

**PREVALENCE AND PREDICTORS OF DIARRHEA  
AMONG CHILDREN UNDER FIVE YEARS IN  
BONDHERE DISTRICT, SOMALIA**

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**Determinants of Diarrhea Occurrence in Children Under Five Years  
in Bondhere District, Somalia**

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the Degree of Master of Science in Public Health of the Jomo  
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**DECLARATION**

This thesis is my original work and has not been presented for a degree in any other University.

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## **DEDICATION**

I dedicate this project to my wife, children and my entire extended family for their support and encouragement through the entire journey of my studies.

## **ACKNOWLEDGEMENT**

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## ACRONYMS AND ABBREVIATIONS

<b>CI</b>	Confidence Interval
<b>DALYs</b>	Disability-Adjusted Life Years
<b>FGM</b>	Female Genital Mutilation
<b>IDPs</b>	Internally Displaced Persons
<b>IYCF</b>	Infant and Young Child Feeding
<b>MICS</b>	Multiple Indicator Cluster Survey
<b>NGO</b>	Non-Governmental Organisations
<b>OR</b>	Odds Ratio
<b>ORS</b>	Oral Rehydrating Solution
<b>SDG</b>	Sustainable Development Goals
<b>SWALIM</b>	Somalia Land and Information Management
<b>UN</b>	United Nations
<b>UNHCR</b>	United Nations High Commissioner for Refugees
<b>UNICEF</b>	United Nations Children’s Fund
<b>WASH</b>	Water Sanitation and Hygiene
<b>WHO</b>	World Health Organization

## DEFINITION OF OPERATIONAL TERMS

<b>Acute Watery Diarrhea</b>	Change in the consistency of stool leading to loose or liquid stools and/or an increase in the frequency of evacuations to three or more in 24 hours, with or without fever or vomiting lasting 7 days or less
<b>Handwashing</b>	Washing hands with plain or antimicrobial soap and water.
<b>Persistent Diarrhea</b>	The passage of three or more loose or liquid stools per day for a period of 14 days or longer.

## ABSTRACT

Diarrhoea remains a significant health concern for children under five years old particularly in developing countries. In Somalia, the situation is even direr with diarrhoea accounting for a substantial proportion of deaths among children under five years. This study aimed to determine the predictors of diarrhoea among children under five years in Bondhere district, Somalia. The research focused on determining the prevalence of diarrhoea occurrence among children, socio-demographic factors, hygiene and sanitation practices, and immunization status among caregivers as potential contributors to diarrheal diseases in this population. A cross-sectional study was conducted in Bondhere district, Somalia. The study population consisted of mothers and caregivers of children under 5 years. A sample size of 246 was calculated using a formula by Fischer et al. Cluster random sampling was used to identify respondents from four sub-districts. Data was collected using research administered semi-structured pre-coded questionnaires and observational checklists. Data analysis was performed using SPSS version 25, employing descriptive statistics, chi-square tests, and binary logistic regression. The study revealed that diarrhoea prevalence was 22.9% among children under five years in the two weeks prior to the study. Socio-demographic factors that were significantly associated with diarrhoea included the caregiver's education level (OR= 1.257, 95% CI = 0.436 - 2.100,  $p = 0.03$ ), number of children under 5 years in the household (OR= 1.054, 95% CI = 0.510 - 2.784,  $p = 0.04$ ), and household monthly income (OR= 1.909, 95% CI = 0.736 – 4.950,  $p = 0.04$ ). Hygiene and sanitation practices were also significant factors, with unsafe water sourcing practices (OR= 1.187, 95% CI = 0.269 – 5.235,  $p = 0.02$ ), improper handwashing (OR= 0.711, 95% CI = 0.145 – 3.500,  $p = 0.04$ ), and improper sanitation practices (OR= 3.373, 95% CI = 0.564 – 6.143,  $p = 0.02$ ) increasing the likelihood of diarrhoea. Interestingly, immunization status was not significantly associated with diarrhoea occurrence ( $p = 0.08$ ). The study concludes that socio-demographic factors, particularly education level, household size, and income played a crucial role in the occurrence of diarrhoea among children under five in Bondhere district. Additionally, improper hygiene and sanitation practices, including unsafe water sourcing practices, improper handwashing, and improper sanitation practices, significantly influenced diarrhoea prevalence among the study population. Therefore, improving caregiver knowledge of hygiene and sanitation practices, alongside enhancing access to safe water sources and promoting proper handwashing techniques will improve diarrhea outcomes.



## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background Information

Diarrheal diseases continue to pose a significant global health challenge across the world. Diarrhea stands as the second leading cause of death worldwide among the children below the age of five years (WHO, 2022). It accounts for one in every five deaths and claims more young lives than AIDS, malaria, and measles combined. Recent estimates paint a grim picture with approximately 500,000 children under five succumbing to diarrhea-related complications annually (Tareke *et al.*, 2022). It also reported that the burden of this disease is disproportionately high in developing countries where about 90% of affected children are reported to reside. Compounding this issue is the role of malnutrition which is often exacerbated by recurrent diarrheal episodes and contributes to an estimated 45% of deaths in this age group (WHO, 2022).

The global health community has increasingly recognized the link between environmental factors and disease burden with approximately 30% of worldwide disease burden attributed to environmental risk factors. Access to clean water sources and adequate sewage systems plays a crucial role in public health outcomes. In response to these challenges the United Nations' third Sustainable Development Goal (SDG) aims to end preventable deaths among children under five by 2030 and therefore emphasizing universal access to clean water and sanitary facilities (Sharrow *et al.*, 2022). However, despite these efforts, reports indicate a rising global burden of diseases related to poor water supply, sanitation, and hygiene (Wolf *et al.*, 2023).

The situation in Sub-Saharan Africa is much worse with the region facing significant hurdles in improving water, sanitation, and hygiene (WASH) conditions. Limited access to clean water, inadequate sanitation facilities, and poor hygiene practices contribute to the high prevalence of diarrhea among children under five (Getahun *et al.*, 2021). These challenges are further worsened by factors such as malnutrition, limited healthcare access, and low maternal education levels which creates a complex web of issues that perpetuate the cycle of diarrheal diseases in the region.

Within this broader context, Somalia faces unique and formidable challenges in addressing diarrheal diseases. As a predominantly Muslim country with an economy largely based on nomadic and semi-nomadic pastoralism practiced by about 85% of the population, Somalia struggles with widespread poverty and limited access to basic services (Mohamed & Abdilahi, 2021). Approximately 15-20% of Somalis live in urban centers with an estimated 43% surviving on less than a dollar a day (Yusuf *et al.*, 2023). The healthcare situation is particularly alarming with about 80% of the people not able to access health services. Consequently, the mortality rate for children under five years is very high at 180 per 1,000 live births placing Somalia in the fourth-last globally in this context (UNICEF, 2016). The prolonged political instability in Somalia since 1991 has further intensified these issues leading to widespread infrastructure destruction, slow economic development, and inadequate access to basic needs for most people (World Bank, 2020). This instability has also resulted in significant population displacement with about 40,000 Internally Displaced People (IDPs) in and around Mogadishu alone (UNHCR, 2022).

Within this challenging national landscape, the Bondhere district located in the heart of Mogadishu serves as a microcosm of the urban challenges faced in Somalia. Divided into four sub-districts of Nasib Bundo, Yusuf Al-Konwnayn, Daljirka and Sinay, Bondhere hosts 12 IDP camps where children are particularly vulnerable to malnutrition and diarrheal diseases. The district's economy primarily revolves around business and manual labor with many residents depending on remittances from relatives to make ends meet (Mahmud, 2021). On this backdrop, several factors are anticipated to contribute to the prevalence of diarrhea among children under five in Bondhere district. In light of these challenges the study aims to investigate the prevalence of diarrhea among children under five years in Bondhere district and the factors associated with its occurrence.

## **1.2 Statement of the Problem**

Globally it has been estimated that diarrhea claims the lives of over 1.3 million children annually (Warsame, 2021). According to the World Health Organization (2023), diarrhea is responsible for an estimated 1 in 5 child deaths in Africa making it

a public health problem of concern and thereby necessitating the urgent need for intervention. In the broader context of Sub-Saharan Africa diarrhea remains a leading cause of mortality among children under five years by contributing to about 9% of all deaths in this age group, which translates to approximately 444,000 child deaths each year globally (Dube & Ojo, 2020). In East Africa, the burden is similarly severe, with countries like Ethiopia and Kenya reporting high rates of diarrhoea-related morbidity and mortality. For instance, it is estimated that over 500,000 children under five dies from diarrhoea each year in the East African region alone (UNICEF, 2021).

In Somalia, the situation is even more dire with diarrhea accounting for a substantial proportion of deaths among children within this age group. The high prevalence in Somalia is associated with the country's complex socioeconomic landscape and limited access to essential services (UNHCR, 2022). Approximately 9,500 children under five dies from diarrhea annually in the country (Isack *et al.*, 2021). Additionally, an estimated 800,000 DALYs are lost annually due to diarrhea-related deaths among children under five in Somalia while complications from diarrhea result in approximately 200,000 DALYs lost annually (Isack *et al.*, 2021). Despite the evident severity of the diarrheal disease burden in Somalia, there is a notable lack of district-specific research, particularly in urban areas like Bondhere. Moreover, the specific prevalence of diarrhea among children under five in this district as well as the localized factors contributing to its spread remain largely unknown.

Furthermore, existing studies on diarrheal diseases in Somalia have primarily focused on immediate risk factors such as water quality and sanitation practices (Isack *et al.*, 2021; AMohamed & Abdilahi, 2021; Warsame, 2021). There is a gap in understanding how these factors interact with broader socioeconomic issues, healthcare accessibility, and community behaviors specific to urban districts like Bondhere. This lack of comprehensive, context-specific research hinders the development of targeted and effective interventions to address the problem. In light of these challenges and knowledge gaps there was an urgent need for research that provides district-specific data on the prevalence of diarrhea among children under five in Bondhere district and their association with the urban-specific risk factors.

### **1.3 Justification**

The persistent prevalence of diarrhea among children under five years in Somalia, represents a critical public health concern that necessitates urgent investigation (Isack *et al.*, 2021). This study is justified by the interplay of several factors contributing to the burden of diarrheal diseases in this vulnerable population. Bondhere District, like many urban areas in Somalia, grapples with significant challenges in water, sanitation, and hygiene (WASH) conditions. Limited access to clean water and inadequate sanitation facilities creates an environment conducive to the spread of diarrheal pathogens. Understanding the specific WASH-related risk factors in this urban area was considered necessary for developing targeted interventions. Moreover, the socioeconomic landscape of Bondhere District, characterized by high poverty levels, severely restricts access to healthcare services and proper nutrition. This economic hardship may not only increase the risk of diarrheal diseases but also may limit the ability of families to seek timely medical care when needed. The presence of 12 Internally Displaced People (IDP) camps in Bondhere District introduces unique challenges. Overcrowding and inadequate living conditions in these camps may significantly exacerbate the risk of diarrheal diseases. By comprehensively examining these factors and their associations with diarrhea prevalence among children under five in Bondhere District, this study aims to fill critical knowledge gaps and provide valuable information for public health interventions. The findings will be instrumental in informing evidence-based policies and interventions tailored to the specific needs and challenges of Bondhere District, guiding the allocation of limited resources to the most effective diarrhea prevention and control strategies, identifying opportunities for integrated interventions that address multiple risk factors simultaneously, and policy making especially those related to primary healthcare and community health volunteers. Moreover, this research will provide a foundation for future studies on child health in urban Somali contexts and support advocacy efforts for improved WASH infrastructure, healthcare access, and nutritional support in vulnerable communities. Given the significant morbidity and mortality associated with diarrheal diseases in Somalia, and the unique challenges faced by urban districts like Bondhere, this research is not only justified but urgently needed. The findings from this study have the potential to contribute significantly to reducing the burden of diarrheal

diseases and improving overall child health outcomes in Bondhere District and similar urban settings in Somalia (UNICEF, 2021; WHO, 2023).

## **1.4 Objectives of the Study**

### **1.4.1 Main Objective**

To determine factors associated with occurrence of diarrhoea among children under five years in Bondhere district, Somalia.

### **1.4.2 Specific Objectives**

1. To determine the prevalence of diarrhea among children under five years of age in Bondhere District, Somalia
2. To determine socio-demographic factors associated with diarrhea among children under five years of age in Bondhere District, Somalia
3. To assess the level of association between hygiene and sanitation practices and the occurrence of diarrhea among children under five years of age in Bondhere District, Somalia.
4. To evaluate the relationship between immunization status and the occurrence of diarrhea among children under five years of age in Bondhere District, Somalia.

