quantity of drinking water available to the household, and the latter describes interventions that improve the microbial quality of drinking water, whether this is at the water source or at the point of use or consumption.

Source of drinking water:
Improved source: Piped into dwelling/yard/plot 'Piped to neighbor, Public tap/standpipe, Tube well or borehole, protected dug well, protected spring, Rainwater, Bottled water, improved source for drinking.

Unimproved source: Unprotected dug well, unprotected spring, Tanker truck/cart with small tank and Surface water.

Sanitation concerns technologies and behaviors that serve to safely contain excreta, preventing human contact.

Height: Length of infants 6–23 months: will be measured in a recumbent position to the nearest

0.1cm using a locally-made board with an upright wooden base and a movable headpiece.
The height of children in the 24–59 months: age range will be measured in a standing, upright position to the nearest 0.1 cm using a locally-made vertical board with a detachable sliding headpiece.
The two primary outcomes will be length-for-age Z-score (LAZ, continuous scale) and stunting(will be dichotomized, defined as LAZ less than -2 standard deviations from the 2006 WHO International Reference Standard) at the individual child-level and at the Kebele-level, will express as a mean value.
The household-level water variable included access to an improved drinking water source (dichotomous).

The household-level hygiene variable included availability of water and soap at a hand washing station (dichotomous).

Latrine /Sanitation status /Type and location of toilet/latrine facility/

Improved: Flush/pour flush to piped sewer system, Flush/pour flush to septic tank, Flush/pour flush to pit latrine ,Ventilated improved pit (VIP) latrine ,Pit latrine with slab, Composting toilet.

Unimproved sanitation:
Shared facility: Flush/pour flush to piped sewer system, Flush/pour flush to septic tank ,Flush/pour flush to pit latrine ,Ventilated improved pit (VIP) latrine ,Pit latrine with slab ,Composting toilet.
Unimproved facility: Flush/pour flush not to sewer/septic tank/pit latrine, Pit latrine without slab/open pit, Hanging toilet/hanging latrine, Other, Open defecation (no facility/bush/field)

2.6. Data Collection and Quality Assurance

The data was collected using a structured questionnaire adapted from WHO Conceptual framework through face-to-face interviews, direct observation, and using anthropometric measurements.
The questionnaire comprised of socio-demographic, WASH, health care, and dietary variables. To ensure the consistency of the questionnaire, was developed in English and was translate into Afan-

oromo (local language) and Amharic languages and translated back into English.

Six female health extension workers and two BSC degree environmental health professionals were employed as data collectors and supervisors respectively.

To ensure the acquisition of reliable data, Data collectors and supervisors training was given by principal investigator for 2 days on the objectives of the study, the content of the questionnaire, ethical issues, and approaches were used during data collection.

During the training session, a pre-test was done on 25 individuals (5% of the sample size) in non-selected kebele Gafersa nonoo. Then necessary an adjustment was made to the questionnaire based on pre-test result.

The collected data was checked daily by the supervisors and principal investigator for completeness. The data collectors were measured and record the height/ length of children. Triple measurements were done to up hold the consistency of anthropometric measurements and an average value with the nearest 0.1 cm was taken. The date of birth for children was collected from the mother or caretaker. For those with written evidence, the date of birth was collected from birth certificates, child health cards, or local event calendars. Length measurement for children 6–23 months also was taken in lying down or recumbent position and standing height was taken for children 24–59 months and Height/length measurement of the child was taken by the health extension workers who are already trained by the government and work the health posts.

2.7. Data Management and Statistical Analysis

The study was descriptive and inferential methods of analysis. The collected data was checked, coded, and entered into Epi-Info version 7.2, WHO Anthro plus and exported to Statistical Package of Social Science (SPSS) version 26.0 for data cleaning and analysis. Both bivariables and multivariable analyses was done using quantile Regression model.

The presence of Multicollinearity among explanatory was examined using the Variance Inflation Factor (VIF) and a variables having larger VIF value (>5), either of the two variables which had VIF value >5 one of the variable was removed. All variables irrespective of the significant level in the bivariables analysis were entered into the multivariable model to control the possible effects of confounder/s and to identify the significant factors.

Finally, variables having independent correlations with the lower cut off nutritional status were identified and reported based on the Adjusted Odds Ratio (AOR) and P-value with its

corresponding 95% CI.

Further, variables having a p-value less than 0.05 was considered to determine a statistically significant association between predictors and outcome variable.

Goodness-of-fit of Quantile Regression was tested using: The Pseudo R-Square, The Adjusted R-square, so has to know the variation in conditional median of dependent variable due to the independent variables, Quasi-LR stastics' value was 40.345 and the (P-value-0.0001) which indicates the model is stable (a good model (P-value was > 0.05).

2.8 .Ethical Consideration

The general ethical issues was raised at each stages of a research process and the researcher was gave due attention because of the nature of the study area. An official letter that, explain aim and justification of the study was taken from Addis Ababa University development studies (CoDs),center for population studies to Oromia Regional Health Bureau and the letter of support from ORHB to the Burayu town health office and also from the town health office to both Anne Dima health center and Burayu Health centers than submitted to the two health posts of the three selected kebeles(Burayu kata, Lakku Kata & Gafersa Burayu) and Permission letter was secured from the head of respective health centers. All the study participants were informed about the objective and importance of the study and their verbal consent was obtained before conducting the data collection. They were also been informed about their right of not participating and/or discontinue in the study at any time. Privacy and confidentiality of information and their responses was guaranteed throughout the entire study period and information was provided for any misconception at the end of the data collection as deemed necessary.

CHAPTER FOUR

4.RESULTS AND DESCUSSION

4.1:RESULTS

This chapter presents the finding of the research obtained from descriptive analysis. Household socio-demographic and economic characteristics, mother and child characteristics, household WASH status and child nutritional status are presented under descriptive analysis.

4.1.1: Households Socio-Economic and Demographic Characteristics

A total of 489 households were included in the survey from which all children which means 489 children were available for the anthropometric measurement. Therefore the final analysis was based on 489 children. Majority of the households (88.8) were male- headed and only 19.2% was female- headed. From the children parents 88.5% were married, 5.7% were divorced and 5.7% were separated. About 76.9% of the of the respondents Ethnic groups were Oromo, 12.5% Amhara and 10.6% were Gurage and others. The majority of the mothers'/caregiver's Educational status(56.4%) were Primary education, 19.4% Secondary education 4.7% Technical/Vocational 7.4% Higher education and 12.1% can't read and write.

The study participants' economic characteristics such as, Wealth quintile, were 22.2% Lowest, 29.2%econd,19.0% Third,7.8% Fourth.21.7% Highest. Mothers', Average number of living children were 3-4. (Table 1)

Table 2: Socio-economic and demography characteristics of households in Burayu town, Oromia special zone, Central Ethiopia, March 2022 (n =489)

Kebele		Frequency	Percent
Burayu Keta		169	34.6
Gafersa Burayu		168	34.4
Lakku Kata		152	31.1
Total		489	100.0
Variables	Category	Frequency	Percent
Sex household Head	Male	395	80.8
	Female	94	19.2
Maternal height	<153	75	15.3
	>153	414	84.7
	Married	433	88.5
Marital status	Divorced	28	5.7
	Separated	28	5.7
Educational status of mother /caregiver	No education	72	14.7
	Primary school	272	55.6
	Secondary school and above	145	29.7
Educational status of Father	No education	48	9.8
	Primary school	237	48.5
	Secondary school and above	174	35.6
Wealth quintile	Lowest/second	259	53.0
	Third	93	19.0
	Fourth/Highest	137	28.0
Number of children ever born(Parity)	1-2	282	57.7
	3-4	134	27.4
	>5	73	14.9
Under >5children in the HH	1 child	403	82.4
	2 and above	86	17.6
Death of a child U5,the last five years	Yes	33	6.7
	No	456	93.3

4.1.2: Children's Characteristics And Carying Practices

The female: male ratio was 51:44 more than 81.31% of the studied children were under three years of age. Consequently, About 31.1% of the children were encountered Sickness episode within 2 wks, 13.1% Diarrhea cases.(Table 2).The HAZ-score for male children was minimum **-3**, and maximum **2**. The findings shows that 93% of the study participates were practicing for Childs' Complementary Feeding at the proper age (At 6–8 months).

Table 2 also presents the demographics of breast feeding computed from the reported data. About 94.1% of the women reported to have given the first milk (colostrums) to their child just at birth.

The findings also showed that 93% of the women start giving supplementary food to their child at about 6-8 months, and the prevalence of bottle feeding reported was 5.7%. Finally, table 2 reveals

that 80.8% and**19.2%** of the women reported The First time offer child to breast feeding with in 1hrs and after 1hrs of birth respectively.

Table-3:Characteristics and carying practice of child aged between 6-59 months in thee selected kebeles in Burayu town,Oromia special zone, Central Ethiopia, March 2022 (n=489)

Variables	Frequency	Percent
Child's Sex		
Male	227	46.4
Female	262	53.6
Age of The Child in months		
6-23	30	6.1
24-35	97	19.8
Above 35	362	74.0
Child's Birth Order		
First	113	23.1
Second	169	34.6
Third and above	207	42.3
Deworming		
Yes	380	77.7
No	109	22.3
The First time offer child to breast feed		
Within 1hrs .	395	80.8
After1hrs	94	19.2
Complementary Feeding		
Before 6 and after 8 month	32	6.5
At 6–8 month	457	93.5
Feeding for child the first yellow milk after		
Yes	460	94.1
No	29	5.9
Food/Fluid before breast milk within 3 days after delivery		
Yes	101	20.7
No	388	79.3
Sickness episode within 2 wks		
No	337	68.9
Yes	152	31.1

4.1.3. Water, Sanitation and Hygiene Characteristics

Mothers/Caregiver's were asked the sanitation and hygiene of their household, households had access to drinking water sources 16%,84% from unimproved and improved source respectively, from which was accessible to them in less than half an hour (Table 3). Majority of the respondents (89.6%) reported that there is high interruption of water supply in their village for at least once water interruption in a week. Around 10.4% of the households labeled almost, always sufficient water supply for their house hold members. However, 93.5% of the households Access toilet Facility, 29.2%used unimproved toilet facilities and 6.5% practiced open defecation which increased the risk of individuals coming into direct contact with human excreta. Toilet Utilization

coverage were about 89% while 30.7%of the households Used shared toilet 30.7% which were categorized under un improved sanitation facilities. Regarding the treatment of water prior drinking, mothers were asked and that more than about 60.7% of the respondents' were using different types of methods of purifying or treating water prior to drinking and 39.3% of the households responded that 'NO' in case they believe that, It was safe or treated at the source. As shown in the below table, regarding the quality of water, 39.3% of them said that the water supplied by the city government is clean, and 60.7% are dissatisfied with the quality of the current water supply.

With regard to water accessibility, distance and time travelled to fetch water are considered. To evaluate it, the respondents were asked about the time they have travelled. The survey result revealed that only 2% of the respondents travelled more than 30 min to collect water the source. While the remaining (98%) reported distances they travel less than 30 minutes. Regarding the per capita water requirement, majority (53.2%) of the respondents reported that they use less than 20 L of water per capita per day which is less than the recommended standard. African Water Development Report (2006) estimated that to ensure the basic water needs of humans, 20 to 50 L of water free from harmful contaminants are needed every day According to Ministry of Water, Irrigation and Energy (MoWIE, 2011), basic access of water for urban dweller is 20 L per capita per day within 0.5 km service radius in universal access plan. On the other hand, as per WHO (2008), the basic access of water is 20 L per capita per day within 100 m to 1 km and the average time spent to collect water is 5 to 30 min. It implies that water accessibility standards are not well exercised in the town.

