WASH RELATED FACTORS ASSOCIATED WITH NUTRITION STATUS OF CHILDREN UNDER FIVE IN EWASO NAROK WETLAND, LAIKIPIA COUNTY, KENYA

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Q57/CE/34028/2016

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF PUBLIC HEALTH (EPIDEMIOLOGY AND DISEASE CONTROL) IN THE SCHOOL OF HEALTH SCIENCES OF KENYATTA UNIVERSITY

FEBRUARY 2025

DECLARATION

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

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DEDICATION

To my family, mentors, and friends, this thesis is dedicated to you for your encouragement and boundless support throughout the journey.

ACKNOWLEDGMENTS

First and foremost, I want to sincerely thank God Almighty for giving me the ability to get this far. I would especially like to express my gratitude to my supervisors, Drs. John Paul Oyore and Isaac Mwanzo, for their tremendous guidance, tolerance, and knowledge, all of which helped to shape my research. Their support served as an ongoing source of inspiration.

I am grateful to the Department of Community Health and Epidemiology lecturers and faculty for their critiques and recommendations which substantially improved the quality of my work. Their rigorous review process and diverse perspectives were invaluable.

I am grateful to Dr Helida Oyieke of the Kenya National Museums for allowing me to conduct my study as part of the larger GlobE Wetlands East Africa initiative. My heartfelt gratitude to the German Federal Ministry of Education and Research (GFMER) for financing my study through the GlobE Wetlands East Africa initiative.

Lastly, I cannot forget the unwavering love, understanding, and encouragement of my friends and family, which were crucial in balancing my academic responsibilities with personal commitments.

Thank you all for your invaluable contribution to my journey.

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ABBREVIATIONS AND ACRONYMS

CHEW	Community Health Extension Worker
CHV	Community Health Worker
DALYs	Disability-adjusted life years
DHS	Demographic and Health Survey
FGD	Focused Group discussion
KII	Key informant Interview
KUERC	Kenyatta University Ethics and Review Committee
NACOSTI	National Commission for Science, Technology and Innovation
NCDs	Non-communicable diseases
SDG	Sustainable Development Goal
SHINE	Sanitation, Hygiene, Infant Nutrition Efficacy Project
SMART	Standardized Monitoring and Assessment of Relief and Transitions
UNICEF	United Nations International Children's Emergency Fund
WASH	Water, sanitation and hygiene
WHO	World Health Organization

DEFINITION OF OPERATIONAL TERMS

Wetland As stated by World Health Organization (WHO) a wetland is an ecosystem that is characterized by oxygen-free processes and is periodically flooded by water. Wetlands are distinguished from other land formations or water bodies by the unique flora of aquatic plants that has developed to the strange hydric soil.

Sanitation: These are public health issues in terms of safe drinking water and efficient sewage and human excreta disposal. Some sanitation practices include avoiding contact with feces and washing hands frequently with soap and clean water. According to WHO, sanitation programs, such as providing a clean environment, are implemented to promote human health, primarily by preventing disease transmission. Proper cleanliness, for example, can prevent diarrhea, a major cause of childhood malnutrition.

Hygiene: "Hygiene refers to practices that are conducive in maintaining health and preventing the spread of diseases," as stated by (WHO). The process of keeping one's body clean is known as personal hygiene.

Nutrition Status: WHO defines this as an individual's health status as influenced by nutrient intake and utilization. It is influenced by two aspects: external factors like food safety, cultural, social, and economic issues, and internal factors like age, gender, nutrition, behavior, physical activity, and the person's ailments.

Stunting: According UNICEF, stsunting occurs when a child is substantially too short for his or her age. As a result of their delayed growth, these youngsters may suffer lasting physical and cognitive harm. Stunting's devastation affects future generations

Wasting: UNICEF states that a young child is said to be wasted if they are very underweight for their height. Wasting results from recent, dramatic weight loss or inability to gain weight.

Underweight: Underweight as defined by UNICEF is characterized by a child who has low weight for his or her age

ABSTRACT

This study investigates the association between Water, Sanitation, and Hygiene (WASH) factors and the nutritional status of children under five in Ewaso Narok Wetland, Laikipia County, Kenya. The specific objectivves of the study were; to assess the status of nutrition among children under five years old in the Ewaso Narok wetland, to establish the socio-demographic factors influencing the status of nutrition among children under five years old in the Ewaso Narok wetland, to determine how WASH-related factors impact the status of nutrition among children under five years in the Ewaso Narok wetland, and to establish the relationship between Nutrition status and selected WASH-related diseases among children under five in Ewaso Narok wetland in Laikipia county. Utilizing a mixed-method approach, both qualitative and quantitative data were collected to assess WASH-related parameters and their impact on child nutrition. The study sample comprised under-five children recruited from selected facilities every month. Data collection involved a review of hospital records and structured questionnaires. Descriptive statistics, including frequency tables, cross-tabulation, pie charts, and graphs, were employed to analyze the data. Additionally, inferential statistics, such as binary logistic regression, were utilized to predict the nutritional status of children based on various WASH factors. The findings reveal significant correlations between WASH factors and child nutrition status. Notably, 62% of caregivers disposed of children's faeces immediately, indicating a positive impact on child nutrition. Moreover, children residing within 1 km of wetlands exhibited a 45% higher prevalence of malnutrition compared to those living farther away. Proper use of protective gear in wetland areas was associated with a 25% reduction in malnutrition rates among children. Furthermore, consistent handwashing before eating was linked to a 30% lower risk of malnutrition. Inferential analysis demonstrated that faeces disposal method ($p = 0.045$), distance to wetlands ($p < 0.001$), and handwashing practices ($p = 0.012$) emerged as significant predictors of child nutrition status. These findings underscore the importance of targeted interventions to improve WASH practices and enhance child nutrition outcomes in the study area. Based on the study's findings, recommendations are proposed to address the identified WASH-related challenges. These include implementing WASH programs targeting faeces disposal practices, wetland proximity, and handwashing behaviors. Additionally, enhancing access to improved water and sanitation facilities, promoting hygiene education, and encouraging safe disposal of children's feces are recommended strategies to improve child nutrition.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Nutrition remains closely linked to several important factors. Malnutrition is defined as nutrient deficiencies or excesses, essential nutrients imbalance or nutrient utilization impairment (WHO. (2024)). Undernutrition, which includes stunting (low Height-for-Age), underweight (low Weight-for-Age), and wasting (low Weight-for-Height); micronutrient-related malnutrition, which includes micronutrient deficiencies or micronutrient excess; and overweight, obesity, and diet-related non-communicable diseases are the three broad categories of conditions (NCDs) (World Health Organization, 2021).

Globally, socio-demographic factors such as household income, caregiver education, and maternal health significantly influence child nutrition. Research by UNICEF (2020) highlights that children in low-income households are more likely to experience malnutrition. Furthermore, poor maternal education correlates with higher stunting and underweight prevalence. WASH-related factors, including limited access to clean water and sanitation, contribute to 45% of child mortality linked to malnutrition (Geissler & Powers, 2023). Burnett et al. (2020) emphasize the role of sanitation infrastructure in reducing diarrheal diseases, a major contributor to malnutrition.

One in every nine people worldwide is still hungry or undernourished, with 149 million stunted children under the age of five, 45 million wasted children, and 38.9 million underweight children. (UNICEF et al., 2020). Underweight is a persistent problem in the poorest countries, with rates up to ten times greater than in wealthy countries. Obesity and overweight are five times more prevalent in wealthy countries than in poorer ones.(GNR, 2020). Poor nutrition, inconsistency in water supply, illnesses, poor

sanitation and hygiene and stunted development and growth are all difficulties that children in low-income nations confront (Adedokun & Yaya, 2021).

Poor care practices, insufficient food intake, and disease caused directly or indirectly by insufficient access to proper hygiene, sanitation and safe water are the main underlying causes of undernutrition. (Sanitation and Water for All (SWA) & Scaling Up Nutrition (SUN) Movement, 2017). Undernutrition accounts for roughly half of all deaths in under five, putting them at a higher danger of dying from common diseases, increasing the incidence and severity of infections and prolonging recovery. 297,000 WASH-related diarrhea deaths occur each year globally, accounting for 5.3% of total deaths among children under the age of five (Chakraborty et al., 2021). It is estimated that one out of every five children born does not live beyond the age of five and this is largely attributed to WASH-related disease. 88% of diarrheal disease is caused by contaminated water, poor sanitation, and poor hygiene (Kwami et al., 2019). According to research, better WASH conditions and practices could avert 45% of worldwide malnutrition-related child fatalities (Geissler & Powers, 2023).

South-East Asia and Africa account for about 78% of all diarrhea-related deaths in under five. Every year, nearly 4 billion instances of diarrhea among children are reported in Africa due to poor sanitation. (Turyare et al., 2020). In addition, 2 billion individuals globally are plagued with intestinal parasites, with children in resource-poor nations or countries bearing the brunt of the affliction. The World Health Organization (WHO) claims that, 50 per cent of malnutrition is caused by recurring diarrhea or intestinal worm infections resulting from contaminated water, poor sanitation, or poor hygiene.

In Sub-Saharan Africa, malnutrition rates are among the highest globally, with 33% of children under five experiencing stunting (GNR, 2020). Socio-demographic factors

such as large family size, low parental education, and poverty exacerbate this situation. WASH-related issues, including inadequate sanitation facilities and unsafe drinking water, are prevalent, leading to recurrent diarrheal diseases and intestinal worm infections (Kwami et al., 2019). Studies in Ethiopia and Nigeria reveal that improved WASH interventions significantly lower the prevalence of stunting and wasting (Freeman et al., 2020).

In Kenya, 26% of under-fives are stunted, 11% are underweight with 4% wasted (Shrestha et al., 2020). In Laikipia County, stunting among under-fives accounts for 27% while underweight and wasting are at 14% and 4.4% respectively (Sabud et al., 2020). This shows that malnutrition is still a huge challenge especially in children aged under 5 years. Socio-demographic factors such as low maternal education and household income directly influence these rates. Inadequate WASH infrastructure exacerbates malnutrition, with rural areas experiencing higher rates of diarrheal diseases (Sabud et al., 2020). Arriola et al. (2020) reveal that handwashing with soap reduces malnutrition by 30% in Kenyan households. However, disparities between urban and rural regions persist, highlighting the need for targeted interventions.

1.2 Statement of the problem

Undernutrition in children remains a significant public health problem despite the numerous nutrition-specific campaigns and interventions. Around 40 to 60% of malnutrition in childhood is attributed to poor WASH conditions predominantly through frequent diarrhoea cases and intestinal nematode infections (Kang et al., 2018) This occurs through the introduction of infectious diseases such as diarrhoea, soil-transmitted helminthic infections and environmental enteropathy. All these infections lead to gut dysfunction which sequentially affects nutrient absorption into the body causing poor nutrition status.

Wetlands are linked with poor sanitation, poverty and insufficient clean water. Living is depicted by high population density and limited infrastructure characterized by lack of potable drinking water, poor housing conditions, overcrowding and sanitation facilities (Peter et al., 2019). Children living in unsanitary and unhygienic environments may become undernourished even in the absence of intestinal worms or diarrhoea (Rah et al., 2020). According to a SMART study conducted in Laikipia County, stunting and underweight prevalence rates were 25.1% and 20.1%, respectively, compared to national prevalence rates of 26% and 11% (Chattopadhyay et al., 2019).

1.3 Justification of the Study

Diarrhea is one of the leading frequent childhood illnesses continuously associated with morbidity, death, and poor nutritional status in children. Improved WASH conditions have a higher potential of improving health outcomes due to reduced susceptibility and disease burden together with higher access levels especially in wetlands areas (Arriola et al., 2020). WASH initiatives, on the other hand, are not adequately incorporated into nutrition and health interventions among children under five. The goal of this study is to see how dietary habits, as well as WASH infrastructure and practices, affect the nutritional and health condition of children under the age of five in Ewaso Narok Wetland, Laikipia County. Establishing this association will help in the integration of WASH into nutrition programs and hence fight this menace of malnutrition in children. This will go a long way toward attaining SDG 2.2, which calls for ending all types of malnutrition by 2030, and SDG 3.2, which calls for ending unnecessary deaths of newborns and under five by 2030 (Gimaiyo et al., 2019). The results of this study will also serve as a critical benchmark for future public health efforts.

1.4 Research Questions

1. What is the status of nutrition among children under five years old in the Ewaso Narok wetland?
2. What socio-demographic characteristics among caregivers influence the status of nutrition among children under five years old in the Ewaso Narok wetland?
3. How do WASH-related factors impact the status of nutrition among children under five years in the Ewaso Narok wetland?
4. What is the link between the nutritional status and selected WASH-related diseases among children under five in the Ewaso Narok wetland?

1.5 Hypothesis

Ho: There is no correlation between the nutritional status and selected WASH-related diseases among children under five in Ewaso Narok wetland.

H01: There is no relationship between caregivers' hygiene and sanitation knowledge with the nutritional status among children under five in the Ewaso Narok wetland.

H02: There is no relationship between caregivers' hygiene and sanitation practice with the status of nutrition among children under five years old in the Ewaso Narok wetland.

1.6 Research Objectives

1.6.1 Broad Objectives

The broad objective is to investigate the association of nutrition status with WASH-related diseases among children under five in Ewaso Narok wetland, Laikipia County.

1.6.2 Specific Objectives

1. To assess the status of nutrition among children under five years old in the Ewaso Narok wetland.
2. To establish the socio-demographic factors influencing the status of nutrition among children under five years old in the Ewaso Narok wetland.
3. To determine how WASH-related factors impact the status of nutrition among children under five years in the Ewaso Narok wetland
4. To establish the relationship between Nutrition status and selected WASH-related diseases among children under five in Ewaso Narok wetland in Laikipia county

1.7 Delimitation and limitation of the Study

1.7.1 Delimitation

The study focused on caregivers of children aged 6-59 months in Ewaso Narok wetland, Laikipia County; hence, the results could only be generalized to areas with similar settings. One of the limitations was the observational assessment of personal hygiene, which mostly dealt with personal appearance, and could sometimes be influenced by work factors

1.7.2 Limitation

There were no validated or standardized procedures for evaluating WASH-related parameters that influenced the status of nutrition among children under five years old. Consequently, there was minimal evidence of the relationship between nutrition status and WASH. The study design was cross-sectional with a random selection of participants and only focused on caregivers with children under five living or working in the wetlands area.

The limitations affected the study in the following ways:

1. **Lack of Standardized Procedures**: The absence of validated tools for evaluating WASH-related parameters created challenges in ensuring the accuracy and comparability of data. This was mitigated by adopting WHO-recommended guidelines and tools for anthropometric measurements and water sanitation assessments.
2. **Cross-Sectional Design**: The cross-sectional nature of the study limited the ability to establish causality between WASH-related factors and nutritional outcomes. However, the use of comprehensive data analysis, including logistic regression, provided insights into potential associations.
3. **Geographic Scope**: Focusing exclusively on caregivers within the Ewaso Narok Wetland limited the generalizability of findings to other regions. To overcome this, the study ensured diverse sampling within the area to capture a wide range of socioeconomic and environmental conditions.
4. **Observational Hygiene Assessments**: The reliance on visual observations for hygiene assessments could have introduced bias. This limitation was addressed by triangulating data through interviews and focus group discussions to validate observations.

1.8 Assumptions of the study

The study presupposed that all participants would give their informed consent and that the information they submitted to the researcher was accurate.

1.9 Conceptual Framework

The relationship between the dependent and independent variables was depicted in the conceptual framework. The socio-demographic parameters of caregivers, water and

hygiene practices, sanitation facilities, and proximity to a wetland that causes diarrhea and helminthic infections are all linked to children's nutritional status. However, knowledge of nutrition was the modifying factor in the prevention of WASH-related infections hence good nutrition status among children 6-59 months.

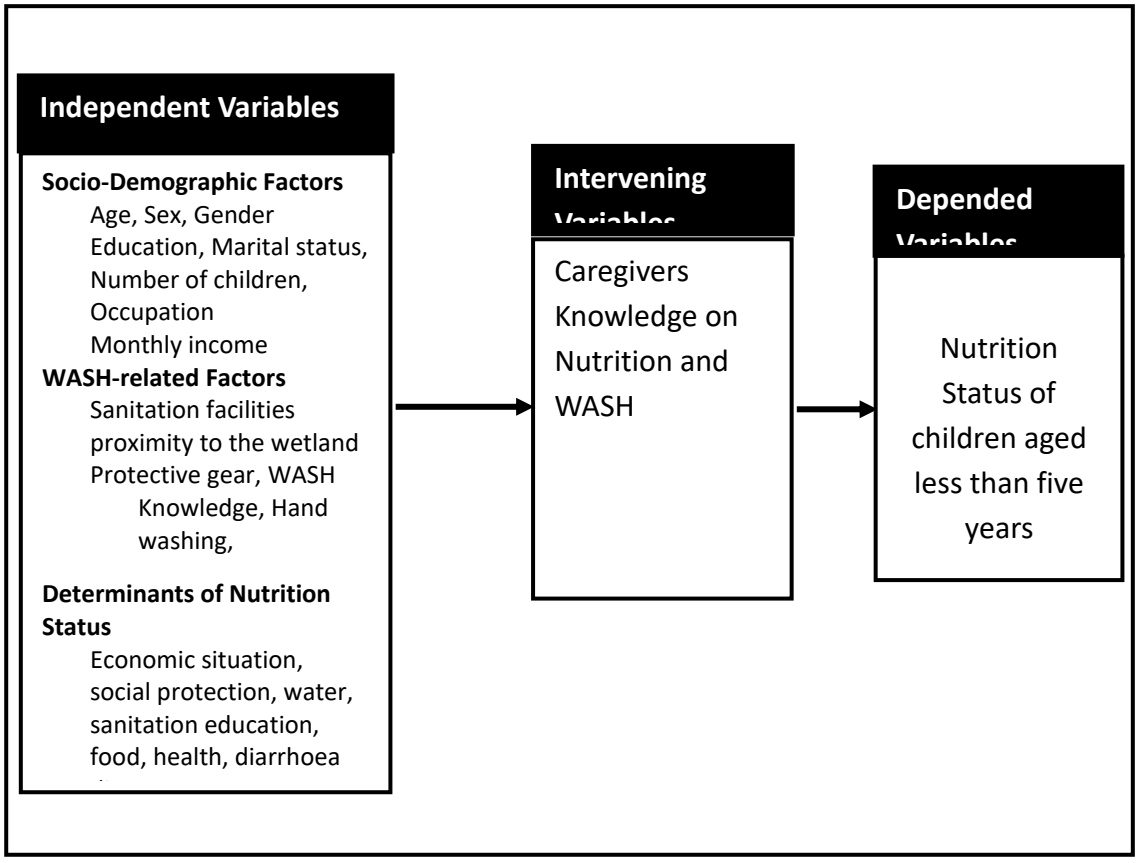


Figure 1.1 Conceptual Framework

***Source**: Adapted and modified from (Zavala and shannan King, 2021)*

1.10 Significance of the Study

The study gave a comprehensive picture of the need for the development and design of integrated nutrition and WASH programs to address identified determinants of nutrition status. The study also added knowledge regarding the factors connected to WASH that influenced the status of nutrition among children under five years old in the Ewaso Narok wetland.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Malnutrition is linked to insufficient water availability, sanitation, hygiene practices, and diarrhea, yet there is limited evidence to support this link. As a result, the goal of this research will be to assess the nutritional state of children under five, as well as explain the relationship between diarrhea and WASH practices.

Malnutrition is a well-known nutrition condition that is a primary cause of Children's morbidity and mortality in low-income nations. Malnutrition is one of Ethiopia's most serious health issues for mothers and children being the second-highest in sub-Saharan Africa as demonstrated by the 2019 Ethiopia mini DHS. Many studies undertaken in various parts of Ethiopia, according to Carmen, indicated that the magnitude of wasting, underweight, and stunting was significant, and that malnutrition was a great concern in Ethiopia (Freeman et al., 2020).

2.2 Overview of WASH

In his study, Freeman (2020) showed that inadequate sanitation, hygiene water supply initiatives generate ideal environments for the spread of infectious illnesses connected to malnutrition. Poor interventions have at least three direct effects on a child's nutritional status: diarrheal disorders, environmental enteropathy and intestinal parasite infections. Lack of childcare time may have an indirect impact on children's nutritional condition, particularly when mothers must travel considerable distances to find water and sanitation services.

As children begin exploring, walking and crawling placing objects in their mouths, they are more likely to absorb bacteria found in feces from both humans and animals. This causes children's nutritional status to deteriorate as a result of recurring diarrhea and worms in the intestine (Momberg et al., 2021).