## **1.5 Research Questions**

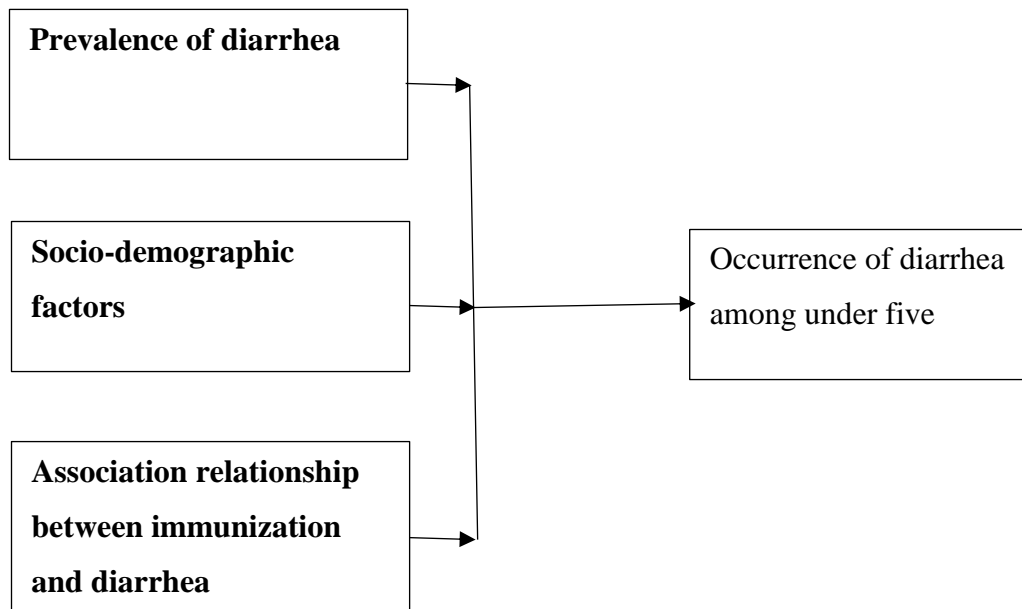
1. What is the prevalence of diarrhea among children under five years of age in Bondhere District, Somalia?
2. Which are the socio-demographic factors associated with diarrhea among children under five years of age in Bondhere District, Somalia?
3. What is the level of association between hygiene and sanitation practices and the occurrence of diarrhea among children under five years of age in Bondhere District, Somalia?
4. Is there a relationship between immunization status and the occurrence of diarrhea among children under five years of age in Bondhere District, Somalia?

## **1.6 Conceptual Framework**

Socio-demographic factors such as age, gender, household size, education level of parents, occupation of parents, income level, and place of residence are believed to influence the occurrence of diarrhea. For example, children from low-income households may have limited access to clean water and sanitation facilities, increasing their risk of infection. Additionally, hygiene and sanitation practices are directly linked to the transmission of diarrhea-causing pathogens. Access to clean water, availability of sanitation facilities, handwashing practices, and food hygiene practices all play crucial roles in preventing the spread of disease. Further, immunization status can protect children from certain diarrheal diseases, such as rotavirus. However, factors like vaccine availability, accessibility, and uptake can influence immunization rates, affecting the prevalence of diarrhea. Nutrition status can mediate the relationship between the independent variables and the dependent variable. Children with poor nutrition may be more susceptible to diarrhea due to weakened immune systems. While, environmental factors such as overcrowding and exposure to pathogens can also contribute to the prevalence of diarrhea. Living in crowded conditions can increase the transmission of disease-causing organisms, while exposure to contaminated water or soil can lead to infection. Understanding the complex relationship between these variables is essential for developing effective interventions to reduce the burden of diarrhea in the region.

**Independent variables**

**Dependent variable**



**Figure 1.1: Conceptual Framework**

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Overview of Diarrhoea

Diarrhea remains a significant public health issue globally, particularly among children under five years old, with a disproportionate burden in low- and middle-income countries such as Somalia. The global mortality rate for children under five due to diarrhea stands at around 9% of total deaths in this age group, accounting for more than 500,000 deaths annually (Tareke *et al.*, 2022). In Somalia, the prevalence of diarrhea among children under five remains one of the highest in the world, exacerbated by poor water, sanitation, and hygiene (WASH) conditions, as well as limited access to healthcare services. According to a study by (Isack *et al.*, 2021), the overall prevalence of diarrhea among children under five in Somalia was found to be 23.5%, placing Somalia among the countries with the highest burden of diarrheal diseases in sub-Saharan Africa. This prevalence rate, however, varies significantly across different regions within the country. In Mogadishu, the capital city, and Hargeisa area, studies have reported prevalence rates as high as 28% and 51%, particularly in internally displaced person (IDP) camps respectively, where access to clean water and proper sanitation is severely limited ((Ismail *et al.*, 2024; Mohamed & Abdilahi, 2021) Meanwhile, in rural areas such as Puntland and Somaliland, the prevalence of diarrhea ranges between 20% and 22%, with lower rates in regions that have better access to WASH interventions (Ismail *et al.*, 2024).

Comparatively, the prevalence of diarrhea in Somalia far exceeds that of neighboring countries. In Kenya, for example, the prevalence of diarrhea among children under five was 15.3%, as reported in the Kenya Demographic and Health Survey (KDHS, 2022). Ethiopia, another neighboring country, reported a prevalence of 12% among children under five (Birhan *et al.*, 2023). Even within the broader East African region, Somalia stands out as having one of the highest diarrhea prevalence rates, significantly higher than countries such as Rwanda (9.2%) and Tanzania (10.7%) (Melese *et al.*, 2023). These variations can be attributed to differences in national health infrastructure, public health interventions, and access to clean water and sanitation.



The prevalence of diarrhea in Somalia also reflects disparities in access to healthcare services. A report by Khan *et al.* (2020) indicates that only 40% of children with diarrhea receive oral rehydration therapy (ORT), a critical intervention for preventing severe dehydration and death. By comparison, Tanzania and Uganda have much higher ORT coverage rates, at 62% and 58%, respectively (Lamshöft *et al.*, 2024; Okutia & Nabukenya, 2024). This lack of access to essential healthcare services further compounds the public health challenge in Somalia, contributing to high morbidity and mortality rates associated with diarrheal diseases.

Globally, diarrhea prevalence among children under five in sub-Saharan Africa averages around 14% (WHO, 2021), but Somalia's rates far surpass this regional average. The highest diarrhea prevalence in the country is observed in southern Somalia, particularly in the Jubaland region, where prevalence rates reach up to 32% (WHO, 2022). The prolonged conflict and displacement in this region have exacerbated WASH challenges, leading to frequent outbreaks of diarrheal diseases. In contrast, regions like Somaliland and Puntland, which have experienced relative stability, show lower prevalence rates, although they are still above the global average, ranging between 18% and 22% (Mohamed & Abdilahi, 2021). When comparing Somalia's diarrhea prevalence rates to those of other conflict-affected countries, such as South Sudan, there are notable similarities. South Sudan reports a diarrhea prevalence of 22%, almost comparable to Somalia's overall rate (Iyya *et al.*, 2020). However, Somalia's figures are still significantly higher than those reported in more stable regions, such as Ghana, where diarrhea prevalence among children under five has been reduced to 9.8% due to sustained public health interventions (Owusu *et al.*, 2024).

In addition to regional disparities within Somalia, temporal trends also reveal that diarrhea prevalence has remained persistently high despite various international efforts to improve WASH conditions and healthcare access. According to the WHO (2022), the national average of diarrhea prevalence has not seen substantial reductions over the past decade, approximately 22% to 25%. This stagnation highlights the ongoing need for more effective and widespread public health interventions to reduce the disease burden. Efforts by international organizations like UNICEF and the WHO have

led to some improvements in select areas, but overall progress has been slow. WASH interventions in Puntland have successfully reduced diarrhea prevalence from 24% in 2020 to 22% in 2024 (Figuerero *et al.*, 2024; Isack *et al.*, 2021). However, such progress is not evenly distributed across the country, with southern and central regions remaining particularly vulnerable to outbreaks.

## **2.2 Association between Social Demographic Factors and Diarrhea among Under 5 Children**

### **2.2.1 Age and Gender**

Diarrhea remains a leading cause of morbidity and mortality in this age group, particularly in low- and middle-income countries where sanitation and hygiene are often inadequate (Figuerero *et al.*, 2024). Age plays a crucial role in susceptibility to diarrhea, with younger children, especially those under two years, being disproportionately affected. For instance, studies by Atari *et al.* (2023) and Vong *et al.* (2021) show that children aged 0–2 years exhibit significantly higher diarrhea prevalence compared to older children. In Sudan, 45% of children under two experienced at least one diarrheal episode, while only 28% of children aged four to five years were affected (Atari *et al.*, 2023). Similarly, Mashoto *et al.* (2022) reported that in Tanzania, children aged 12–23 months had a prevalence rate of 38.5%, compared to just 20.3% in children aged 24–60 months. The marked reduction in diarrhea prevalence with increasing age can be attributed to factors such as the maturation of the immune system and improved ability to avoid high-risk behaviors like frequent hand-to-mouth actions that characterize early childhood development. Moreover, younger children’s increased exposure to contaminated environments and objects further heightens their vulnerability to diarrheal diseases.

The role of gender in the prevalence of diarrhea among children under five has been explored in several studies, but findings remain inconsistent. Some research indicates that boys may experience diarrhea more frequently than girls. For example, in Ethiopia, Tareke *et al.* (2022) reported that 54% of boys under five years had experienced at least one episode of diarrhea, compared to 46% of girls in the same age group. The potential explanation for this disparity lies in behavioral differences, with

boys potentially engaging more in activities that expose them to pathogens, such as playing in dirt or contaminated water. However, not all studies support this conclusion. Mashoto *et al.* (2022) found no significant gender differences in diarrhea prevalence among children in Tanzania, with similar rates observed for boys (22.5%) and girls (21.9%). This lack of consistent gender-based trends suggests that while gender may influence diarrhea risk in some contexts, it is not a universal determinant. The varying results across regions indicate that other environmental or cultural factors may mitigate or exacerbate the gender differences in diarrhea prevalence, making it essential to investigate gender dynamics within specific contexts.

Environmental and behavioral factors, which are generally consistent across genders, also play a significant role in the transmission of diarrheal diseases among young children. Regardless of gender, common practices among children, such as crawling, putting objects in their mouths, and using bottles or pacifiers, expose them to similar risks. Access to clean drinking water and proper sanitation remains a critical determinant of diarrhea prevalence. In Somalia, for example, where conflict and poor infrastructure have severely limited access to clean water, the prevalence of diarrhea in children under two years is as high as 42%, with children aged 6–23 months being the most affected (Warsame, 2021). These figures are consistent with findings from other regions in sub-Saharan Africa, such as Ethiopia, where 32.2% of children under two experienced diarrhea (Getahun & Adane, 2021). The high incidence of diarrhea in these regions highlights the intersection of poor sanitation, inadequate healthcare infrastructure, and limited access to clean water. Additionally, studies suggest that socio-political factors exacerbate these challenges, particularly in conflict-affected regions like Somalia, where mothers and caregivers face immense difficulties in maintaining proper hygiene and sanitation for their children due to displacement and limited resources (Braam *et al.*, 2021). Addressing these systemic issues through improved water, sanitation, and hygiene (WASH) interventions, along with targeted health education, is crucial to reducing the burden of diarrheal diseases in children under five, irrespective of gender. On this basis there is need to further investigate the potential gender-specific risk factors and interventions in the Somali context.

### 2.2.2 Marital Status

Marital status has been identified as a significant socio-demographic factor influencing child health outcomes, including the incidence of diarrhea among children under five years old. The association between a caregiver's marital status and childhood diarrhea is complex, with various studies suggesting that children raised by single parents, particularly single mothers, may face a higher risk of diarrhea due to economic constraints, reduced access to healthcare, and limited caregiving support. Conversely, children in households with both parents' present may experience protective benefits, as dual-parent households are more likely to have better financial stability, improved health-seeking behaviors, and shared caregiving responsibilities (Hou *et al.*, 2020).

Empirical evidence underscores the increased risk of childhood diarrhea in households led by single mothers. In Ethiopia, a study found that children of single mothers were 1.5 times more likely to suffer from diarrhea than children from dual-parent households (Feleke *et al.*, 2022). The study attributed this increased risk to the financial instability commonly experienced by single mothers, who often struggle to provide consistent access to clean water, nutritious food, and adequate sanitation. Similarly, in a study conducted in Tanzania, children raised by unmarried or separated caregivers had a 30% higher prevalence of diarrhea compared to children living with married parents (Mashoto *et al.*, 2022). The researchers noted that single-parent households often face higher levels of economic hardship, reducing their ability to afford hygiene products and services necessary to prevent diarrheal diseases.

In contrast, children from dual-parent households benefit from greater economic security, which plays a pivotal role in mitigating the risk of diarrhea. Dual-parent households are more likely to have access to clean water and improved sanitation facilities due to their combined income, as well as better health-seeking behaviors, such as seeking prompt medical attention when a child falls ill (Peterson *et al.*, 2024). Additionally, the presence of both parents enables a more even distribution of caregiving tasks, which can reduce the likelihood of poor hygiene practices and subsequently lower the incidence of diarrhea.

The marital status of caregivers also influences health education and awareness. Single parents, particularly those with low levels of education or those who face social stigmatization, may lack access to public health campaigns or educational resources that promote hygiene and sanitation practices. A study in Bangladesh revealed that children of unmarried mothers had a 35% higher likelihood of suffering from diarrhea, primarily due to a lack of maternal health education and awareness (Rahman & Hossain, 2022). This points to the need for targeted health interventions and support systems for single caregivers to reduce the prevalence of diarrhea among children. Despite these findings, gaps in the literature remain regarding the influence of marital status on childhood diarrhea, particularly in different socio-cultural contexts. Further research is needed to explore the mechanisms through which marital status impacts child health and to design interventions that can support single parents in reducing the incidence of diarrhea among their children.