Considering the usual hand washing practice at Five critical time of the house hold members, Hand washing After defecation, After cleaning a child, Before preparing food, Before feeding a child were, 80.4%**,**79.1%,96.7%,95.9%and 99.4% of them practicing hand washing with Water and soap respectively. And hygienic practices of the households were 70.1% good and 29.9%were poor (Table 3).

Table -4: WASH characteristics of households in thee selected kebeles in Burayu town,Oromia special zone, Central Ethiopia, March 2022 (n=489)

Variables	Category	Frequency	Percent
Source of drinking water	Improved	411	84.
	Not improved	78	16.
Time taken	>30min	10	2.0
	<30min	479	98
Water Used in Liters	<20Liters	260	53.2
	>20Liters	229	46.8
Water interruption in a week from the source	At least once water interruption in a week	438	89.6
	No, always sufficient	51	10.4
Tanker for water storage	Yes	128	26.2
	No	361	73.8
HH store water in small containers	Yes	442	90.4
	No	47	9.6
Covered Containers for water storage	Yes	349	71.4
	No	140	28.6
Latrine Utilization	Yes	435	89.0
	No	54	11.0
Latrine status	Improved	311	63.6
	Not improved	178	36.4
Disposal of solid wastes	Not proper disposal	74	15.1
	Proper disposal	415	84.9
Availability water &soap at hand washing facility	Yes	423	86.5
	No	54	11.0
Hygienic practice	Good	343	70.1
	Poor	146	29.9

4.1.4: Nutritional Status

A community's food and nutritional status is usually measured by the nutritional status of children less than five years of age. This is the most vulnerable group to growth faltering, diseases, mental impairment and death. Child anthropometric assessment indices used are Height for Age (HFA), Weight for Age (WFA) and Weight for Height (WFH).The three indices by which a child or a group of children are compared to the reference are known as "percentage of the median", "percentiles" and" z-scores" respectively. Nonetheless, z-score is acknowledged to have a statistical meaning, and therefore, recommended. Moreover, it is advisable to report nutritional status data as z-scores rather than percentage of reference median or percentiles so as to be able to compare information from different studies (Beaton, 1993; WHO, 1994).

Descriptive analyses were conducted to summarize the characteristics of the sample using frequencies and their associated percentages. Data on a total of 489 children were analyzed out of which 15 (3.1%) were stunted. The findings of the study also show that (25%) children were found

to be at the lower cut off nutritional status (>-1z-scores) as shown below.

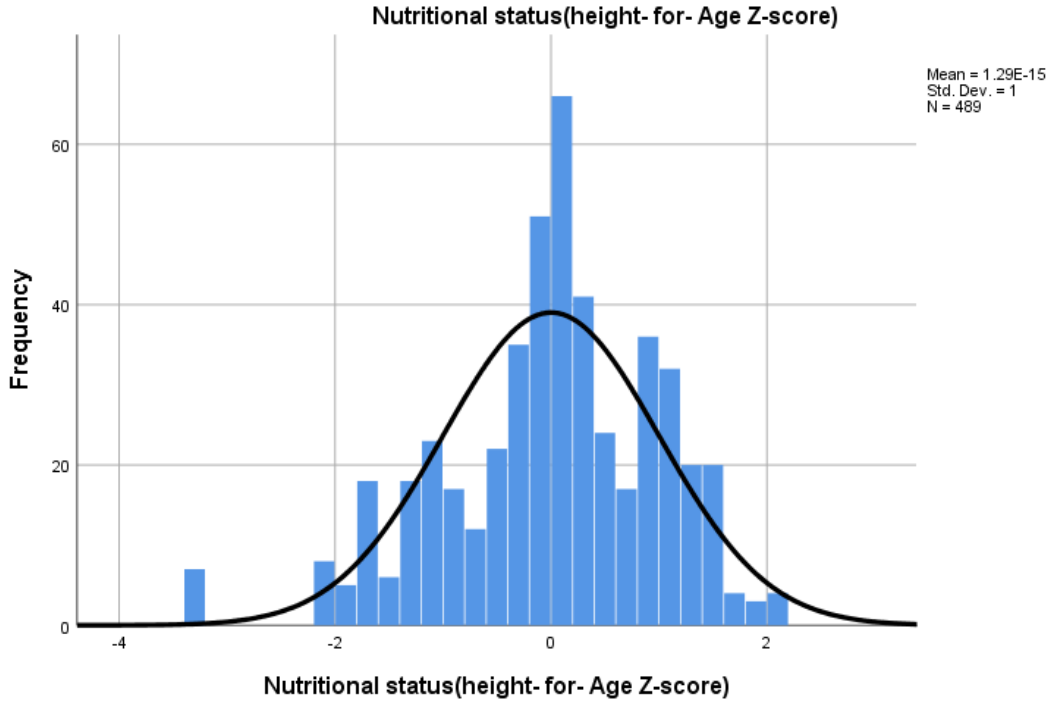

Figure-4:Histogram of Height-For-Age Z-Score

This research was based on the whole Height for age-Z values (HAZ) distribution using the Quantile Regression Technique (QR). It may assist to identify the variables that influence HAZ by dividing the distribution into distinct quantiles instead of the population average score. Corresponding to the quantiles of (25^{th}) The models were also extended beyond stunting to capture the full distribution of HAZ. Thus, to examine the effects of the risk factors at different points of the conditional distribution of (HAZ) .

Generally, the quantile regression is used to describe conditional quantile of the outcome variable in relation to covariates rather than modeling the mean. Thus, quantile regression modeling is a statistical procedure used to model quantile (percentiles) within a regression framework.

It has been shown extensively in the literature that modeling anthropometric measurements, especially nutritional status through quantile regression approach is more appropriate than the mean (mean regression).

Thus, quantiles regression model is *robust* non-normal data and statistical outliers, gives much more information about the underlying associations and provides flexibility in analyzing the determinants of nutritional status corresponding to quantile of interest either in the lower tail (e.g.

0.25), the upper tail (e.g. 0.97) of the distribution rather than investigating only the determinants of the mean distribution (Koenker et al., 2003;Lê Cook et al., 2013;Fenske,et al.,2011). It is obvious that distributions may not only vary by their means but also by their upper or lower tails so modeling the mean as in linear regression models could miss critical aspects of the relationship that may exist between the response variable and its determinants, notable in the presence of skewed data as is usually the case with *medical* and *health data.*

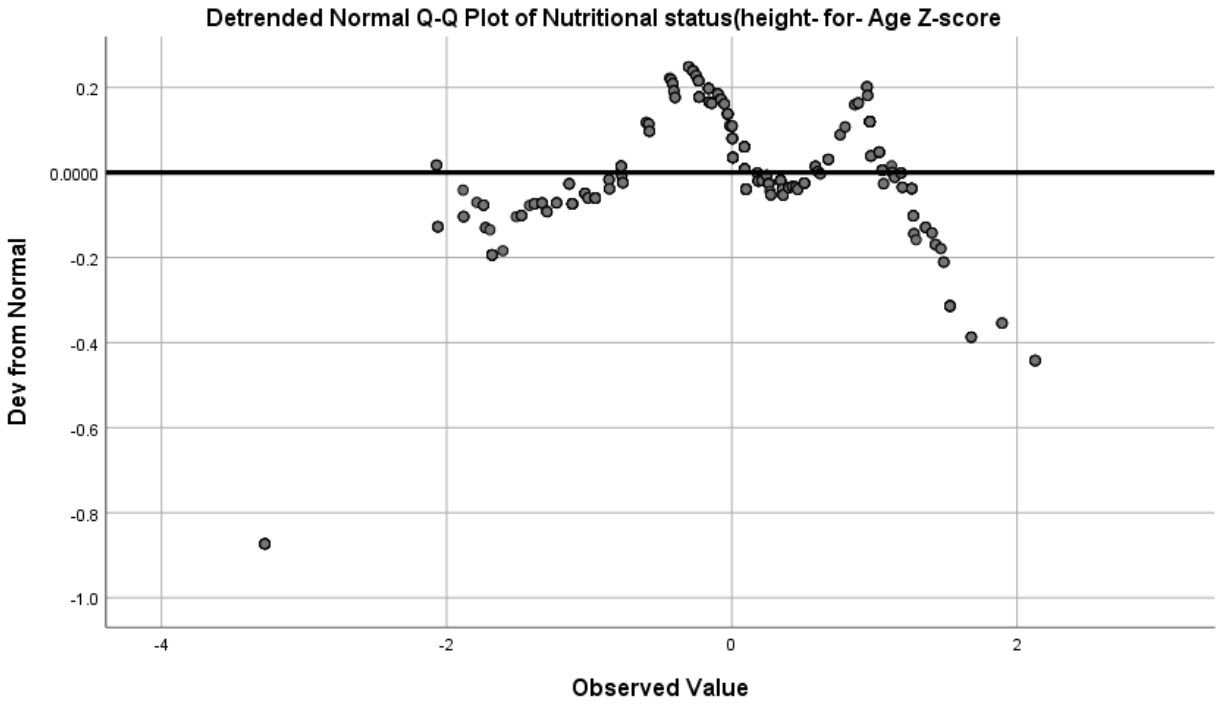

Figure-5:Q-Q Plot of nutritional status

However, quantiles regression is rarely used in the medical and health data modeling despite its *advantages over linear regression*, especially when modeling *anthropometric outcome*.

4.1.5: Results of Bivariate quantile regression analysis for children aged between 6-59 for lower cut off nutritional status

Quantile regression analysis was tabulated for dummy variables for height-age (HFA) for lower Cut off nutritional status of children aged between 6-59 in the households in Burayu town selected kebeles. Attributes such as Marital status, Educational level of mother/caregiver, Mother's age, Wealth quantile ,parity, Age of The Child in months, a Complimentary feeding, Feeding colostrums milk after birth, Hygiene practices ,Source of drinking water, Water interruption in a week from the source, HH store water in small containers, Using Tanker for water storage,

Disposal of solid wastes ,sanitation status and Availability water &soap at hand washing facility showed inter-group statistical significance with the lower cut off HAZ distribution /quantile=25th/(table 4).

Table -5: Results of Bivariate quantile regression analysis for child aged between 6-59 for lower cut of nutritional status in Burayu town,Oromia special zone, Central Ethiopia,(n =489)