The WASH benefit and Sanitation, Hygiene, Infant Nutrition Efficacy Project (SHINE) study report shows that children receiving WASH interventions had a greater rate of enteric infections than children in high-income countries. Furthermore, recent study findings found that various WASH therapies had little or no benefit in lowering childhood diarrhea and stunting, as mentioned in Anthonj et al., (2021) findings.

2.3 Wetlands

Wetlands are important water and nutrient sources, as well as areas where people make a living (Peter et al., 2019) Wetlands as defined by the Ramsar Convention on Wetlands are natural swampy areas comprising reservoirs, rice paddies, oases, deltas, estuaries, and other man-made and natural water resources. Wetlands provide important ecological services and ideal circumstances for the survival and multiplication of helminths, bacteria, viruses, and protozoa as well as their vectors, hosts, and reservoirs in aquatic habitats. According to Rah et al. (2020), several of these microbes cause diseases.

Transmission occurs through ingestion of contaminated water or direct contact with parasite-infested water on the skin and mucous membrane surfaces. Disease transmission can also be aided by inadequate water to maintain hygiene and cleanliness. Diarrhea, cholera, typhoid fever, schistosomiasis, malaria, and other diseases are commonly related to wetlands, according to Gimaiyo et al (2020) work.

Globally inadequate WASH accounts for over 7% of disease burden of disability-adjusted life years (DALYs) and above 4% of all deaths worldwide, with the majority of deaths occurring in developing countries (Chattopadhyay et al., 2019). Diseases related to WASH affect families, quality of life, social networks, agricultural output and overall socio-economic growth (Kang et al., 2018). Wetlands are perfect

environments for agents that cause diseases, hence the need for prioritization of WASH and proper handling of similar settings, particularly in wetlands heavily used by various communities with insufficient water and sanitation infrastructure.

Despite the preceding summary, Derne et al. point out that there is still a void in the WASH literature with respect to wetlands. The prevailing status of WASH for people who use wetlands prompted the necessity for this study.

2.4 Association between WASH and Nutrition Status

Previous research has linked socioeconomic factors, inadequate nutrition, and caregivers' poor understanding of feeding methods to an increase in the malnutrition rate. Childhood diarrhea, proper disposal of children's excrement, and the usage of soap for handwashing were all identified as risk factors for malnutrition in different locations of Ethiopia, according to (Arriola et al., 2020).

In Kenya, the research suggests that there is a weak link amid availability of water, sanitation, and cleanliness initiatives and childhood malnutrition. In Ewaso Narok Wetland, Laikipia County, Kenya, the study's goals were to detect childhood malnutrition and its relationship to diarrhea, water, sanitation, and hygiene practices. These findings will aid policymakers, program planners, donors, and other interested parties in preventing child malnutrition. It also makes recommendations for additional research in areas where gaps have been identified.

2.5 Water Factors Influencing Nutrition Status

2.5.1 Access to Clean Water Sources

Access to clean water sources is paramount for child nutrition, as it directly influences hydration, food preparation, and overall sanitation practices. Clean water is essential

for the proper functioning of the human body, facilitating the absorption of nutrients and the elimination of toxins (Adedokun & Yaya, 2021). Inadequate access to clean water can lead to dehydration, which can compromise a child's health and nutritional status, particularly in arid or semi-arid regions like the Ewaso Narok Wetland area of Laikipia County, Kenya. Moreover, contaminated water sources pose a significant risk of waterborne diseases, such as diarrhea, cholera, and typhoid, which can have severe consequences for child health and development.

Numerous studies have highlighted the critical role of clean water access in improving child nutrition outcomes. For example, research conducted in various low- and middle-income countries has consistently demonstrated the positive association between improved access to clean water and reduced rates of malnutrition and stunting among children under five years old (Chakraborty et al., 2021). These studies have shown that children who have access to clean water are less likely to suffer from waterborne illnesses, which can lead to malnutrition due to decreased appetite, nutrient malabsorption, and increased metabolic demands. Additionally, access to clean water facilitates proper sanitation and hygiene practices, such as handwashing and food preparation, which are essential for preventing the spread of infectious diseases and promoting optimal nutrition.

In the context of the Ewaso Narok Wetland area, where water resources may be limited or contaminated due to agricultural runoff, industrial pollutants, and inadequate sanitation infrastructure, ensuring access to clean water is particularly challenging (Chakraborty et al., 2021). However, addressing this challenge is critical for improving child nutrition and overall well-being in the region. Interventions aimed at enhancing access to clean water sources, such as improving infrastructure, promoting water treatment technologies, and implementing community-based water management

schemes, are essential for safeguarding child health and nutrition in the study area. By prioritizing access to clean water, policymakers, public health officials, and community leaders can mitigate the risk of waterborne diseases and promote the nutritional security of children in the Ewaso Narok Wetland area and similar settings worldwide.

2.5.2 Water Quality and Contamination

Water quality and contamination pose significant challenges to child health and nutrition, particularly in regions like the Ewaso Narok Wetland area of Laikipia County, Kenya. Waterborne diseases resulting from poor water quality can have detrimental effects on child health and nutrition. Contaminated water sources can harbor pathogens such as bacteria, viruses, and parasites, which can cause diseases like diarrhea, cholera, typhoid fever, and dysentery (Kwami et al., 2019). These illnesses can lead to dehydration, nutrient malabsorption, decreased appetite, and increased metabolic demands, all of which can contribute to malnutrition and stunting among children under five years old.

Research conducted in the Ewaso Narok Wetland area and similar settings has shed light on various water quality issues affecting child health and nutrition. Studies have identified sources of contamination, including agricultural runoff, industrial pollutants, inadequate sanitation infrastructure, and improper waste disposal practices (Kwami et al., 2019). These contaminants can enter water sources such as rivers, streams, wells, and boreholes, compromising their quality and safety for human consumption. Moreover, seasonal variations in rainfall and water flow can exacerbate contamination risks, particularly during periods of heavy rainfall or flooding when pollutants are washed into water bodies.

Efforts to address water quality issues in the Ewaso Narok Wetland area have focused on improving water treatment and purification technologies, implementing watershed management strategies, and promoting community-based water quality monitoring and surveillance systems. Additionally, hygiene education programs aimed at promoting safe water practices, such as proper water storage, treatment, and handling, play a crucial role in reducing the risk of waterborne diseases and improving child nutrition outcomes. By addressing water quality and contamination issues comprehensively, policymakers, public health officials, and community leaders can protect the health and well-being of children in the study area and enhance their nutritional security.

2.5.3 Water Scarcity and Its Impact on Nutrition

The existing literature on water scarcity and its impact on child nutrition, particularly in regions like the Ewaso Narok Wetland area of Laikipia County, Kenya, provides valuable insights into the complex dynamics at play. Studies have extensively explored the relationship between water scarcity and food security, highlighting the significant implications for child nutrition (Shrestha et al., 2020). In water-scarce regions, agricultural productivity is often compromised, leading to reduced availability of nutritious foods and increased vulnerability to malnutrition among children. However, while these studies shed light on the broader implications of water scarcity on food security, further research is needed to elucidate the specific pathways through which water scarcity affects child nutrition outcomes, considering contextual factors such as household socio-economic status and access to healthcare.

Moreover, research has consistently emphasized the importance of hygiene and sanitation practices in mitigating the impact of water scarcity on child nutrition. Limited access to clean water for handwashing, bathing, and food preparation can increase the risk of waterborne diseases and other infections, compromising child health and

nutritional status. Interventions aimed at promoting improved hygiene and sanitation practices have shown promise in reducing the burden of waterborne diseases. However, challenges remain in ensuring sustained behavior change and equitable access to sanitation facilities, particularly in marginalized communities where infrastructure and resources may be lacking.

Community-based interventions have emerged as promising approaches to addressing water scarcity-related nutrition challenges among children. These initiatives often involve active participation from local communities in decision-making processes, empowering women and marginalized groups, and promoting sustainable water resource management practices (Sabud et al., 2020). While these interventions have demonstrated some success in improving access to clean water and promoting hygiene and sanitation practices, their long-term effectiveness and scalability require further evaluation. Additionally, evaluating the impact of these interventions on child nutrition outcomes is crucial for informing evidence-based approaches to addressing water scarcity-related nutrition challenges in the study area.

Furthermore, the literature underscores the importance of policy interventions in addressing water scarcity-related nutrition challenges among children. Policies aimed at promoting sustainable water resource management, improving access to clean water and sanitation facilities, and enhancing hygiene and sanitation practices are essential for safeguarding child health and nutrition in water-scarce environments (Kang et al., 2018). However, the effectiveness of these policies depends on their successful implementation and enforcement, as well as adequate investment in infrastructure and capacity-building initiatives. Thus, future research should focus on evaluating the effectiveness of policy interventions in addressing water scarcity-related nutrition

challenges and informing evidence-based approaches to improving child nutrition outcomes in water-scarce environments like the Ewaso Narok Wetland area.

2.6 Sanitation Factors Influencing Nutrition Status

2.6.1 Access to Sanitation Facilities

The sanitation factors influencing nutrition status among children under five years in the Ewaso Narok Wetland area of Laikipia County, Kenya, are crucial components of ensuring their health and well-being. Adequate access to sanitation facilities plays a pivotal role in safeguarding child health and nutrition by reducing the risk of waterborne diseases and promoting hygienic practices. Research has consistently highlighted the importance of proper sanitation for preventing diarrheal diseases, which can have severe consequences for child nutrition, including malnutrition and stunting. Moreover, access to sanitation facilities is essential for maintaining personal hygiene, especially among young children who are particularly vulnerable to infections (Peter et al., 2019). However, despite its importance, studies on sanitation facilities availability in the study area are limited, and there is a lack of comprehensive data on the coverage and quality of sanitation infrastructure. Understanding the current status of sanitation facilities availability and identifying gaps in coverage and access are critical steps in developing targeted interventions to improve child nutrition outcomes in the Ewaso Narok Wetland area. Therefore, further research is needed to assess the adequacy and accessibility of sanitation facilities, as well as to identify barriers and challenges to their utilization, in order to inform evidence-based interventions aimed at promoting child health and nutrition in the study area.

2.6.2 Hygienic Practices in Sanitation

Hygienic practices in sanitation are essential for promoting child nutrition and overall health in the Ewaso Narok Wetland area of Laikipia County, Kenya. The relationship between hygienic sanitation practices and child nutrition is well-documented in the literature, highlighting the critical role of proper sanitation in reducing the risk of waterborne diseases and improving nutritional outcomes among children under five years old. Hygienic sanitation practices, such as regular handwashing with soap, safe disposal of human waste, and maintenance of clean sanitation facilities, are instrumental in preventing the transmission of pathogens that can cause diarrheal diseases and other infections (Rah et al., 2020). These practices not only contribute to improved child health but also support optimal nutrient absorption and utilization, thereby reducing the risk of malnutrition and stunting.

Several studies have investigated the relationship between sanitation behavior and child health outcomes, providing evidence of the significant impact of hygienic sanitation practices on child nutrition. Research has consistently demonstrated that households with access to improved sanitation facilities and practicing hygienic behaviors have lower rates of diarrheal diseases and other waterborne illnesses among children. Moreover, improved sanitation facilities have been associated with reduced morbidity and mortality rates, as well as improvements in child growth and development indicators, such as weight-for-age and height-for-age z-scores.

However, despite the importance of hygienic sanitation practices, challenges remain in promoting their adoption and sustained practice, particularly in resource-constrained settings like the Ewaso Narok Wetland area. Barriers such as lack of access to clean water for handwashing, cultural beliefs and practices, and inadequate sanitation infrastructure can hinder the uptake of hygienic behaviors and compromise child health

and nutrition outcomes (Chattopadhyay et al., 2019). Therefore, interventions aimed at promoting hygienic sanitation practices should be contextually tailored and address socio-economic, cultural, and environmental factors that influence behavior change.

2.6.3 Open Defecation and Its Effects on Child Nutrition

Open defecation poses significant risks to child health and nutrition in the Ewaso Narok Wetland area of Laikipia County, Kenya. The impact of open defecation on child health and nutritional status is well-documented in the literature, highlighting the increased risk of diarrheal diseases, parasitic infections, and environmental contamination associated with inadequate sanitation practices. Children exposed to open defecation are particularly vulnerable to waterborne diseases, which can lead to malnutrition, stunting, and other adverse health outcomes (Arriola et al., 2020). Moreover, open defecation contributes to environmental pollution and contamination of water sources, further exacerbating the risk of disease transmission and compromising child nutrition.

Efforts to eliminate open defecation and improve child nutrition in the study area have been underway, with various interventions aimed at promoting improved sanitation practices and behavior change. Community-led total sanitation (CLTS) programs, for example, have been implemented to raise awareness about the health risks of open defecation and encourage communities to construct and use latrines (Gimaiyo et al., 2019). These efforts often involve community mobilization, participatory approaches, and social norms change strategies to promote sustainable behavior change and eliminate open defecation practices. Additionally, investments in sanitation infrastructure, such as the construction of latrines and sanitation facilities, play a crucial role in providing households with safe and hygienic alternatives to open defecation.

Despite these efforts, challenges remain in addressing open defecation and its effects on child nutrition comprehensively. Socio-economic factors, cultural beliefs, and inadequate infrastructure continue to hinder progress in achieving universal access to improved sanitation facilities. Furthermore, sustained behavior change and community engagement are essential for ensuring the long-term success of sanitation interventions and eliminating open defecation practices (Freeman et al., 2020). Therefore, multi-sectoral approaches that address the root causes of open defecation and prioritize investments in sanitation infrastructure, hygiene education, and community empowerment are needed to improve child nutrition outcomes and promote the health and well-being of children in the Ewaso Narok Wetland area.

2.7 Hygiene Factors Influencing Nutrition Status

2.7.1 Personal Hygiene Practices

Hygiene factors play a crucial role in influencing the nutrition status of children under five years in the Ewaso Narok Wetland area of Laikipia County, Kenya, with personal hygiene practices being particularly significant. The importance of personal hygiene for child health and nutrition cannot be overstated, as it directly impacts the risk of infectious diseases and overall well-being. Proper personal hygiene practices, including regular handwashing with soap, bathing, and oral hygiene, are essential for preventing the transmission of pathogens and reducing the incidence of waterborne diseases, which can have detrimental effects on child nutrition outcomes (Momberg et al., 2021). Studies have consistently demonstrated that caregivers' adherence to personal hygiene practices significantly influences child health and nutritional status, with improved

hygiene behaviors associated with reduced rates of diarrheal diseases, respiratory infections, and other illnesses among children.

However, research on personal hygiene practices among caregivers in the study area is limited, and there is a need for comprehensive studies to assess the prevalence of key hygiene behaviors and identify barriers to their adoption. Understanding the current status of personal hygiene practices among caregivers, as well as factors influencing behavior change, is critical for designing targeted interventions to improve child nutrition outcomes (Momberg et al., 2021). Additionally, efforts to promote personal hygiene should consider socio-economic, cultural, and environmental factors that may influence caregivers' hygiene practices and prioritize strategies that are contextually appropriate and sustainable.

2.7.2 Handwashing Behavior and Its Impact on Nutrition

Handwashing behavior is a critical hygiene factor influencing the nutrition status of children under five years in the Ewaso Narok Wetland area of Laikipia County, Kenya. The role of handwashing in preventing waterborne diseases and improving child nutrition cannot be understated. Handwashing with soap is one of the most effective and inexpensive ways to prevent diarrheal diseases and respiratory infections, which are major contributors to child morbidity and mortality, especially in low-resource settings (Anthonj et al., 2021). By removing pathogens from hands before eating or preparing food, handwashing reduces the risk of ingesting harmful bacteria and viruses that can compromise child health and nutritional status.

Several studies have examined the impact of handwashing behavior on child health outcomes, providing compelling evidence of its effectiveness in reducing the incidence of waterborne diseases and improving overall child well-being. Research has

consistently shown that households practicing regular handwashing with soap have lower rates of diarrheal diseases, respiratory infections, and other infectious illnesses among children (Anthonj et al., 2021). Moreover, handwashing interventions have been associated with improvements in child growth and development indicators, such as weight-for-age and height-for-age z-scores, highlighting the broader benefits of promoting hand hygiene for child nutrition.

Despite the proven benefits of handwashing, challenges remain in promoting its widespread adoption and sustained practice, particularly in resource-constrained settings like the Ewaso Narok Wetland area. Barriers such as lack of access to clean water and soap, inadequate sanitation facilities, and low awareness of the importance of hand hygiene can hinder behavior change efforts and compromise child health outcomes. Therefore, interventions aimed at promoting handwashing behavior should be contextually tailored and address socio-economic, cultural, and environmental factors that influence behavior change.

Handwashing behavior plays a crucial role in preventing waterborne diseases and improving child nutrition in the Ewaso Narok Wetland area. Further research is needed to assess the prevalence of handwashing behavior among caregivers and identify effective strategies for promoting its adoption and sustained practice. By prioritizing investments in hygiene education, behavior change interventions, and sanitation infrastructure, policymakers, public health officials, and community leaders can improve child nutrition outcomes and enhance the well-being of children in the study area.

2.7.3 Food Hygiene and Nutritional Outcomes

Food hygiene practices significantly influence the nutritional outcomes of children under five years in the Ewaso Narok Wetland area of Laikipia County, Kenya. The relationship between food hygiene practices and child nutrition is profound, as proper food handling, storage, and preparation are essential for preventing foodborne illnesses and ensuring the availability of safe and nutritious food for children (Anthonj et al., 2021). Inadequate food hygiene practices can lead to contamination of food with harmful pathogens, which can cause diarrheal diseases, food poisoning, and other gastrointestinal infections, ultimately compromising child health and nutritional status.

Research on food hygiene practices among caregivers in the study area is crucial for understanding the current status of food handling and preparation practices and identifying areas for improvement. However, studies on this topic are limited, and there is a need for comprehensive research to ass`ess the prevalence of key food hygiene behaviors and their impact on child nutrition outcomes. Understanding caregivers' knowledge, attitudes, and practices related to food hygiene can inform targeted interventions aimed at promoting safer food handling and preparation practices and reducing the risk of foodborne illnesses among children.

2.8 Relationship Between WASH and Nutrition Status

Globally, the relationship between Water, Sanitation, and Hygiene (WASH) practices and nutritional status has been well-documented. Poor WASH practices have been shown to exacerbate malnutrition through repeated infections, particularly diarrheal diseases (Prüss-Üstün et al., 2019). Regional studies in Sub-Saharan Africa confirm this association, with high prevalence rates of malnutrition linked to inadequate sanitation and lack of clean water access (Kwami et al., 2019). However, many of these

studies do not delve into the specific pathways through which WASH practices influence malnutrition, representing a gap in understanding localized factors that amplify these risks.

In Kenya, research highlights similar findings, with regions experiencing poor sanitation and hygiene reporting higher rates of wasting and stunting among children under five (Kimani-Murage et al., 2014). Despite this, few studies have focused on specific contexts such as wetland environments, which present unique challenges due to ecological factors like waterlogging and proximity to contaminated water sources. This gap highlights the need for targeted studies within such unique settings, including Laikipia County.

2.9 Socio-Demographic Factors and Nutrition

Globally, caregiver education, income, and marital status have been identified as critical socio-demographic factors influencing child nutrition (UNICEF, 2020). Regional studies in East Africa demonstrate that caregivers with higher education levels are more likely to adopt proper feeding practices and access healthcare services (Fekadu et al., 2015). However, there is limited research focusing on how these factors interact with WASH practices to influence nutritional outcomes.

In Kenya, caregiver education and income disparities have been shown to significantly impact child nutrition outcomes (Muchiri et al., 2016). Yet, studies often generalize findings without considering variations in socio-demographic factors across different geographic and cultural contexts. For Laikipia County, there is limited data exploring how these factors influence nutritional outcomes, leaving a critical gap in the literature.

2.10 WASH-Related Diseases and Nutrition

Globally, diarrheal diseases and intestinal parasitic infections are strongly linked to malnutrition, with children in low-resource settings being disproportionately affected (Chakraborty et al., 2021). Regional studies affirm this association but often overlook the compounded impact of concurrent infections in wetland regions, where parasitic diseases are more prevalent (Negussu et al., 2020).

In Kenya, diarrheal diseases are a leading cause of malnutrition among children under five, yet studies rarely integrate WASH interventions with nutrition-focused programs (Mutunga et al., 2017). Within Laikipia County, there is insufficient data on the prevalence of WASH-related diseases and their direct impact on nutritional outcomes, underscoring the need for localized research.