### **2.2.3 Education Level**

As of 2021, UNESCO reported that approximately 30% of women aged 15 and above in Africa are illiterate, a significant barrier to implementing proper child health practices, including hygiene and feeding (UNESCO, 2021). Research indicates that children of mothers with no formal education are 2.5 times more likely to experience diarrhea due to poor hygiene practices (WHO, 2020). A study by Wang *et al.* (2021) revealed that maternal education correlates directly with child mortality rates; children born to mothers with secondary or higher education had a 35% lower risk of dying from diarrhea-related complications. In rural Africa, where access to education is often limited, only 23% of mothers' complete primary education, contributing significantly to poor health outcomes (UNICEF, 2022). These statistics highlight the continent-wide challenge of low maternal education and its direct link to preventable childhood illnesses like diarrhea.

Sub-Saharan Africa faces significant health challenges due to low maternal education, with only 53% of women completing primary education (Adedokun & Yaya, 2020). Children of uneducated mothers are 3.1 times more likely to suffer from diarrhea than those with mothers who have secondary education. In countries like Ethiopia and

Niger, where female literacy rates are 49% and 15% respectively, diarrhea accounts for over 10% of deaths among children under five (Feleke *et al.*, 2022; Ugboko *et al.*, 2021). In Somalia, only 26% of women of reproductive age have completed primary education, with rural areas reporting just 19% (UNICEF, 2022). This low educational attainment is linked to poor health practices, as children of uneducated mothers are 2.8 times more likely to suffer from diarrhea than those with educated mothers (Ali *et al.*, 2023). In regions with female literacy below 20%, 42% of children under five experience diarrhea annually (Shibre *et al.*, 2022). Urban areas with higher literacy, like Mogadishu, report a 35% lower prevalence of diarrhea.

The education level of mothers and caregivers is critically linked to the prevalence of diarrhea among children under five, with significant implications for child health outcomes. A robust body of research indicates that children with unschooled mothers or caregivers are at a heightened risk of experiencing diarrheal diseases. For instance, Mohamed & Abdilahi, (2021) found that children of uneducated mothers are 1.5 times more likely to suffer from diarrhea compared to those whose mothers have received formal education. This correlation can be attributed to the fact that mothers lacking education often demonstrate inadequate knowledge about essential hygiene practices, nutrition, and disease prevention, which are vital in mitigating the risk of diarrheal infections. Further reinforcing this point, (M. Ali *et al.*, 2022) highlighted that low maternal education levels are associated with poor dietary and hygiene practices, leading to inadequate complementary feeding and unhygienic food preparation methods. Their findings indicated that children whose mothers had less than primary education were 1.6 times more likely to experience diarrhea due to the lack of awareness regarding pathogens, hygiene, and vaccination. A significant gap in the literature is the need for more localized studies that assess the specific pathways through which maternal education influences childcare practices in the context of Somalia.

A study conducted in Ghana and Nigeria revealed that educational programs aimed at promoting exclusive breastfeeding and proper hygiene during food preparation resulted in a 20% reduction in diarrhea incidence among children (Adogu, 2021; Amalga, 2020). Additionally, Demissie *et al.* (2021b) reported that children of mothers

with formal education had a 35% lower likelihood of experiencing diarrhea compared to those whose mothers were uneducated. This demonstrates the importance of targeted maternal education in combating diarrheal diseases; however, there is a lack of focused research on how such interventions can be effectively implemented within the unique socio-cultural context of Somalia. The positive relationship between maternal education and improved child health is further evidenced by Bennion *et al.* (2021), who found that caregivers with formal education are more likely to engage in effective childcare practices, thereby reducing the incidence of diarrhea. In their analysis, they reported that children of educated mothers had a 27% lower risk of diarrhea than those of uneducated mothers. However, a critical gap in current research is the need to examine the barriers that prevent mothers in Somalia from accessing education, as well as how these barriers contribute to the high rates of diarrhea.

In Somalia, the stark reality of low educational attainment exacerbates the problem of childhood diarrhea. The 2022 Multiple Indicator Cluster Survey (MICS) reported that only 51% of children in Somalia attend primary school, and merely 21% continue to secondary education (Shibre *et al.*, 2022). This low level of educational engagement is concerning, particularly in rural areas, where only 38% of children are reported to be enrolled in school, and the gender gap in education widens as children grow older. Boys are more likely to attend school than girls, with only 48% of girls attending primary education compared to 55% of boys. The implication of such disparities in education is significant, as the absence of educated mothers directly correlates with inadequate hygiene practices and higher rates of diarrhea. The impact of education on health outcomes extends beyond formal schooling; it encompasses the broader social determinants of health. The involvement of children in labor, particularly in rural Somalia, further complicates educational access. Ali *et al.* (2023) reported that approximately 42% of children in urban areas and 38% in rural areas are engaged in child labor, which not only hinders their educational opportunities but also exposes them to environments that increase the risk of diarrheal diseases. Regions in Somalia characterized by low female literacy rates have been shown to report a 40% higher incidence of diarrhea among children under five, underscoring the urgent need for educational interventions tailored to mothers and caregivers.

#### **2.2.4 Economic Status**

Somalia faces a severe economic crisis, with over 45% of the population living on less than \$1 per day and 73% on less than \$2 (World Bank, 2020). These dire economic conditions have dire consequences for public health, particularly regarding diarrhea prevalence. A study by Ali (2024) reported that children from low-income households in Somalia are 30% more likely to suffer from diarrhea compared to their wealthier counterparts. This increased risk is primarily due to inadequate access to safe water and sanitation facilities, which are essential for preventing waterborne diseases. In communities with a poverty prevalence above 60%, the incidence of diarrhea is alarmingly high, reaching as much as 45% among children under five (United Nations Children's Fund (UNICEF), 2020).

Research indicates that poor sanitation and hygiene practices linked to low economic status contribute significantly to the prevalence of diarrhea. A study in Somalia found that households lacking access to improved sanitation facilities experienced diarrhea rates of 50% higher than those with proper sanitation (Yusuf *et al.*, 2023a). Furthermore, children from impoverished households are at a 40% increased risk of experiencing severe dehydration due to diarrhea, which can lead to higher morbidity and mortality rates (Manetu *et al.*, 2021). Disparities in access to improved water sources further emphasize the impact of economic status on health outcomes. Only 17% of rural households in Somalia have access to improved water sources, compared to 64% in urban areas (Manetu *et al.*, 2021). This significant gap illustrates how economic status contributes to unequal health outcomes. Children in rural areas are 1.5 times more likely to suffer from diarrhea than their urban counterparts, reflecting the broader implications of economic inequality on public health (Demissie *et al.*, 2021).

The inability to invest in proper sanitation infrastructure due to economic constraints exacerbates the situation. In Somalia, the lack of financial resources prevents families from constructing adequate sanitation facilities, leading to increased human waste exposure in living environments. The (Mudau *et al.*, 2023) notes that poor waste disposal practices are responsible for approximately 50% of diarrhea cases in low-income communities. As a result, Somalia continues to grapple with high rates of



malnutrition and mortality linked to diarrheal diseases, highlighting the urgency of addressing the economic factors contributing to this public health crisis. Efforts to improve economic conditions must therefore be integral to strategies aimed at reducing diarrhea prevalence among vulnerable populations. Interventions targeting poverty reduction and improved sanitation access have been shown to reduce diarrhea incidence by 20% in similar contexts (Patrick *et al.*, 2021). By tackling the underlying economic determinants of health, Somalia can make significant strides in reducing the burden of diarrheal diseases and improving the overall well-being of its population.

Therefore, the direct link between economic factors and diarrheal disease is primarily through access to clean water and sanitation. In countries with higher poverty rates, individuals often cannot afford the necessary infrastructure or services to ensure safe drinking water and proper waste disposal. This leads to contamination of water sources and increased exposure to pathogens that cause diarrhea. As a result, the economic status of a population directly influences its vulnerability to diarrheal diseases.

### **2.2.5 Household Size**

Research shows a strong correlation between household size and the prevalence of childhood diarrhea. A study conducted in Ethiopia, for instance, found that children living in households with more than five members were 2.2 times more likely to suffer from diarrhea than those in smaller households (Tsehay *et al.*, 2021). Similarly, a study in Bangladesh revealed that diarrhea prevalence in children under five was 35% higher in households with six or more members compared to those with fewer members (Rahman & Hossain, 2022). Larger households are often characterized by overcrowded living conditions, which can compromise hygiene practices, reduce the availability of resources like clean water, and increase the likelihood of fecal-oral contamination pathways. According to the WHO (2022), overcrowded households are more likely to have insufficient sanitation facilities, which increases the risk of diarrhea by 50%, especially in rural settings.

The association between household size and childhood diarrhea is also influenced by economic constraints. Larger households, particularly in LMICs, tend to have lower per capita income, leading to limited access to essential resources like safe drinking

water and adequate healthcare (Wolf *et al.*, 2022). In Nigeria, a survey revealed that children from larger households (seven or more members) had a 30% higher risk of developing diarrhea compared to those from smaller households, primarily due to the reduced affordability of basic health services and hygiene products (Demisse *et al.*, 2021). Additionally, households with more children may experience caregiver strain, reducing the quality of childcare practices, which further increases the risk of diarrheal diseases. The need to allocate resources across a larger number of household members results in a dilution effect, whereby the quality of hygiene, nutrition, and healthcare decreases with each additional member.

Despite the well-established link between household size and diarrhea, there remains a gap in understanding how specific household dynamics, such as the role of gender, income distribution, and cultural practices, mediate this relationship. In many LMICs, larger families are considered a social asset, yet the health risks associated with overcrowding are rarely addressed in public health interventions (Dubey *et al.*, 2022). Furthermore, most studies have not disaggregated data by rural versus urban settings, which may provide more nuanced insights into how household size affects childhood diarrhea in different contexts. The need to study household size in relation to childhood diarrhea is critical, as it can inform targeted interventions in overcrowded and resource-poor settings. Interventions aimed at improving sanitation, promoting hygiene education, and increasing access to clean water must consider household size as a significant risk factor to reduce the prevalence of childhood diarrhea.

### **2.2.6 Occupation of the Caregiver**

The occupation of the caregiver plays a critical role in shaping health outcomes for children, particularly in low- and middle-income countries (LMICs). Evidence shows a strong association between the caregiver's employment status and the occurrence of childhood diarrhea, which is heavily influenced by factors such as income, time availability, and access to sanitation and healthcare services. Caregivers working in informal, low-wage jobs often face challenges that limit their ability to provide adequate supervision and hygiene practices, increasing the risk of diarrhea among children under their care.

In a study conducted in Ethiopia, children whose caregivers were engaged in informal, low-paying jobs were found to have a 32% higher likelihood of experiencing diarrhea compared to those whose caregivers worked in formal employment, such as teaching or civil service (Aydamo *et al.*, 2024). This difference is attributed to the increased financial constraints and limited access to clean water and sanitation facilities, which are more common among families with caregivers in informal occupations. Similarly, a study demonstrated that children whose caregivers worked as domestic helpers or in street vending were 1.5 times more likely to experience diarrheal episodes than children whose caregivers had salaried jobs in the formal sector (Odo *et al.*, 2023). In these contexts, informal employment is often associated with inadequate access to sanitation and reduced capacity to afford medical care, both of which are crucial in preventing and treating diarrheal diseases.

Time constraints also contribute to the risk of diarrhea among children, particularly when caregivers are employed in occupations that demand long or irregular working hours. A study conducted in Bangladesh found that caregivers working in garment factories had 25% less time for child supervision, leading to a 1.7-fold increase in diarrheal episodes compared to caregivers working in less time-intensive jobs (Hasan *et al.*, 2020). These caregivers were less likely to engage in preventive practices such as handwashing before feeding their children or maintaining hygienic food preparation environments, directly increasing the child's exposure to pathogens.

Moreover, the occupation of the caregiver is intertwined with education and awareness about proper hygiene practices. Caregivers in formal employment typically have more access to health education, enabling them to better implement sanitation measures at home. In contrast, caregivers in informal occupations often lack both the time and resources to learn about or practice these essential hygiene behaviors. In a study from Nigeria, children of caregivers engaged in low-wage, informal work, such as market vendors, were 40% more likely to suffer from diarrhea than children whose caregivers were professionals or in salaried positions, primarily due to poor sanitation practices and lack of health awareness (Yeboua *et al.*, 2022). These findings underscore the need for further research into how specific occupational categories affect childhood health outcomes, particularly in the context of diarrhea. Existing literature highlights the

broad divide between formal and informal employment, but there is limited understanding of the nuances within informal occupations, which may vary significantly in terms of income, time demands, and access to sanitation. Targeted studies exploring these factors can help identify high-risk occupational groups and inform interventions to reduce the incidence of childhood diarrhea.

### **2.2.7 Residence**

The place of residence, whether rural or urban, has been shown to significantly influence the prevalence of childhood diarrhea, with considerable disparities in sanitation, water access, and healthcare availability contributing to these differences. Studies have consistently found that children in rural areas are at higher risk of developing diarrhea than their urban counterparts, largely due to poorer infrastructure and lower access to clean water and sanitation facilities (Rahman & Hossain, 2022; Yeasmin *et al.*, 2022). However, urban settings, particularly in low-income urban neighborhoods and informal settlements, also experience elevated risks of childhood diarrhea due to overcrowding and inadequate services. Understanding the relationship between residence and the risk of diarrhea is critical for designing targeted public health interventions. Research across various countries illustrates the heightened risk of diarrhea in rural areas. A study conducted in Ethiopia found that children residing in rural areas were 43% more likely to suffer from diarrhea compared to children in urban settings (Solomon *et al.*, 2020). The rural-urban disparity was attributed to the lack of access to improved water sources and sanitation facilities in rural areas, with only 31% of rural households having access to safe drinking water, compared to 84% of urban households. Similarly, in Nigeria, a study found that rural children had a 50% higher prevalence of diarrhea compared to urban children (Odo *et al.*, 2023). The study revealed that the absence of proper sanitation and handwashing facilities in rural areas, combined with the practice of open defecation (prevalent in 33% of rural households), contributed to the higher risk of diarrheal diseases.