	Quantile=0.25					Quantile=0.97				
Variables	B	Std. Er.	95% CI		Sig	B	Std. Er.	95% CI		Sig
Household Head's Sex										
Male	.150	.7904	-1.403,	1.703	.849	.127	.8317	-1.507	1.761	.879
Female	0[c]	.	.	.	.	0[c]	.	.	.	.
Marital status										
Married	1.077	.3081	.472,	1.682	.001	.063	.3440	-.613	.739	.854
Divorced	-.252	.4223	.081,	.578	.552	-.342	.4715	-1.269	.584	.468
Separated	0[c]	.	.	.	.	0[c]	.	.	.	.
Educational level of mother/caregiver	-	.								
No Education	-1.320	.2231	-1.758,	-.881	.000	.429	.1565	.122	.736	.006
Primary education	.157	.1591	-.155,	.470	.323	.063	.1116	-.156	.283	.570
Sec. education and above	0[c]	.	.	.	.	0[c]	.	.	.	.
Mother's age										
15-24	.300	.5598	-.799,	1.400	.592	.925	.0281	.870	.980	.000
25-34	.932	.5528	-.154,	2.018	.092	.862	.0277	.807	.916	.000
35 and above	1.168	.5710	.046,	2.289	.041	1.291	.0286	1.234	1.347	.000
	0[c]	.	.	.	.	0[c]	.	.	.	.
ANC										
1-3 TIMES	.889	.6341	-.357,	2.135	.162	.467	.5732	-.659	1.593	.416
4 and above	-.156	.1706	-.491,	.179	.362	.101	.1542	-.202	.404	.511
	0[c]	.	.	.	.	0[c]	.	.	.	.
Wealth quantile										
Lowest/ Second	-.550	.1364	-.818,	-.282	.000	-.150	.0882	-.324	.023	.089
Third	.331	.1735	-.010,	.672	.057	.447	.1122	.227	.668	.000
Fourth/ Highest	0[c]	.	.	.	.	0[c]	.			.
Child's Sex										
Male	.168	.1718	-.169,	.506	.328	.063	.1826	-.296	.422	.729
Female	0[c]	.	.	.	.	0[c]	.	.	.	.
Age of The Child in months										
6-23	-1.530	.1763	-1.876,	-1.183	.000	-1.982	.2996	-2.571	-1.393	.000
24-35	-1.220	.1061	-1.428,	-1.012	.000	-.194	.1803	-.548	.161	.283
Above 35	0[c]	.	.	.	.	0[c]	.	.	.	.
Child's Birth Order										
First	.007	.2242	-.433,	.448	.974	-.431	.1084	-.644	-.218	.000
Second	.541	.1993	.150,	.933	.007	.409	.0964	.220	.599	.000
Third and above	0[c]	.	.	.	.	0[c]	.	.	.	.
Complementar										

y Feeding										
Before 6 and after 8 month	.690	.2984	.103,	1.276	.021	-.043	.3383	-.708	.621	.898
At 6–8 month	0[c]	.	.	.	.	0[c]	.	.	.	.
Feeding colostrums milk after birth										
No	1.473	.3199	.845,	2.102	.000	.063	.3378	-.600	.727	.851
Yes	0[c]	.	.	.	.	0[c]	.	.	.	.
Sickness episode within 2 wks										
No	-.185	.1689	-.517,	.147	.275	-.063	.1968	-.450	.323	.748
Yes	0[c]	.	.	.	.	0[c]	.	.	.	.
Hygienic practice										
Poor	.434	.1965	.048,	.820	.027	.150	.1740	-.192	.492	.388
Good	0[c]	.	.	.	.	0[c]	.	.	.	.
Source of drinking water										
Improved	.726	.2373	.260,	1.192	.002	.043	.2191	-.387	.474	.843
Not improved	0[c]	.	.	.	.	0[c]	.	.	.	.
Time taken										
>30min	.000	.7733	-1.537,	1.537	1.000	-.865	.6029	-2.063	.333	.155
<30min	0[c]	.	.	.	.	0[c]	.	.	.	.
Water Used in Liters										
<20Liters	.156	.1696	-.178,	.489	.359	.000	.1677	-.329	.329	1.000
>20Liters	0[c]	.	.	.	.	0[c]	.	.	.	.
Tanker for water storage										
Yes	.541	.1745	.198,	.884	.002	.150	.2072	-.257	.557	.469
No	0[c]	.	.	.	.	0[c]	.	.	.	.
Small Covered Containers For Water Storage										
Yes	-.366	.1876	-.734,	.003	.052	-.366	.1086	-.579	-.152	.001
No	0[c]	.	.	.	.	0[c]	.	.	.	.
Latrine/Sanitation status										
Not improved	.706	.1595	.393,	1.019	.000	-.366	.1651	-.690	-.041	.027
Improved	0[c]	.	.	.	.	0[c]	.			.
Disposal of solid wastes										
Proper disposal	-.711	.2157	-1.135,	-.287	.001	-.043	.2305	-.496	.409	.851
Not proper disposal	0[c]	.	.	.	.	0[c]	.	.	.	.
Availability water &soap at hand washing facility										
No	1.173	.2393	.703,	1.643	.000	.127	.2537	-.372	.625	.618
Yes	0[c]	.	.	.	.	0[c]	.	.	.	.

Quantile regression results

The previous analysis has relied on the mean effect estimation. In these estimations, some important correlates of child health and nutrition at different points of the HAZ and WHZ distributions could be masked. This problem can be handled by employing quantile regression (QR). The QR offers the opportunity to examine the size of the coefficients of parameters over the entire conditional distribution as well as to test whether the size differs in the estimated coefficients between different quantiles. Moreover, in a country where child health and nutrition problems are severe, assessing the impact of maternal characteristics on the low tail of the health and nutritional status has much more policy relevance than the mean effect. The following section further analyses the health and nutritional status of children employing the QR method.

Koenker& Basset (1978) have introduced the quantile regression model by extending the concept of ordinary quantile in a location model to a more general class of linear models. The theoretical underpinning of QR regression is employed following (Cameron &Thrived ,2009) as well as(Imbeds& Wooldridge ,2007).

Table 5: Revealed that significant differences exist in slopes between the Lower quantiles of 0.25(q0.25) and higher 0.97(q0.97) of HAZ. The slopes of Mother's age at age(15-24)(q0.25: β = .498, 95% CI: − 545, − 0.451,p-value=.000 and at age(25-34) (q0.25: β = -.553, 95% CI: − 592, − 0.514,p-value=.000 &q0.97: β = -.626, CI: -.626, -.626; p-value =.000,Age of The Child in months at age(6-11) (q0.25: β = -1.129, 95% CI: -1.186, − -1.071,p-value=.000 and at age (24-35) (q0.25: β=-.996, 95% CI: -1.031,-.962,p-value=.000 &q0.97: at age(6-11) β =-1.904, CI=-1.904, =-1.904; p-value =.000, and at age (24-35) (q0.97: β= -1.131, 95% CI: -1.131,-1.131,p-value=.000 ,Educational level of mother/care giver at Secondary education and above(q0.25: β = -.735, 95% CI: -.783, -.687; and at age (Primary education) (q0.25: β= .169, 95% CI: .135,.2032,p-value=.000 &q0.97 at Secondary education and above(q0.97: β = .080, 95% CI: .080, .080; and at age (Primary education) q0.97: β= -.133, 95% CI: -.133,-.133,p-value=.000,Marital status:(q0.25: at Married: β =.324, 95% CI: .232, .232,p-value=.000 & and at Divorced; β =.207, 95% CI: 0.84, 0.329,p-value=.001 & q0.97: β = .633, 95%CI: .633, .633; p-value = 0.000 at both categories), Wealth quantile: (q0.25: at Lowest/ Second: β =.118, 95% CI: .082, .154,p-value=.000 & and at Third; β =.256, 95% CI: .215, .296,p-value=.000 & q0.97: β = -.558, 95%CI: -.558, -.558; p-value = 0.000) at lowest/second and β = .004, 95%CI: .004, .004; p-value = 0.000) at third. Latrine/Sanitation status: (q0.25: Not improved: β =.158, 95% CI: .129, .129,p-value=.000 and q0.97: β = -.291, 95%CI: -.291, --.291; p-value = 0.000),Disposal of solid wastes:(q0.25:β =-.534, 95% CI: -.575, -.493,p-value=.000 and q0.97: β = 1.373, 95%CI: 1.373, 1.373; p-value = 0.000) ; Availability water &soap at hand washing facility:(q0.25:β =.701, 95% CI: .652, .750,p-value=.000 and q0.97: β = .694, 95%CI: .694, .694; p-value = 0.000) ; Hygienic

practice:(q0.25:β =-.365, 95% CI: -.398, -.331,p-value=.000 and q0.97: β = -.766, 95%CI: -.766.694,-.766694; p-value = 0.000) ; Complementary Feeding: :(q0.25:β =.282, 95% CI: .225, .339,p-value=.000 and q0.97: β = -.246, 95%CI: -.246, -.246; p-value = 0.000)varied significantly across the lower cut off 0.25 and the higher cut off 0.97quantiles of HAZ.

Quantile plots of covariate effects for the lower quantile ranges of 0.25 and the upper of 0.97 quantiles of HAZ

The results presented in Fig. 6 is the plot of covariate effects on quantiles of HAZ from multivariable simultaneous quantile regression (black dots) and their associated 95% confidence interval (gray shaded regions).The solid red lines in the plots are the ordinary least square (linear) regression lines with their 95% confidence intervals (dashed red lines).On this Fig. 6, also an attempt was made to provide a larger scale figure for child's age covariate for better examination of the effects on the varying quantiles of HAZ. Figure 6 revealed that child age had greater effects at the lower quantiles of HAZ and minimal effects at upper quantiles of HAZ.

The quantile regression provided a good fit to the data, especially at the lower or/and upper tails of the

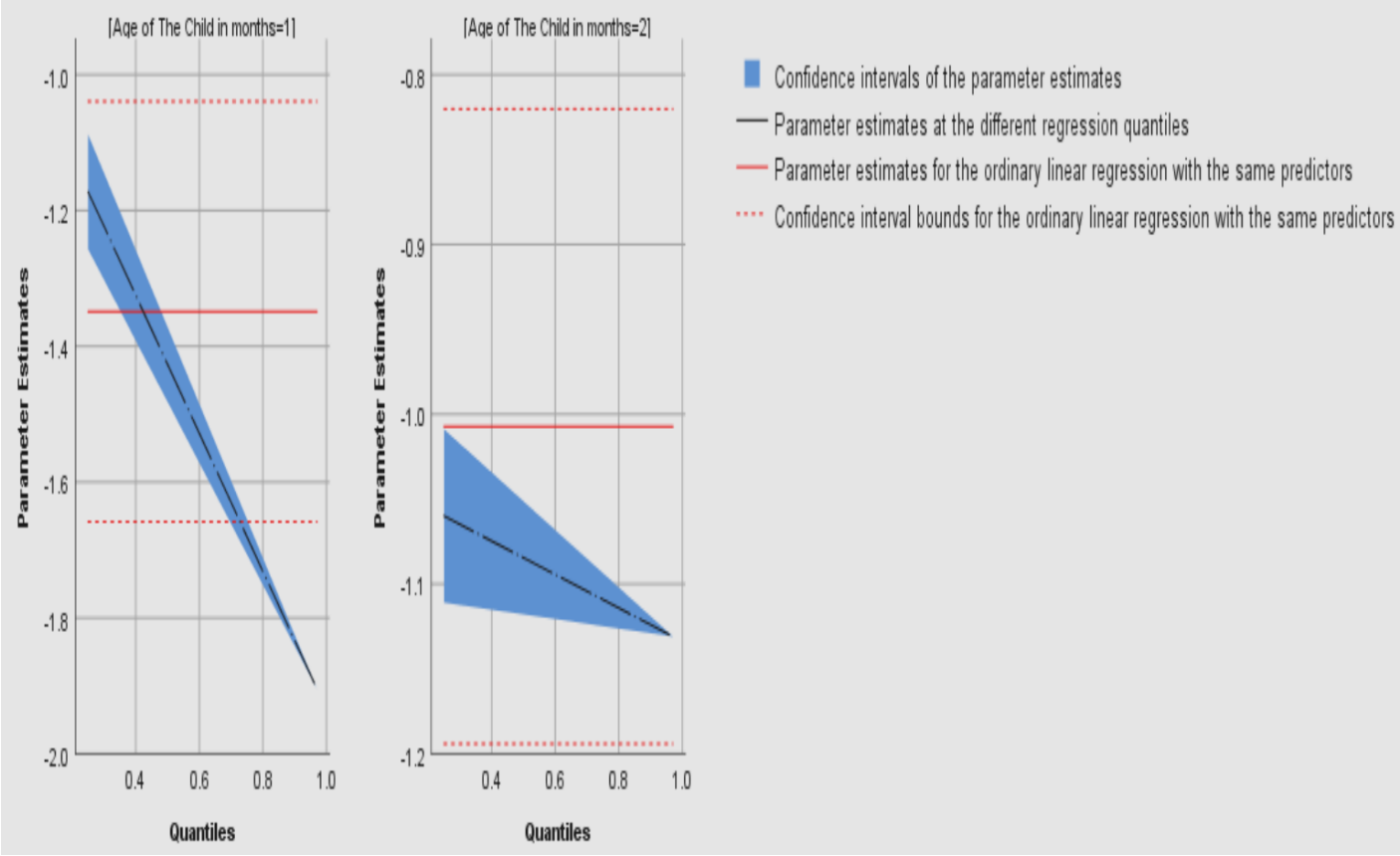

Figure-6: Quantile plots of covariate effects at different child age by quantile regression and ordinary least square (linear) regression with their 95% confidence intervals.