2.11 Study Gaps

While the global and regional literature establishes a clear relationship between WASH practices and nutritional outcomes, significant gaps remain in understanding how these relationships manifest in specific contexts, such as wetland regions in Kenya. Most studies in Kenya focus on urban or peri-urban settings, neglecting rural and ecologically unique areas like Laikipia County. This study aims to fill these gaps by exploring the intersection of WASH practices, socio-demographic factors, and nutritional outcomes in a wetland context, providing data-driven insights for targeted interventions.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Study Design

This study employed a cross-sectional design integrating both quantitative and qualitative approaches to comprehensively investigate the factors influencing nutritional status among children under five years in the Ewaso Narok Wetland, Laikipia County. The cross-sectional design was selected to provide a snapshot of the population, capturing data on socio-demographic characteristics, WASH practices, and nutritional outcomes at a single point in time. Quantitative data collection involved structured household surveys, anthropometric measurements, and observational checklists, allowing for statistical analysis of patterns and associations. Complementary qualitative data were obtained through focus group discussions and key informant interviews to provide in-depth insights into community perceptions and contextual factors. The mixed-methods approach enhanced the study's robustness by triangulating findings, ensuring a nuanced understanding of the interplay between WASH factors and child nutrition in a resource-constrained, wetland setting.

3.2 Study Variables

3.2.1 Independent Variables

The independent variables in this study were aligned with the specific objectives, focusing on socio-demographic factors, WASH-related factors, and their association with child nutrition. Socio-demographic factors included the caregiver's age, education level, marital status, occupation, household income, and the number of children in the household. WASH-related factors encompassed access to clean water sources, proximity to wetlands, availability and utilization of sanitation facilities, handwashing practices, hygiene behaviors, and food preparation methods. The study also assessed

the relationship between nutritional status and selected WASH-related diseases, including diarrheal infections and intestinal parasitic infestations. These variables were investigated to determine their individual and collective influence on the nutritional outcomes of children under five years in the Ewaso Narok Wetland, providing a holistic view of the multifaceted determinants of malnutrition in the study area.

3.2.2 Dependent Variables

The nutrition status of children under five was the dependent variable. This was demonstrated by anthropometric measurements used to assess the child's growth and development. The following anthropometric measurements were used to establish nutritional status: height, weight, and MUAC (Middle-Upper Arm Circumference). Height for Age indices (stunting), Weight for Height (wasting), Weight for Age (underweight) and presence or absence of oedema were used to determine nutrition status.

3.3 Study Location

The study was done in the Ewaso Narok wetland semi-arid wetlands in the Laikipia west sub-county of Laikipia County. Laikipia East, Laikipia West, and Laikipia Central are the three main regions of the county, with two significant urban centers; Nyahururu to the southwest and Nanyuki to the southeast. Rumuruti is the country's capital. The County is located between the latitudes of 0° 51" North and 0° 18" South and the longitudes of 37° 24' East and 36° 11" West (Rah et al., 2020). According to the Kenya Population and housing Laikipia 2019, Laikipia has a population of 518,560+29.9% (Rah et al., 2020).

The Ewaso Narok Wetland is located in Laikipia County in Kenya. The Wetland is roughly 250 kilometers north of Nairobi, Kenya, near Rumuruti town and

administrative centre which has a population of approximately 33,000 people and adjacent to Gatundia town which has a population of around 500 people (Shrestha et al., 2020). The Aberdare Mountains are the principal watershed for the papyrus wetland, which gets floodwater from Mutara and Eng'are Narok Rivers seasonally (Rah et al., 2020). The Ewaso Narok Wetland is vital to its people's lives, as many of them rely only on the natural resources and perennial surface water of the wetland.

Ewaso Narok Wetland, like wetlands across other parts of East Africa, ensures agricultural productivity, food security, domestic water, animal grazing, and other diversified uses (Shrestha et al., 2020). As a result, it is attracting a greater number of people. The effects of widespread use and growing population are visible in ecological degradation, poor waste management, and a decrease in the quantity and quality of water. The Ewaso Narok Wetland is situated in a rural area with limited access to safe water and sanitation. Because it is the region's most vital source of water, the under-studied wetland is critical to a big portion of the population.

3.4 Study Population

The Laikipia County SMART Survey Report of 2017 indicated that children under five years comprised 19.2% of the county population. The target population for this study included all persons of reproductive age (15-49 years) residing within Laikipia County who were primary caregivers of children under five years. This group, representing 127,047 individuals, was identified as the study population, as they could provide informed consent and detailed information on the children’s nutritional status, socio-demographic factors, and WASH practices. Data collection involved 289 caregiver interviews, with 235 conducted in Rumuruti Ward, 22 in Mathenge Ward, and 31 in Sosian Ward. This comprehensive sampling ensured diverse representation across the study area, aligning with ethical considerations and study objectives.

3.5 Sampling Technique and Sample Size

This study utilized a stratified random sampling technique to ensure representation across different wards within the Ewaso Narok Wetland region of Laikipia County. The study was community-based, targeting mothers and caregivers aged 15-49 years responsible for children under five years of age. The unit of study was the caregiver-child dyad, where caregivers provided information and consent on behalf of the children.

Health facilities were selected strategically based on their proximity to the study area and the volume of patients they served. Facilities included in the study were Rumuruti Health Centre, Mathenge Dispensary, and Sosian Health Centre, as these were the primary points of care for residents in the study region. These facilities were chosen because they provided access to caregivers whose children had recently received health or nutrition services, ensuring the relevance of data collected.

The determination of malnourished children was based on anthropometric measurements conducted during the study. Standardized procedures recommended by WHO were used, including the measurement of weight, height, and Mid-Upper Arm Circumference (MUAC). Nutritional status was assessed using Z-scores for Weight-for-Age (WAZ), Height-for-Age (HAZ), and Body Mass Index-for-Age (BAZ). Children with Z-scores below -2 for any of these indices or showing signs of nutritional edema were classified as malnourished.

The sample size was calculated using the standard formula for large populations, ensuring adequate power to detect significant associations. A total of 289 caregiver-child pairs were sampled, distributed as follows: 235 from Rumuruti Ward, 22 from Mathenge Ward, and 31 from Sosian Ward. This stratification ensured a diverse

representation of socio-demographic and environmental factors influencing nutritional outcomes.

3.5.1 Inclusion criteria:

The inclusion criteria for this study ensured that only eligible participants who could provide relevant data were involved. Mothers or caregivers aged 15-49 years who were primary caregivers of children under five years of age were included in the study. These caregivers were required to have resided in the Ewaso Narok Wetland area for at least six months to ensure familiarity with local WASH practices and environmental conditions. Additionally, participants needed to provide informed consent to participate in the study and offer information on behalf of their children. This approach ensured ethical compliance and the reliability of data collected about the children's nutritional and health status.

3.5.2 Exclusion criteria:

Participants were excluded from the study if they were unable or unwilling to provide informed consent, which ensured that only those who fully understood and agreed to the study's objectives participated. Caregivers or mothers whose children were critically ill or hospitalized at the time of data collection were excluded to avoid compromising their ability to provide reliable information or participate effectively. Additionally, individuals who had recently moved to the Ewaso Narok Wetland area (less than six months of residence) were excluded to ensure data consistency and relevance to the study's focus on long-term WASH practices and their impact on child nutrition.

3.6 Sample size determination

The sample size was calculated using Cochran's formula for sample size determination in large populations, ensuring sufficient power to detect statistically

significant associations.

$n = Z^2pqD/ d^2$

Where;

n = number of samples required

Z = The standard normal deviation at the appropriate confidence level of 95 per cent (Usually set at 1.96).

p = adherence rates in Kenya 90%

q = 1-p (1-0.5 = 0.5)

d = The level of precision (0.05)

$$= \frac{1.96^2 \times 0.245 \times 0.755 \times 1}{0.05^2}$$

n = 285

Therefore, n = 285

The calculated sample size was 285; however, to account for potential non-response or incomplete data, an additional buffer of 4 participants was included, bringing the final sample size to 289. This adjustment ensured the study met its objectives without compromising data integrity due to non-responses or dropouts

3.7 Data collection Instruments

Both quantitative and qualitative data was used collected. Interviewer-administered semi-structured interview schedules, focus group talks, and key informant interview schedules were used as research instruments which were developed per the study's unique objectives to acquire the desired data. Using both FGDs and KIIs was essential to triangulate data, ensuring the validity and reliability of findings. FGDs captured community-level behaviors and perceptions, while KIIs provided technical and policy-level insights, creating a well-rounded understanding of the complex interplay between WASH practices and child nutrition

3.7.1 Household Questionnaire

Data was collected from caregivers using household surveys. There were five sections to the questionnaire. Section A of the instrument collected information on the caregiver's and child's social and demographic characteristics which included age, sex of both caregiver and child, household income, caregiver's occupation and caregiver's level of education. Section B collected information on the WASH knowledge among the caregivers which included water treatment methods, a disease caused by consumption of contaminated water, the importance of handwashing, signs and symptoms of worm infections and prevention of worm infections diarrhea. Section C collected information on WASH practices which included source, storage and treatment of drinking water, household sanitation, handwashing practice, food hygiene and environmental hygiene. Section D collected information on Child’s morbidity which assessed diarrhea prevalence. Finally, section E gathered information on the nutritional status among the children which was assessed through the anthropometric measurements; height, weight and MUAC.

3.7.2 Focused Group Discussion (FGD) Guide

This is a structured conversation with a small group of people expressing their viewpoints and experiences on a particular topic. An FGD guide was used to gather information from the Community Health Volunteers (CHVs) and caregivers whereby we gathered information on household hygiene and sanitation practices, barriers to sanitation and personal hygiene in households and around the wetlands, knowledge on undernutrition, the link between poor WASH and sanitation and any training information on WASH in households as well as the common diseases suffered by children in the wetland area. Four FGDs were conducted, one with the CHVs and three with the caregivers.

3.7.3 Key Informant Interview (KII) Guide

The KII guide was used to collect opinions from experts within the study area. This included the Community Health Extension Worker (CHEW), a nutritionist in charge and the facility in charge- Rumuruti Health Centre. The information collected using this tool included WASH messages disseminated to households, barriers to proper WASH conditions within the wetland area, the linkage between WASH and nutritional status, training on WASH, common diseases suffered by children in the study area and the link between WASH and nutrition status among children.

3.8 Pre-test

A pre-test of the research tools was conducted at a Kahari village in Rumuruti ward which had similar characteristics as the study location. 10% of the sample size was used for piloting which was represented by 25 households. This was done to establish the accuracy of the tool as well as determine if the respondents understood the questions and had the information required. The pre-test was done to establish direct evidence for

the validity of the questionnaire data. Feedback received during the pre-test provided an opportunity for modification and alignment of the tool.

3.8.1 Validity of the data collection tools

Pre-testing of the tools was conducted before the actual study to assess the instruments and determine their viability. This helped determine whether the questions were clear to the respondents, acceptable, and analyzable and assisted in modifying them where necessary. The content validity of the questionnaires was established through expert review by my supervisors from Kenyatta University. Anthropometric data was collected using a Salter scale and height board which was also pre-tested to ascertain the degree of both the intra and inter-observer error. Standardization of the tool was done through the use of WHO-validated questionnaires.

3.8.2. Reliability of the data collection tools

Reliability was achieved through the training of research assistants on data collection and the use of a standardized questionnaire. The principal researcher randomly went through the filled questionnaires daily to check for completeness and consistency. The principal researcher also conducted all the key informant interviews and focused group discussions.

3.9 Data Collection Techniques

The study collected data using both quantitative and qualitative methodologies. For quantitative data collection, the researcher used a semi-structured questionnaire and an observational checklist. The qualitative data was collected using the FGD and KII guides.

3.9.1 Demographic and Socioeconomic Data

The study participants' demographic and socioeconomic characteristics was collected using a semi-structured questionnaire and face-to-face interviews to obtain information on the caregiver's and child's ages, genders, household income, caregiver's occupation and caregiver's level of education.

3.9.2 Knowledge of WASH among the caregivers

Face to face interviews was used to assess the caregivers' knowledge using semi-structured questionnaires. The respondents were assessed on water treatment methods, diseases caused by consumption of contaminated water, the importance of handwashing, signs and symptoms of worm infections and prevention of worm infections and diarrhea.

3.9.3 WASH Practices among the caregivers

The practices were divided into the source, storage and treatment of drinking water, household sanitation, handwashing practice, food hygiene and environmental hygiene within the wetland area. This section also assessed proximity to the wetland area and the use of protective gear when dealing with agricultural practices at the wetland area.

3.9.4 Nutritional status among the children

Anthropometric information of under-five was collected through the use of a salter scale for the weight with an accuracy of 0.1 kg and height boards to measure the height of the children with an accuracy of 0.1cm. The child's mid-Upper Arm Circumference was measured with MUAC tape to check for wasting. Oedema was also assessed by the researcher by gently pressing on both feet of the youngsters with their thumbs for three seconds, and those who displayed the thumbprint after three seconds were judged to have oedema.

3.9.5 Qualitative Data

On the qualitative dimension, Key Informant Interviews (KII) were used to obtain opinions from the CHEW in charge of the Ewaso Narok area within the wetland area, the Nutritionist in charge and the health centre facility in charge. The KII focused on the following dimensions: WASH messages disseminated to households, barriers to proper WASH conditions wetland area, the linkage between WASH and nutritional status, training on WASH and the common diseases suffered by children in the study area. Focused Group Discussion (FGD) were conducted with the CHVs and caregivers. The following aspects were discussed: household hygiene and sanitation practices, barriers to sanitation and personal hygiene in households, knowledge on undernutrition, use of protective gears, the link between poor WASH and sanitation and any training information on WASH in households as well as the common diseases suffered by children in the study area.

3.10 Data Analysis

Before being loaded into the Statistical Package for Social Sciences (SPSS Version 28) computer software program, the data collected from questionnaires was cleaned and coded. Bloom Cut Off Points were utilized to assess sanitation and hygiene knowledge and practice. Questions in the knowledge and practice sections were converted to 100 points, with scores categorized as poor knowledge (0-50 per cent), moderate knowledge (50-75 per cent), and high knowledge (75 per cent). Chi-square was only used to determine the relationship between nutritional status linked to the presence of stunting, BMI for age, and wasting against the presence of a WASH-related disease contracted by a child in the previous two weeks. The study variables being compared had a frequency of more than five responses.

The level of significance was set at a p-value ($p<0.05$) with any p-value less than the 0.05 level being considered significant. Anthropometric data was analyzed using WHO cut off to explain the nutrition status. The indices of interest were W/H (wasting), H/A (stunting) and W/A (underweight). A Z score of between -2 SD and -3SD was categorized as malnourished while <-3 SD reflected severe malnutrition. MUAC cut of above 135mm reflected well-nourished children, 125-135mm reflected mild malnutrition, <125-115mm reflected moderate malnutrition while less than 115mm reflected severe malnutrition. Qualitative data from FGDs was typed and the common views captured, coded and organized into themes. Results were presented in form of graphs and tables.

The researcher used the WHO AnthroPlus software for PC (downloaded from www.who.int/growthref/software) to calculate the z-scores for Weight for Age (WAZ), Height for Age (HAZ), and BMI for age (BAZ). These Z-scores were used to describe the children with wasting, or stunting. Children were considered stunted when they had a HAZ of -2 compared with the WHO Child Growth standards median of same age and sex. Wasting was defined as children with BAZ below -2 to suggest acute undernutrition or rapid weight loss.

3.11 Logistical and Ethical Consideration

Kenyatta University Graduate School was consulted for approval to conduct the study. The Kenyatta University Ethics and Review Committee (KUERC) was consulted for ethical clearance (Approval No: PKU/12580/11706). The National Commission for Science, Technology, and Innovation (NACOSTI) issued the study permit (Ref No: 370106). Permission to conduct the research was also obtained from relevant Laikipia County and Sub-county authorities. Before delivering the questionnaires, the researcher also obtained informed consent from the subjects. When managing all respondent

information, confidentiality was ensured and no names were used to identify the participants in the study.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents findings from a thorough analysis of the data, together with an interpretation and explanation of the findings in relation to the study objectives. The findings of the study are arranged as follows: respondents' socio-demographic characteristics, knowledge and practice of caregivers regarding WASH, the nutritional status of children and the relationship between WASH-related diseases and child's nutritional status.

The results of a thorough analysis of the data are presented in this chapter, together with an interpretation and an explanation of the findings in relation to the goals. The findings of the study are arranged as follows: the respondents' sociodemographic traits, the knowledge and practices of caregivers regarding WASH, the nutritional status of children, and the relationship between WASH-related diseases and children's nutrition. The results of a thorough analysis of the data are presented in this chapter, together with an interpretation and an explanation of the findings in relation to the goals. The findings of the study are arranged as follows: the respondents' sociodemographic traits, the knowledge and practices of caregivers regarding WASH, the nutritional status of children, and the relationship between WASH-related diseases and children's nutrition

4.2 Socio-demographic profile

The subsection represents the demographic information of respondents who participated in the survey. Table 4.1 below summarises the respondent profile by marital status, education level, source of income, and religion. Based on the information derived from the table, more than half (59%) of the respondents interviewed were married, 25% were single/never married, 12% were divorced/separated and 5% were

widowed. The education status of all respondents indicates that more than two-thirds (68%) had received post-primary level education whereby 39% had completed secondary education, 15% had tertiary/university level education and 14% had not completed secondary level education. Overall, of the 32% who had not received post-secondary school education, 13% had no formal education, 12% had completed primary school and 7% had not completed primary school.

Source of income shows that nearly half of all respondents either were casual labourers (31%) or had no reliable source of income (17%). For the rest, they were mainly in formal employment (17%) or had running their own businesses (15%).

The religious status of all respondents reveals that the majority (73%) were Christians mainly practicing as protestants (37%) or Roman Catholics (36%). Muslims made up 9% of the total respondents while the remaining proportion was shared by Adventists (8%), traditionalists (5%) while 5% were not practising any form of religion.

Table 4.1: Socio-demographic profile of the respondents

		N	%
Marital Status	Married	169	59
	Never married/ Single	71	25
	Separated/ Divorced	34	12
	Widowed	14	5
Education level	Secondary Completed	113	39
	Tertiary college /University	42	15
	Secondary Not Completed	41	14
	No formal education	36	13
	Primary Completed	35	12
	Primary Not Completed	21	7
Source of Income	Casual labor/wage earner	90	31
	No reliable household income source	50	17
	Employment/Salaried	50	17
	Business	42	15
	Crop farming	27	9
	Animal husbandry	17	6
	Assistance (hand-outs)	9	3
	Others specify	3	1
Religion	Protestant	107	37
	Roman Catholic	103	36
	Muslim	25	9
	Adventist	22	8
	None	15	5
	Traditional Religion	15	5
	Pagan	1	0

Table 4.2 captures the age of respondents at the time of the survey, age during the first delivery, and the number of biological children a respondent has given birth to (parity). According to the information captured, the average age of respondent at the time of the

interview was 31.5 years, the average of age during the first delivery was 21.6 years while the parity was 2 children.

Table 4.2: Mean age and parity of the Respondent's at the time of survey

	n	Mean (sd)
Age	288	(31.5,8.8)
Age of first delivery	288	(21.6,4.1)
Parity	288	(2,1)

The pie chart below displays information about the gender of the youngest child. From the chart, 53% of total respondents interviewed mentioned that the gender of their youngest child was female while the other 47% stated the gender to be male. The age in months of the youngest child, the average age was 21.8 months.

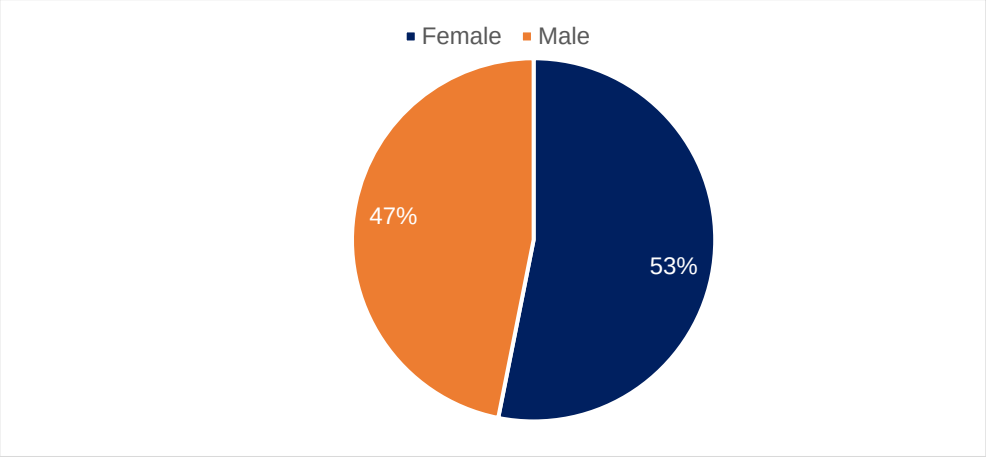


Figure 4.1: Gender distribution of the respondents youngest child

4.3 Nutrition status

This subsection will present nutrition status in terms of source of food consumed, minimum dietary diversity score and nutritional oedema.