The risk of childhood diarrhea in rural areas is often exacerbated by limited access to healthcare services. In many rural regions, healthcare facilities are scarce, and caregivers may have to travel long distances to seek medical care for their children,

resulting in delays in treatment and increased complications from diarrhea. A cross-sectional study conducted in India found that rural children were 1.8 times more likely to experience delayed treatment for diarrhea compared to their urban counterparts, due to the unavailability of nearby healthcare facilities (Roy, 2023). The lack of awareness regarding hygiene practices and the low coverage of health education programs in rural areas further compound the problem, making rural children more vulnerable to diarrheal diseases. Urban areas, on the other hand, are not immune to the burden of childhood diarrhea, particularly in low-income and informal settlements. In many urban slums, overcrowding, poor sanitation, and inadequate access to clean water create conditions that foster the spread of diarrheal pathogens. A study conducted in Nairobi, Kenya, found that children living in urban slums were 1.5 times more likely to suffer from diarrhea than those in more affluent urban areas (Mulatya & Ochieng, 2020). In these settings, over 60% of households lacked access to piped water, and only 42% had access to improved sanitation facilities, leading to frequent contamination of food and water sources. Similarly, in India, children in urban slums experienced a 30% higher prevalence of diarrhea than children in non-slum urban areas, due to factors such as overcrowding, inadequate waste management, and poor water quality (Zeeshan *et al.*, 2023).

While urban children in wealthier areas benefit from better infrastructure and access to healthcare, disparities persist within urban settings, particularly in informal settlements where living conditions are akin to those in rural areas. The heterogeneity within urban areas necessitates targeted interventions that address the unique challenges faced by children in informal settlements. Recent studies in the Saharan Africa found that urban-rural differences in diarrhea prevalence were highly dependent on the socio-economic status of urban dwellers, with children in low-income urban households experiencing diarrhea rates similar to those in rural areas (Yeasmin *et al.*, 2022; Zeeshan *et al.*, 2023). The association between residence and childhood diarrhea underscores the need for context-specific interventions that address the unique challenges of rural and urban environments. In rural areas, efforts should focus on improving access to clean water and sanitation, as well as enhancing healthcare services to reduce delays in treatment. In urban areas, particularly in informal settlements, improving infrastructure and providing targeted health education

programs can significantly reduce the burden of diarrhea. Despite progress in some regions, the rural-urban gap in childhood diarrhea remains a pressing public health concern, necessitating further research and tailored interventions.

## **2.3 Hygiene and Sanitation Practices**

### **2.3.1 Access to Safe Water**

Bondhere, a district in Mogadishu, Somalia, is an urban settlement with a mix of permanent residents and internally displaced persons (IDPs). According to UNHCR (2022), IDPs make up 34% of the population. Water sources in Somalia are limited; only 40% of households have access to piped water, while 35% rely on wells, and 25% use water vendors (Mohamed, 2021). Due to infrastructure challenges, 56% of residents report irregular water supply, and 70% of IDPs lack access to safe drinking water (Wairia, 2023). Additionally, 45% of households do not have adequate sanitation facilities in Somalia (Saed *et al.*, 2021). Access to safe drinking water is critically linked to the incidence of diarrhea among children under five. In Somalia, where nearly 58% of the population lacks access to safe water sources, the risk of diarrheal diseases is substantially heightened (WHO, 2021). A study found that children who rely on contaminated water sources are 2.5 times more likely to experience diarrhea compared to those with access to treated water (Yusuf *et al.*, 2023). In areas with poor water quality, such as rural Somalia, the incidence of diarrhea among children under five reaches alarming rates of 65%, with pathogens like *Vibrio cholerae* frequently detected in drinking water supplies (Mohamed, 2021). These findings underscore the direct relationship between access to safe water and the health outcomes of young children. Furthermore, a longitudinal study indicated that the risk of diarrhea increases by 40% for each additional day that children are exposed to contaminated water sources (Daly & Harris, 2022). In regions where livestock share water supplies with humans, children are particularly vulnerable, as evidenced by a 45% higher prevalence of diarrhea among those in mixed-use water settings compared to those with exclusive access to safe water (UNICEF, 2016). These statistics highlight the urgent need for interventions that enhance access to safe drinking water, as the lack thereof is a significant contributor to the burden of diarrhea among young children in Somalia.

Water handling and storage practices play a crucial role in the risk of diarrhea among children under five. In many Somali households, water is often stored in open containers, which significantly increases the risk of contamination. A study revealed that improper water storage practices lead to a 60% increased risk of diarrhea among children in these households (McGuinness *et al.*, 2020). Moreover, households that engaged in unsafe water handling behaviors had a prevalence rate of diarrhea of 57%, compared to just 22% in households that practiced safe storage methods (Getahun & Adane, 2021). This association highlights the critical need for education and interventions focused on safe water handling and storage to reduce diarrheal disease incidence in vulnerable populations. Additionally, the burden of water collection often falls on women and girls, leading to long distances traveled for water, which can expose it to contamination. A study found that households that travelled more than 1 kilometer for water reported a 45% higher rate of diarrhea among children under five compared to those with closer access (McClelland *et al.*, 2022).

According to UNICEF (2020), approximately 80% of households lack access to safely treated water, primarily relying on unregulated sources. Common water treatment practices include boiling (utilized by 35% of households), solar disinfection (20%), and chlorination (15%) (Damtew & Geremew, 2020). However, only 10% of households consistently implement these methods, highlighting a critical gap in water safety practices. Unsafe water handling is prevalent; about 65% of families utilize containers that have not been adequately cleaned, contributing to the risk of contamination (WHO, 2022). Furthermore, a study revealed that 70% of children under five in Somalia who experience diarrhea, primarily due to unprotected water (Shibre *et al.*, 2022; Warsame, 2021). Alarmingly, only 15% of caregivers employ safe water storage techniques, exacerbating the public health crisis in this region (Ali *et al.*, 2023). This link between water collection practices and increased diarrhea incidence emphasizes the importance of addressing not only the quality of water sources but also the practices surrounding water handling and storage in public health initiatives aimed at reducing diarrhea prevalence in Somalia.

### 2.3.2 Availability of Sanitation Facilities

The availability of sanitation facilities is a critical determinant of childhood health, particularly concerning the prevalence of diarrhea among children under five years old. In Somalia, where sanitation infrastructure is severely lacking, studies indicate that approximately 60% of the population lacks access to improved sanitation facilities, leading to a higher incidence of waterborne diseases, including diarrhea (UNICEF, 2021). Research shows that children living in households without access to improved sanitation facilities have a 1.8 times higher risk of experiencing diarrhea compared to those with adequate sanitation (Ismail *et al.*, 2024). Furthermore, a systematic review revealed that improved sanitation can reduce diarrhea incidence by up to 36% in low-income settings (Daly & Harris, 2022). The correlation between sanitation access and diarrhea is particularly pronounced in rural areas, where only 32% of the population has access to improved sanitation compared to 74% in urban settings (World Bank, 2022). These disparities highlight the urgent need for interventions aimed at improving sanitation infrastructure, which is crucial for reducing diarrhea morbidity and enhancing overall child health in Somalia.

The lack of proper sewerage systems and effective waste disposal methods is a significant contributor to diarrhea among children under five in Somalia. With approximately 82% of households practicing open defecation, the resultant fecal contamination of water sources poses a severe health risk (Appiah-Effah *et al.*, 2024). A study conducted in urban Somalia revealed that children living in households without adequate sanitation facilities had a diarrhea incidence rate of 55%, compared to just 22% among those with improved sanitation options (Wolf *et al.*, 2022). Moreover, the presence of pathogens such as *Escherichia coli* in drinking water sources, often linked to poor waste management, has been shown to increase the likelihood of gastroenteritis by up to 60% in affected populations (Sthapit *et al.*, 2024). These statistics illustrate a direct association between inadequate sewerage infrastructure and increased rates of diarrheal diseases among young children. Furthermore, a systematic review across various African countries found that regions with poor waste management practices experienced diarrhea prevalence rates as high as 48% in children under five (McClelland *et al.*, 2022). The contamination of drinking



water due to inadequate sanitation has been linked to an increased risk ratio of 2.1 for diarrhea among children in Somalia (Yusuf *et al.*, 2023). This reinforces the importance of addressing sanitation and waste disposal issues as part of comprehensive strategies to reduce diarrhea rates in vulnerable populations. The evidence clearly indicates that improving sewerage systems and waste management practices is crucial for mitigating the burden of diarrheal diseases among children in Somalia.

### **2.3.3 Handwashing Practices**

Proper handwashing with soap at critical moments is a proven strategy for reducing the incidence of diarrhea. Studies indicate that proper handwashing can lead to a 30% to 50% reduction in diarrhea-related morbidity (McClelland *et al.*, 2022). In a meta-analysis conducted across multiple low- and middle-income countries, it was found that children in households that practiced proper handwashing were 40% less likely to experience diarrhea compared to those who did not (Noguchi *et al.*, 2021). In Somalia, the challenge of implementing proper hand hygiene is exacerbated by limited access to clean water and soap, with UNICEF (2016) reporting that inadequate hygiene practices contribute to 88% of childhood deaths from diarrhea globally. A study conducted in Somalia found that children from families who failed to practice handwashing at critical times had a diarrhea prevalence rate of 63%, significantly higher than the 24% observed in households practicing effective hand hygiene (Getahun & Adane, 2021). This stark contrast demonstrates the direct link between inadequate handwashing practices and increased diarrhea incidence among young children.

In rural areas of Somalia, where access to clean water is particularly poor, the risk associated with improper handwashing is further amplified. A cross-sectional study found that children under five years of age in households without proper handwashing facilities had a diarrhea prevalence of 54%, compared to only 18% in households with adequate facilities (Ali *et al.*, 2022). Furthermore, a systematic review of hygiene interventions in sub-Saharan Africa indicated that improving handwashing practices could prevent approximately 1.3 million deaths annually from diarrheal diseases among children under five (Manetu *et al.*, 2021). The strong correlation between

handwashing behaviors and diarrhea underscores the need for targeted public health interventions aimed at promoting hygiene education and accessibility to soap and water in Somalia.

Proper handwashing education for siblings significantly impacts hygiene practices in households, reducing the incidence of diarrhea. A study by Hailu *et al.* (2021) found that teaching siblings proper handwashing techniques decreased diarrhea rates by 47% among children under five. Additionally, a study reported that only 58% of children in low-income families practice proper handwashing after handling soiled clothes (Robinson & Howland, 2022). Another study found that poor handling of soiled clothes increased the risk of infection by 2.5 times due to contamination (Ali *et al.*, 2022). Furthermore, households that did not regularly wash soiled clothes with soap and water were 3.1 times more likely to report frequent diarrhea cases among children under five (Alemayehu *et al.*, 2021). These findings underscore the critical need for hygiene education to reduce infection risks. Cleanliness and the disposal of soiled clothes are crucial; research shows that 62% of households do not properly dispose of soiled items, leading to higher infection risks (Shire, 2023). Education on handling soiled clothing is vital, with studies indicating that improper handling increases contamination risks by 2.5 times (Ali *et al.*, 2022). Furthermore, only 30% of caregivers reported regularly washing soiled clothing with soap and water, highlighting a significant gap in hygiene education (Onama & Babughirana, 2023). This shows evidently that educational gaps persist. Therefore, the study provides the importance of targeted hygiene education, particularly in regions like Somalia, where maternal education is low, to improve child health outcomes and reduce the incidence of diarrheal diseases among young children.

#### **2.3.4 Food Hygiene Practices**

In Somalia, where foodborne pathogens are prevalent due to inadequate sanitation and hygiene infrastructure, the adoption of proper food hygiene practices is essential for safeguarding child health. Studies have shown that families who regularly wash their hands before food preparation have a 29% lower incidence of diarrhea compared to those who do not practice regular hand hygiene (Solomon *et al.*, 2021). Moreover, the

type of food consumed and the methods of food preparation significantly impact the prevalence of childhood diarrhea. Research indicates that the consumption of contaminated or undercooked food can lead to a 70% increase in the likelihood of diarrhea among children (Fekele *et al.*, 2022). In Somalia, a survey revealed that only 34% of households reported cooking food to safe temperatures, exposing children to potential pathogens that could lead to diarrheal diseases. The World Health Organization (2021) reports that in regions where food hygiene education is provided, diarrhea rates in children can decrease by up to 50%. This underscores the importance of integrating food hygiene training into community health programs to enhance awareness and encourage the adoption of safe food practices.

Additionally, socio-economic factors significantly influence food hygiene practices within households. Families with higher income levels are more likely to adopt proper food hygiene practices, resulting in a lower prevalence of diarrhea among their children. A study conducted in urban Somali communities found that households with access to clean water and proper sanitation facilities were 1.8 times less likely to report instances of diarrhea in children compared to those without access (Mohamed *et al.*, 2021). Furthermore, education level plays a crucial role; households led by individuals with secondary education or higher demonstrated a 36% higher compliance with food hygiene practices than those led by individuals with no formal education (Yusuf *et al.*, 2023a). These findings highlight the need for targeted interventions that address both food hygiene education and the underlying socio-economic factors affecting food safety to effectively reduce childhood diarrhea rates.