Table -6: Results of multivariable quantile regression analysis of child aged 6-59 Months(n=489)

Variables	Quantile = 0.25				Quantile = 0.97			
	β	95% CI		p-value	β	95% CI		p-value
Characteristics								
Mother's age								
15-24	-.498	-.545	-.451	.000	-.626	-.626	-.626	.000
25-34	-.553	-.592	-.514	.000	-.312	-.312	-.312	.000
35 and above	0[c]	.	.	.	0[c]	.	.	.
Age of The Child in months								
6-23	-1.129	-1.186	-1.071	.000	-1.904	-1.904	-1.904	.000
24-35	-.996	-1.031	-.962	.000	-1.131	-1.131	-1.131	.000
Above 35	0[c]	.	.	.	0[c]			.
Educational level of mother/caregiver								
Secondary education and above	-.735	-.783	-.687	.000	.080	.080	.080	.000
Primary education	.169	.135	.203	.000	-.133	-.133	-.133	.000
No Education	0[c]	.	.	.	0[c]	.	.	.
Marital status								
Married	.063	-.544	.670	.838	.633	.633	.633	.000
Divorced	-.299	-1.141	.544	.487	.633	.633	.633	.001
Separated	0[c]	.	.	.	0[c]	.	0[c]	.
Wealth quantile								
Lowest/ Second	.118	.082	.154	.000	-.558	-.558	-.558	.000
Third	.256	.215	.296	.000	.004	.004	.004	.000
Fourth/ Highest	0[c]	.	.	.	0[c]			.
Source of drinking water								
Improved	.398	-.027	.823	.066	-.062	-.062	-.062	.002
Not improved	. 0[c]				0[c]	.	.	
Latrine/Sanitation status								
Not improved	.158	.129	.188	.000	-.291	-.291	-.291	.000
Improved	0[c]	.	.	.	0[c]			.
Disposal of solid wastes								
Proper disposal	-.043	-.442	.355	.830	1.373	1.373	1.373	.000
Not proper disposal	0[c]	.	.	.	0[c]			.
Availability water &soap at hand washing facility								
No	.701	.652	.750	.000	.694	694	694	.000
Yes	0[c]	.	.	.	0[c]			.
Hygienic practice								
Good	-.365	-.398	-.331	.000	-.766	-.766	.766	.000
Poor	0[c]	.	.	.	0[c]			.
Complementary Feeding								
Before 6 and after 8 month	.282	.225	.339	.000	-.246	-.246	.246	.001
At 6–8 month	0[c]	.	.	.	0[c]			.
Colostrums milk after birth								
No	.292	.204	.379	.000	.731	.731	.731	.000
Yes	0[c]	.	.	.	0[c]			.000

4.2. DISCUSSION

Analyses were conducted on 489 children out of which 15 (3.1%) were identified as stunted the among Lower cut off nutritional status (Quantile 25^{th}) on the entire distribution of HAZ-scores.
Risk factors associated with the lower cut off height-for-age-z-scores were, Maternal age, Child's age, Educational level of mother/caregiver, household wealth quantile, Latrine/Sanitation status, Availability water &soap at hand washing facility, Hygienic practice, Complementary Feeding and Colostrums milk at birth. The use quantile regression to model nutritional status (At a lower cut off; i.e. 0.25& at the higher cut off .97quantiles of HAZ-scores) is the paramount of interest in this study. The quantile regression modeling approach employed in this study provided a richer characterization of the data, thereby revealing the effect of a covariate on the entire distribution of HAZ, making it possible to identify the more vulnerable groups and to formulate more effective interventions to these groups. Both Bivariate and multivariate quantile regression analysis were performed between the Lower and the upper cut off nutritional status (dependent variable) and associated factors (independent variable).The results have shown that quantile regression models provided much more information about the underlying associations better than the ordinary least squares regression, suggesting that the conditional distributions of HAZ did not only differ by their means but also by their lower and upper tails as reported in previous studies (Koenker ,2003). Thus, the ordinary least squares regression missed critical aspects of the associations that exist between the conditional distributions of HAZ and its determinants as shown in Fig.6 above. For example, the impact of child age on HAZ was higher at the lower quantiles of HAZ and lower at the higher quantiles of HAZ. This finding suggests that children at the lower tail of the HAZ distribution who are more likely to be at the Lower cut off nutritional status benefit more from interventions aimed at addressing issues surrounding child age than those in the upper end of the distribution. Thus, child age interventions to address under-five severe stunting could have more impacts on children who are at higher risk of being at the Lower cut off nutritional status. Based on data obtained by crossectional study, the determinants associated with HAZ and trend in the HAZ distribution among children aged 6–59 months were identified using quantile regression. This study analyzed the socio-economic, demographic WASH Factors correlates of nutritional status of Children aged 6-59 months in by using quantile regression.

Mother's age the analysis identified the Mother's age is one of the strongest determinants of the

child nutritional status. Results showed a negative increment in coefficients from lower age to upper age. The mother's age was also associated and statistical significance with children's nutrition. Children of mothers age,15-24 and 25-34years are 49.8% and 55.3% less likely to be with the lower HAZ-scores when compared with their reference age groups (35 years and above) respectively. One striking finding from this estimation, mother's age is found to be negative in this study, this result contradicts the argument that mature and older mothers are better at child care than younger mothers; It is evident from the analysis that increasing age of mother at birth reduces underweight status of children. That is younger mothers tend to have more underweighted children than older mothers Mother age at birth shows significant effect on underweight status of children under age of five years old. The effect of mother's age on her child's underweight status (other constant) negatively increase as her age increase up to 25 years and then after the effect of mothers age on her child's underweight status positively increase. Three cross-sectional studies showed a moderate association between younger maternal age and child stunting (Best et al., 2008; Samba et al., 2011; Samba, Kalm, et al., 2007). In these studies, the odds of women ≤24 years having a stunted child were between 1.09 and 1.23 greater than women ≥33 years. Sari et al. (2010) found the opposite association but did not report the strength of the relationship. Results from (Oddo et al., 2012). The possible explanation suggested: maternal and child double burden is more likely to occur in older women than in younger women, but this is likely due to greater body mass index in older women, not necessarily a greater prevalence of child stunting.

Child's age was one of the factors significantly associated with HAZ scores in the study area. Comparing with children aged 6-24 months, children within age groups 24-35 and 35 and above months were 10% and11.2 % more like to be with the lower cut off height-for-age Z-score over the entire conditional distribution HAZ. In the same way study conducted in Hawasa town, children who were aged above 24 months were 4 times more likely to be stunted than below 24 months (AOR (95%CI) 3.79(1.30-12.11).In all of the estimates, child health and nutritional status is found to worsen as the age of the child increases. This is in conformity with other empirical studies such as(Girma &Genebo ,2002) and (Sahn&Stifel ,2002),Local and regional studies in Ethiopia have also shown an increase in malnutrition with increase in age of the child (Yimer, 2000; Genebo et al., 1999; Samson and Lakech, 2000).Increase in the likelihood of severe stunting observed among older ages of children in this study supports previous, One explanation for this could be that as

children grow older they are more exposed to poor health and lack of nutrition because of weaning and less access to breast milk (Mariara et al.,2008)

As stunting has a constant and cyclical nature, inadequate dietary practice, weaning, lower and insufficient breast, and complementary feeding strategies have been weakened and become unsuccessful as the child's age increases, which further causes stunting.
Another possible explanation might be increased exposure to infections associated with taking other fluids, solids, and ingestion of contaminated materials as the children start exploring their environment. Diarrhea affects children's nutritional status by diminishing appetite, reducing nutrient absorption, increasing metabolic requirements, and increasing nutrient losses.
To sum up Children's nutritional status is also more sensitive to factors such as feeding/weaning practices, care, and exposure to infection at specific ages. A cumulative indicator of growth retardation (height-for-age) in children is positively associated with age (Anderson, 1995)as cited in (Aschalew,2000)

Drinking water source: The findings of this study showed that drinking water source had significantly associated with stunting of last born 6-59 months aged children. Children lived in households that had improved drinking water source are 40% less likely to be with the lower cut off HAZ scores compared with those children who had lived in households having unimproved drinking water source. This is because hygiene practices directly affect the cleanliness of the environment and the number of infectious agents that children may ingest. This result is consistent with a study conducted by (Rah *et al.*, 2015) in rural India that showed improved conditions of sanitation and hygiene practices are associated with reduced prevalence of stunting.Similar research in Ethiopia found that households drinking water from an unprotected source were more stunted than their counterparts, corroborating this result (Abuya, 2013).The lack of safe water causes multiple types of infection and diarrhoeal disease, which in turn raises chronic malnutrition. To tackle the problem of malnutrition in the area, improving access to better water sources is very necessary. Hence, these studies bold out that to tackle stunting among children, non-nutrition-specific strategies have also paramount importance.

Also, the current study showed that one of the important predictors of chronic malnutrition was

introduced complementary feeding at age of 6–8 month. children who introduced complementary feeding at age Before 6 and after 8 month were 2.8 times more likely to be with the lower cut off HAZ scores than those children who introduced complementary feeding at age greater than 6–8 month). A parallel can be drawn with scholarly articles (Gebre,2013).

The likely explanation is that for children whose digestive and immune systems are not yet mature, inappropriate timing for providing complimentary food will affect their nutritional status. The provision of food supplements may be a significant cause of malnutrition, particularly under unhygienic conditions (Fikadu, 2014).To prevent infections that could hinder the development of the infant, exclusive breastfeeding is very necessary, particularly in the region where the sanitation status is very poor. Therefore, mothers should be advised to benefit from this and an enabling environment should be developed that promotes optimal breastfeeding.

Mother's educational status also showed a significant impact on the stunting of children age 6-59 months. The quantile regression indicated that educated mother at the higher level (Secondary education and above)children had 7.3% less likely to be with the lower cut off HAZ-scores compared with those of the reference category not educated while educated mother children at primary level had 16.9% more likely to be with the lower cut.

Education is one of the most important resources that enable women to provide appropriate care for their children, which is an important determinant of children's growth and development (Engle and Menon,1996). Studies in the Philippines (Aguillion et al, 1982), Libya (Pumpkin and Bisgrove, 1988), Uganda (Statistics Department and Macro International Inc.,1996), and Ethiopia (Yimer, 2000; Genebo et al., 1999) show a decreased incidence of malnutrition among young children with an increase in the level of mothers' education.

Consistent with this result, a study done by (Liaqat *et al.*, 2007) was found a positive relationship between the nutritional status of infants and educational status of mothers. The study revealed that the majority of infants with evidence of malnutrition belonged to a mothers with virtually no school education. In line with this similar study done by Giashuddin*et.al*, in 2003 in Bangladesh also shows that children of illiterate women were nutritionally more vulnerable than children of

their women who had secondary and higher education another study conducted by Ajao*et al.*, in 2010 in Nigeria also shows that children with less educated mothers were significantly more likely to be stunted.

Possible explanation; After controlling for household economic status, which is an important predictor of child nutritional status, parental education has a positive and significant effect on child nutrition. Some studies have shown that parental education is associated with more efficient management of limited household resources, greater utilization of available health care services, better health promoting behaviors, lower fertility and more child-centered caring practices, all factors associated with better child health and nutrition (McGuire, 1988; Nancy, 1997). Small-scale studies in Ethiopia have also shown the importance of maternal education to child nutrition (Genebo et al., 1999 and Yimer, 2000).