4.3.1 Source of food consumed in the household

Respondents were asked to provide information on the main source of food that was consumed in their household and the response they provided are captured by the chart below. From the chart, nearly 7 in every 10 were purchasing the food that was consumed in the household. The second source mentioned by 15% by total respondents interviewed was food sourced from own production.

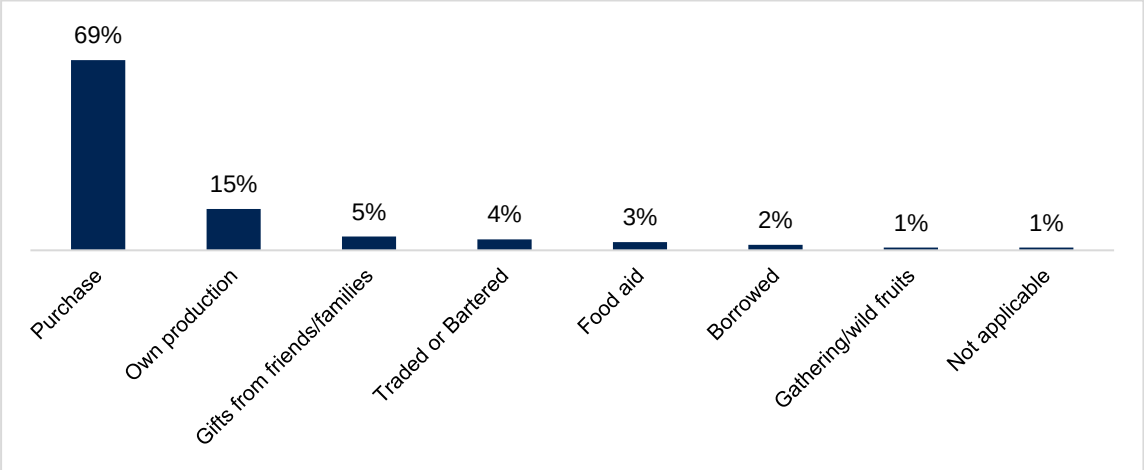


Figure 4.2: Source of food consumed in the household

4.3.2 Minimum dietary diversity

The minimum dietary diversity is based on the number of food groups among the seven food groups consumed in the household by a children 5 years and below. (1) cereals, roots and tubers; (2) legumes and nuts; (3) milk and its derivatives; (4) meat products (meat, poultry, offal, and fish); (5) eggs; (6) vitamin A-rich fruits and vegetables (leafy green vegetables, yellow fruits and vegetables and (7) other fruits and vegetables are the seven food groups that adhere to the WHO dietary guideline. The amount of food categories the child had taken the day before was used to calculate the dietary diversity score (DDS). A DDS of four is regarded as the minimal DDS. Consequently, a child was considered to have limited dietary diversity if their DDS was less than 4. The chart

below shows the consumption of the 7 food groups defined by MDDS and based on the survey findings; majority (87%) had consumed all food groups in the last seven days.

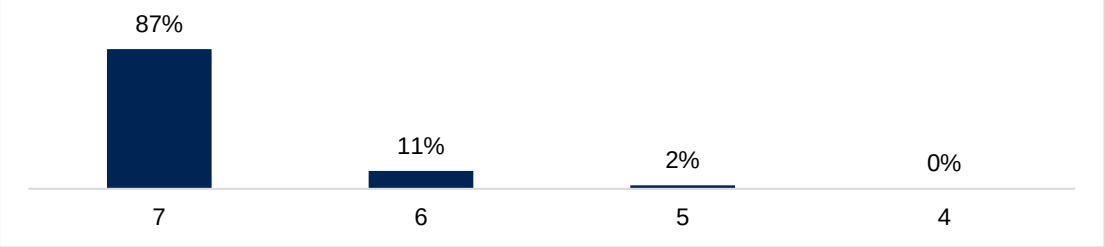


Figure 4.3: Household minimum dietary diversity score.

4.3.3 Presence of nutritional oedema

Nutritional oedema is a sign of severe acute malnutrition. In nutritional oedema, water accumulates most likely as a result of reduced metabolism, with or without hypokalaemia. Nutritional oedema always starts from the feet and extends upwards to other parts of the body. The figure below shows that 36% of households visited had a child with nutritional oedema.

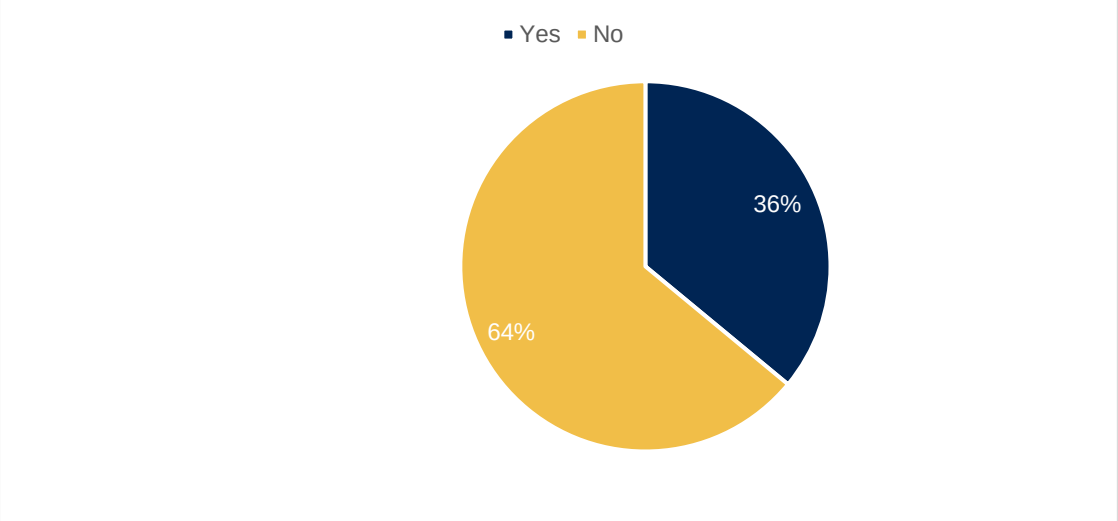


Figure 4.4: Presence of nutritional oedema in children under five among households visited

4.3.4 Wasting and Stunting

Distribution of z-score indices

Means for age, weight and height were 21 months, 11 kilograms and 73 centimeters respectively. Most children had no oedema 185/288(64.2%), although 103 had oedematous malnutrition. The mean and ±SD WAZ-score for children <24 months old was -0.45±2.4, and children 24-60 months was 0.31±1.9. The mean and ±SD HAZ-score for children <24 months old was -0.86±2.36, and children 24-60 months was -2.84±1.97. The mean and ±SD BAZ-score for children <24 months old was -0.02±2.0, and children 24-60 months was 1.4±1.8 (table 4.3). For WAZ and BAZ-scores, boys had lower Z scores than girls but girls 24-60 months old were more stunted than boys.

Table 4.3: Distribution of Z-Score Indices For Wasting And stunting

	N*	Weight-for-age (%), mean, SD			
Age groups (months		**% < -3SD**	**% < -2SD**	**Mean**	**SD**
Set 1: Sexes combined					
0-23	110	34.9	45.3	-0.45	2.43
24-60	39	53.3	55.4	0.31	1.9
Set 2: Males					
0-23	55	44.7	52.6	-1.31	2.36
24-60	22	58.8	60.8	0.15	1.71
Set 3: Females					
0-23	55	27.1	39.6	0.24	2.28
24-60	17	46.3	48.8	0.46	2.08
		Length/height-for-age (%) , mean, SD			
		% < -3SD	**% < -2SD**	**Mean**	**SD**
Set 1: Sexes combined					
0-23	110	21.8	30.9	-0.86	2.36
24-60	39	48.7	69.2	-2.84	1.97
Set 2: Males					
0-23	55	25.5	34.5	-1.2	2.24
24-60	22	40.9	59.1	-2.39	2.11
Set 3: Females					
0-23	55	18.2	27.3	-0.53	2.44
24-60	17	58.8	82.4	-3.41	1.65
		BMI-for-age (%) , mean, SD			
		% < -3SD	**% < -2SD**	**Mean**	**SD**
Set 1: Sexes combined					
0-23	110	50.0	54.0	-0.02	2.0
24-60	39	67.2	68.7	1.4	1.8
Set 2: Males					
0-23	55	54.2	61	-0.38	2.1
24-60	22	68.3	70.7	0.99	1.9
Set 3: Females					
0-23	55	46.2	47.7	0.31	1.9
24-60	17	65.4	65.4	1.99	1.5

*****For each indicator all children with plausible z-scores for all the three indices are included in the table (n=149)

According to weight-dependent indicators, percentages below the median are classified as either <-3 SD or oedema or <-2 SD or oedema. Cases of edema are not included in the calculation of the z-score mean and SD.

Weight for age Z-scores

Given the WHO reference population, and children who had valid WAZ measurements, 45.3% of children <24 months old and 55.4% of the children 24-60 months old were below the median (<-2 SD or oedema) (figure 4.6 and table 4.4).

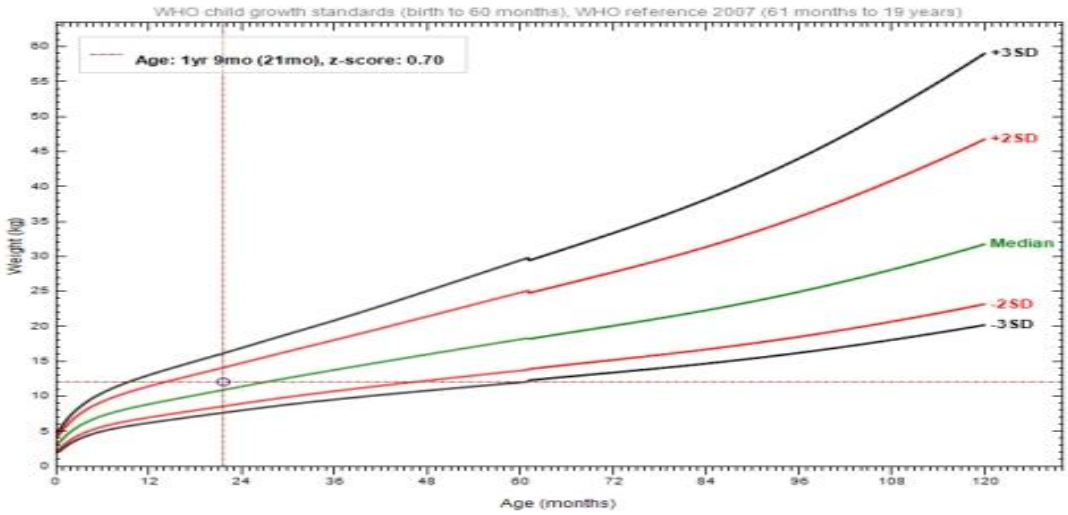


Figure 4.5: Weight for age z-score among children under five

Length/height for age Z-scores

Based on valid HAZ, 62/150 (41.3%) of the children were considered stunted (HAZ <-2 SD).

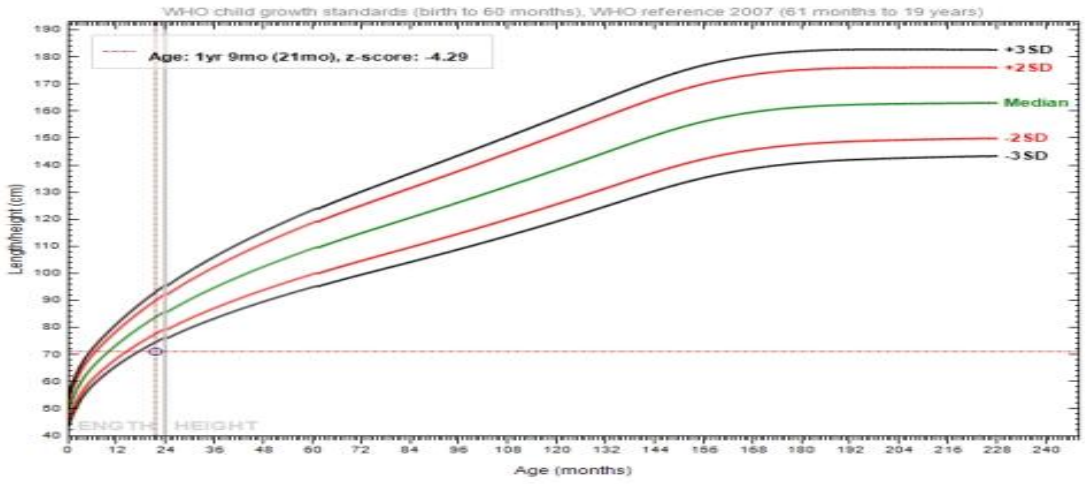


Figure 4.6: Length/height for age Z-scores of children under five

BMI for age Z-scores

Based on valid BAZ, 54.0% of children <24 months old and 68.7% of the children 24-60 months old were below the median (<-2 SD or oedema) (figure 4.18 and table 4.4).

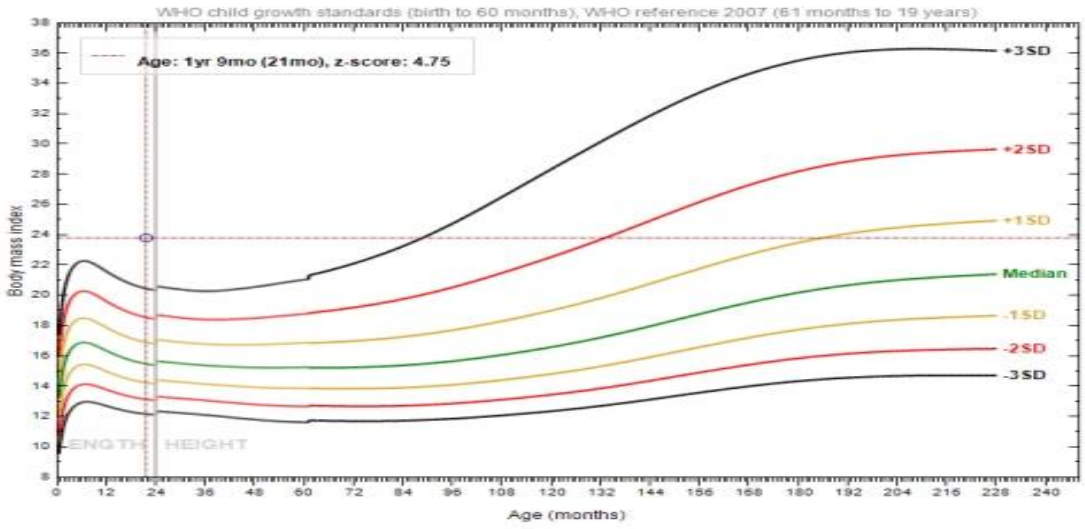


Figure 4.7: BMI for age Z-scores among children under five

4.4 Socio-demographic factors influencing nutritional status

The table below present the socio-demographic factors influencing nutritional status. The nutritional status has been assessed on the basis of presence/absence of oedema in the body. A binary logistic regression has been used to perform this analysis.

Based on survey results displayed by the table, significant socio-demographic factors that affect nutritional status are education level of the caregiver and marital status. In the case of education level, children of caregivers who either have completed secondary schools or have tertiary/ university level education had a 79% less likelihood of better nutrition outcomes compared to those whose caregivers have no education or have not completed primary school education.

Regarding the marital status, children of caregivers who were married were 15% more likely to have presence of oedema than those of other caregivers. In addition, they were 33% more likely to have oedema that those whose caregivers were single.

Table 4.4: Respondents socio- demographic factors influencing nutrition status

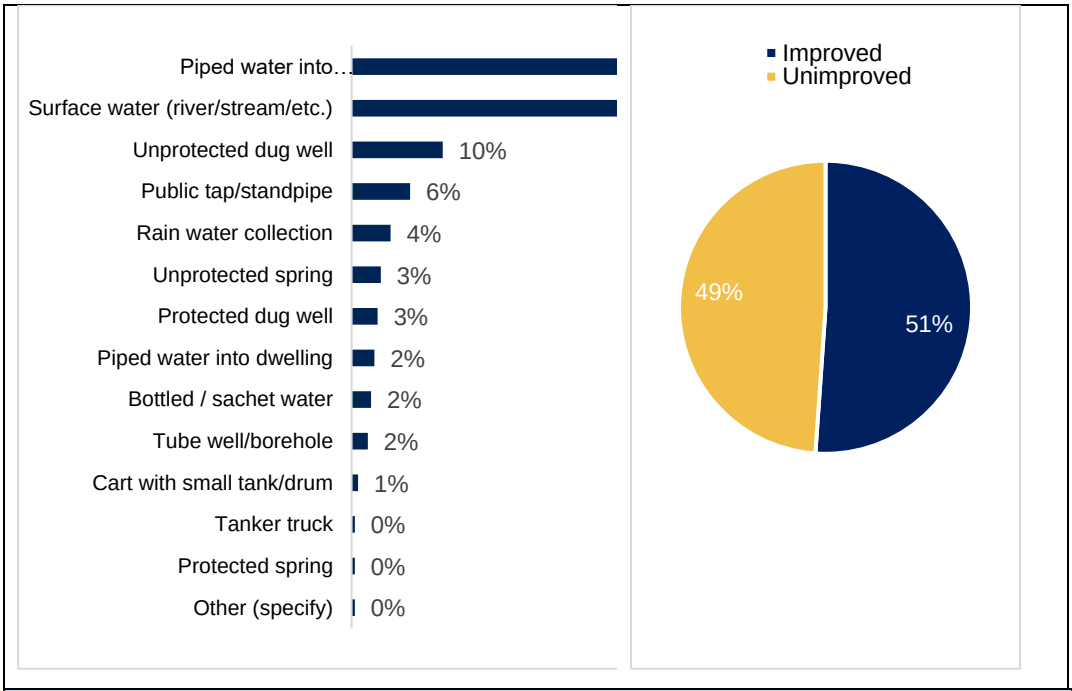
Variables	B	Std. Error	P-value	Odd ratio
Gender of youngest child				
Female (reference group)				
Male	-0.012	0.0543	0.823	0.988
Education level				
None/primary incomplete (reference group)				
Tertiary college /University	-0.233	0.1016	0.022	0.792
Secondary Not Completed	-0.034	0.1087	0.757	0.967
Primary Completed	-0.136	0.1093	0.212	0.873
Secondary Completed	-0.236	0.0892	0.008	0.79
Marital status				
Married (reference group)				
Widowed	0.19	0.1545	0.219	1.209
Divorced/separated	0.29	0.0956	0.002	1.336
Single/never married	0.141	0.0705	0.045	1.152
Age	-0.002	0.0036	0.521	0.998
Number of children	0	0.0069	0.968	1
Constant	0.529	0.1554	0.001	1.697

4.5 WASH-related factors

This subsection covers WASH factors that are closely associated with nutritional status and diseases of children under the age of 5 years.

4.5.1 Source of drinking water

The charts below show the sources of drinking water and the proportion of improved and unimproved sources of drinking water. According to survey findings, the two most common sources of drinking water were piped water into yard/plot/building and surface water as mentioned by 33% of total respondents respectively. Overall and based on WHO categorisation[1] 51% drinking water sources were unimproved while 49% were improved.



According to WHO improved water sources include protected springs, tube well/borehole, protected dug well, public tap/standpipe, piped water into dwelling, rain water collection, piped water into yard/plot/building
Unimproved: Bottled water, cart with small tank/drum, tanker truck, unprotected dug well, unprotected springsurface water (river/stream/etc.),

Figure 4.8: Main source of drinking water in the household

Respondents were asked whether they did anything to make drinking water sources and among those who said yes, they were asked to mention the technique they used. From the first chart, 47% mentioned that they do something to make their drinking water safe while the most common method that used to make drinking water safe is boiling at 33%. Additional evidence on the source of water and improved practices around handling emerged in open sessions with the respondents: "*I fetch water from the river and boil small amounts for drinking. For the other activities I use it the way it is*". Another one added "*I go to the river and wash my Jerri can well. I feel that is enough cleanliness*" (FGD caregivers- Rumuruti).