### **2.3.5 Feeding Practices and their Impact on Diarrhea among Children under Five**

According to the Somalia Health and Demographic Survey (SHDS) 2020, 34% of Somali infants are exclusively breastfed, while the remaining majority are vulnerable to infections due to the use of alternative feeding methods, such as formula and bottle feeding (SHDS, 2020). Research shows that formula feeding, compared to breastfeeding, exposes infants to a higher risk of diarrhea, with formula-fed infants being 2.3 times more likely to contract diarrheal diseases (Ali *et al.*, 2021). The high

risk is often attributed to improper formula preparation, use of unclean water, and unsafe storage conditions, particularly in areas where only 52% of households have access to safe drinking water (Ismail *et al.*, 2024). Moreover, children in Somalia who are not exclusively breastfed have a 2.8 times higher risk of developing diarrhea, especially in regions where education on proper feeding practices is scarce (Warsame *et al.*, 2021).

The risks of diarrhea due to formula feeding are amplified by the lack of sterilization practices among caregivers. In urban areas, where formula is often used as a substitute for breastfeeding, many caregivers fail to properly prepare formula due to limited access to clean water and a lack of knowledge on hygiene standards. A study by Mohamed and Abdilahi (2021) revealed that 45% of caregivers in Somaliland used unprotected water sources for formula preparation, contributing to a 2.9-fold increase in diarrhea cases. Similarly, storing formula at room temperature for extended periods, a common practice in households without refrigeration, increases the risk of bacterial contamination, leading to a 3.1 times greater chance of diarrhea in infants (Budge *et al.*, 2020). Addressing these gaps requires comprehensive educational interventions targeting caregivers, focusing on safe feeding and formula storage practices.

### **2.3.6 Bottle Feeding and Hygiene Standards**

The use of feeding bottles, especially in unsanitary environments, is a major contributor to diarrhea in Somali children. According to the (Ahmed, 2022), 41% of Somali infants are bottle-fed, with improper cleaning of feeding bottles being widespread. In Somalia, only 39% of households have access to improved sanitation facilities, making it difficult to maintain the high hygiene standards required to prevent contamination of feeding bottles (Ahmed & Ali, 2024). The use of unsterilized bottles has been associated with a 3.5 times higher risk of diarrhea due to the growth of pathogens like *Escherichia coli* and *Salmonella* in feeding bottles that are not adequately cleaned (Baidya, 2021). A cross-sectional study conducted in Mogadishu found that 68% of mothers did not sterilize feeding bottles properly, resulting in a 2.6-fold increase in diarrhea cases among their children (Mohamed, 2021).

Moreover, the absence of proper sterilization equipment in many Somali households further exacerbates the problem. In rural Somalia, where electricity and clean water are scarce, only 22% of households have access to basic hygiene supplies, leading to higher contamination rates (Mohamed, 2021). The widespread use of feeding bottles in these conditions contributes significantly to the burden of diarrhea among children under five, necessitating urgent public health interventions focused on improving sanitation and hygiene practices. Bottle sterilization remains critical, with studies showing that children whose bottles were improperly cleaned had a 2.7 times higher likelihood of contracting diarrhea (Isack *et al.*, 2021). Efforts to reduce diarrhea prevalence must prioritize access to sanitation and hygiene education, especially in rural areas where these challenges are most acute.

### **2.3.7 Hygiene of Feeding Items, Pacifiers, and Cross-Contamination Risks**

Improper handling of children's feeding items, pacifiers, and utensils also contributes significantly to the incidence of diarrhea in Somalia. In many Somali households, children's feeding utensils are not separated from those used by adults, increasing the risk of cross-contamination with harmful bacteria. A study by Warsame reported that 62% of Somali households do not maintain separate feeding items for children, leading to a 1.9 times higher risk of diarrhea (Warsame, 2021). This issue is particularly concerning in rural areas, where cultural practices of sharing utensils, coupled with poor hygiene standards, expose children to higher rates of infection. A study in Puntland revealed that children whose feeding utensils were not separated from adults' had a 2.1-fold increased risk of diarrhea (Isack *et al.*, 2021).

Pacifiers, a common tool for soothing infants, also pose a contamination risk. Research by Yusuf *et al.* (2021) found that 58% of pacifiers used in Somalia were contaminated with fecal bacteria, which increased the likelihood of diarrhea by 2.5 times among children under two years old. The practice of returning dropped pacifiers to infants without cleaning further exacerbates this issue, as only 19% of caregivers reported regularly sterilizing pacifiers (Schmidt-Sane *et al.*, 2022). Given the limited access to clean water and sterilization equipment in many parts of Somalia, public health programs must focus on educating caregivers about the importance of hygiene in

handling feeding items and pacifiers. To reduce diarrhea incidence among Somali children, it is critical to address these hygiene challenges through improved sanitation infrastructure and targeted educational campaigns. Strengthening caregiver knowledge about the risks of cross-contamination and the importance of cleanliness in child feeding practices will be essential in mitigating the high burden of diarrheal diseases in the country.

## **2.4 Immunization Status**

Vaccination is an essential public health strategy that significantly reduces the prevalence of infectious diseases that can lead to diarrhea among children under five years of age. In Somalia, where the burden of childhood morbidity and mortality remains disproportionately high, vaccines against rotavirus and polio are crucial in mitigating the impact of diarrheal diseases. Rotavirus is recognized as a leading cause of severe diarrhea among infants and young children, often resulting in dehydration and substantial health complications. The introduction of the rotavirus vaccine into Somalia's national immunization program has demonstrated significant protective effects against severe diarrheal disease. Rotavirus vaccination has contributed to a 58% reduction in the incidence of severe diarrhea hospitalizations among vaccinated children compared to their unvaccinated counterparts (Nazuridinov *et al.*, 2022).

In a study evaluating the effectiveness of the rotavirus vaccine in Somalia, researchers found that among children under five years of age, the hospitalization rate for rotavirus-related diarrhea dropped from 1,200 per 100,000 children to 500 per 100,000 children following the introduction of the vaccine (World Health Organization, 2021). This statistic underscores the critical role of vaccination in protecting vulnerable populations and highlights the necessity for sustained advocacy and support for comprehensive vaccination programs to combat diarrheal diseases in Somalia. Polio vaccination also plays a pivotal role in preventing complications associated with diarrhea. The poliovirus can disrupt intestinal function, leading to diarrhea and dehydration. A comparative study found that children under five years of age who were fully vaccinated against polio had a 37% lower risk of developing diarrhea compared to those who were unvaccinated (Ali *et al.*, 2022). In regions where polio

vaccination coverage exceeded 80%, the incidence of diarrhea-related morbidity dropped significantly, showcasing the interconnectedness of immunization and child health.

Despite the clear benefits of vaccination, Somalia faces substantial challenges in achieving high immunization coverage, which directly impacts childhood health outcomes. According to the World Health Organization (2022), the overall immunization coverage in Somalia is estimated at only 54% for routine childhood vaccinations, with rotavirus vaccination coverage at a mere 43%. These low coverage rates are a consequence of ongoing conflict, political instability, and logistical difficulties in delivering vaccines, particularly to remote and rural areas. Consequently, children in these regions remain at heightened risk for vaccine-preventable diseases, including those leading to diarrhea.

Moreover, cultural beliefs and misinformation regarding vaccinations contribute to significant vaccine hesitancy among caregivers in Somalia. A survey conducted in urban and rural communities found that 40% of parents expressed concerns about the safety and effectiveness of vaccines, which directly correlated with lower vaccination rates (Lewandowska *et al.*, 2020). The study emphasized the urgent need for targeted health education initiatives to enhance awareness of the benefits of vaccination and to dispel myths surrounding vaccine safety and efficacy.

Furthermore, the link between low vaccination rates and increased diarrhea prevalence is evident in demographic studies. A recent study revealed that unvaccinated children had a 2.4 times higher likelihood of experiencing diarrhea compared to those who received all recommended vaccinations (Bramante *et al.*, 2022). This finding highlights the critical need for ongoing efforts to improve vaccination coverage as a means to reduce the incidence of diarrhea and enhance child health outcomes.

## **2.5 Environmental Factors**

Overcrowding is a significant environmental factor contributing to the prevalence of childhood diarrhea, particularly in low-income settings where living conditions are often suboptimal. Studies have shown that households with a higher number of

residents are at an increased risk of diarrheal diseases due to limited access to clean water and sanitation facilities. A study in urban slums in Nairobi found that children living in overcrowded households (defined as more than four individuals per room) were 1.5 times more likely to experience diarrhea compared to those in less crowded homes (Mulatya & Ochieng, 2020). Overcrowding can also lead to increased stress on sanitation systems, which may result in the contamination of water sources and the spread of pathogens, further heightening the risk of diarrheal outbreaks. In Somalia, where urban migration has led to rapid population growth in cities like Mogadishu, overcrowding exacerbates the challenges of maintaining proper hygiene and sanitation, ultimately impacting child health (United Nations High Commissioner for Refugees (UNHCR, 2022).

Exposure to pathogens, particularly in environments where sanitation and hygiene practices are inadequate, significantly increases the risk of childhood diarrhea. In densely populated areas, the likelihood of children coming into contact with contaminated surfaces and food increases, making them more susceptible to infections caused by pathogens such as *E. coli* and rotavirus. Research indicates that children under five years living in areas with poor sanitation facilities have a 2.3 times higher risk of developing diarrhea compared to those in regions with improved sanitation (Hailu *et al.*, 2021). Furthermore, exposure to contaminated water sources—common in overcrowded environments—has been linked to a 60% increase in the incidence of diarrheal diseases among young children (Ikua *et al.*, 2020; Wolde *et al.*, 2022). In Somalia, the interplay between overcrowding and inadequate sanitation creates an environment conducive to the transmission of waterborne pathogens, highlighting the urgent need for targeted interventions aimed at improving living conditions and sanitation infrastructure to reduce the burden of childhood diarrhea.



## **CHAPTER THREE**

### **MATERIALS AND METHODS**

#### **3.1 Study Area**

Bondhere district is located 2.0333°N and 45.3500°E in the southeastern part of Banaadir region in Somalia. The district encompasses an area of about 200 KM<sup>2</sup> making it a relatively a large region within Somalia. As of the year 2013 Bondhere district had a population of approximately 1,650,227 which included a significant population of 369,288 internally displaced persons (IDPs) the district's geography is characterized by its proximity to the lower Shebelle and middle Shebelle. This coastal location influences the region's weather patterns with semi-arid conditions and an average annual rainfall of 300 to 400 mm. Bondhere district is predominantly an urban setting with about 55% of the population residing in urban areas In terms of healthcare infrastructure Bondhere district has 10 health facilities including private and public hospitals, health centers, and dispensaries. The district also benefits from the presence of government and non-governmental public health organizations which offer programs such as immunization, maternal and child health outreaches and disease surveillance and prevention. The map of the study area is as shown in appendix IV.

#### **3.2 Study Design**

The research employed cross sectional design which helped in determining factors influencing the occurrence of diarrhoea among children under 5 years in Bondhere district.

#### **3.3 Study Population**

The study population were mothers and caregivers of children under 5 years living in Bondhere district.

### 3.3.1 Sample Size Determination

The sample size was calculated using the Cochran formulae which was described by Birhan *et al.* (2023) as follows;

$$n = Z^2 p(1 - p)/d^2$$

Where **n** is the desired sample size when the study population is over 10 000, **Z** is the standard normal deviate which equals 1.96 and corresponds to 95% confidence interval (CI), **P** is the proportion of target population estimated to have the desired characteristic. In our study we used a prevalence score of 20%. **Q** is the Population without the desired characteristics and **d** is the degree of accuracy usually set as 10. Since proportion of population with the characteristic was 20%, **p** was 0.2 and **q** was 0.8 (1-**p**).

$$n = \frac{1.96 \times 0.2(1-0.2)}{(0.1 \times 0.1)} = 246 \text{ mothers/caregivers.}$$

### 3.4 Inclusion and Exclusion Criteria

#### 3.4.1 Inclusion Criteria

- i. Mothers or caregivers having a child or children below 5 years in Bondhere district.
- ii. Mothers or caregivers who consent to give information

#### 3.4.2 Exclusion Criteria

- i. Mothers or caregivers who have lived in Bondhere district for less than six months.
- ii. Mothers or caregivers with a child below 5 years who is severely ill.

### 3.5 Sampling Method

Cluster random sampling was used to identify the respondents. Bondhere district was clustered into four sub districts i.e. Nasib Bundo, Yusuf Al-Konwnayn, Daljirka and

Sinay. Then random sampling was applied to identify households with children below 5 years. The sample size was proportionately distributed in the four sub districts as shown below:

Total sampling frame in Bondhere district = 34435

Total households in Nasib Bundo = 8736

Sample size in Nasib Bundo =  $\frac{8736 \times 246}{34435} = 64$

Total households in Yusuf Al-Konwnayn = 9456

Sample size in Yusuf Al-Konwnayn =  $\frac{9456 \times 246}{34435} = 67$

Total households in Daljirka = 8851

Sample size in Daljirka =  $\frac{8851 \times 246}{34435} = 63$

Total households in Sinay = 7392

Sample size in Sinay =  $\frac{7392 \times 246}{34435} = 52$

A systematic sampling technique was then implemented within each subdistrict to select households with children under five years of age. A random starting point was chosen using computer generated random number followed by the selection of every nth household where n was calculated by dividing the total number of households in each of the subdistrict by the desired sample size in the subdistrict. This approach guaranteed a systematic and unbiased selection of participants from the target population. The sampling frame for this study consisted of the complete list of households in each subdistrict of Bondhere district which was obtained from the local government records.