Wealth quantile: The result of this study also shows that household wealth status had significant association with the lower cut off HAZ distribution of children 6-59 months of age. The present study also showed that household wealth quantile had significant association with the lower cut off HAZ distribution of children 6-59 months of age. Children in the households of Lowest/ Second and third wealth quantiles were11.8%and 25.8% respectively more likely to be with the lower cut off HAZ distribution compared to their counterparts from Fourth/ Highest households 6-59 months aged children. Under-five children in the household also significantly contribute for stunting of the last born6-59 months aged children. The study conducted by (Khattack and Ali, 2010) and (Tette *et al*.,2016) and (Tarkio *et al*.,2016) also shows that there was strong association of malnutrition with income of the parents and child number in the family. The finding that children from poor households are more likely to be severely stunted compared to their counterparts from average/rich households is consistent with previous studies (Cheung, 2008). This could be as a result of low quality and inadequate food consumption, exposure to infections and lack of access to health services commonly associated with poor households. Thus, the effect of poverty could be manifested through lower purchasing power, low literacy, and food insecurity resulting in poor nutritional outcomes among poor households.

Latrine status among WASH variables improved sanitation has significant effect on child height-for-age Z-score. Children from those households which use unimproved sanitation facilities 1.58

times more like to be with the lower cut off over the entire conditional distribution HAZ-scores than those which use improved sanitation facilities. Similarly, Study conducted in rural Somalia confirms that, unimproved toilet facilities availability had significant association with risk of being stunted (AOR: 1.71, 95% CI 1.13-2.58).

The study further justified that households with poor environment (poor latrine) had more likely stunted children than those households who had improved latrine since households with poor latrine where children might play toddler which was contaminated wastes with microorganisms (bacteria) which could lead to different health problems like incidence of diarrhea, reduction of appetite where taking less quantity of fluids and foods which could affect nutritional status of children.

Many observational studies of older children in Ecuador, Mali, and India that have found Community-level sanitation to be associated with child growth that may be greater than the effect of household-level sanitation (Harris,2017).

This study adds to a growing body of evidence suggesting that the relationship between water and sanitation infrastructure, hygiene, nutrition, and growth outcomes is complex, variable, and Context-specific. Several recent nutrition and WASH trials have been designed and implemented. Assuming a causal framework linking improved nutrition and WASH to improved child health Outcomes, including linear growth and stunting. A systematic review identified five randomized Controlled trials that found a small but statistically meaningful effect among children under five Years of age (MoH ,2015).

Availability water &soap at hand washing facility Presence of water and soap at a household's hand washing station at the time of survey was found to be associated with the lower cut off HAZ distribution of children 6-59 months of age. Children in the households with Availability water &soap at hand washing facility at the time of survey were 70% less likely to be with the lower cut off over the entire conditional distribution HAZ Scores compared to with the counterparts. Similarly, the national representative data of the 2011 Ethiopian Demographic and Health Survey (EDHS) was used to assess the WASH practices among well-nourished and acutely malnourished children aged 6 to 59 months and to determine the association between these practices and moderate-to-severe wasting in rural Ethiopia. Possible reason, Water, sanitation, and hygiene

(WASH) has been linked to all four “pillars” of the food and nutrition security framework (Cumming &Cairn cross, 2016; Pritchard et al., 2016), as immediate or proximate risk factors, but also as more distant causes. The most direct pathway that links poor WASH to under nutrition is via repeated bouts of diarrhoea (Cairncross and Ensink, 2013; Casanovas et al., 2013). It is now well accepted that diarrhoea can be both a cause and a consequence of malnutrition.

Hygienic practice: The results of this study also shows that household Hygienic practice had significant association with the lower cut off HAZ distribution of children 6-59 months of age. Children lived in households that had Good hygienic practices are 36.5% less likely to be with the lower cut off HAZ scores compared with those children who had lived in households having not good Hygienic practice. Our study did not detect any evidence of an association between access to improved sanitation facilities and child linear growth. Although, this finding differs from findings elsewhere (Jones et al., 2003).it is consistent with that of the Burkina Faso study (Poda et al.,2010). The current study has been unable to demonstrate a statistically significant association between access to improved hand washing (water and soap) facilities and child linear growth. This may be explained by the fact that the presence of soap and water on premises may not necessarily reflect hand washing practices at critical times such as before and after meal preparation, eating and after visiting the toilet. Biran et al in 2008 made the valid point that estimating hand washing through observation of facilities with soap may be poorly associated with actual hand washing practices (Biran et al.,2008).and even among those with access, hand washing is often inadequately practiced (Johnston et al.,2010).

The possible reason: The effects of lack of appropriate water facilities, hand washing, and hygiene practices on child health outcomes. Impaired cognitive learning and learning performance are long-term outcomes of the negative effects of infections such as diarrhea, worm infestations, and dehydrations which are largely attributed to poor water, sanitation, and hygiene conditions. (Waddington, 2017).

Colostrums milk after birth chronic malnutrition is found to be associated with the time of initiation of breastfeeding for the inborn child, in this study. Children who started breastfeeding immediately after birth within an hour whose mothers began breastfeeding 2.9times less likely to

be with the lower cut off over the entire conditional distribution HAZ Scores compared to with the counterparts. To improve the nutritional status of the infant, it is commonly recommended that children start breastfeeding immediately after birth. This may be because early breastfeeding leads to increased secretion and production of breast milk that will provide the baby with sufficient nutrients, such as colostrums (Hurrah et al., 2020).Colostrums provides natural immunity to the infant and thereby decreases hypoglycemia and hypothermia, which in turn protects the infant's wellbeing WHO, 2009).This study supports the WHO recommendation, which underlines the value of timely breastfeeding to children's health (WHO, 2009). The results are backed by similar studies in Tigray, Northern Ethiopia (Alemayehu et al., 2012) in Indonesia (Muldiasman,2018). These findings demonstrate the importance of early breastfeeding initiation as a means of early maternal care and the best food that can reduce the risk of stunting. Early breastfeeding is designated as one of the gateways to effective breastfeeding practice and ensures that infants obtain sufficient food (Black et al.,2008)Hence, health education should also be given to mothers on the benefits of early breastfeeding in improving the nutritional status of children. In providing a close follow-up on the matter, health extension workers and women's health development armies are vital (Martin et al.,2013).

CHAPTER FIVE

5.CONCLUSION AND RECOMMANDATION

5.1. CONCLUSION

Use quantile regressions, this paper have explored the effects of variables such as Risk factors associated with the lower cut off height-for-age-z-scores were, Maternal age, Child's age, Educational level of mother/caregiver, marital status, household wealth quantile, Latrine/Sanitation status, Disposal of solid wastes, Source of drinking water, Availability water & soap at hand washing facility, Hygienic practice, Complementary Feeding and Colostrums milk at birth are identified.

Therefore for raising the nutritional status of children in the lower tail of the conditional height-for-age distribution, it may be important to target direct nutritional interventions, providing better sanitation facility and spreading awareness among uneducated women for tackling child malnutrition. The critical risk factors identified can aid formulation of child nutrition and health policies and interventions that will improve child nutritional outcomes and survival. Improvement in maternal education and household socioeconomic status, Availability of water &soap at hand washing facility& Hygienic practice, promoting adult motherhood, promoting improved Latrine/Sanitation status, Latrine/Sanitation utilization, Disposal of solid wastes, and targeting on households with safe water supply and covering small containers used in the house hold for water storage as primary interventions are warranted as part of the overall strategy to ameliorate the nutritional status of children.

5.2. RECOMMENDATION

The study recommends the use of quantile regression modeling techniques in analyzing determinants of malnutrition in populations to provide a richer characterization of the data which will permit identification of more vulnerable groups and to formulate more effective nutrition interventions to these groups. Using fully quantile regression approach to model chronic nutritional status among children aged below 5 years could be explored as a further research.

As earlier mentioned, of quintile regression modeling techniques in analyzing determinants of malnutrition in populations**.** However, our research was directed on Application of quantile regression to examine Chronic malnutrition among children aged 6-59Months in Burayu town, Oromia special zone, Central Ethiopia.

It would be interesting to extend this study to other sectors taking into account a longer period of analysis to capture a more comprehensive causal effect of chronic malnutrition among children aged 6-59Months. Lastly, it would be ideal to conduct a similar study but using a qualitative or mixed method approach in trying to understand the interaction between chronic malnutrition among children aged 6-59Months.

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ANNEX-I:ENGLISH VERSION QUESTIONNAIRE

ADDIS ABABA UNIVERSITY COLLEGE OF DEVELOPMENT STUDIES
CENTER FOR POPULATION STUDIES

CONSENT

Hello, my name is_____ Currently, I am collecting data for the study of household hygiene and sanitation practices in Burayu town, Oromia Special zone. I am here to ask you some questions related to Socio demographic information, WASH, health care, and dietary factors and overall health of household members (especially children aged 6-59 months).

Purpose: This tool is prepared to collect data to assess the associations between Water, Sanitation & Hygiene (WASH) and Stunting (height/length-for-age) among children aged 6-59 months.
Your participation in this study is very important as it will help us create more in-depth understanding of the problems associated with access and utilization of WASH factors.
Be assured that all the information you provide will be treated strictly with at most confidentiality. This questionnaire will be assigned a unique identification number, which means that none of the answers you give will be linked to your name. The interview and Anthropometric measurement will take 45-90 minutes.

PLEASE NOTE THAT…
Your participation in this study is entirely voluntary and involves no cost.
You can refuse to participate or stop at any time without giving any reason for doing so.
Some of the questions are very personal, requiring you to give your own opinion
Please remember that you are free to skip any question you do not want to answer, and that you are free to stop answering questions at any time.
There are no right or wrong answers; we want to know about you, your opinions, experiences and the anthropometric measurement of child aged 6-59 months.
May I continue the interview?
Respondent consent obtained:

Yes	No

Town---------- Keble ---------- House No. ---------
Date of interview (-------/----------/ ----------
Name of Interviewer……. and signature ----------
Mother or the immediate caretaker ID number: _____

Part I-Household Information		
HI01	Who is the head of the house hold?	01 Mother 02 father/partner 03father'spartner04mother's partner
HI02	How long have you been living continuously in Burayu town? IF LESS THAN ONE YEAR, RECORD '00' YEARS	Years_____
HI03	Sex of head of house hold	1-Male 2-Female
HI04	Total number of children/ household members	
HI05	How many children under age 5 are living in this household?	