"…we only boil water for drinking when a child has diarrhea…" (FGD Caregiver Rumuruti)

One of the CHVs from the focussed group discussion reported that *"…The majority of the caregivers here do not treat the water before drinking it, believing that because it is clear, it cannot be contaminated…."* CHV Sossia

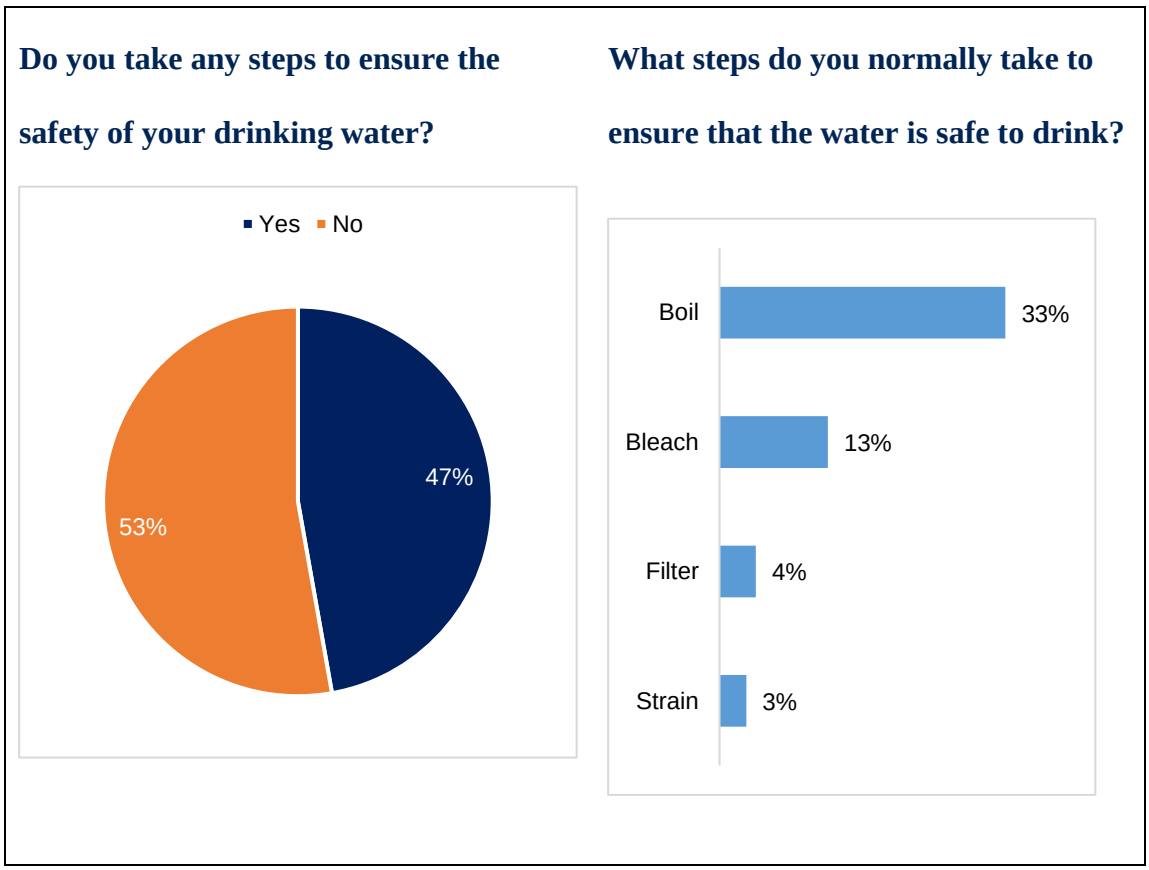


Figure 4.9: Method of water treatment in the household

4.5.2 Handwashing Practices

The survey further sought to understand whether respondents were aware about the time it was important to wash hands.

Figure shows that the most common times that were mentioned by respondents were washing of hands after using toilet (66%) and washing of hands before eating (64%). This information was also backed up by an FGD discussant who reported that "*Already we had started handwashing so when COVID-19 came people were already washing their hands and we did not get a hard time telling them to regularly wash their hands*" (FGD caregiver – Rumuruti). Additionally, another caregiver also reported that *"…We wash our hands to remove germs, but since most of the time they seem clean, we only do so when the dirt is visible in order to use less water…" (FGD* Caregiver – Rumuruti)

*"...Since most caretakers claim to have picked up germs from the toilet, they usually wash their hands after using the restroom..." (*KII Facility in-charge – Rumuruti)

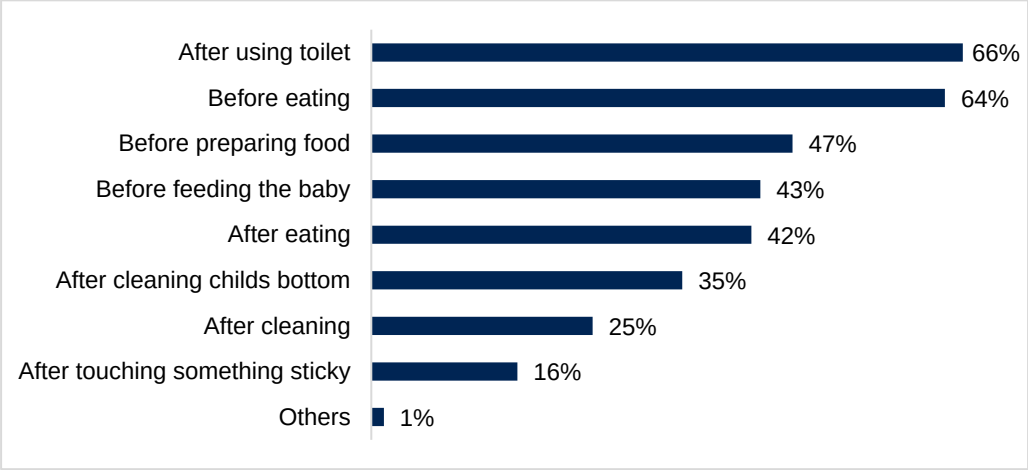


Figure 4.10: Handwashing practices by the respondents

Respondents were further asked to show the place they were washing their hands and their responses are captured by the figure below. The survey shows that most (52%) did not have a specific place of washing their hands. For those that had a specific place, 21% were washing their hands inside the kitchen, 10% in their yard, 9% near the toilet while 5% were washing their hands outside their yards.

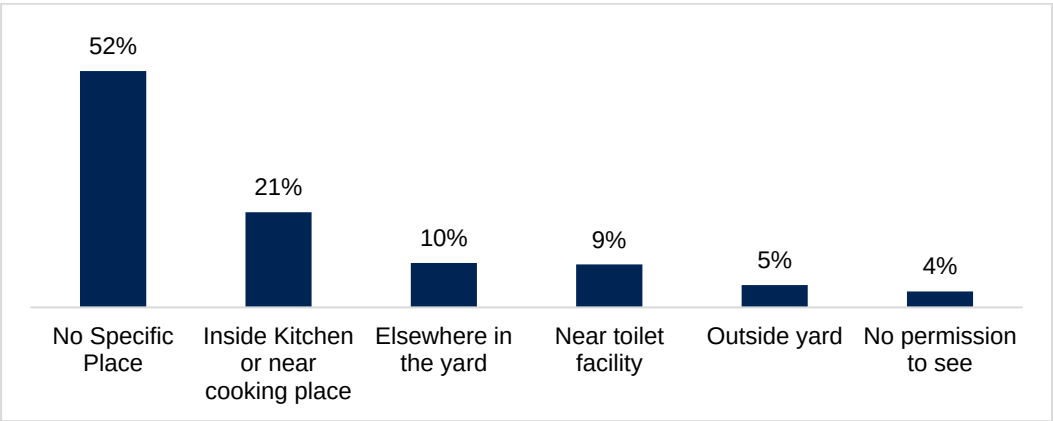


Figure 4.11: Location of household handwashing facilities.

The figure below shows the proportion of respondents who were using soap or a cleansing agent to wash their hands. From the chart, 60% were using a soap while 19% were using a detergent.

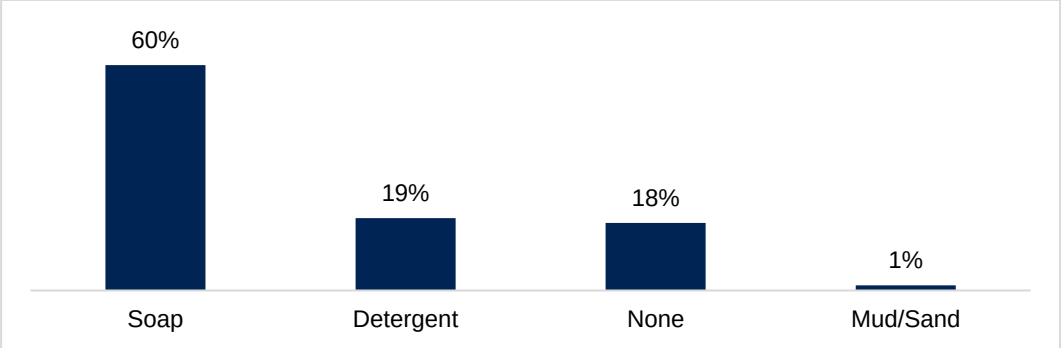


Figure 4.12: Availability of handwashing agent in the household.

4.5.3 Toilet facilities

Assessment of wash factors also considered presence of toilet facilities in the household and the findings are captured by the figure below. The first chart seeks to present the findings on the proportion of respondents that had access to a toilet facility while the second chat show the type of toilet facility used by those who have a facility. According to survey findings, majority (86%) had access to a toilet facility. Among those with a toilet facility 47% used a traditional pit latrine, 43% used a ventilated improved pit latrine while 9% used a flush toilet. 9.4% of the toilets has clean water for hand washing. A respondent from the FGD discussant also added that *"...Most landlords choose to build a basic pit latrine rather than a Ventilation Improved Pit (VIP) latrine since it is less expensive to do so..." (FGD* CHV - Mathenge)

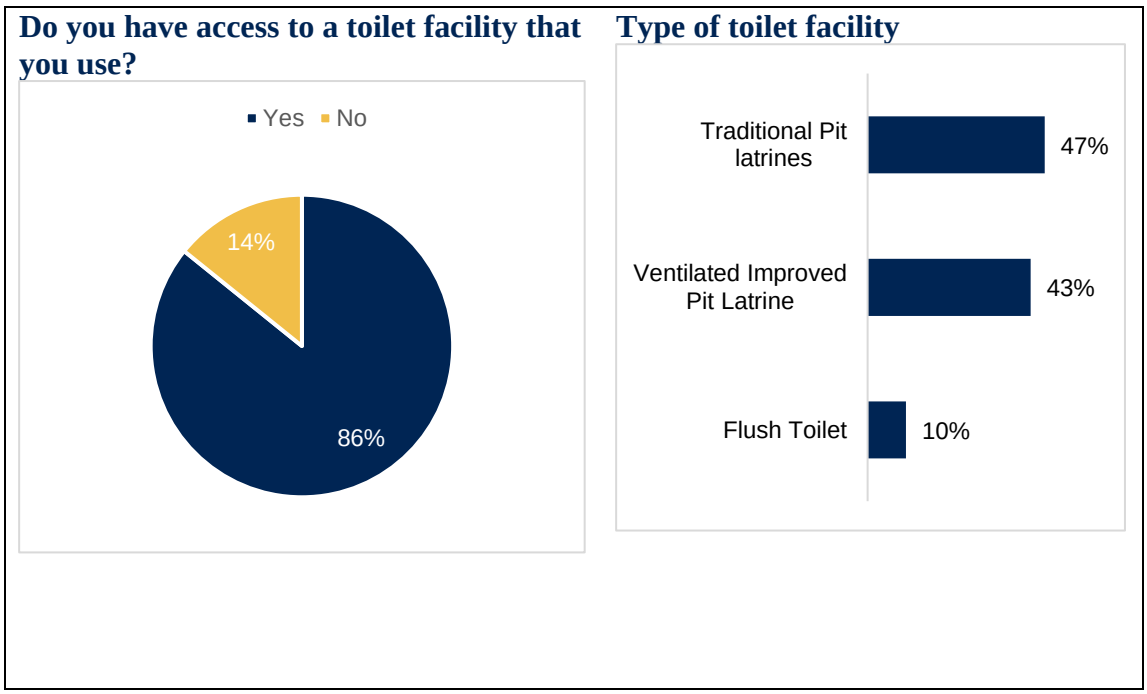


Figure 4.13: Caregivers access to toilet facilities in the household

For those that did have access to a toilet facility (n=41) they were asked about the place they went to discharge human waste. From the figure below that captures the responses provided, majority (73%) mentioned that they went to discharge human waste in a bush.

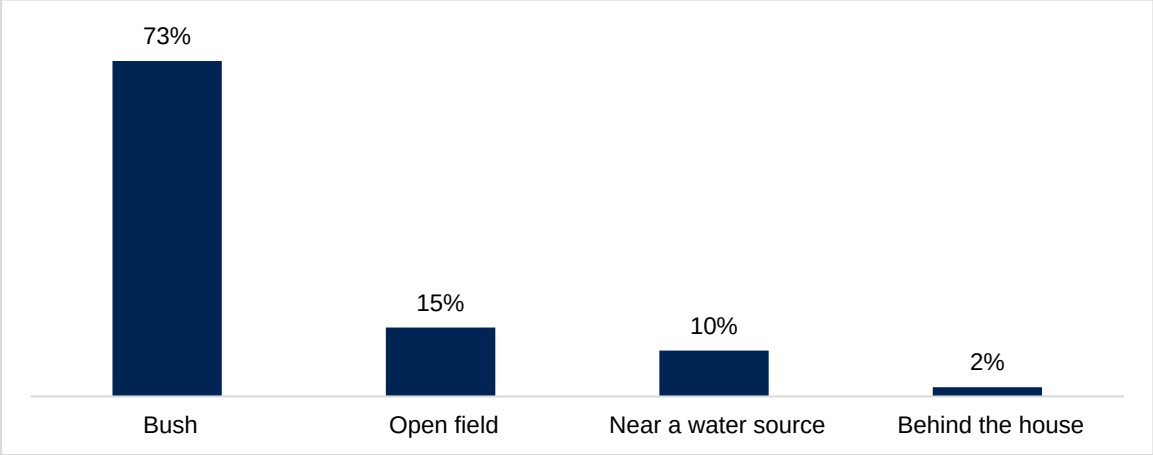


Figure 4.14 Alternative methods for human waste disposal among households

Figure 4.1 captures finding regarding the management of child faecal matter and based on the chart 83% of caregivers were disposing faecal matter immediately and hygienically while the rest (17%) were not properly disposing the faecal matter. An FGD discussant reported *"...We don't use anything to protect the children while*

they walk, so they just urinate on the ground and throw it right away. Diapers are quite expensive for us. Even though the water contains faeces, we dispose of the soiled water in the bush after cleaning the napkins…" FGD Caregiver

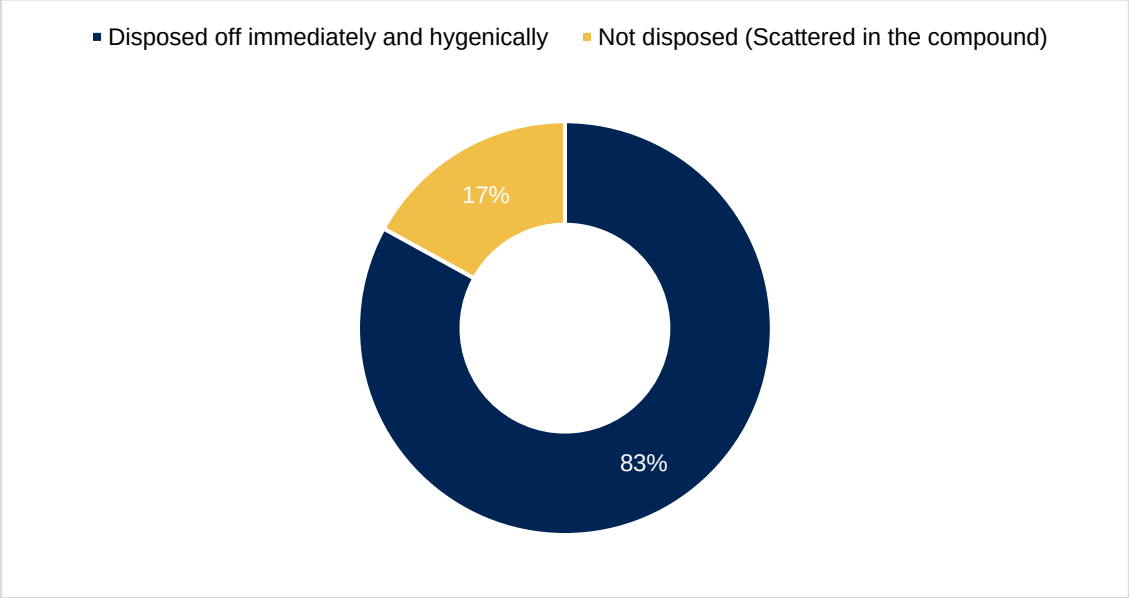


Figure 4.15: Management of child faecal matter as reported by the respondents.

4.5.4 Wetland and Caregiver Location

The study sought to examine the association between wetlands, nutrition status and diseases. The figure below seeks to establish the location of the respondent's homestead to a wetland. Based on the first chart, 67% of all respondents were located near a wetland. The approximate distance to a wetland was mainly between 1km-5km as mentioned by 44% of all respondents.

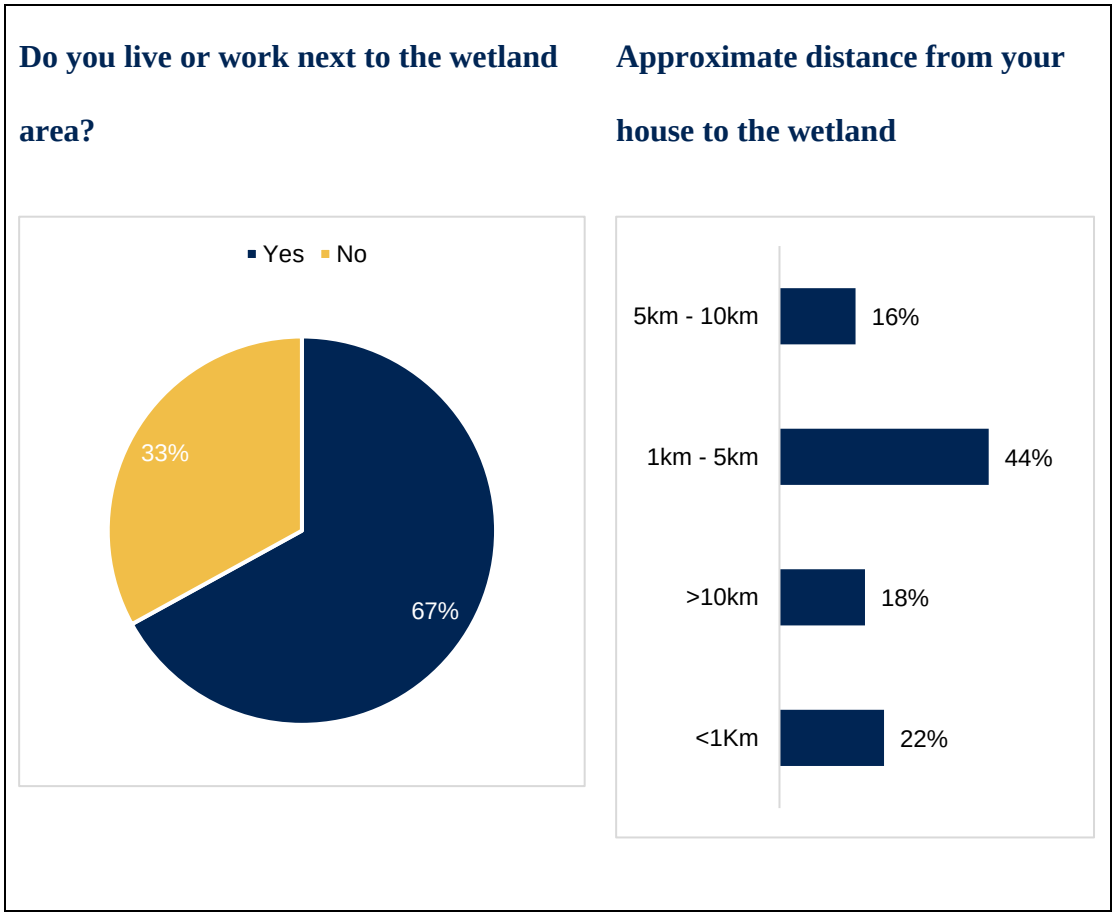


Figure 4.16: Respondents proximity to the wetland area

Respondents were asked whether they were wearing protective gears while working within a wetland and their responses are captured by the figure below. Based on the findings captured by the first chart, most (52%) were wearing a protective gear. Among those who were not wearing protective gears (48%), the two main reasons they gave were lack of money to purchase a gear (55%) and lack of awareness of the necessity to use a gear (42%)