### **3.6 Reliability and Validity**

A pilot study was conducted to pretest the questionnaires. Twenty five (25) questionnaires were administered to mothers/caregivers having children aged 6 to 59 months in Dayniile District. Cronbach's alpha statistic was used to test for reliability of the questionnaire as it is recommended in previous studies (Birhan *et al.*, 2023). The Cronbach's alpha statistic was 0.73 which was within the satisfactory range of 0.58-0.97 suggesting that the questionnaire was reliable for measuring the various variables. To ensure validity of the data collection tools, the tools were subjected to expert validation to determine if the tool would measure what they were designed to measure as recommended by Bolarinwa (2015).

### **3.7 Data Collection Tools**

Semi structured pre coded questionnaires and observational checklists were used to collect data as shown in appendix II and III respectively. The questionnaires were interviewer-administered and they contained three sections to assess socio-demographic characteristics, hygiene practices and immunization.

### **3.8 Data Collection Procedure**

The questionnaires were administered by trained data clerks under the supervision of the principal investigator. The respondents' consent was first sought before commencing the interview. The caregivers were visited at their respective homes whereby the interview was done. The interviews were done at home for purposes of authenticating that the caregivers had a child below 5 years. The diarrhoea episodes were monitored by asking caregivers to record the number of times their child had loose, or watery stools in the past 24 hours and the duration of these episodes. A child was considered to have diarrhoea if they had three or more loose, watery, or bloody stools in the past 24 hours.

### **3.9 Data Analysis and Presentation**

Once data was collected the raw data was meticulously cleaned to ensure accuracy and consistency. The process of cleaning involved tasks such as removing duplicate entries

and correcting errors in data entry. Additionally, missing values was handled at this point. After cleaning the data was coded into a format suitable for statistical analysis. This involved assigning numerical values to categorical variables and ensuring consistency in coding across different data points. The coded data were then entered into a statistical package for social sciences (SPSS) version 25 for further processing. To understand the characteristics of the study population and identify potential factors influencing diarrhea, descriptive statistics were employed. These statistics included calculating proportions for various socio-demographic and health-related variables. This analysis enabled the investigator to establish the prevalence of diarrhea and the distribution of various characteristics. To investigate the relationship between socio-demographic and health-related factors and the occurrence of diarrhea, chi square and binary logistic regression analysis were conducted. This statistical technique allowed us to assess the impact of these factors on the likelihood of a child developing diarrhea. All factors that were found to have association with diarrhea were considered as potential cofounders and thus were controlled for during analysis. By controlling these potential cofounder variables logistic regression provided valuable data into the relative importance of each factor in predicting diarrhea. The findings of both the descriptive and logistic regression analyses were presented in clear and concise tables and charts. The results were reported as adjusted odds ratios and the confidence interval was set at 95%. *P* value was also set at 0.05.

### **3.10 Ethical Considerations**

Ethical clearance for the study was sought from University of Eastern Africa Baraton as shown in appendix V. Written informed consent to carry out the study was sought from the administrative leadership of Bondhere district. Consent was also sought from the mothers and caregivers before administration of the questionnaire as shown in appendix I. Anonymity was maintained throughout the research process to safeguarding the confidentiality and privacy of the participants. This was done by use of unique codes to identify the participants. Additionally, all in-depth interviews were carried out in designated private rooms. Completed study tools were stored under lockable cabinets. All data was saved under password-restricted computers. Only study-related personnel would have access to study materials. There were no direct

benefits for participating in the study. However, the knowledge gained from the study would inform the development of targeted interventions to improve child health and reduce the burden of diarrhea-related illnesses in the study area. Additionally, there were no known potential risks associated with participating in the study other than a possibility of minor discomfort or inconvenience during the interview process.

## CHAPTER FOUR

### RESULTS

#### 4.1 Socio Demographic Characteristics of the Caregivers

Close to a half (46.2%) of the caregivers were 26-35 years old, slightly above a third (35.6%) were 16-25 years old while the least number of caregivers were above 45 years. Close to a half of the caregivers were married, close to a quarter were divorced while the least number of caregivers were single. A majority of the caregivers had no formal education, a quarter of the caregivers had primary level education while 17.5% and 13.0% had secondary and tertiary education. A high number of caregivers had 5 children below 5 years, close to a quarter of the caregivers had 3 or 4 children below 5 years while the least caregivers had one child below the age of 5 years. Close to a half of the caregivers were unemployed, close to a third were business women while 18.7% were formally employed. Close to a half of the caregivers had a household monthly income of 101-200 USD, slightly over a third had a household monthly income of less than 100 USD while the least number had a household monthly income of 301-400 USD. A majority of the caregivers children were 13-24 months, 21.5% of the caregivers' children were 25- 36 months while the least number of caregivers' children were 49-59 months.

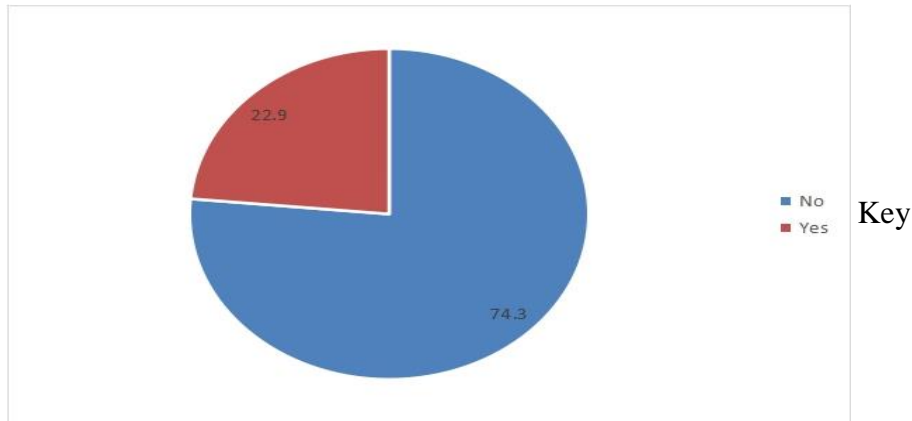
**Table 4.1: Socio Demographic Characteristics of the Caregivers**

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
Age		
16-25 years	88	35.6
26-35 years	114	46.2
36-45 years	37	15.0
above 45 years	7	2.8
Marital status		
Single	14	5.7
Divorced	61	24.8
Married	121	49.2
Widowed	50	20.3
Level of education		
No formal education	109	44.3
Primary	62	25.2
Secondary	43	17.5
Tertiary/ college/university	32	13.0
Number of children below 5 years		
One	14	5.7
Two	46	18.7
Three	61	24.8
Four	61	24.8
Five	64	26.0
Occupation		
Unemployed	122	49.6
Formal employment (government/private)	46	18.7
Business	78	31.7
Household monthly income		
<100 USD	89	36.2
101-200 USD	121	49.2
201- 300 USD	18	7.3
301- 400 USD	7	2.8
401- 500 USD	11	4.5
Age of the child		
0-12 months	26	10.6
13- 24 months	119	48.4
25- 36 months	53	21.5
37- 48 months	35	14.2
49-59 months	13	5.3



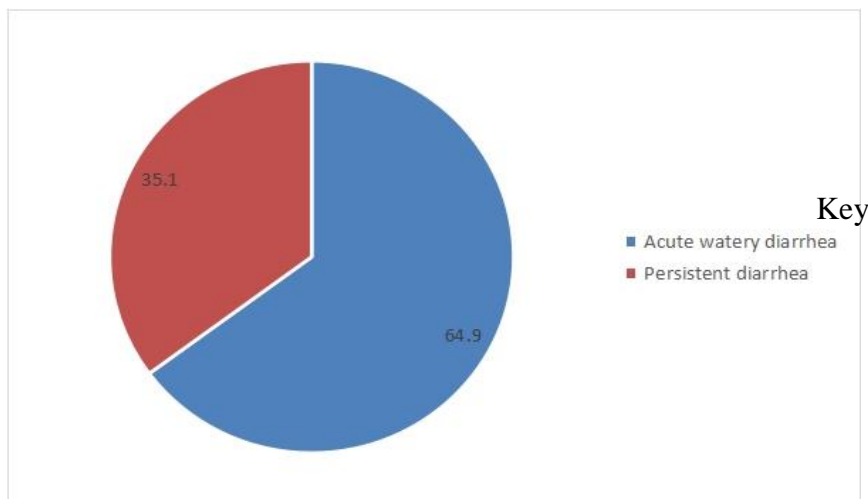
## 4.2 Prevalence of Diarrhea

In the present study 22.9% of the children had experienced diarrhea in the last two weeks prior to commencement of the study while 74.3% of the children had not experienced diarrhea.



**Figure 4.1: Prevalence of Diarrhea among Children below 5 Years**

A majority of the children who had diarrhea experienced acute watery diarrhea while 35.1% experienced persistent diarrhea.



**Figure 4.2: Presentation of Diarrhea among Children below 5 Years who had Diarrhea**

### **4.3 Bivariate Association between Socio Demographic Factors and Diarrhea**

Close to a half of the caregivers whose children had diarrhea were 16-25 years, 37.5% were 26-35 years while the least were above 45 years. Furthermore there was a significant association between age and occurrence of diarrhea ( $p < 0.001$ ). Slightly over a half (51.1%) of caregivers whose children had diarrhea were married, slightly over a quarter (26.3%) were divorced while the least were single (9.8%). There was a significant association between education and occurrence of diarrhea whereby a majority of the caregivers whose children had diarrhea had no formal education, 26.4%, 22.9% and 10.7% had primary, secondary and tertiary education respectively ( $p = 0.004$ ). A majority of respondents whose children had diarrhea had five children below 5 years, followed by those with four children below 5 years while the least had one child below 5 years. Furthermore there was a significant association between number of children below 5 years and occurrence of diarrhea ( $p = 0.035$ ). There was a significant association between occupation and occurrence of diarrhea whereby a majority of caregivers whose children had diarrhea were unemployed followed by those who were in business while the least were those formally employed ( $p < 0.001$ ). Close to a half of caregivers whose children had diarrhea had a monthly income of 101-200 USD, 44.4% had a monthly income of less than 100 USD while the least had a monthly income of 401- 500 USD. Additionally there was a significant association between household monthly income and occurrence of diarrhea.

**Table 4.2: Association between Socio Demographic Factors and Diarrhea**

Variables	Diarrhea		$\chi^2$	P value
	Yes f(%)	No f(%)		
Age			35.962	<0.001
16-25 years	67(49.3)	21(19.1)		
26-35 years	61(37.5)	53(48.2)		
36-45 years	17(12.5)	30(27.3)		
Above 45	1(0.7)	6(5.5)		
Marital status			13.976	0.003
Single	13(9.8)	1(0.9)		
Divorced	35(26.3)	26(23.0)		
Married	68(51.1)	54(47.8)		
Widowed	17(12.8)	32(28.3)		
Level of education			15.552	0.004
No formal education	56(40.0)	53(50.0)		
Primary	37(26.4)	25(23.6)		
Secondary	32(22.9)	11(10.4)		
Tertiary	15(10.7)	17(16.0)		
Number of children below 5 years				
One	11(6.7)	3(3.7)	7.492	0.035
Two	28(17.1)	18(22.0)		
Three	39(23.8)	22(26.8)		
Four	41(25.0)	20(24.4)		
Five	45(27.4)	19(23.2)		
Occupation			16.513	<0.001
Unemployed	81(60.9)	41(36.3)		
Formal employment	18(13.5)	28(24.8)		
Business	34(25.6)	44(38.9)		
Household monthly income			17.129	0.002
<100 USD	63(44.4)	26(25.0)		
101-200 USD	66(46.5)	55(52.9)		
201-300 USD	9(6.3)	9(8.7)		
301-400 USD	3(2.1)	4(3.8)		
401-500 USD	1(0.7)	10(9.6)		

#### 4.4 Multivariate Analysis of Sociodemographic Factors Influencing Diarrhoea among Children below 5 Years

The following socio demographic factors were found to significantly influence diarrhea among children below 5 years; level of education [(OR= 1.257, 95% CI = 0.436 - 2.100, p<0.05)], number of children below 5 years [(OR= 1.054, 95% CI =

0.510 - 2.784,  $p < 0.05$ ) and household monthly income [(OR= 1.909, 95% CI = 0.736 – 4.950,  $p < 0.05$ )]. Children whose caregivers had higher level of education were less likely to have children experiencing from diarrhea. Furthermore households with a high number of children below 5 years were more likely to have children experiencing diarrhea. Additionally children living in households with low monthly income were more likely to experience diarrhea.

**Table 4.3: Sociodemographic Factors Influencing Diarrhea among Children below 5 Years**

Variables in the Equation	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Age	.348	.431	.650	1	.420	1.416	.608	.298
Marital status	.286	.550	.270	1	.603	1.331	.453	3.916
Level of education	-.044	.401	.012	1	.032	1.257	.436	2.100
Number of children below 5 years	-.048	.320	.022	1	.042	1.054	.510	2.784
Step 1 <sup>a</sup> Occupation of the caregiver	-.217	.640	.115	1	.735	.805	.230	2.820
Age of children	-.079	.342	.053	1	.818	.924	.472	1.808
Household monthly income	.646	.486	1.768	1	.044	1.909	.736	4.950
Constant	-2.711	1.941	1.951	1	.163	.066		

a. Variable(s) entered on step 1: Age, Marital status, Level of education, Household size, Occupation of the caregiver, Age of children below 5 years, Household monthly income.