Socio- Demographics		
CG01	Identify the respondent: Are you the Mother/caregiver of the child aged 6-59 months in the house?	1.Yes-Mother 2.Yes-Caregiver
CG02	Gender of the YOUNGEST CHILD aged 6-59months	1-Male 2-Female
CG03	What is the age the youngest child aged 6-59months	_____/_____/_____year,month,day
	How do you confirm the birth date (observation)	01 birth certificate 02 christening certificate 03 health center certificate 04 home registration 05 local calendar 06 mother or caregiver diary 07 from other people
CG04	What is the birth order of (name of the youngest child)?	_____
CG05	Age of the mother/caregiver	_____
CG06	How old were you when you gave birth to your youngest aged 6-59months child? (in years)	_____
CG07	To which ethnic group do you belong?	1-Oromo 1-Amahara 3-Guragie 4-Wolaita 5-Tigray 6Others(specify)_____
CG08	What is your religion?	1-Orthodox 2-Protestant 2-Islam 3-Catholic4-Others if Others, Specify _____
CGO9	What is your marital status?	1- Married 2 -Single / Never Married 3 - Divorced 4 - Separated 5 – Widowed
CG10	What is the highest level of school that you attended? Mother/caregiver/	0-No Education 1. Primary 2. Secondary 3. Technical/Vocational 4. Higher
CG11	What is the highest level of school that your husband attended: primary, secondary, or higher?	0-No Education 1. Primary 2. Secondary 3. Technical/Vocational 4. Higher

CG12	What is the average monthly Income of your house hold? (Remark: Convert income in kind to cash income)	_____birr

Part II: Household Water Access and Treatment

HW01	What is the main source of drinking water for members of your household? If unclear, probe to identify the place from which members of this household most often collect drinking water (collection point).	Piped Water Piped Into Dwelling ------1 Piped To Yard/Plot -------2 Piped To Neighbor--------3 Public Tap/Standpipe-----4 Tube Well Or Borehole----------5 Dug Well Protected Well----------6 Unprotected Well-------7 Water From Spring Protected Spring----------8 Unprotected Spring ------9 Rainwater Tanker Truck (Boti) ----------10 Cart With Small Tank----------11 Surface Water (River/Dam Lake/Pond/Stream/Canal/---12 Irrigation Channel)----------13 Bottled Water----------14 Other _____15
HW02	Where is that water source located?	1 - In own dwell 2 -In own yard / compound 3 – Elsewhere Skip to HW 04if the answer is '1'or' 2'
HW03	How long does it take to go there, get water, and come back?	1.Number of minutes: __ __ __[estimate]
HW04	Amount of water used in the household daily?	1-In liters_____ [estimate]
HW05	In the past two weeks, was the water from this source not available for at least one full day?	1 - Yes, at least once ☐ No, always sufficient ☐ 88 Don't know ☐
HW06	Do you treat the water to make it safer to drink?	1.Yes ☐ 2. No ☐ 88Don't know. Skip to HW 08 if the answer is 'No'
HW07	What do you usually do to the water to make it safer to drink? Anything else? Check all that apply	

	Yes	No
1-Boil	1. ☐	2. ☐
2- Add bleach / chlorine	1. ☐	2. ☐
3-Strain it through a cloth	1. ☐	2. ☐
4-Use water filter (ceramic, sand, composite, etc.)	1. ☐	2. ☐
5-Solar disinfection	1. ☐	2. ☐
6 - Let it stand and settle	1. ☐	2. ☐
7 - Other (specify)_____		

HW08	Does your household have a water storage tanker?	1.Yes ☐ 2 .No ☐
HW09	Does your household store drinking water in small containers? And have a cover?	1 – Yes ☐ 2. No ☐
HW10	Observe if all water containers are covered	1 – Yes ☐ 2-No ☐

Part III:Household Sanitation Access and utilization: Interview and Visual Inspection

HSV01	Does the household have a toilet facility?	1.Yes 2.No Skip to HSV#16if the answer is ' No'
HSV02	If yes, Can all the house hold members use the latrine every time they need to defecate (during the day and at night) when they are in or near the house?	1.Yes 2.No Skip to HSV #04if the answer is ' Yes'
HSV03	If you cannot use the latrine every time you need, then where do they go instead? Do you do anything else? Check all that apply. Do not prompt.	1 - use another family's latrine 2 - use a bucket which is emptied into a latrine 3 - go on the floor and someone picks it up and puts it into the latrine 4 - go in a black plastic bag and throw the bag out of the house in the morning 5 - defecate on the ground and leave it there 6 - dig and bury it
HSV04	What kind of toilet facility do members of your household usually use? If 'Flush' or 'Pour flush', probe: Where does it flush to? If not possible to determine, ask permission to observe the facility.	1.Flush/pour flush to piped sewer system 2Flush/pour flush to septic tank 3Flush/pour flush to pit latrine 4Ventilated improved pit (VIP) latrine 5Pit latrine with slab 6Composting toilet 7Flush/pour flush not to sewer/septic tank/pit latrine 8Pit latrine without slab/open pit 9Hanging toilet/hanging latrine ,Other Shared facility 10Flush/pour flush to piped sewer system , 11Flush/pour flush to septic tank 12Flush/pour flush to pit latrine 13Ventilated improved pit (VIP) latrine 14Pit latrine with slab 15Composting toilet 16,Open Defication
HSV05	Observe if the house hold have a latrine	1.Yes,they have 2.N
HSV06	If the answer of HSV#04 is'1-9'Do you share this facility with others who are not members of your household?	1.Yes 2.No Skip to HW# 08 if the answer is 'NO'
HSV07	Do you share this facility only with members of other households that you know, or is the facility open to the use of the general public?	1Shared with known households (not public) 2Shared with general public
HSV08	Who has primary responsibility for maintaining the latrine?	1Respondent's household 2 Another household 3 shared responsibility
HSV9	How many households in total use this toilet facility, including your own household? Enter '88' if they do not know	___ ___ households
HSV10	Has your latrine pit or septic tank ever been emptied?	1 – Yes 2 – No 88Don't know..... Skip to HSV #12if the answer is ' No'
HSV11	When was your pit latrine or septic tank last emptied? Determine number of months. If they don't know, enter '88'	___ ___ months
HSV12	If the answer of HSV#04 is'1-9'Does the latrine have a slab?	1 – Yes 2 – No
HSV13	If the answer of HSV#04 is'1-9'Is there a container for water inside the latrine?	1 – Yes 2 – No
HSV14	If the answer of HSV#04 is'1-9'Does the latrine have covering	1 – Yes 2 – No

	on all four sides?	
HSV15	If the answer of HSV#04 is'1-9' Does the latrine have an intact roof that provides shelter?	1 – Yes ☐ 2 – No ☐
HSV16	If the answer of HSV#01 is' No' where do the members of your household usually use?	*Adapt to local context* 1. Bush / Field 2._____
HSV17	How do you dispose solid wastes?	1 Open filed ☐ 2 Dump into pit ☐ 3 Burning ☐ 4 Communal waste disposal Container ☐

Household Hand washing Materials		
HM01	Can you please show me where members of your household most often wash their hands? Observation: What type of facility was it? Record result and observation.	1 Fixed facility observed (Sink / Tap) in dwelling 2 Fixed facility observed (Sink / Tap) in yard /plot 3 Mobile object observed (Bucket / Jug / Kettle) 4 No hand washing place in dwelling / yard / plot 5 No permission to see 6 Other (specify) 6a: _____
HM02	Does the household have a functional hand washing station with available of water? Observation: Observe availability of water at the place for hand washing. Verify by checking the tap/pump, or basin, bucket, water container or similar objects for presence of water.	1 Water is available..... ☐ 2 Water is not available
HM03	Does the household have soap or detergent at the place for hand washing? Observation: Observe availability of soap or detergent at the place for hand washing.	1 Yes, Soap or detergent available ☐ 2 No, Soap or detergent not available
HM04	Do you and your house hold members wash your hands with soap; (Multiple responses accepted)	1) After defecation? Yes ☐ No ☐ 2) After cleaning a child? Yes ☐ No ☐ 3) Before preparing food? Yes ☐ No ☐ 4) Before feeding a child? Yes ☐ No ☐ 5) Before eating? Yes ☐ No ☐

	Health Care		
H01	Was (NAME) your youngest child aged 6-59 months given any drug for intestinal worms in the last 6 months?	1-Yes ☐	2-No ☐
H02	Has (NAME) the youngest child aged 6-59 months had diarrhea in the last two weeks?	1-Yes ☐	2-No ☐
H03	How many times did you receive antenatal care during the pregnancy of (NAME) your youngest child aged 6-59 months?	1.Number of times_____	
H04	Did you visit health facility for PNC after the delivery of your youngest child?	1-Yes ☐	2-No ☐
	Dietary Factors		
HD05	How long after birth did you first offer(NAME) the your youngest child to breast feed?	1.Within 1hrs	2.After1hrs
HD06	Did you give anything to drink and/or eat before breast milk within 3	1-Yes ☐	2-No ☐

	days for your(Name) youngest child, after delivery?	
HD07	Did you feed for(NAME) your youngest child the first yellow milk) after birth?or squeeze out and throw away the cholesterol?	1-Yes ☐ 2-No ☐
HD08	What do you use to feed (NAME) your youngest child?	1.Spoon 2.Cup 3.Bottle 4.Hand
HD09	At what age did you start feeding(NAME) your youngest child additional food?	1.Before 6 and after 8 month 2.At 6–8 month
HD10	How many times did (name of the child) eat foods, that is meals and snacks other than liquids yesterday during the day or at night? in 24 hours ? (Frequency of feeding per day)	1.Number of times 88.I ☐ know ☐

Part IV: Effects of WASH on child nutritional status(Stunting)

Now I am going to ask you some questions about the overall health and safety of your household members

IW01	During the last 15 days, has(NAME) your youngest child in the household had cough?	1.Yes ☐ 2.No ☐
IW02	During the last 15 days, has the youngest in the household had stomach ache?	1 – Yes ☐ 2 – No ☐ 3Don't Remember……
IW03	During the last 15 days has the youngest childin the household had visited a clinic/ health facility due to some health issues?	1 – Yes ☐ 2 – No ☐ 3Don't Remember……
IW04	During the last 15 days, has the youngest childunder aged 6-59months had diarrhea?	1 – Yes ☐ 2 – No ☐ 3Don't Remember……
IW05	During the last 15 days, has the youngest child under aged 6-59monthshad any pain or discomfort needing medical attention?	1 – Yes ☐ 2 – No ☐ 3Don't Remember……
IW06	Have you encountered death of a child under 5 during the last five years?	1 – Yes ☐ 2 – No ☐ 3Don't Remember…… Skip to ES 08 if the answer is 'No'
IW07	If the answer for the IW06 is YES, what was the cause	1.Diarrhea 2Respiratory disease 3Internal body pain 4 Communicable diseases 5Other causes
IW08	During the last one year, has the youngest child under aged 6-59months been admitted to the hospital or clinic or health facility due to respiratory or communicable disease?	1 – Yes ☐ 2 – No ☐ 3Don't Remember…….

Part V:Anthropometric Measurements

	Ask Consent: Now I am going to measure anthropometric measurements ☐ Child's height in centimeters_____ ☐ Child 'sweight in kilogram_____ ☐ Maternal height in centimeters _____ Notice:- The measurement should be taken three times and the average is used for analysis	A.Height in C.m 1st Ht_____Cm 2nd Ht_____C.m 3rd Ht_____C.m 4th Average_____Cm B.Weight in kg 1st Wt_____kg 2nd Wt_____kg 3rd Wt_____kg 4th Average_____kg C.Maternal height 1st Ht____C.m 2nd Ht____C.m 3rd Ht_____C.m 4th Average_____C.m

Thank you for your participation in this survey!!

ANNEX-II: AFAN OROMO VERSION QUESTIONNAIRE

Yunivarsiitii Finfinnee koollajjii qu‘annoowwan Misooma Biyyaatti giddu gala qu‘annoo Uummataa addumaattii wal-hormaata fayyaa, Qorannaa skat’insa qulqullinaa fi quucaruu(haala hiri’ina nyaataa) Ijoolee Ji’a 6-59 jidduu Jiran iirratt Godina bul.Addaa Oromiyaa Naannoo Finfinnee, Magaalaa Burrayyuutti,2022 gaggefamuu dha.

Waraqaa Bargaaffii Qorannoof Qophaa’e

Nagaa Seensa_____

Qorannoon kun kan qophaa‘e BarataaNaggasaa Gabbisaa Daadhii barataa yunivarsiitii Finfinnee koollajjii qu‘annoowwan Misooma Biyyaatti giddu gala qu’annoo Uummataa addattimoo wal-hormaata fayyaa itti guutinsa barnoota digirii 2ffaa (MA) tiif qu‘annoo akkaadaamii gaggeessuuf dha. Qorannichi kan irratti xiyyeeffatu mata duree “Prevalence of stunting and its association with Water Sanitation and Hygiene among children aged 6-59Months in Burayu town,Oromia special zone, Central Ethiopia”.