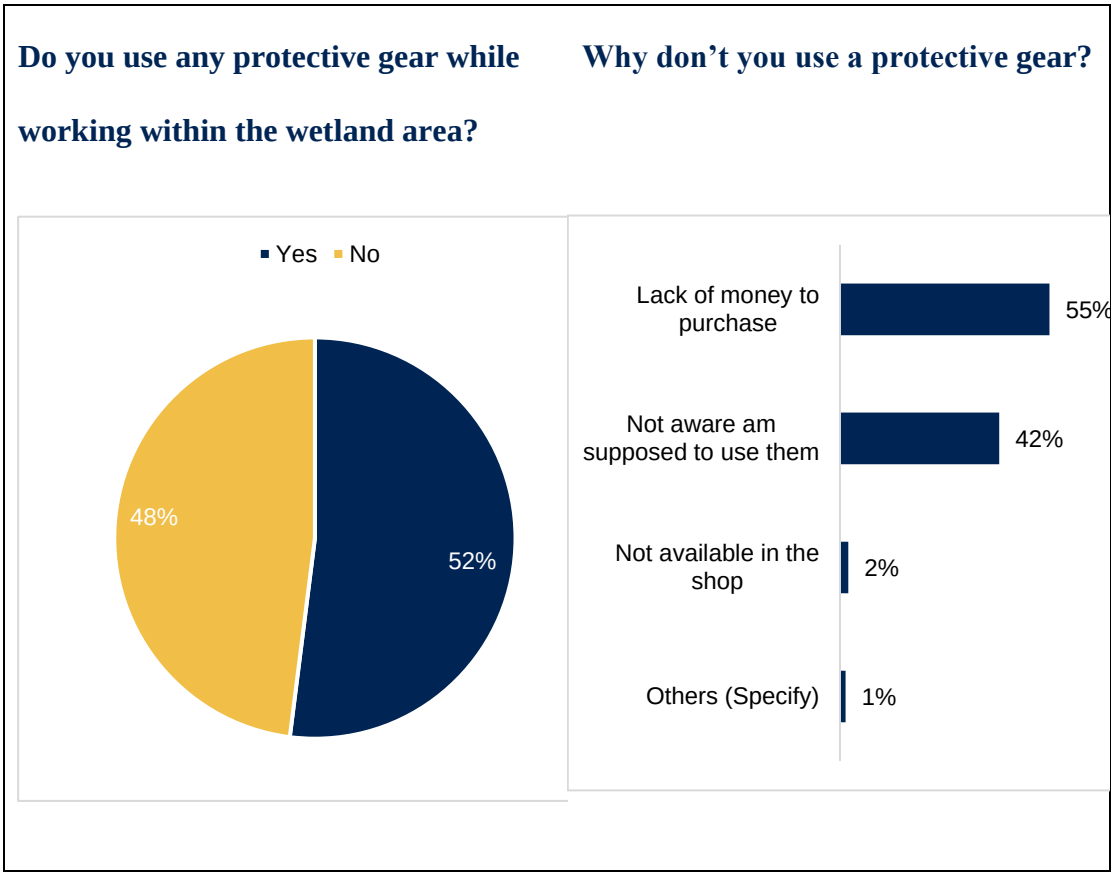


Figure 4.17: Usage of protective gear by respondents within the wetland

4.6 WASH factors influencing nutritional status

The table below shows wash factors that influence nutritional status of a child that is assessed in terms of presence/absence of oedema. Based on the findings captured by the table the factors with significance difference are distance to wetland; use of protective gear in wetland; washing of hands especially when eating, feeding a child, after eating and after cleaning, and the type of toilet facility.

Table 4.5: Respondents WASH factors influencing the nutrition status of children under five

Variable	B	Std. Error	Sig.	Odd ratio
Children's faeces disposal				
Not disposed (reference group)				
Disposed of immediately	-1.38	0.6879	0.045	0.252
Distance to wetlands				
<1km (reference group)				
5km - 10km	-2.972	0.7504	0.00	0.051
1km - 5km	-0.771	0.5775	0.182	0.462
>10km	-0.915	0.4875	0.061	0.401
Use of protective gear in wetland				
Yes	-0.998	0.4118	0.015	0.369
Do you take any steps to ensure the safety of your drinking water?				
Yes	-0.394	0.3902	0.312	0.674
What steps do you normally take to ensure that the water is safe to drink?				
Before preparing food	0.414	0.4393	0.346	1.513
Before eating	-1.479	0.396	0.00	0.228
Before feeding child	0.929	0.4258	0.029	2.532
After cleaning child's bottoms	-0.327	0.5212	0.531	0.721
After using the toilet	0.535	0.3994	0.181	1.707
After eating	-1.737	0.502	0.001	0.176
After cleaning	1.776	0.6922	0.01	5.908
After touching something sticky	-1.018	0.563	0.071	0.361
Type of toilet facility				
No facility (reference group)				
Flush toilet	0.332	1.1032	0.764	1.393
Traditional pit latrines	1.937	0.7788	0.013	6.936
Ventilated improved pit latrine	1.212	0.8661	0.162	3.36
Constant	1.258	0.5241	0.016	3.517

4.7 WASH-related Diseases

This subsection presents survey findings on diseases that a child may have contracted in the previous two weeks at the time of survey and immunization against Rotavirus.

4.7.1 Contracting of diseases by a child

Caregivers were asked if their last-born child had contracted a disease in the last two weeks and their responses are captured by the charts below. Results from the household survey show that 2 weeks prior to the survey, 4 out of 10 respondents reported their lastborn child having suffered from one form of disease or another. The most common disease was diarrhea (46%) followed by typhoid-related fevers (22%) and malaria (12%). Eye infections (8%), worm infections (7%), skin infections (4%) were the other reported diseases. The respondents couldn't specify 1% of the other reported diseases.

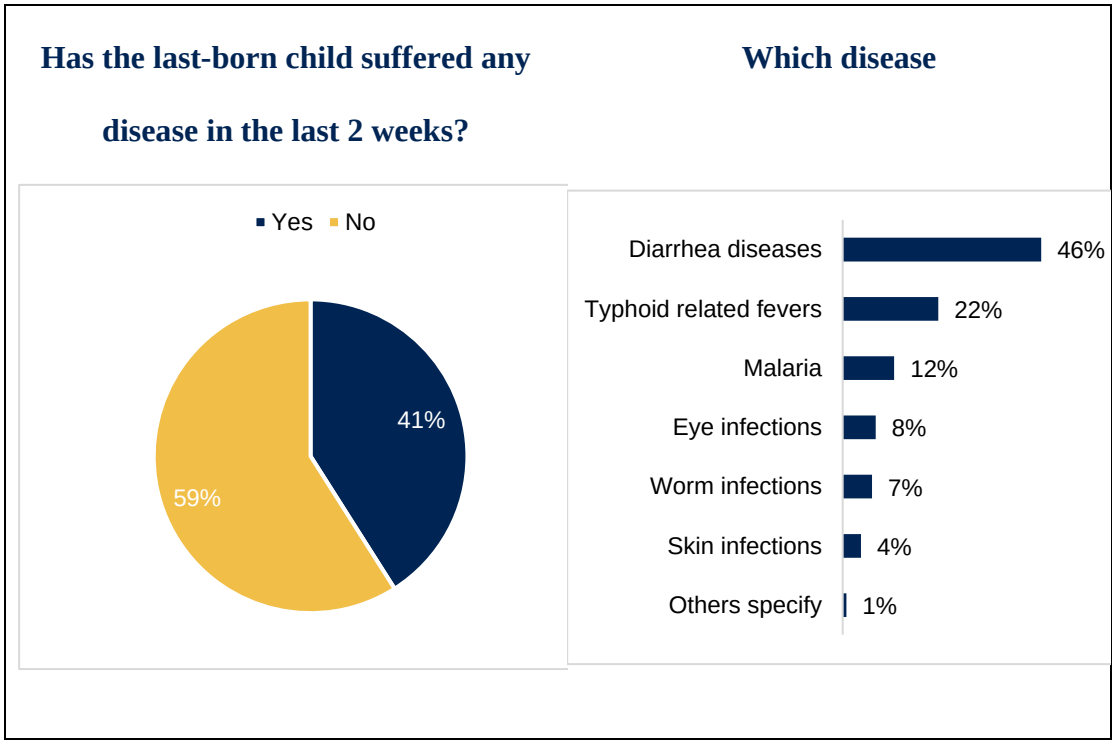


Figure 4:18: Diseases contracted by a child in last two weeks

This was also reported in the FGD and KII discussants as quoted below;

"...my children only drink boiled water when they have diarrhea, otherwise we don't waste cooking energy boiling water for treatment because there are no harmful effects from unboiled water..." (FGD Caregiver Mathenge). Another reported that *"...Caregivers in this area do not know a lot about hygiene and sanitation since we haven't yet succeeded in implementing a thorough awareness raising strategy, especially at the home level. In addition, due to financial constraints, some people may not be able to attend heath facilities to receive treatment for conditions like diarrhea..." (KII* CHEW Mathenge)

4.7.2 Immunization against Rotavirus

Caregivers were asked whether their last-born child had been immunized against Rotavirus and their responses are captured by the chart below. Based on the information presented by the chart, 57% mentioned that the last-born child had been immunized against the virus.

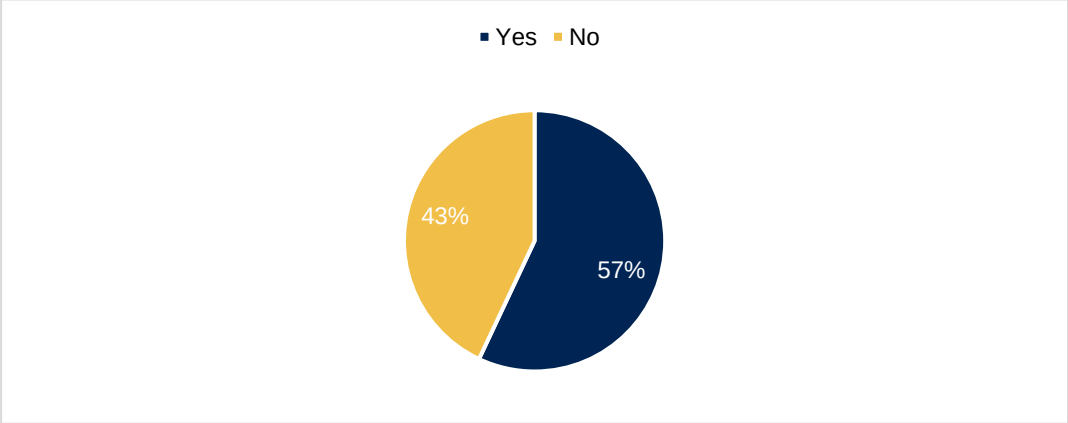


Figure 4.19: Children Under Five Immunized Against Rotavirus

4.8 Relationship between WASH-related diseases and Nutrition Status

Table 4.6 summarises the relationship between nutritional status that has been linked to the presence of stunting, BMI for age and wasting against presence of a WASH-related disease contracted by a child in the previous two weeks. A chi-square test has been used

to test this relationship and a binary logistic regression utilized to provide information on odd ratio (OR).

Based on the information presented in the table, there is a significant relationship between the nutritional status of a child and WASH-related diseases (p-value<0.001). Notably, children who had presence of oedema were 3.35 times more likely to suffer from WASH diseases than those who were observed as not having presence of nutritional oedema.

Table 4.6 Nutrition oedema and diarrhea diseases in the last two weeks

		Has the last-born child suffered WASH-related disease in the last 2 weeks?	
		Yes	No
Presence of oedema	Yes	59%	41%
	No	30%	70%
p-value	<0.001 at 95% level of significance		
Odd ratio	3.35		

Further, table 4.7 summarizes the relationship between the different categories of nutrition status and the occurrence of specific diseases. The most common WASH-related disease presented was diarrhea (46%) whereby of the 54 children with diarrheal diseases, 18 were underweight (WAZ), 17 had both underweight and stunting (HAZ), 5 children were stunted and 4 had a low BMI for age. 10 of the children with diarrhea did not have any form of malnutrition. Of the 26 children with typhoid-related fevers (22%), 11 had both stunting and wasting, 7 were underweight while 6 of them were stunted. This was followed by Malaria at 12% (n=14) where 7 children were underweight, 6 were both underweight and stunted and only 1 child was stunted. Other

common WASH-related diseases reported were Eye infections, skin infections, and worm infections. Subsequently, out of the 171 children who did not have a WASH-related disease, 108 (63%) had one for, of nutrition condition (either stunting, BMI for age or wasting). Further, out of the 108 who had nutritional conditions, 93 (86%) were either stunted or wasted or both.

Table 4.7: Cross-tabulation of WASH-related diseases and nutrition status of children under five

Nutrition condition	No disease	Diarrhea diseases	Eye infections	Malaria	Others specify	Skin infections	Typhoid related fevers	Worm infections	Total
None	63	10	5	0	0	3	2	0	83
BAZ	15	4	0	0	0	0	0	0	19
HAZ	37	5	0	1	0	0	6	1	50
HAZ, WAZ	43	17	2	6	0	2	11	7	88
WAZ	13	18	2	7	1	0	7	0	48
Total	171	54	9	14	1	5	26	8	288

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The findings of the study on the relationship between WASH-related variables and children under-five's nutritional status in the Ewaso Narok wetland in Laikipia County, Kenya, are discussed in this chapter. The chapter is structured according to the specific objectives of the study.

5.2 Discussion

5.2.1 Nutrition Status among children under Five years in the Ewaso Narok Wetland

The findings of the survey present a mixed picture of the nutrition status of children under 5 years in the surveyed area. While the majority of households reported consuming all seven food groups recommended by WHO for minimum dietary diversity, a significant proportion (36%) had a child with nutritional oedema, which is a sign of severe acute malnutrition.

The distribution of z-score indices for Weight-for-Age, Height-for-Age, and BMI-for-Age show that a considerable proportion of children were stunted, wasted, or underweight. For instance, the mean HAZ-score for children aged 24-60 months was -2.84±1.97, indicating severe stunting. Furthermore, boys had lower WAZ scores than girls, suggesting that boys are more likely to be underweight.

These findings have significant implications for the nutrition and health of children under 5 years in the surveyed area. Children who are stunted, wasted, or underweight are at higher risk of morbidity and mortality from infectious diseases, such as

pneumonia, diarrhoea, and malaria. Malnutrition can also have long-term consequences on cognitive development, educational attainment, and economic productivity (Mwene-Batu et al., 2020). Malnourished children may experience stunted growth, impaired cognitive development, and delayed mental milestones, affecting their ability to learn, concentrate, and retain information. This can lead to reduced educational attainment, limiting opportunities for employment and economic mobility. Malnutrition can also reduce economic productivity by making individuals more susceptible to illness and disease, leading to absenteeism from work or reduced work capacity (Mwene- Batu et al., 2020). Additionally, malnourished individuals may have lower cognitive function, reducing their ability to learn new skills and contribute to their workplaces. Addressing malnutrition by providing access to nutritious food and necessary nutrients is crucial to preventing these long-term consequences.

The finding that 36% of households visited had a child with nutritional edema is particularly concerning, as it indicates that severe acute malnutrition is prevalent in the area. This requires urgent attention, as untreated severe acute malnutrition can lead to death within a few weeks. Interventions such as therapeutic feeding programs and treatment with ready-to-use therapeutic foods (RUTF) can be lifesaving for children with severe acute malnutrition. Therapeutic feeding programs typically involve providing a combination of nutrient-dense foods and medical care to treat the underlying cause of malnutrition (Awuchi, Igwe & Amagwula, 2020). RUTF, on the other hand, is a specially formulated nutrient-dense paste that can be used to treat severe acute malnutrition in children. These interventions can help improve a child's nutritional status, promote healthy growth and development, and ultimately save lives. It is crucial to ensure that these interventions are widely available and accessible to

those who need them most, particularly in low-income and resource-limited settings where malnutrition is most prevalent.

It is reassuring to learn that most households reported eating all seven of the food groups that the WHO recommends for a minimum of dietary diversity. On the other hand, the incidence of underweight, wasting, and stunting suggests that the food being ingested may not be of sufficient quality. Interventions like encouraging the consumption of nutrient-rich meals like fruits and vegetables and supplementing staple foods with vital vitamins and minerals can improve the quality of the food consumed.

The survey's results, in summary, show that severe acute malnutrition affects a sizable percentage of children in the investigated area, and stunting, wasting, and underweight are all highly prevalent forms of malnutrition. To address these nutritional issues and enhance the health and wellbeing of the area's under-5 children, immediate measures are required.

5.2.2 The Prevalence of Disease and Immunization Status

The findings on diseases contracted by children in the last two weeks have important implications for child health and well-being. Diarrhoea was reported as the most common disease, which is concerning as it can lead to dehydration and malnutrition, particularly in young children. When a child has diarrhoea, their body loses fluids and essential nutrients, which can quickly lead to dehydration and malnutrition if not properly treated (Sarmin et al., 2023). In severe cases, diarrhoea can also lead to electrolyte imbalances, which can be life-threatening. This emphasizes the necessity of initiatives to provide access to hygienic conditions and clean water, as well as the importance of good hygiene habits like handwashing, which can stop the spread of diarrheal illnesses.

The finding that 57% of last-born children had been immunized against Rotavirus is positive, as this virus can cause severe diarrhoea and dehydration in infants and young children. However, this also means that a significant proportion of children have not been immunized, leaving them at risk of contracting the disease. Rotavirus is a leading cause of diarrhoea-related deaths among children under the age of five worldwide. Vaccination provides an effective and cost-effective means of preventing rotavirus infections and reducing child mortality rates (Burnett, Parashar & Tate, 2020). High vaccination coverage not only protects individual children but also provides herd immunity, thereby limiting the spread of the disease within the community. As such, increasing vaccination coverage for rotavirus is a critical public health measure that can save lives and improve the health outcomes of children worldwide. This highlights the need for continued efforts to increase access to and uptake of vaccines, as well as public education campaigns to raise awareness about the importance of vaccination. Improving vaccination coverage can help prevent the spread of infectious diseases and reduce child mortality rates.

5.2.3 Nutrition status and diseases

The survey's results indicate a strong correlation between children's nutritional status and the prevalence of diseases linked to WASH. The most common WASH-related disease presented was diarrhea (46%) whereby of the 54 children with diarrheal diseases, 18 were underweight (WAZ), 17 had both underweight and stunting (HAZ), 5 children were stunted and 4 had a low BMI for age. 10 of the children with diarrhea did not have any form of malnutrition. Of the 26 children with typhoid-related fevers (22%), 11 had both stunting and wasting, 7 were underweight while 6 of them were stunted. This was followed by Malaria at 12% (n=14) where 7 children were underweight, 6 were both underweight and stunted and only 1 child was stunted. Other

common WASH-related diseases reported were Eye infections, skin infections, and worm infections. Subsequently, out of the 171 children who did not have a WASH-related disease, 108 (63%) had at least one of the nutrition conditions (either stunting, low BMI for age or wasting). Further, out of the 108 who had nutritional conditions, 93 (86%) were either stunted or wasted or both.

Children who had nutritional oedema were 3.35 times more likely to suffer from WASH diseases than those who did not have nutritional oedema. These results indicate that malnutrition is a major contributing factor to the occurrence of WASH-related diseases among children under the age of five in Ewaso Narok wetland.

The presence of nutritional oedema in a child is an indication of severe acute malnutrition, which is a serious and potentially life-threatening condition. Malnutrition weakens the immune system, making children more vulnerable to infectious diseases. Inadequate intake of nutrients such as vitamins and minerals impair the body's ability to fight infections, resulting in a higher incidence of WASH-related diseases (Sarmin et al.,2023). Additionally, malnutrition can cause stunted growth and cognitive development, which can have long-term consequences on the child's health and future opportunities.

5.2.4 Social demographic factors influencing the status of nutrition

The findings shown in Table 6 show that children's nutritional status in the Ewaso Narok wetland is highly influenced by sociodemographic characteristics. The two most important factors influencing nutritional status in this area are marital status and degree of education.

Education level is a crucial factor affecting the nutritional status of children. The study shows that children whose caregivers have either completed secondary school

education or tertiary/university education were 10% less likely to have oedema compared to those whose caregivers have no education or have not completed primary school education. Education can equip caregivers with the knowledge and skills needed to provide adequate and appropriate nutrition for their children (Ramírez-Luzuriaga et al., 2020). Caregivers with higher levels of education may also have better access to healthcare services and resources, enabling them to address their children's nutritional needs more effectively. Improving access to education, particularly for girls and women, is crucial for promoting child health and reducing malnutrition and related health problems. This finding indicates the importance of education in promoting child health and nutrition.