## 4.5 Hygiene and Sanitation Practices among Caregivers of Children below 5 Years

### 4.5.1 Water Sourcing

A majority of the caregivers sourced their water from a tap, close to a quarter sourced their water from a borehole while the least number sourced their water from a river. A high number of the caregivers treated their drinking water while 16.3% did not. A majority of the caregivers boiled their drinking water, 38.8% chlorinated their water while the least number of caregivers treated their water by decanting. Over four fifth of the caregivers covered a distance of below 0.5 km to the nearest water source while the least number of caregivers covered a distance of 1 to 1.5 km to the nearest water

source. A majority of the caregivers took less than 0.5 hours to get to the nearest water source and to go back home while the least number of caregivers spent 1 to 1.5 hours to get to the nearest water source and to go back home. Over a half of the caregivers (57.7%) had safe water sourcing practices while 42.3% had unsafe water sourcing practices.

**Table 4.4: Water Sourcing Practices among Caregivers of Children below 5 Years**

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
Source of drinking water		
Borehole	57	23.2
River	4	1.6
Tap water	175	71.1
Well	10	4.1
Treating drinking water		
No	40	16.3
Yes	206	83.7
Water treatment method		
Boiling	94	45.6
Chlorination	80	38.8
Decanting	4	1.9
Filtration	21	10.2
Sieving	7	3.4
Distance to nearest water source		
<0.5 km	217	88.2
0.5 to 1 km	18	7.3
1 to 1.5km	4	1.6
1.5 to 2km	7	2.8
Time taken to the nearest water source and back home		
<0.5 hours	210	85.4
0.5 to 1 hour	25	10.2
1 to 1.5 hours	4	1.6
1.5 to 2 hours	7	2.8
Water sourcing practices		
Safe	142	57.7
Unsafe	104	42.3

#### **4.5.2 Handwashing**

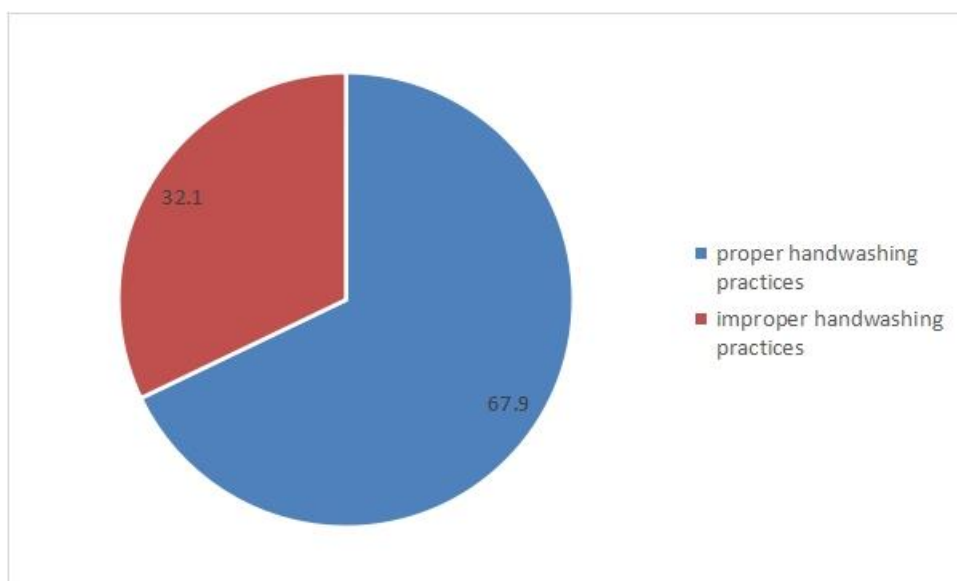
A majority of the caregivers sometimes washed hands before, during and after preparing food while the least number of the caregivers were not sure if they washed

hands. An equal number of caregivers (45.5%) always and sometimes washed their hands before and after feeding the baby. A high number of caregivers always washed children hands before and after feeding, after visiting the toilet and after changing the children diapers. A high number of caregivers sometimes washed their children hands after the children used the toilet. Slightly over a third of the caregivers always washed their hands after blowing their nose, coughing and sneezing, 34.8% were not sure if they washed hands while 28.8% sometimes washed their hands after blowing their nose, coughing and sneezing. Slightly over three quarters of the caregivers were not sure if they washed their hands after handling animals while 24.6% of the caregivers washed their hands after handling animals. Over a half of the caregivers (58%) were not sure if they washed their hands after handling garbage while 42% of the caregivers sometimes washed their hands after handling garbage.

**Table 4.5: Handwashing Practices among Caregivers of Children below 5 Years**

<b>Handwashing practices</b>	<b>Always (%)</b>	<b>Sometimes (%)</b>	<b>Not sure (%)</b>
Handwashing before, during and after preparing food	20	69.6	10.4
Handwashing before and after feeding the baby	45.5	45.5	9
Washing children hands before and after feeding	48.5	39.7	11.8
Handwashing after visiting the toilet	55.9	33.8	10.3
Handwashing after changing child's diapers	46.9	45.3	7.8
Washing children hands after they use the toilet	44.1	48.5	7.4
Handwashing after blowing nose, coughing and sneezing	36.4	28.8	34.8
Handwashing after handling animals	0	24.6	75.4
Handwashing after handling garbage	0	42	58

Slightly over two thirds of the caregivers had proper handwashing practices while 32.1% of the caregivers had improper handwashing practices.



**Figure 4.3: Handwashing Practices among Caregivers of Children below 5 Years in Bondhere District**

#### **4.5.3. Sanitation Practices**

A majority (91.5%) of the caregivers had access to toilet facility while 8.5% had no access. Slightly over three quarters of the caregivers had a toilet facility in their compound, 15.9% used public toilet while 4.5% of the caregivers used the neighbors' toilet. A high number (79.7%) of caregivers had an improved toilet facility while 20.3% used an unimproved toilet facility. In a majority (83.7%) of the caregivers' households the toilet was used by all household members while in the least number of households the toilet was used by children and men. Slightly over a half of the caregivers reported that their children defecated in the toilet, 23.2% defecated in diapers while the least number of children defecated in the open. A high number of caregivers buried the child faecal matter, 37.4% threw the child faecal matter in the toilet while 23.6% threw child faecal matter in the nearby bush. A majority of the caregivers practiced proper sanitation practices while 22% had improper sanitation practices.

**Table 4.6: Sanitation Practices among Caregivers of Children below 5 Years**

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
Access to toilet facility		
No	21	8.5
Yes	225	91.5
Location of toilet facility		
Neighbor's toilet	11	4.5
Own compound	196	79.7
Public toilet	39	15.9
Type of toilet facility		
Improved toilet	196	79.7
Unimproved toilet	50	20.3
People who use the toilet		
All	206	83.7
Children	4	1.6
Men	4	1.6
Women	32	13.0
Defecation for children		
Diapers	57	23.2
In an open space	21	8.5
Toilet	125	50.8
Potty	43	17.5
disposal of child fecal matter		
Bury	96	39.0
Throw in the latrine	92	37.4
Throw to nearby bush	58	23.6
Sanitation practices		
Proper	192	78
Improper	54	22

#### **4.6 Association between Hygiene and Sanitation Practices**

Over a half of caregivers whose children had diarrhea unsafe water sourcing practices while 40.4 had safe water sourcing practices. Furthermore there was a significant association between water sourcing practices and diarrhea ( $p= 0.021$ ). There was a significant association between handwashing and diarrhea whereby a majority of caregivers whose children had diarrhea had improper handwashing practices while 47.5% had improper handwashing practices ( $P= 0.008$ ). Additionally there was a significant association between sanitation practices and diarrhea ( $p= 0.025$ ). An equal



number (50%) of caregivers whose children had diarrhea had proper and improper sanitation practices.

**Table 4.7: Association between Hygiene and Sanitation Practices with Diarrhea**

Variables	Diarrhea		$\chi^2$	P value
	Yes f(%)	No f(%)		
Water sourcing practices			9.023	0.021
Safe	23(40.4)	119(63.0)		
Unsafe	34(59.6)	70(38.0)		
Handwashing practices				
Proper	28(47.5)	137(73.3)	13.984	0.008
Improper	31(52.1)	50(26.7)		
Sanitation practices				
Proper	24(50)	168(84.8)		
Improper	24(50)	30(15.2)		

#### **4.7 Hygiene and Sanitation Related Factors Influencing Occurrence of Diarrhea among Children below 5 Years**

Based on the regression analysis water sourcing [(OR= 1.187, 95% CI = 0.269 – 5.235, p<0.05)], handwashing [(OR= 0.711, 95% CI = 0.145 – 3.500, p<0.05)] and sanitation practices [(OR= 3.373, 95% CI = 0.564 – 6.143, p<0.05)] were found to significantly influence diarrhea among children below 5 years. Children living in households with unsafe water sourcing practices were more likely to experience from diarrhea. Furthermore children living in households where caregivers had improper handwashing practices were more likely to experience from diarrhea. Additionally children living in household where caregivers had improper sanitation practices were more likely to experience diarrhea.

**Table 4.8: Hygiene and Sanitation Related Factors Influencing Occurrence of Diarrhea among Children below 5 Years**

<b>Variables in the Equation</b>		<b>B</b>	<b>S.E.</b>	<b>Wald</b>	<b>df</b>	<b>Sig.</b>	<b>Exp(B)</b>	<b>95% C.I. for EXP(B)</b>	
								<b>Lower</b>	<b>Upper</b>
Step 1 <sup>a</sup>	Water sourcing	.172	.757	.051	1	.021	1.187	.269	5.235
	Handwashing	-.341	.813	.176	1	.045	.711	.145	3.500
	Sanitation practices	2.046	1.336	2.345	1	.026	3.737	.564	6.143
	Constant	-1.570	2.251	.487	1	.485	.208		

a. Variable(s) entered on step 1: water sourcing, handwashing, sanitation practices, Immunization.

#### **4.8 Association between Immunization Status and the Occurrence of Diarrhea**

Slightly over a half of caregivers whose children had diarrhea took their children for immunization sometimes, slightly over a quarter did not take their children for immunization while the least took their child for immunization. However, there was no significant association between diarrhea and immunization ( $p= 0.089$ ).

**Table 4.9: Association between Immunization Status and the Occurrence of Diarrhea**

<b>Variable</b>	<b>Diarrhea</b>		$\chi^2$	<b>P value</b>
	<b>Yes f(%)</b>	<b>No f(%)</b>		
Immunization			4.835	0.089
Do not take child for immunization	35(25.7)	32(29.1)		
Take the child for immunization	24(17.6)	30(27.3)		
Take the child for immunization sometimes	77(56.6)	48(43.6)		

## CHAPTER FIVE

### DISCUSSION CONCLUSION AND RECOMMENDATIONS

#### 5.1 Discussion

##### 5.1.1 Prevalence of Diarrhea

The study found Bondhere District in Somalia to have a two-week prevalence of diarrhea among children under five years at 22.9%. This is alarming because diarrheal diseases are still a public health concern in the region. About 64.9% of the diarrheal cases presented as acute watery diarrhea and 35.1% as persistent diarrhea. This prevalence is close to that reported in other studies in similar facility. For instance, a two weeks prevalence calculated from under-five children in Ethiopia found a 22% prevalence (Fekele *et al.*, 2021). Similarly, a study revealed a 2-week prevalence of 25.2 % in one of the villages (Ismael *et al.*, 2024) Though our findings are within the prevalence levels of these studies in Ethiopia and India, it was higher than the 14% prevalence established in a similar study conducted in Kenya Malatya and Ochieng (2020) and lower than that of 32.7% from a study conducted in Nigeria (Odo *et al.*, 2023). Such differences in the observed prevalence could be explained by a number of factors. First the differences could be attributed to limited access to water, sanitation and hygiene facilities in Somalia compared to that of Kenya, since access to WASH facilities are often compromised in areas affected by conflict and instability. Additionally, the comparatively lower prevalence in the current study compared to that in Nigeria could be due to the differences in the study settings, urban and rural and due to seasonal variations whereby diarrhoea occurrence varies with seasons (Odo *et al.*, 2023).

##### 5.1.2 Socio-Demographic Factors Associated with Diarrhea

Several social demographic factors were significant predictors of occurrence of diarrhea. Caregivers between the ages of 16 and 25 had the highest prevalence of children with diarrhea. This could be as a result of lack of young mothers' exposure to childcare practice, and possibly their lower education levels. Of similar revelation have

been other scholars from other developing countries. For instance, a study done on children and mothers in Ethiopia showed that those children whose mothers were below the age of 15-years had 2.3 times the likelihood to contract diarrhea in a given period than children whose mothers were old (Tereke *et al.*, 2022). Yet, a study conducted in Bangladesh failed to establish an inverse relationship between maternal age and childhood diarrhoea suggesting that various contextual factors can explain this association (Rahman & Hossain, 2022).

It was also found in the current study that level of education was associated with the prevalence of diarrhea with the highest risk of diarrheal prevalence being found among children whose mothers had no formal education. Maternal education has been reported in literature to have a positive association with childhood diarrhea. A systematic review and meta-analysis study by Adogu (2021) identified that children of illiterate mothers were 2.17 times more likely to be affected by diarrhea than children of educated mothers. Education is reported to improve awareness of mothers with regards to the hygienic practices, diet and where to seek medical care as well. Another research conducted in India observed association between maternal education and effective practicing of hand washing and proper handling of children's feces, key factors in prevention of diarrhea (Roy, 2023).

The current study observed that the number of children under 5 years in a household had a direct relationship with diarrhea occurrence. This may be as a result of high person to person transmission particularly in the crowded living houses and difficulty in observing hygiene measures with many young children (Ali *et al.*, 2023). Similar studies in Bangladesh and Ethiopia have also revealed similar patterns. They noted that the possibility of diarrheal prevalence amongst under-fives was 2.39 times higher for households with two or more under-fives children (Rahman & Hossain, 2022). This association can be attributed to increased care demands on the mother and a relatively high risk for contamination where there are multiple children in the family.

The results also depicted those children below the age of five years in households with low income as well as those in households with unemployed caregivers or breadwinners had higher rates of diarrhea. This concurs with many other works that

have confirmed the correlation between poverty and both incidence and prevalence of childhood diarrheal diseases. A study in Kenya revealed that children from the poorest wealth quintile had a 2.5 times higher odds of contracting diarrhea than their counterparts from households categorized in the richest quintile (Mulatya & Ochieng, 2020). Poor income hinders access to adequate clean water, good sanitation facilities and improved diets all of which are important in avoiding diarrheal diseases (Mohamed, 2021). These studies further noted that poverty can influence the way people seek treatment and therefore can play a critical role in increasing the chances of incidence and prevalence of diarrhea.

### **5.1.3 Hygiene and Sanitation Practices**

The current findings suggested important association between sources of drinking water, hand washing and sanitation practices and the frequency of diarrheal diseases. As reported in earlier studies, this study concurs with the idea that those households that had no access to safe water were readily found to have children who developed diarrhea (Ali *et al.*, 2023). Therefore, it can be affirmed based on these findings that access to safe water reduces diarrheal diseases. Additionally, a study conducted by Fekele *et al.* (2021) demonstrated that contaminated drinking water led to 502,000 diarrhea related deaths per day.

Poor hand washing hygiene was correlated with existence of diarrhea. This supports the knowledge that hand washing is one of the cheapest and effective measures of containing diarrheal diseases (Dubey *et al.*, 2022). A study by Daly and Harris (2022) noted that hand washing promotion in low- and middle-income settings reduced diarrheal prevalence among populations by 30% of diarrheal episodes. Therefore, given that a proportion of our respondents did not wash their hands properly and did so irregularly indicates the need for more caregiver education and behaviour change.

More diarrheal events were furthermore associated with improper sanitation practices. This is in agreement with global evidence that have shown that best practices in sanitation reduce diarrheal diseases. A study by Atari *et al.* (2023) pointed that reduction of open defecation to improved access to sanitation reduced diarrhea risk among the participating community by 16%. Therefore, if the 22% of households in

our study who had improper sanitation practices is to go by, a clear area for intervention exist.

#### **5.1.4. Immunization Status**

Interestingly the results of this research could not identify the immunization status as a risk factor for diarrhea. This is in contrast with the previous research showing that rotavirus vaccination has a positive effect against diarrheal diseases. For example, (Nazuridinov *et al.*, (2022). indicated that rotavirus vaccines had decreased all-cause diarrhea hospitalization by 38 percent in low- and middle- countries.

The findings in our study may be attributed to various factors as follows. First of all, the specific enteric pathogens that are common in this region, could partially differ from the pathogens against which the existing vaccines. A study in Ghana that investigated the effect of rotavirus vaccination on diarrhea disease burden showed that rotavirus vaccination reduced only rotavirus specific diarrhea but did not reduce all-cause diarrhea (Amalga, 2020). Second, low and intermittent coverage and incomplete vaccination could potentially ‘water down’ the effectiveness of vaccination at the operational level (Adogu, 2020). One research conducted in Ethiopia indicated that only children fully vaccinated had a lower risk of diarrhea (Fekele *et al.*, 2021). Lastly, there is a possibility that our assessment of immunization status based on caregiver recall proved to be inaccurate in some cases. Subsequent studies should employ improved immunization status indicators and study diarrheal diseases by pathogen type in order to determine the existed relationship among the Somalia population.

#### **5.2 Conclusion**

Diarrhea amongst children under five years in Bondhere District in Somalia was 22.9% with majority of the patients presenting with acute watery diarrhea. This prevalence is similar to prevalence in similar settings, but varies when compared to others which could be an indication of the complex nature of diarrhea as well as its context specific nature. The higher prevalence in Bondhere district calls for urgent attention to address childhood diarrhea.

A number of socio-demographic determinants affect the diarrheal disease amongst children below five years in Bondhere District. Caregiver age shorter than 35 years, a low education level, more than two children younger than 5 years in the family, unemployment, and lower household income are considered predictor factors for diarrhea. Such results point to the need for multicomponent strategies intending to respond to existing health problems but also to work on education, family planning, and poverty.

In its essence, the findings corroborate the intervention's primary emphasis on aspects of hygiene and sanitation in the overall management of childhood diarrhea. Vulnerability in access to clean and safe water, poor hand washing and sanitation practices are statistically related to increased incidences of diarrhea. Such practice shows that a large number of households had improper water, sanitation and hygiene practices which reveal the potential in this area for performing significant social interventions.

The indifference in diarrhea frequency in children with and without appropriate immunizations in this study is a surprising finding and deserves further analysis. This conclusion can be discussed with data from other settings, wherein vaccinations including rotavirus showed protective effect.

### **5.3 Recommendations**

The study recommends need to develop and implement a comprehensive national action plan specifically targeting childhood diarrhea in Somalia. This plan should prioritize areas with high prevalence, like Bondhere District. Additionally, the study recommends need to implement a community-based education program specifically targeting young mothers and families with multiple children under 5 years. This program should focus on essential childcare practices, proper nutrition, and hygiene. There is also need to launch a district-wide handwashing and proper use of sanitation facilities campaign. This campaign should promote proper handwashing techniques through practical demonstrations, distribute affordable handwashing stations to households, and work with local leaders to improve community sanitation facilities. Lastly, there is need to conduct a comprehensive study on the effectiveness of the

current immunization program in preventing diarrheal diseases in Somalia. This research should:

- a) Use more robust measures of immunization status, such as vaccination card records or health facility data.
- b) Investigate the prevalence of different diarrheal pathogens in the region, including those not targeted by current vaccines.
- c) Assess the coverage and timeliness of vaccinations, particularly for rotavirus.
- d) Explore potential barriers to vaccine effectiveness, such as malnutrition or co-infections.
- e) Consider a longitudinal study design to better understand the long-term impacts of vaccination on diarrhea incidence.



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## APPENDICES

### Appendix I: Consent Form

Hallo, my name is Mahad Dahir Turyare I am student at Jomo Kenyatta University of Agriculture and Technology; I am here to investigate factors influencing hygienic practices associated with diarrhoea among under five in Bondhere district Somalia. The research will involve your participation by answering an interviewer administered questionnaire for 15 minutes.

We will not be share information about you or your children to anyone outside of the research team. The information that we collect from this research project will be kept private and confidential, your participation in this research is entirely voluntary.

You are being invited to take part in this research because we feel that your experience will contribute much to our understanding and knowledge about the above topic. There will be neither direct benefit nor an incentive.

### Somalia translation

### Somali Translation

Asc. Magacaygu waxaa la yiraahdaa Mahad Dahir Turyare, waxaan ahay arday wax kabarta Jamacadda Jomo Kenyatta University of Agriculture and Technology, waxaa doonayaa in aan cilmi baaris kusameeyo waxyaalaha saameeynta ku leh nadaafada iyo shubanka ee Caruurta ka yar 5 sano . Waxaan hayaa dhowr su'aaloodoo la xiriiro wacyiga Nadafada iyo Shubanka. Natijada daraasadani waxa ay kaalmayndoontaa Wasaarada caafimaadka si ay u ogaato daldaloolada jira islamarkaana uga gun dhigto hanaanka nadafad wanaaga. Daarasadani waxaa ansixiey wasaarada caafimaadka, qeybta baraarujinta caafimaadka.

Xog-waraysigani waxa uu qaadankaraa 15 daqiiqo, ma doonaysaaa inaad kaqaybqaadatid?

Haddii jawaabtaadu haa tahay waxaa bilaamayo xo-waraysigii. Haddii ay tahay maya, waad mahadsantay

**Name of Mother/ Caregiver**\_\_\_\_\_

**Date**\_\_\_\_\_----- **Signature**\_\_\_\_\_

**Day/month/year**

## Appendix II: Questionnaire

A questionnaire for understanding factors influencing hygienic practices associated with diarrhoea in Bondhere District Somalia.

<b>Socio Demographic Characteristics</b>		
1.	Age	01= 16- 21 years 02= 22- 27 years 03= 28- 33 years 04= 34- 39 years 05= 40- 45 years 06= Above 45 years
2.	Marital status	01= Single 02= Married 03= Divorced 04= Widowed
3.	Level of education	01= No formal education 02= Primary 03= Secondary 04= Tertiary/ college/university
4.	Household size	01= 2- 4 members 05= 5-7 members 06= 8- 10 members 07= More than 10 members
5.	Number of children below 5 years	01= 1 02= 2 03= 3 04= 4 05= 5
6.	Age of children below 5 years (months)	
7.	Occupation of the caregiver	01= Unemployed 02= Business 03= Formal employment (Government/ private)
8.	Household monthly income	01= <100 USD 02= 101- 200 USD 03= 201- 300 USD 04= 301- 400 USD 05= 401- 500 USD 06= More than 500 USD
9.	Residence status	01= IDP 02= Inhabitant

### Prevalence of Diarrhea

10.	Has the child/children had diarrhea in the last 2 weeks	01= Yes 02= No
11.	Presentation of diarrhea	01= Acute watery diarrhea 02= Bloody diarrhea 03= Persistent diarrhea
12.	Does the child have any other disease/ medical complication (specify)	

### Hygiene and Sanitation Practices

#### Water Supply

13.	Source of water used in the household	01= River 02= Well 03= Borehole 04= Tap water
14.	Do you treat drinking water	01= Yes 02= No
15.	If yes, in the above question how do you treat drinking water	01= Boiling 02= Chlorination 03= Filtration 04= Sieving 05= Decanting
16.	Distance to your water source	01= < ½ Km 02= ½ to 1Km 03= 1 to 1.5 Km 04= 1.5 to 2Km 05= > 2Km
17.	Time taken to get to the nearest water source and return home	01= Less than ½ hour 02= ½ hr to 1 hr 03= 1 to 1.5 hrs 04= 1.5 to 2 hrs 05= > 2hrs

## Hand Washing

(use 1 = Always, use 2= Sometimes, use 3 = Not sure )

		Always	Sometimes	Not sure
18.	Do you wash your hands before, during and after preparing food			
19.	Do you wash your hands before and after feeding the baby			
20.	Do you wash children hands before and after feeding			
21.	Do you wash your hands after visiting the toilet			
22.	Do you wash your hands after changing child's diapers			
23.	Do you wash children hands after they use the toilet			
24.	Do you wash your hands after blowing your nose, coughing and sneezing			
25.	Do you wash your hands after handling animals			
26.	Do you wash your hands after handling garbage			

## Sanitary Facility

27.	Do you have access to a toilet facility	01= Yes 02= No
28.	Location of toilet facility	01= Own compound 02= Neighbor's toilet 03= Public toilet
29.	Type of toilet	<b>Improved:</b> 01= Flush toilet linked to closed system 02= Pit latrine with slab (floor) 03= Pit latrine with poles (floor) 04=Cover of the squatting hole <b>Unimproved:</b> 05= Bucket 06= Pit latrine with open squatting hole 07= Open defecation
30.	Who uses the toilet	01= Men 02= women 03= Children 04= Others (specify)

31.	Place for defecation for the child	01= Potty 02= Latrine 03= Diapers 04= In an open space
32.	How do you dispose child fecal matter	01= Throw to nearby bush 02= Bury 03= Throw in the latrine 04= Others (specify)
33.	Immunization practice	01= Take the child for immunization 02= Take the child sometimes for immunization 03= Do not take the child for immunization











### Appendix III: Observation Checklist

<b>Water source</b>		
1	Presence of a water tap in the compound	01= Yes 02= No
	Hand washing	
2	Handwashing equipment outside the toilet without water	01= Yes 02= No
3	Handwashing equipment outside the toilet with water only	01= Yes 02= No
4	Handwashing equipment with water and soap	01= Yes 02= No
<b>Hand washing</b>		
5	Handwashing before, during and after preparing food	01= Yes 02= No
6	Handwashing before and after feeding the baby	01= Yes 02= No
7	Handwashing of children hands before and after feeding	01= Yes 02= No
8	Handwashing after visiting the toilet	01= Yes 02= No
9	Handwashing after changing child's diapers	01= Yes 02= No
<b>Sanitary facility</b>		
10	Presence of a toilet	01= Yes 02= No
11	Type of toilet	<b>Improved:</b> 01= Flush toilet linked to closed system 02= Pit latrine with slab (floor) 03= Pit latrine with poles (floor) 04=Cover of the squatting hole <b>Unimproved:</b> 05= Bucket 06= Pit latrine with open squatting hole 06= Open defecation
	Disposal of child fecal matter	
12	Presence of fecal matter in the compound	01= Yes 02= No
13	Presence of used diapers in the compound	01= Yes 02= No
14	Presence of used diapers in household rubbish pit	01= Yes 02= No
15	Presence of fecal matter in household rubbish pit	01= Yes 02= No

## Appendix IV: Map of Bondhere District



Sub:Boundries Yusuf Al-Kownayn		Sinay	Nasib Bundo	Daljirka
	Yusuf Al-Kownayn			
	Sinay			
	Nasib Bundo			
	Daljirka	