Kaayyoo gooroon qorannoo kanaa:-Sakatta‘insa ’'the associations between Water, Sanitation & Hygiene (WASH) and Stunting (height/length-for-age) among children aged 6-59 months’’ ta’aniidha. Kanaafuu,faayidaan deebii dhugaa isin bargaaffii kanarratti kennitan argannoo qorannoon mul‘suuf baay‘ee olaanaa dha.Ragaan isin qorannoo kanarratti kennitan icciitiin isaa kan eeggamee dha.Deebiin isin gaaffilee dhiyaataniif kennitan bu‘aa qorannoo kanaa qofaaf kan
oolu ta‘a.

Bilbilaa Mobile-0911746303-Negesse Gebissa Dadi

Hirmaannaa fi Deeggarsa Qorannoo kanaaf Taasiftaniif dursee isin galateeffadha.

Qajeelfama Deebbiin Ittiin Kennamu

Gaaffilee filannoodhaan dhiyaatan qubee ykn Lakkoofsa deebii sirriitti maruun deebisaa.
Kanneen iddoo duwwaan dhiifameef deebii sirrii fi ifa ta‘e barreessudhaan deebisaa
Maqaa fi teessoo barreessuun hin barbaachisu.

Waliigaltee

Gafiin isin deebisuu hin-barbanne yoo jiratee dhisuun mirga keessan ta’e yeroo barbaadanis gafii fi debii gageesinu dhaabuu ni-dandeessu.

Haa ta’u malee, gaaffilee hundaaf deebiin sirrii ta’e kaayyoo qorannaa kanaaf baaayyee barbachisadha. Hirmaachuudhaaf fedhii qabduu?

1-Eeyyee. 2-Lakkii

Mallattoo gaafaataa,Namni gaafatamu kun waligaltee isaa jechaan ibsu isaa mirkaneessuuf
_____

001. Teesso; Magalaa_____Gand_____Lakk.Manaa_____
002. Lakkoofsa bargaaffii /_____/
003. Lakkoofsa addaa Kan haadhaa /guddiftuu/_____
004. Maqaa nama gaafatuu _____ Mallattoo_____
005. Guyyaa gafii fi deebii _____
006. Frii: 1. Hundi guutame 2. Walakkaa guutame 3. kan biraa (Ibsi)_____
To’ata hordofe:-Maqaa _____, Mallattoo_____

Kutaa 1ffaa-Odeeffannoo dhuunfaa /Murteesso?hirmaattotaa /deebistootaa/			Gara itti aanutti darbi
Lakk	Gaaffillee	Filannoo deebii/koodii	
HI01	Maatii kana kan Bulchu eenyuudha?	01 Haadha 02 Abbaa 03 Fira Haadhaa 04 Fira Abbaa	
HI02	Magaala Burayyuu keessa waggaa meeqa jiraattan?waggaa tokkoo gadi yoo ta'e'00'galmeessa.	Baayyinawaggaa galmeessi_____	
Hi03	Saala Nama Maatii Kana Bulchuu	1 Dhiiraa 2 Dalaa	
HI04	Baayyina Maatii/Ijollee		
HI05	Baayyina Ijollee waggaa 5 gadii		
	Ragaalee Haala Hawwasummaa fi Uummataa		
CG01	Nama Deebi kennu adda baafadudhu. Isin,Haadha/guddiftuu mucaa/mucayyoo maatii kana keessa xiqaa umurii ji'a 6-59 gigguu jiruu/jirtuudhaa?	1 Eyyee-haadh 2 Eyyee-guddiftuu	
CG02	Mucaa/Mucayyoo Keessan/Maqaa waamudhaan/ maatii kana keessa xiqaa umurii ji'a 6-59 gigguu jiruu/jirtuudhaa saala adda nuuf baasaa?	1- Dhiiraa 2- Dhalaa	
CG03	Mucaa/Mucayyoo Keessan/Maqaa waamudhaan/ maatii kana keessa xiqaa umurii ji'a 6-59 gigguu jiruu/jirtuudhaa Umurii ishii/isaa meeqa?	___/__/__ J'ia,Guyyaa	
	Maddi bara dhalootaa maalidhaan nuuf mirkaneessitu? (nutty agarsiisaa..?)	01 Waraqaa ragaa bara dhalootaa 02. Waraqaa ragaa bara cuuphaa 03 Waraqaa raga dhaabbata fayyaa 04. Galmee Manaa Mana 05. Akka Lakkofasa guyyaa naannoo sana 06. Galmee yaadannoo Haadha/guddftuu 07. kan biraa yoo jiraate	
CG04	Mucaa/Mucayyoo/ Keessan/Maqaa waamudhaan/ maatii kana keessa xiqaa umurii ji'a 6-59 gigguu jiruu/jirtuu kuni dhalootaan meeqaffaadha?	Tartiiba dhalootaa_____	
CG05	Umurii Haadha/guddftuu meeqadha?	Waggaa_____	
CG06	Yeroo mucaa kana Hulfa turtan umuriin keessan meeqa ture?	Waggaa_____	
CG07	Sabni keessan Maaliidha?	1- Oromoo 2- Amaara 3- Guragee 4- Walaayitaa 5- Tigiree 6- Kan Biraa (Ibsaa)_____	
CG08	Amantaa isa kamiin hordoftu?	1- Ortodoksii 2- Pheenxxee 3- Isilaama 4- Kaatolikii 5 kan Biraa _____	
CGO9	Halaa bultii/ fuudhaaf heerumaa?	1. Kan Heerumte 2. Kan Bultii Hin Ijaaratin 3 Kan hiikte/Addaan bahan 4. Abbaan Warra Kan Irraa	

		Du'e 5.Kan Biro____	
CG10	Sadarkaa Barumsaa keessan kan ibsu kami?	0 Hin baranne 1 Sadarkaa 1ffaa 2. Sadarkaa 2ffaa 3. Teekiniikaa fi Ogummaa 4. Sadarkaa ol'aanaa	
CG11	Sadarkaa Barumsaa abbaa warraa keessan kan ibsu kami?	0 Hin baranne 1 Sadarkaa 1ffaa 2. Sadarkaa 2ffaa 3. Teekiniikaa fi Ogummaa 4. Sadarkaa ol'aanaa	
CG12	Galiin Ji'aa Maatii Kana Meeqa?	_____Qarshiidhaan	
Kutaa 2ffaa- Haala dhiyeessa Bishaanii dhgaatii fi Qulqullinaa Ilaalchisee			
HW01	Maddi Bishaan dhugaatii eessaa argattu?	Bishaan boonbaa 1. Mana ofiitii ujummoo 2.kan dhuunfaa Foonaa keessa 3. Kan waliinii ollaa irraa 4. Bishaan Boonoo 5 Bishaan Boolla waliinii Bishaan Boolla 6. Bishaan Boolla kan dallaa qabu 7. Bishaan Boolla kan dallaa hin qabine Burqaa 8.Bishaan Burqaa kan dallaa qab 9.Bishaan Burqaa kan dallaa hin qabine Bishaan Roobaa/Bokkaa 10.Taankaridhaan kan kuusame 11.Qodaa xixiqqaatti/barmeelaaan kan kuusame Bishaan Dachee irraa 12.(Laga,Hidhaa,kuufamaa,Jallisii) 13.Jallisii 14.Bishaan Warshaa/kan danfe 15.kab biroo_____	
HW02	Maddii bishaan kanaa eessatti argama?	1.Mana Jireenyaa Keessan Keessa 2.Dallaa Mana Jireenyaa Keessan Keessa 3.Bakk biroo_____	Deebiin '1'ykn '2' yoo ta'e gara HW 04 darbi
HW03	Bishaan dhugaatii waraabuuf mana keessanirraa dhaqaa-gala sa'aatii ammamii sinitti fudhata?	Baayyina daqiiqaa/……./……../	
HW04	Giddu galeessaan guyyaatti hangi itti fayyadama bishaan maatii keessanii liitirii meeqa?	Litrii_____	
HW05	Torban lamaan darbee keessattii maddi bishaan irraa argatan kuni,GUYYAA tokko guutuu addan cite beekaa?	1.Eeyyee- Yoo Xiqqaatee Yeroo Tokkoof 2.Lakkii,-Yerooo Hunda Ga'aadhaaa 88.Ani Hin Beeku	
HW06	Maddi Bishaan dhugaatii maatii keessanii kuni dhugaatiif akka ta'utti qulqullinni isaa /	1 Eeyyee 2.Lakkii 88.Ani Hin Beeku	Deebiin ' '2' yoo

	keemikaalaan/eegamee jiraa?		ta'e gara HW 08 darbi
HW07	Maddi dhiyyessii Bishaan dhugaatii maatii keessanii kuni qulqulluu miti/dhukkuba adda addaa fida jettanii yoo yaadan, Tooftaa/mala/ akkamiitiin qulquleessitu?	1. Danfisuudhaan 2keemikaala/kiloorinii/adda addaa ittidabaluudhaan 3Hucuu qulqulludhaan calaluu 4.Meshaa bishaan calalu fayyadamuudhaan 5.Tooftaa ho'ina aduutiin fayyamuudhaan 6 Hanga ofiif calalutti eegudhaan 7.Kan biro ibsaa_____ 8- Lakkii qulqulludhaa_____	Eeyyee / Lakkii
HW08	Maatiin keessan taankarii bishaan kuusudhaa ni fayyadamaa?	1. Eyyee 2. Lakkii	
HW09	(Ilaalii Mirkaneessi) Maatiin keessan meeshaalee /qodaa/ bishaan kuusuuf ni fayyadamaa?	1. Eyyee 2. Lakkii	
HW10	(Ilaalii Mirkaneessi) Meeshaalee bishaa itti kuusaman hundinuu qadaa ni qabuu?	1. Eyyee 2. Lakkii	
Kutaa-3ffaa: Ragaa haala dhiyeessii bishaanii,qulqullinaa fi ittifayadama isaa:gaafiif deebii dhaaf ijaan ilaaluudhaan			
HSV01	Maatiin kuni kan itti fayyadamu mana fincaanii dhuunfaa qabduu? Ilaalii Mirkaneessi)	1. Eyyee 2. Lakkii	Yoo Deebiin '2'ta'e gara Gaaffii HSV #16 Darbi
HSV02	Deebiin gaaffii HSV01 Eeyyee yoo ta'e miseensi maatii kana hundinuu halkaniif guyyaa yeroo isaan barbaachise hundayyuu ittfayadamuu ni danda'uu?	1. Eyyee 2. Lakkii	yoo deebiin"1" ta'ee HSV #04 darbi
HSV04	Maatiin kuni kan itti fayyadamu mana fincaanii akkamiiti/gosa mana fincaanii? Mana Fincanii'Flush' ykn 'Pour flush' yoo ta'e Dhangala'aan isaa garamitti akka deemu ilaaluuf eeyyama gaafadhu. (Ilaalii Mirkaneessi)	1. Fooya'aa-kan matii biraa waliin hin qoodanne 1.Sarara Balfa dhangala'aa Bulchiinsa magalchaa waliin wal-kanqunnameeedha. 2.Seeptik Taankii waliin kan wal-qunameef bishaaniin kan deemudha. 3Fana Fincaanii Gara Boolla mana fincaanitti kan dhangala'uudha. 4Mana Fincanii Fooyya'aa kan foolii hin qabnee (VIP)dha. 5 Mana Fincaanii Koonkiritidhaan hojjetame kan qadaada qabuu dha. 6 Mana Fincanii 'compostiidha'. 2. Kan hin Fooya'in 7 Sarara Balfa dhangala'aa	

		Bulchiinsa magalchaa waliinis ta'ee seeptik taankii waliin kan wal- hin qunnameeedha. 8 Mana Fincaanii Koonkiritidhaan malee kan hojjetame kan qadaada hinqabinee dha 9 Mana Ficanii Rara'aadha/ Kan Biraa_____ 3.Mana Fincaanii Waliin 10 Sarara Balfa dhangala'aa Bulchiinsa magalchaa waliin wal-kanqunnameeedha 11 Seeptik Taankii waliin kan wal-qunameef bishaaniin kan deemudha 12 Fana Fincaanii Gara Boolla mana fincaanitti kan dhangala'uudha. 13 Mana Fincanii Fooyya'aa kan foolii hin qabnee (VIP)dha. 14 Mana Fincaanii Koonkiritidhaan hojjetame kan qadaada qabuu dha. 15 Mana Fincanii 'compostiidha'	
HSV05	Maatichi Mana Fincaanii yoo qabaate isanii ilaali. Ilaalii Mirkaneessi)	1Eyyee-qabu 2Lakkii-hin qabani	
HSV06	Gaaffii HSV#04 Deebiin 1-9 yoo ta'em mana Fincaanichaa maatiin gara biraa ni fayyadamuu/ni qoodatuu/?	1.Eyyee 2.Lakkii	Deebiin '2' yoo ta'e gara #08 darbi
HSV07	Mana fincaanichaakana maatii wal beektanii qofa fayyadamtumoo uummata baladhaafis banaadha?	1.Maatii Wal Beeknu Waliin Qofa Fayyadamina (Kan Uummataa Kan Hin Ta'in)2.Uummata Hundaaf Banaadha.	
HSV08	Mana ficaanii kana kunuunsuu ykn suphuun isaa ittigaafatamumaan isaa kan eeenyuuti??	1. Kan Maatii Kanaa 2. Kan Maatii Biraa 3.Iittigafatamummaa waliin qabna	
HSV9	Mana fincaanii kana maatii meeqatuu waliin fayyadama?hin beekani yoo ta'e '88' barreessi	Baayyina Maatii	
hsv10	Boolla mana fincaanii/seeptik taankii/ kana keessaa duuwwaa ta'ee.goosiftanii beektuu?	1.Eyyee 2.Lakkii 88 Ani hin beeku	Deebiin '2' yoo ta'e gara HSV #12 darbi
HSV11	Boolli mana fincaanii/seeptik taankiim kuni yeroo dhumaaf kam keessa duuwwa godhame yoomi?ji'a isaa barreessi/hin beekani yoo ta'e '88' barreessi	___ ___ Ji'oota	
HSV12	Gaaffii HSV#04 Deebiin 1-9 yoo ta'e mana fincaanichaa lafti isaa simintoodhaan hojjetamee?	1.Eyyee 2.Lakkii	
HSV13	Gaaffii HSV#04 Deebiin 1-9 yoo ta'e mana fincaanichaa bakka bishaan harka dhiqanaa taa'u ni qabaa?	1.Eyyee 2.Lakkii	
HSV14	Gaaffii HSV#04 Deebiin 1-9 yoo ta'e mana fincaanichaa Kallatti arfaniiniyyuu aguuggii/mana/ ni qabaa?	1.Eyyee 2.Lakkii	

HSV15	Gaaffii HSV#04 Deebiin 1-9 yoo ta'e mana fincaanichaa karaa gubbatiin/Roof/ aguuggii Kallatti arfaniini ni qabaa?	1.Eyyee 2.Lakkii	
HSV16	Gaaffii HSV#01 dhaaf deebiin issa lakkii/2/ yoo ta'e Miseensi Maatichaa yeroo baayyee eessatti fayadamu?	* Akka Naannoo sanatti ibsi* 1.Bosonatti/Dirree irratti 2._____kan biraa	
HSV17	Koosii/Balfa/ gogaa akkamittin maqisitu/dhabamsiistu?	1.Dirree irratti gatuudhaan 2.boolla kosii 3.Ibidaan gubuudhaan	
Ragaa Dhiyyessi Meeshaalee Harka Dhiqanaa Maatichaa ilaalchissee			
HM01	Maaloo!Bakka maatiin keessan hakra itti dhiqatan nutty agarsiisu dandeessuu? Ilaalii Mirkaneessi)waan ijaan argitan sana galmeesssi.	1-Bakki harka dhiqannaa mana keessa siinkiin/boonboon ni jira2 Bakki harka dhiqannaa Mooraa/dallaa/ keessa siinkiin/boonboon ni jira 3-Meeshaan harka dhiqanaaf tajaajilukan akka Joogii.Baalddii kan bakkaa bakkatti socho'uutuu jira. 4-Mana keessa ta'ee mooraa keessaa bakki harka dhiqanaaf tajaajilu hin jiru! 5-Ialaaluuf naaf hin eeyyama hin arganne6-kan biraa (ibsaa) :_____	
HM02	Bakka/meeshaan/ maatiin kuni hakra itti dhiqachuuf qopheesse kuni bishaan qabaa? Ilaalii Mirkaneessi)waan ijaan argitan sana galmeesssi._____	1.Eyyee –Bishaan qaba 2.Lakkii-Bishaan hin qabu/jiru/	
HM03	Maatiin kuni hakra itti dhiqachuuf Kan oolu;Saamunaa ykn dhiyyessi biraa kan akka daaraa kkf…jiraa? Ilaalii Mirkaneessi)waan ijaan argitan sana galmeesssi._____	1.Eyyee –Saamunaa ykn dhiyyessi biraa kan akka daaraa kkf…jira 2.Lakkii-Saamunaa ykn dhiyyessi biraa kan akka daaraa kkf hin qabu/jiru/	
HM04	Miseensi Maatii kanaa hakra yoomi,yoomifaa/yeroo akkamii/ dhiqata? (Deebii baayyee qabaachuu ni danda'a)		Eeyyee / Lakkii
		1.Mana Fincaanii erga fayyadamee booda 2)Daa;iman qulqulleesse booda? 3)nyaataa qopheessuun dura 4) Ijoollee nyaachusuun dura 5)Nyaataa nyaachuun dura	

Gaaffilee Kunuunsa Fayyaa Ilaachisee			
lakk.	Gaaffilee	Filannoo Deebii/Koodii	Gara Itti Aanutti Darbi
H01	Daa'imin maatii kana keessa xiqaa /Maqaa waamudhaan/ umurii ji'a 6-59 gigguu jiruu/jirtuu kuni ji'oota 6 darban keessatti qorchaa raammoo garaa keessaa fudhatee jiraa?	1.Eyyee 2.Lakkii	
H02	Daa'imin maatii kana keessa xiqaa /Maqaa waamudhaan/ umurii ji'a 6-59 gigguu jiruu/jirtuu kuni torban 2 n darban keessatti mallattoon dhukkuba garaa kaassa irratti mulatee turee?	1.Eyyee 2.Lakkii	
H03	Yeroo Daa'imin maatii kana keessa xiqaa /Maqaa waamudhaan/ umurii ji'a 6-59 gigguu jiruu/jirtuu kana ulfa turtan sana qorannoo da'umsa-duraa yeroo meeqaa siniif godhame?	1 Baayyina Yeroo_____	
H04	Daa'imin maatii kana keessa xiqaa /Maqaa waamudhaan/ umurii ji'a 6-59 gigguu jiruu/jirtuu kana ega deessanii boodaahoo tajaajila fayya da'umsa-boodaa siniif godhamee jiraa?	1.Eyyee 2.Lakkii	

Ragaa Haala nyaata(soorata) Daa'imaa ilaalchissee			
HD05	Mucaan dhalatee/ttee hagam turtanii harma hoosisuu eegaltan?	1.Sa'aatii1keessatti 2.Sa'aatii tokko Booda	
HD06	Mucaan dhalatee hanga guyyaa 3tti harma haadhaatiin hala nyaata dabalataa biro ykn dhangala'aa kennitaniifii jirtuu?	1.Eyyee 2.Lakkii	
HD07	Mucaan keessan yeroo dhalate Aanan duraa biifaan keelloo(silga) hodhee jiraa?	1.Eyyee 2.Lakkii	
HD08	Mucaa nyaachisuuf meeshaa akkamii fayyadamtuu?	1.Maankaa 2.kubaayyaa 3. Buttullee 4. Harka 5.xuuxxoo	
HD09	Umurii meeqatti nyaata dabalataa laachuufii eegaltan?	Ji'a_____	
HD10	Mucaan nyaata biraa dhangala'aadhaan ala sa'a 24 darbe yeroo meeqa fudhatee/ttee?	1.Baayyina Yeroo_---------- 88hin Beeku	

Kutaa- 4ffaa- Ragaa haala Bishaan,sanitashiniif,Qulqullinaa fi dhiibba nyaata daa'imanii irraan ga'u.			
Ammamoo Haala Fayyaa miseensa maatii keessanii tokko tokko sin gaafachuuf.			
IW01	Daa'imin maatii kana keessa xiqaa /Maqaa waamudhaan/ umurii ji'a 6-59 gigguu jiruu/jirtuu kuni torban 2 n darban keessatti hutaalloo/qofaa qaba turee?	1.Eeyyee 2.Lakkii 3.Hinyaadadhu	
IW02	Daa'imin maatii kana keessa xiqaa /Maqaa waamudhaan/ umurii ji'a 6-59 gigguu jiruu/jirtuu kuni torban 2 n darban keessatti dhukkuba garaatiin qabamee ture?	1.Eeyyee 2.Lakkii 3.Hin yaadadhu	
IW03	Daa'imin maatii kana keessa xiqaa /Maqaa waamudhaan/ umurii ji'a 6-59 gigguu jiruu/jirtuu kuni torban 2 n darban keessatti Sababa rakkina fayyatiin dhaabata fayyaa dhaqee ture?	1.Eeyyee 2.Lakkii 3.Hin yaadadhu	
IW04	Torban lamaan darbe keessa mucaan dhukkuba garaa kaasaa qabaa /qabdii?	1.Eeyyee 2.Lakkii 3.Hin yaadadhu	
IW05	Torban lamaan darbe keessa mucaan rakkina fayyaa hordoffii barbaadu ykn rakkini fayya biraa qunamee ture?	1.Eeyyee 2.Lakkii 3.Hin yaadadhu	
IW06	Wagga shaman darbe keessatti duutii ijolleewaggaa 5 gadii sin qunnamee?	1.Eeyyee 2.Lakkii 3.Hin yaadadhu	Deebiin''1' 'yoo ta'e IW08darbi
IW07	Gaaffii- IW06 deebiin Eeyyee yoo ta'e sababa maaliitiin ture?	1.Garaa kaassaa 2. Rakkina dhukkuba ujummoo Afuuraa 3.Dhukkuba garaa keessaa 4Dhukkuba Dadarboo 5.kan biraa----------	
IW08	Torban lamaan darbe keessa dhukkuba afuuraa /sombaa/ ykn dhukk.dadarboo biratiin dhaabbata fayyaa ciissee/tee ture?	1.Eeyyee 2.Lakkii 3.Hin yaadadhu	

Gafiif deebii keenya xummurree jira! yeroo keessan haarsa gootanii waanhirmataniif guddaa galatoomaa!!

Ammamoo dheerina keessanii,Ulfinaa fi dheerina mucaa madallle baruu barbaanna! naaf Eeeyyamtuu?

Madaallii ittfufuu? 1. Eeyyee 2.Lakkii

DeebiinEEEYYEF:- yoo ta'e madallii ittifufaa!

Kutaa 5. Madaala Qaamaa			
Maqaa mucaa _____		umurii mucaa __	Saala mucaa 1. Dhi. 2. Dha
A01	Dheerinni mucaa dhaabbatee seentiimetraan(umurii jia'a24-59)	1ffaa__ 2ffaa__ 3ffaa__	Average
A02	Dheerinni mucaa dugdaan ciisee/tee seentiimetraan (umurii jia'a -06-23)	1ffaa__ 2ffaa__ 3ffaa__	Average
A03	Ulfinni haadhaa kiilograamaan	1ffaa__ 2ffaa__ 3ffaa__	Average
A04	Dheerinni haadhaa seentiimetraan	1ffaa__ 2ffaa__ 3ffaa__	Average

Yeroo keessan aarsaa gootanii waan qu'annoo kanatti irratti hirmaataniif guddaa galatoomaa!