Children's nutritional status is also significantly influenced by their marital status. According to the study, children of married caregivers had a 15% higher risk of oedema than children of single caregivers. They also had a 33% higher chance of oedema compared to children whose caregivers were single. This result is quite surprising, as married caregivers are usually expected to provide better care for their children. However, this finding could be due to other factors such as economic status, living conditions, and cultural practices.

5.2.5 WASH-Related factors influencing the status of nutrition

The results show that a child's nutritional condition is greatly impacted by how far they live from wetlands. youngsters who live five to ten kilometers away from the wetlands are far less likely to get edema than those who live less than one kilometer away. This discovery raises the possibility that the wetlands are contaminated and puts nearby youngsters at risk of contracting dangerous infections. Consequently, limiting the amount of time spent near wetlands may be a good way to improve kids' nutritional status.

The use of protective gear in wetlands significantly improves the nutritional status of the child. This finding suggests that exposure to harmful pathogens in the wetlands could be reduced by the use of protective gear such as boots and gloves. Therefore, promoting the use of protective gear in wetlands could be an effective strategy for improving the nutritional status of children.

The findings indicate that handwashing practices significantly influence the nutritional status of the child. Children who do not wash their hands before eating or after cleaning have a significantly higher chance of developing oedema than those who do. This finding suggests that promoting proper handwashing practices could be an effective strategy for improving the nutritional status of children.

The type of toilet facility significantly influences the nutritional status of the child. Children living in households with traditional pit latrines have a significantly higher chance of developing oedema than those living in households with no toilet facility or flush toilets. This finding suggests that the use of traditional pit latrines may contribute to the contamination of the environment, which could increase the risk of exposure to harmful pathogens. Therefore, promoting the use of improved toilet facilities could be an effective strategy for improving the nutritional status of children.

Overall, the findings of this study suggest that several WASH factors significantly influence the nutritional status of the child. The study highlights the importance of promoting proper handwashing practices, reducing the proximity to wetlands, promoting the use of protective gear in wetlands, and promoting the use of improved toilet facilities to improve the nutritional status of children. These findings have significant implications for policy and practice in the areas of health, hygiene, and sanitation. They suggest that interventions aimed at improving WASH practices could

be effective in improving the nutritional status of children, particularly those living in resource-limited settings.

5.3 Comparison with Related Studies

This study's findings were compared with those of other related studies to evaluate consistency and identify potential reasons for any discrepancies.

Socio-Demographic Factors: The study revealed that caregiver education and marital status significantly influenced child nutrition outcomes. These findings align with research by UNICEF (2020), which highlights the role of maternal education in reducing malnutrition. However, disparities in the magnitude of the effect may be attributed to differing socio-economic contexts between this study area and other regions.

WASH-Related Factors: The association between access to clean water, sanitation facilities, and reduced malnutrition risk corroborates findings by Kwami et al. (2019), who reported similar results in Sub-Saharan Africa. However, this study's observation of a higher prevalence of malnutrition near wetland areas contrasts with studies in urban settings, likely due to environmental and infrastructural differences.

Handwashing Practices: Consistent with Arriola et al. (2020), this study found that regular handwashing reduced malnutrition risks. The higher effect size observed in this study could be attributed to targeted interventions in the Ewaso Narok Wetland, emphasizing handwashing behaviors.

WASH-Related Diseases: The study identified a strong relationship between diarrheal diseases and malnutrition, aligning with findings by Chakraborty et al. (2021).

However, the prevalence of intestinal parasitic infections was higher in this study compared to similar studies in Ethiopia, likely due to the wetland's unique ecological conditions.

The consistency of findings with other studies underscores the universality of WASH and socio-demographic factors in influencing child nutrition. Inconsistent results highlight the importance of contextual factors, suggesting a need for localized interventions tailored to environmental and socio-economic conditions.

5.4 Conclusion

This study provides critical insights into the interplay between socio-demographic factors, WASH-related practices, and nutritional outcomes among children under five in the Ewaso Narok Wetland. The findings demonstrated that caregiver education significantly reduced the likelihood of malnutrition (OR = 0.79, p = 0.008), while marital status showed a notable influence on nutritional outcomes (OR = 1.33 for divorced caregivers, p = 0.002). These results validate the hypothesis that socio-demographic factors are strongly associated with child nutrition.

The role of WASH-related practices was pivotal, with consistent handwashing reducing the risk of malnutrition by 30%, and proper faeces disposal practices showing a significant positive impact (p = 0.045). Furthermore, proximity to wetlands was linked to a 45% higher prevalence of malnutrition, emphasizing the environmental determinants of nutrition. These findings partially support the hypothesis that WASH-related factors influence nutritional outcomes, highlighting the importance of contextual environmental factors.

WASH-related diseases, particularly diarrhea, were strongly correlated with poor nutritional status ($p < 0.001$), confirming the hypothesis that these diseases exacerbate

malnutrition. Children with frequent episodes of diarrhea were more likely to exhibit wasting and stunting, as evidenced by mean HAZ scores of -0.86 and -2.84 for children under 24 months and 24-60 months, respectively.

In synthesizing these findings, the study underscores the necessity for integrated health and hygiene interventions, particularly in wetland areas. The conclusions highlight actionable insights, such as enhancing caregiver education, improving sanitation infrastructure, and addressing environmental risk factors. These recommendations align with global WASH strategies and provide a roadmap for localized interventions aimed at reducing malnutrition and improving child health outcomes.

5.5 Recommendations

5.5.1 Recommendations from the study

5.5.1.1. Assessment of Nutritional Status

1) The County Government Department of Health Services should take proactive measures to establish and sustain comprehensive nutritional screening programs within healthcare facilities across the Ewaso Narok wetland area. This initiative should encompass training and capacity-building of healthcare workers, allocation of resources towards the procurement of essential equipment and supplies for screening, and engagement of community health workers to conduct periodic household surveys for timely identification of at-risk children.
2) The County Government Department of Health Services should implement targeted nutritional education and counseling programs aimed at caregivers of children under five years old residing in the Ewaso Narok wetland area. These programs should be designed to raise awareness about the importance of optimal nutrition during the early years of life including exclusive breastfeeding

and provide practical guidance on age-appropriate feeding practices, dietary diversity, and the preparation of nutritious meals using locally available resources.

3) The County Government Department of Health Services should collaborate with relevant stakeholders, including non-governmental organizations (NGOs), community-based organizations (CBOs), and faith-based organizations (FBOs), to implement community-led initiatives focused on improving access to nutritious foods and enhancing food security among households with children under five years old in the Ewaso Narok wetland area. These initiatives could include the establishment of community gardens, the promotion of backyard poultry farming, the provision of training on sustainable agricultural practices and income-generating activities and strengthening existing social safety nets and support mechanisms, to mitigate the impact of food insecurity on child nutrition outcomes.

5.5.1.2. Influence of Socio-Demographic Factors

1) The Ministry of Education, in collaboration with local education authorities, should prioritize initiatives aimed at improving caregiver education levels in the Ewaso Narok wetland area. This could involve implementing adult education programs with scholarships and bursary schemes tailored to the specific needs and constraints of caregivers, such as flexible scheduling and distance learning options to accommodate their caregiving responsibilities and socioeconomic circumstances.
2) Efforts should be made to integrate nutrition education into school curricula at both primary and secondary levels, incorporating practical modules on child feeding practices, dietary diversity, and food hygiene into existing subjects.

These educational interventions will empower caregivers with the knowledge and capabilities to make informed decisions regarding their children's nutrition and overall well-being, thereby contributing to the long-term health and development of future generations in the community.

3) The County Government Department of Social Services should implement targeted interventions to support vulnerable families and single caregivers in the Ewaso Narok wetland area. This involves establishing community-based support networks and social welfare programs aimed at providing essential resources and assistance to families facing economic hardship, food insecurity, and social isolation. Additionally, microfinance initiatives and psychosocial support services should be made available to address the emotional and mental health needs of caregivers.

5.5.1.3. Impact of WASH-related Factors

1) The County Government Department of Water and Sanitation, in partnership with non-governmental organizations (NGOs) and community-based organizations (CBOs), should undertake comprehensive infrastructure development projects aimed at improving access to safe water sources and sanitation facilities in the Ewaso Narok wetland area. This initiative involves conducting thorough assessments of existing water and sanitation infrastructure to identify gaps and prioritize areas for intervention and development of sustainable water supply systems, such as fully equipped boreholes.
2) Efforts should be made to promote community ownership and participation in water and sanitation projects through community mobilization, capacity building, and awareness-raising activities.

5.5.1.4. Relationship Between Nutrition Status and WASH-related Diseases

1) The County Government Department of Health Services should implement comprehensive WASH interventions targeting households and communities in the Ewaso Narok wetland area. This involves conducting health education campaigns to promote proper hygiene practices,
2) Community health volunteers should be trained to deliver key messages on WASH-related diseases, prevention and management, thereby empowering community members to adopt healthy behaviors and reduce the incidence of WASH-related diseases among children under five years old.
3) The Department of Health Services should collaborate with local stakeholders, including community leaders and non-governmental organizations, to ensure the sustainability of these interventions through the establishment of community-based and community-led monitoring and support systems. By engaging communities and building local capacity, these initiatives can contribute to long-term improvements in WASH practices and child health outcomes in the Ewaso Narok wetland area.

5.5.2 Recommendations for further study

1) **Longitudinal Study on Nutritional Status Trends:** Conduct a longitudinal study to track the nutritional status of children under five years old in the Ewaso Narok wetland area over an extended period. This study could investigate seasonal variations, temporal trends, and the impact of interventions on nutritional outcomes to provide insights into the effectiveness of ongoing programs and identify areas for improvement.

2) **Qualitative Exploration of Socio-Cultural Factors:** Undertake qualitative research to explore the socio-cultural factors influencing child nutrition in the Ewaso Narok wetland area. This could involve in-depth interviews, focus group discussions, and participatory observations to gain a deeper understanding of community perceptions, beliefs, and practices related to nutrition, hygiene, and sanitation. Insights from this study could inform the design of culturally sensitive interventions tailored to the local context.
3) **Environmental Assessment of WASH Infrastructure:** Conduct an environmental assessment to evaluate the adequacy and sustainability of water and sanitation infrastructure in the Ewaso Narok wetland area. This assessment could include technical audits, water quality testing, and infrastructure mapping to identify gaps, vulnerabilities, and areas requiring improvement. Findings from this study could guide the prioritization of investments and infrastructure development initiatives to ensure equitable access to safe water and sanitation facilities for all community members.
4) **Impact Evaluation of Integrated WASH Programs**: Evaluate the impact of integrated WASH programs on child nutrition and health outcomes in the Ewaso Narok wetland area. This could involve rigorous impact assessments, randomized controlled trials, or quasi-experimental studies to measure changes in nutritional status, disease prevalence, and household hygiene practices following the implementation of WASH interventions. By assessing the effectiveness and cost-effectiveness of integrated approaches, this research could provide valuable evidence to guide future program planning and resource allocation decisions.

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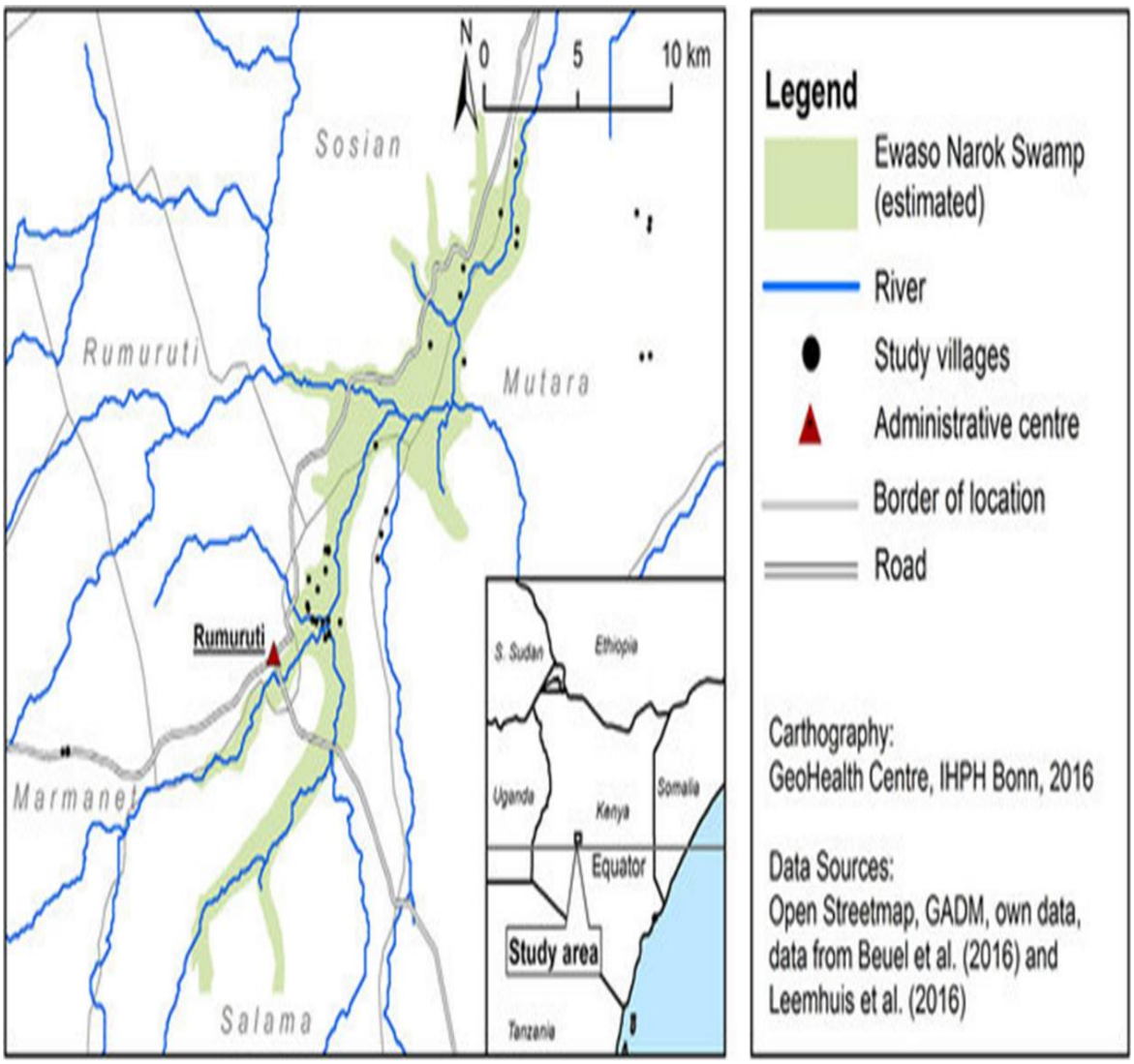
APPENDICES

Appendix 1: Map of Study Area



Appendix 2: Informed consent form

Greetings, I'm Colleta Kiilu. I am a master's student at Kenyatta University. I am conducting a study in the Ewaso Narok wetland in Laikipia County, Kenya, on WASH-related parameters connected to the nutritional status of children under five. The study's major goal is to look into the link between poor nutrition and wash-related disorders in children under the age of five. Kenya's Ministry of Health will make use of the data to improve WASH and nutrition for children throughout the nation. This informed consent is for caregivers of children under the age of five who are invited to engage in research in the Ewaso Narok marsh. It is absolutely up to you whether or not you participate. As we go over the material, there might be certain terms you don't understand. If so, kindly ask me to pause so I can clarify. You are welcome to contact me if you have any questions. One of the most important aspects of a healthy community is hygiene. We feel you can assist us by sharing your knowledge about sanitation and hygiene practices in relation to children's health and safety.

Steps to be taken:

Taking care of and safeguarding study subjects:

You might be asked to complete a questionnaire that will be given to you, or you might be given the choice to have the questionnaire read aloud to you and indicate aloud what you would like me to record. If you don't want to respond to any of the questionnaire's questions, you can skip it and go on to the next one. Your name will not appear on the forms, and the information you submit will be kept confidential. I will be the only one with access to the data, along with my research assistants, and we will only use your number to identify you. If any of the study's questions concern you, you are free to decline to take part in it. Please remember that taking part in the study is completely voluntary. At any point, you are welcome to ask any questions you may have on the

research. You are free to end the interview at any moment and to decline to answer any questions. It's also completely fine for you to exit the study whenever you like.

Discomforts and risks:

You take the chance of inadvertently revealing private or sensitive information or of feeling awkward bringing up particular topics. Conversely, we do not wish for this to occur. You can choose to ignore these queries or decline to answer if this happens. The interview can be ended at any moment by you. It could take you fifteen to thirty minutes for the interview.

Benefits

There will be no direct benefit to you, but your participation is likely to help us learn more about local household food hygiene practices, as well as assist the Ministry of Health in learning how to improve household sanitation and hygiene, which will help reduce the high rates of malnutrition in children aged 6-59 months in our communities and throughout the country.

Confidentiality of research participants:

You won't directly benefit from this, but your involvement will probably help us learn more about the food hygiene practices used in local households and support the Ministry of Health in its efforts to improve household sanitation and hygiene. Together, these efforts will help lower the high rates of malnutrition among children between the ages of 6 and 59 months in our communities and across the nation.

Community considerations:

People from the public may question you if you participate in the research, which is likely to draw attention. Your personal information won't be shared with anybody outside the research team. The study aims to improve public or community health, but the data gathered will remain confidential.

Contact information:

If you have any queries, please reach out to Dr Oyore or Dr Mwanzo, my supervisors, at 0722335878 or 0729932026 respectively, or the Secretariat of the Kenyatta University Ethical Review Committee at kuerc@ku.ac.ke.

Participant's statement: I am aware of the information above regarding my participation in the study. I was allowed to ask questions, and I received satisfactory answers. Whether or whether I take part in this study is totally up to me. I acknowledge that the information I provide will be kept private and that I can withdraw from the study at any moment.

Participant's name and signature date

_____ _____ _____

Investigators statement: The volunteer has received an explanation of the study protocols in a language that they can comprehend from me, the undersigned.

Investigator's Name and Signature Date

_____ _____ _____

Appendix 3: Household Tool

WATER, SANITATION, AND HYGIENE FACTORS ASSOCIATED WITH NUTRITION STATUS AMONG CHILDREN UNDER FIVE YEARS IN EWASO NAROK WETLAND, LAIKIPIA COUNTY, KENYA

INFORMED CONSENT

Hello. From Kenyatta University, I am _____. My research aims to investigate the impact of WASH-related factors on children under five years old's nutritional status. I would want to ask you a few questions regarding your general health practices, social demographic, and basic knowledge and experience with WASH. About forty minutes will pass throughout the interview. All of the information you give will be kept 100% confidential.
You are free to decline to answer any or all of the questions during this interview; you are not required to participate. You are under no obligation to continue taking the survey. Nevertheless, since your input is important, we sincerely hope you will participate in this survey.

Will you participate in this research? Do you have any questions for me regarding the survey?

Interviewer Signature: _____ Date: _____

CONSENTS	DECLINES
1 – Proceed to Section 1	2 – STOP the Interview

SECTION 1: IDENTIFICATION OF THE HOUSEHOLD

This section must be filled out for each household that has been visited.

101. Ward:	
102. Village:	

103. Interviewer number:	
104. Date of interview:	
105. Interview Start Time:	
106. Interview End Time:	

SECTION 2: SOCIODEMOGRAPHIC CHARACTERISTICS

No.	**Questions and Filters**	**Coding Categories**
201	Age	AGE ☐☐ DON'T KNOW……998
202	Current marital status	Never married/ Single Married Separated/ Divorced Widowed
203	Religion	Protestant Islam Catholic Adventist Faith Based on traditional Other (Explain) Not at ll

No.	Questions and Filters	Coding Categories
204	How are you related with the household head?	Head Wife Mother Daughter Grand Mother Daughter-In-Law Mother-In-Law Sister-In-Law Niece Sister Grandchild Other (Specify)
205	What is the highest level of education completed by you?	No formal education Primary Not Completed Primary Completed Secondary Not Completed Secondary Completed Tertiary college /University
206	How old were you when had your first child?	AGE ☐☐ DON'T KNOW…… 998

No.	Questions and Filters	Coding Categories
207	What is the number of your biological offspring (parity)?	Number of Biological children ☐☐
208	What is the name of your youngest living child that you gave birth to?	YOUNGEST CHILD NAME _____
209	What is the gender of your youngest living child that you gave birth to?	MALE……. 1 FEMALE……. 2
210	How old is [Name] in months?	☐☐
211	How many of your biological children are under five years old now?	Number of children under five ☐☐
212	What is the **primary** source of income for your household?	No consistent source of revenue for HH Employment and Salary Temporary worker or pay earner Assistance (hand-outs) Business Farming Animal husbandry Others specify

SECTION 3: WATER, SANITATION AND HYGIENE

301	Which is this household's **primary** source of drinking water? (SELECT ONE)	Water piped into the house Piped water into yard/plot/building A borehole or tube well Unprotected dug well Bottled / sachet water Protected spring Unprotected spring Rainwater collection Protected dug well) Cart with small tank/drum) Tanker truck) Public tap/standpipe) Surface water (river/stream/etc.)) Other (specify)
302	Do you take any steps to ensure the safety of your drinking water?	YES NO
303	If yes, what do you usually do to the water to make it safer to drink? Anything else? ONLY CHECK MORE THAN ONE RESPONSE IF MULTIPLE METHODS ARE TYPICALLY	Allow it to remain and undergo sedimentation Strain it through cloth Boil Add bleach/ chlorine Water filter (ceramic, sand, composite)

	USED IN TANDEM, SUCH AS CHLORINE AND CLOTH FILTRATION.	Solar disinfection Other/ (specify) Don't know
304	Are you aware of the occasions where hand washing is crucial? (*PLEASE ASK THE RESPONDENT TO BE SPECIFIC. DO NOT READ THE ANSWERS. ENCOURAGE "WHAT ELSE" UNTIL NOTHING ESLE IS MENTIONED AND CIRCLE ALL THAT IS APPLICABLE*)	Before preparing food Before eating Before the child is fed After changing the child's diapers After visiting the toilet After eating a meal After cleaning After contact with something sticky, greasy, odorous Other/ (specify)
305	Would you kindly show me where and how you usually wash your hands? ASK TO SEE AND OBSERVE	Inside/near toilet facility Inside/near kitchen/cooking place Somewhere in the yard Backyard No particular place No authorization to observe
306	**OBSERVATION ONLY**: is there any detergent, soap, or cleaning agent that is used locally?	Soap Detergent Ash

	WITHIN A MINUTE, THE INTERVIEWEE HAS TO HAVE THIS ITEM READY OR BRING IT WITH THEM. EVEN IF IT IS BROUGHT OUT LATER, CHECK NONE IF THE ITEM IS NOT PRESENT WITHIN ONE MINUTE.	Mud/sand None Other/ (specify)
307	Do you have access to a bathroom (toilet facility) that you often use?	Yes No
308	(If the answer is yes in Q 707), what kind of restroom facility do you have?	A bucket Conventional pit latrines A ventilated improved pit latrine Flush toilet Other Specify
309	(If No Q 707), what do you use/where do you go? (Ask more)	Bush An Open field Close to a body of water Backyard Other (specify)
310	[OBSERVE] The disposal of children's feaces	Immediately and hygienically disposed off Not disposed off (scattered in the compound)

SECTION 4: CHILD MORBIDITY

Q401	Has the last-born child suffered any disease in the last 2 weeks? **(confirm from the mother/child booklet)**	Yes No
Q402	If yes, which disease (Multiple answers allowed)	Diarrhoea diseases Typhoid related fevers Eye infections Malaria Worm infections Skin infections Others specify
Q403	Has the child been immunized against rotavirus? (ask for those who mention	Yes No

SECTION 5: PROXIMITY TO THE WETLAND

Q501	Do you live or work next to the wetland area?	Yes No
Q502	What is the approximate distance from your house to the wetland?	Less than 1 Kilometer 1 kilometer – 5 Kilometers 5 Kilometers – 10 Kilometers More than 10 Kilometers
Q503	Do you use any protective gear while working within the wetland area?	Yes No

(Probe for use of Gloves, boots, Masks etc)

Q504 If No, why don't you use it?

Lack of money to purchase

Not available in the shop

Not aware am supposed to use them

Others (Specify)

SECTION 6: FOOD FREQUENCY AND DIVERSITY OF HOUSEHOLD DIET

	Q601: In the previous seven days, did any members of your household eat any food from these dietary groups? (Food needs to	**Q602**: If yes, mark days the food was consumed in the last 7 days? Yes No	**Q603:** What was the **MAIN** source of the dominant food item consumed in the HHD? (***DO NOT READ THE CHOICES***) 1. Own production 2. Purchase 3. Gifts from friends/families 4. Food donation

	have been prepared or served in the home.) Yes No									5. Exchanged or Bartered 6. Borrowed 7. Gathering/wild fruits 8. Other (provide details) 9. Not Relevant
Type of food		**D1**	**D2**	**D 3**	**D 4**	**D5**	**D 6**	**D7**	**TOTAL**	
cereals and their derivatives (such as bread, spaghetti, Ugali, sorghum, pasta, and injera)?										
Vitamin A-rich vegetables and tubers include carrots, orange										

sweet potatoes, and pumpkins.										
White tubers and roots: cassava, White potatoes, white yams, or foods derived from roots										
Dark green leafy vegetables: Dark green leafy vegetables, particularly wild ones additionally locally sourced leaves high in vitamin A, such cassava leaves, etc.										

Other veggetables, such as onions, tomatoes, and eggplant?										
Fruits high in vitamin A: + other fruits high in vitamin A that are available locally										
Other fruits										
Iron-rich organ meats include liver, heart, kidney, and other organ meats as well as dishes made from blood.										
Offal and flesh meats: Meat, poultry, offal (such as beef,										

goat, or camel meat, or chicken or poultry)?										
Eggs										
Fish: Shellfish and/or fresh fish										
Nuts and pulse (such as green grams, cowpeas, lentils, and beans)?										
Milk and dairy products (such as powdered milk, fermented milk, camel milk, etc.)?										
fats or oils (such as butter, ghee, margarine, blueband, cooking fat, etc.)?										

Sweets: Sugar, honey, drink with added sugar, or sugar-filled meals like candy, chocolate, or candies										

SECTION 7: NUTRITIONAL MEASUREMENTS FOR THE CHILD

Q701	Age of the child	…….. Months	
Q702	Sex of the child	1. Male 2. Female	
Q703	Weight (in Kilograms) (to the nearest 100g is equal to 0.1kg)	Initial reading……KG Second reading ……..KG	
Q704	Height/length (Centimeters) (to the closest 0.1cm =1mm)	Initial reading …….CM Second reading …….CM	
Q705	MID Upper arm circumference (MUAC) (to the nearest 0.1cm =1mm)	Initial reading……..…CM Second reading …….CM	
Q706	Oedema	Yes NO	

THE END. THANK YOU

Appendix 4: FGD Guide

WATER, SANITATION, AND HYGIENE FACTORS ASSOCIATED WITH NUTRITION STATUS AMONG CHILDREN UNDER FIVE YEARS IN EWASO NAROK WETLAND, LAIKIPIA COUNTY, KENYA

Focus Group Discussion (FGD) guide for CHVs and caregivers

1. Which safe sanitation and hygiene practices do you know?
2. What are the common sanitation and hygiene practices in households among the caregivers in this community?
3. What are the barriers to proper caregiver's sanitation and personal hygiene in households?
4. What are some of the hygiene and sanitation practices of household members during and after use or access to the wetland area?
5. When do you say a child is undernourished? (Probe for the various types of undernutrition)
6. Can poor sanitation and hygiene lead to undernutrition in children? (Probe on the relationship)
7. Have you ever been trained on sanitation and hygiene practices in households? (probe contents of the training if any)
8. Which illnesses are prevalent in children under five years old in the Ewaso Narok swamp?

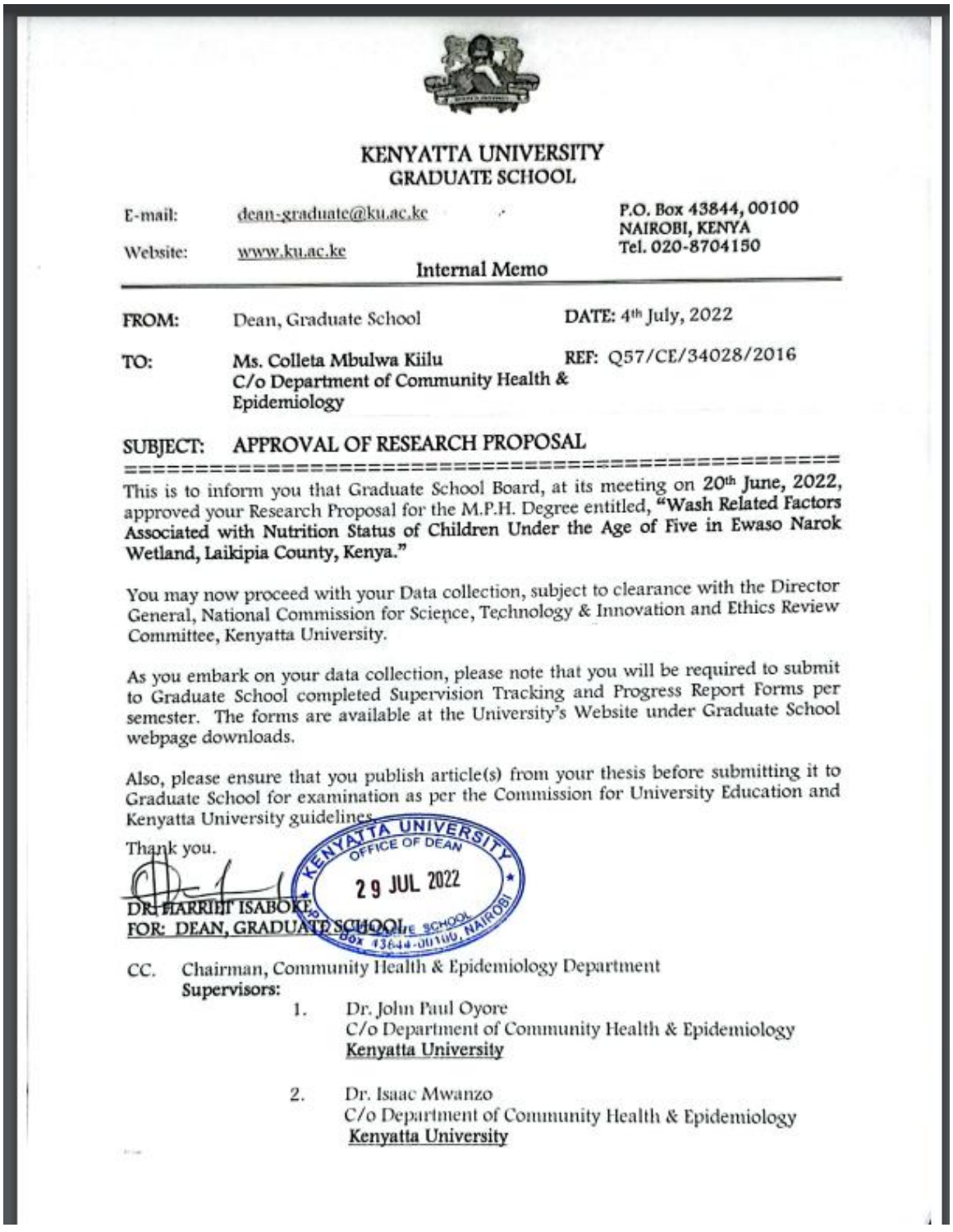
Appendix 5: Key Informant Tool

WATER, SANITATION, AND HYGIENE FACTORS ASSOCIATED WITH NUTRITION STATUS AMONG CHILDREN UNDER FIVE YEARS IN EWASO NAROK WETLAND, LAIKIPIA COUNTY, KENYA

Key Informant Interview (KII) guide for CHEW, Health Facility In-charge and Nutritionist In-charge

1. Do you offer training or health talks on proper sanitation and personal hygiene in households? (Probe on the messages and where disseminated)
2. Do caregivers in Ewaso Narok wetland practice proper sanitation and hygiene practices?
3. What could be the barriers to proper sanitation and hygiene in households in the Ewaso Narok wetland area?
4. Do you think poor sanitation and hygiene in households can be linked to undernutrition in children under the age of five in the Ewaso Narok wetland?
5. Have you ever been trained on proper sanitation and hygiene practices in households? (probe contents of the training if any)
6. What are the common diseases that children under five years suffer from in the Ewaso Narok wetland?

Appendix 6: Approval of Research Proposal



KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke
P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Dean, Graduate School DATE: 4th July, 2022

TO: Ms. Colleta Mbulwa Kiilu REF: Q57/CE/34028/2016
C/o Department of Community Health & Epidemiology

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

This is to inform you that Graduate School Board, at its meeting on 20th June, 2022, approved your Research Proposal for the M.P.H. Degree entitled, **"Wash Related Factors Associated with Nutrition Status of Children Under the Age of Five in Ewaso Narok Wetland, Laikipia County, Kenya."**

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The forms are available at the University's Website under Graduate School webpage downloads.

Also, please ensure that you publish article(s) from your thesis before submitting it to Graduate School for examination as per the Commission for University Education and Kenyatta University guidelines.

Thank you.

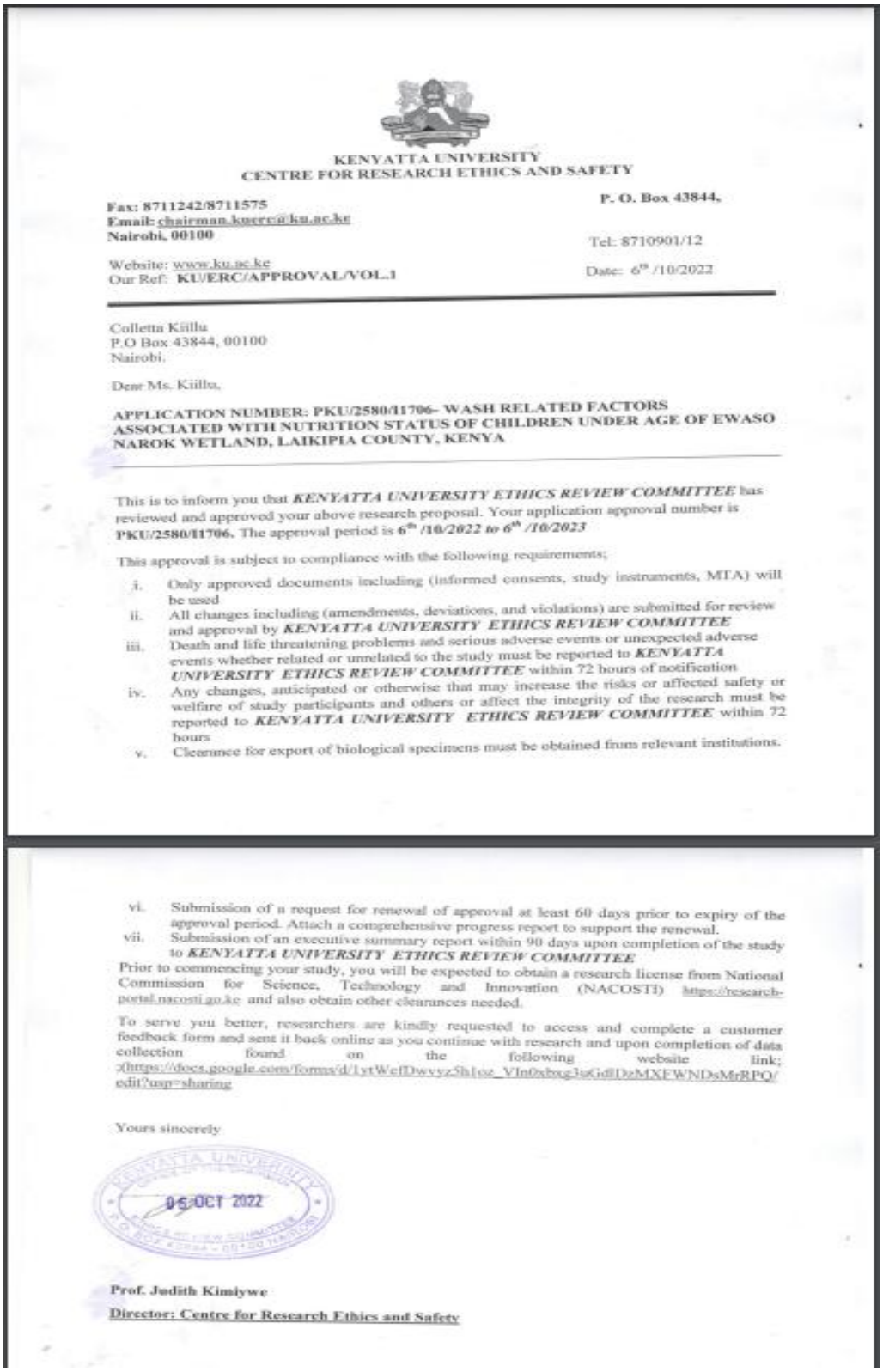
KENYATTA UNIVERSITY OFFICE OF DEAN 29 JUL 2022 GRADUATE SCHOOL P.O. BOX 43844-00100, NAIROBI

DR. HARRIET ISABOKE
FOR: DEAN, GRADUATE SCHOOL

CC. Chairman, Community Health & Epidemiology Department
Supervisors:

1. Dr. John Paul Oyore
   C/o Department of Community Health & Epidemiology
   Kenyatta University
2. Dr. Isaac Mwanzo
   C/o Department of Community Health & Epidemiology
   Kenyatta University

Appendix 7: Ethical Approval Letter



KENYATTA UNIVERSITY
CENTRE FOR RESEARCH ETHICS AND SAFETY

Fax: 8711242/8711575
Email: chairman.kuerc@ku.ac.ke
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P. O. Box 43844,

Tel: 8710901/12

Website: www.ku.ac.ke
Our Ref: KU/ERC/APPROVAL/VOL.1

Date: 6th /10/2022

Colletta Kiilu
P.O Box 43844, 00100
Nairobi.

Dear Ms. Kiilu,

APPLICATION NUMBER: PKU/2580/11706- WASH RELATED FACTORS ASSOCIATED WITH NUTRITION STATUS OF CHILDREN UNDER AGE OF EWASO NAROK WETLAND, LAIKIPIA COUNTY, KENYA

This is to inform you that ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** has reviewed and approved your above research proposal. Your application approval number is **PKU/2580/11706.** The approval period is ***6th /10/2022 to 6th /10/2023***

This approval is subject to compliance with the following requirements;

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE*** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.

vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to ***KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE***

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research-portal.nacosti.go.ke and also obtain other clearances needed.

To serve you better, researchers are kindly requested to access and complete a customer feedback form and sent it back online as you continue with research and upon completion of data collection found on the following website link: https://docs.google.com/forms/d/1ytWefDwvyz5h1oz_VIn0xbxg3uGidIDzMXFWNIDsMrRPQ/edit?usp=sharing

Yours sincerely

KENYATTA UNIVERSITY
06 OCT 2022
P.O. BOX 43844 - 00100 NAIROBI

Prof. Judith Kimiywe
Director: Centre for Research Ethics and Safety

Appendix 8: Research Authorization

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Our Ref: Q57/CE/34028/2016

DATE: 4th July, 2022

Director General,
National Commission for Science, Technology
and Innovation
P.O. Box 30623-00100
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MS. COLLETA MBULWA KIILU REG. NO. Q57/CE/34028/16

I write to introduce Ms. Colleta Mbulwa Kiilu who is a Postgraduate Student of this University. She is registered for M.P.H. degree programme in the **Department of Community Health & Epidemiology.**

Ms. Kiilu intends to conduct research for a M.P.H. thesis Proposal entitled, **"Wash Related Factors Associated with Nutrition Status of Children Under the Age of Five in Ewaso Narok Wetland, Laikipia County, Kenya."**

Any assistance given will be highly appreciated.

Yours faithfully,

KENYATTA UNIVERSITY OFFICE OF DEAN 29 JUL 2022 GRADUATE SCHOOL P.O Box 43844-00100, NAIROBI

PROF. ELISHIBA KIMANI
DEAN, GRADUATE SCHOOL

Appendix 9: Research License - NACOSTI Approval

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **370106**

Date of Issue: **27/October/2022**

RESEARCH LICENSE

This is to Certify that Ms.. Colleta Mbulwa Kilu of Kenyatta University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Laikipia on the topic: WASH RELATED FACTORS ASSOCIATED WITH NUTRITION STATUS OF CHILDREN UNDER THE AGE OF FIVE IN EWASO NAROK WETLAND, LAIKIPIA COUNTY, KENYA for the period ending : 27/October/2023.

License No: **NACOSTI/P/22/21001**

370106

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions