CAREGIVER PRACTICES ASSOCIATED WITH OCCURRENCE OF MALNUTRITION, DIARRHEA AND BIDIRECTIONAL DIARRHEA-MALNUTRITION AMONG UNDER-FIVES AND A FRAMEWORK FOR INTERVENTION IN THE INFORMAL SETTLEMENTS

BY

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DECLARATION AND APPROVAL

Declaration

This thesis is my original work and has not been presented for an award of a degree or Doctor of Philosophy in any other university or institution.

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DEDICATION

This work is dedicated to Paige Kerry who accompanied me to my final thesis defense. It is also dedicated to the Pediatricians, Pediatric nurses, Nutritionists, sub County Community Health Service Coordinators, Community Health Promoters and caregivers of under-fives, who work tirelessly to ensure that children who are under five years remain in good health.

ABSTRACT

Safe water, improved sanitation, hand hygiene and infant feeding are community-based interventions that have been implemented to improve malnutrition and diarrhea and bidirectional diarrhea- malnutrition outcome among under-fives. Nevertheless, their benefits are limited in informal settlements. About half of under-fives from developing countries lack hand washing facilities; 37% and 63% are exclusively breastfed and receive any breast milk within 6-23months respectively. Study aimed to develop a framework for community based interventions for the prevention of malnutrition, diarrhea and bidirectional diarrhea- malnutrition among under-fives. Findings of the study provides other researchers and readers with useful information for reference and suggest critical policy ideas through its recommendations. A cross-sectional study design using mixed methods, was conducted in hospitals and communities. The sample comprised 105 under-fives and their care-givers, 6 pediatric unit in-charges, 20 community health promoters(CHPs) and 2 sub county community health service coordinators (SCCHSCs) participated. Specific objectives were to determine occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives; identify practices that are associated with risks and to develop a framework of community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea malnutrition. Objectives one and two were implemented in the hospitals; the second and third objectives were addressed in the community. Care givers CHPs and SCCHSCs were included through census and purposive sampling methods while pediatric unit in-charges were selected purposively. Data was collected using semi structured questionnaires, interview guides and focus group discussions. Quantitative and qualitative data were analyzed using descriptive and inferential statistics and content and thematic analyses respectively. The results showed that 52 and 53 under-fives had malnutrition and diarrhea respectively. The high occurrence of malnutrition and diarrhea ranging between 71.7% and 78.85% was among the ages 6-23 months; other groups had 13.46- 18.87% < 6 and 7.69- 9.43% 24-59 respectively; 56.67% with MUAC < 115mm were females. Fisher's exact test of association between malnutrition and gender revealed a statistically significant relationship at 5% significance level (P-value < 0.05). Of the 33 cases with bidirectional diarrhea-malnutrition, n=28 (84.85%) were aged 6-23 months and 21 (63.64 %,) had diarrhea then malnutrition; 38% with malnutrition and 73.58% with diarrhea had their fingernails untrimmed; under-fives of caregivers who experienced water shortage were 5.4 times more likely to have bidirectional diarrhea -malnutrition (OR=5.40, 95%CI=1.49-19.59, P-value=0.01; 67.3% -83.02% of under-fives with malnutrition and diarrhea respectively were on complementary feeding, 36.54% and 37.7% with malnutrition and diarrhea respectively lived in households not treating drinking water. Community health assistants had inadequate knowledge on early initiation of breast milk, Complementary feeding, construction of any type of latrine where there is none. In conclusion, occurrence of malnutrition and diarrhea is high in age groups 6-23 months; caregiver practices like partial adherence to hand washing, failure to trim fingernails of under-fives are risks for malnutrition, diarrhea and bidirectional diarrhea malnutrition and a framework for strengthening community based interventions has been developed. This study recommends that national and County governments should put in place strategies that focus on prevention of bidirectional diarrhea malnutrition among under-fives; studies be conducted to determine if the practice of complementary feeding among caregivers is associated with malnutrition and diarrhea and the developed framework should further be validated in other settings to ensure wide utilization in the region for prevention of bidirectional diarrhea malnutrition among under-fives.

ACRONYMS AND ABBREVIATIONS

AKDN- Aga Khan Development Network

CDC- Centre for Disease Control

CHP- Community Health Promoters

CLTS- Community Led Total Sanitation

DALYs- Disability Adjusted Life Years

DHIS- District Health Information System

ESPEN- European Society for Clinical Nutrition and Metabolism

FGD- Focus Group Discussion

HAZ- Height for Age Z-Score

IQ- Intelligent Quotient

IYCF- Infant and Young Child Feeding

JOOTRH- Jaramogi Oginga Odinga Teaching and Referral Hospital

KCRH- Kisumu County Referral Hospital

KHSSP- Kenya Health Sector Strategic Plan

KWHDSS- Kisumu West Health and Demographic Surveillance System

MD- Moderate Diarrhea

MDG- Millennium Development Goal

MOH- Ministry of Health

MPI- Multidimensional poverty index

MSD- Moderate Severe Diarrhea

OD- **O**pen defecation

RUSF- Ready to use supplementary food

RUTF- Ready to use therapeutic food

SAM- Severe Acute Malnutrition

SCCHSC- Sub County Community Health Service Coordinator

SD- Standard deviation

SDG- Sustainable development goals

UN- United Nations

UNICEF- United Nations Children's Funds

WASEP- Water Sanitation Extension Program

WASH- Water Sanitation and Hygiene

WAZ- Weight for Age Z-Score

WHO- World Health Organization

WHZ- Weight for Height Z-Score

OPERATIONAL DEFINITION OF TERMS

Acute malnutrition- This is recent and severe weight loss that can be attributed to food shortage or presence of an infectious disease such as diarrhea (Jima *et al.,*, 2021;WHO, 2020). For this study, acute malnutrition was applied to mean wasting or low weight for height observed in under five.

Basic water- drinking water from an improved source provided collection time is less than 30 min for a round trip, including queuing

Bidirectional malnutrition -diarrhea

This is the relationship that exists between diarrhea and malnutrition. Diarrhea affects nutritional status of the under-fives through reduced food intake due to loss of appetite, intestinal absorption, increased nutrient breakdown and removal of nutrients that are required for tissue synthesis and growth. This presents as low weight for age and short height for age in case of prolonged diarrhea. Malnutrition, on the other hand, causes susceptibility to infections by impacting negatively on the barrier protection provided by the skin and mucous membranes and also leads to reduced host immune function (Mulatya *et al.,*, 2020). In this study, bidirectional diarrhea- malnutrition was a feature exploited to develop a framework of selected community based interventions for prevention of a combination of diarrhea and malnutrition.

Caregiver. This word was used in the current study to refer to anyone, other than health care providers, thatprovided care to under-fives, who because of their young age need help taking care of themselves.

Chronic malnutrition- Also referred to as recurrent undernutrition is a condition that results from prolonged food shortage (appropriate type and qualities (WHO, 2020). In this study any under-five that presented with a history of recurrent episodes of malnutrition and height for age score <-2 compared to the WHO Child Growth standards median of same age and sex was considered as suffering chronic malnutrition.

Community based interventions- These areprograms and initiatives that target to improve the health that an under five had **episodes** of loose or liquid stool three or more times in a day or unusual regularity of diarrhea episodes by under-five (Degebasa *et al.,*., 2018)

Diarrhea: diseases generally set in either as a result of infection, medication, foods that upset the digestive system, diseases affecting the bowel or following surgery on the bowel.This study considered diarrhea arising from infection, which mainly occurs due ingestion of food or drink, that is contaminated by disease causing organisms. Also, due to reduced immunity among under-fives with chronic malnutrition, diarrhea may set in as an opportunistic infection

Dysentery- an infection of the intestines that causes severe blood stained diarrhea with mucus presence in stool WHO, (2020). For this study, any under-five who presented with a history of blood stained diarrhea was considered to suffer dysentery.

Frame work is a set of facts (Bas & Tegan, 2022). In this study, framework was used to refer to facts that would be used to develop certain community interventions

Hand hygiene: This is a wayof hand cleansing that significantly minimizes the presence of possible pathogens (harmful germs) on the hands (CDC, 2023). In this study hand hygiene was used to imply hand wash among caregivers of children under five years at critical points in time which include: after visiting the toilet, after changing a child's nappy, after cleaning the environment, before preparing food, and before feeding the under five

Malnutrition -Whereas malnutrition indicates either undernutrition or overnutrition, this study adopted under nutrition, a deficiency of nutrients in line with the fact that informal settlements are characterized by inadequate basic services rather than excesses (Gomez, *et al.,*, 2023). Malnutrition was considered to be present if the under-five taking part in this study presented in either of the three ways:

Severe stunting: In this study severe stunting referred to a statewhere the height for age of the under-five was less than the median by 85% representing a standard deviation of -3SD as compared to the WHO Child Growth standards median of same age and sex

Severe underweight: This was applied in the current study to refer to any under-five whose weight for age was<-3 Standard Deviation (SD).

Severe wasting: In this study any under-five who presented with weight for height below the median by 70%, a standard deviation of -3 SD was considered to have severe wasting (Jima *et al.,* 2021)

Stunting This is when height-for-age Z score [HAZ] was less than 2.00 Standard Deviation). In this study, stunting was applied to under five whose height for age score was <-2 compared to the WHO Child Growth standards median of same age and sex (WHO, 2020).

Underweight also defined as low weight for age -weight-for-age Z score [WAZ] was < -2.00 SD) was applied in the current study to signify an under five who presented with low weight for age compared to the WHO Child Growth standards median of same age and sex

Wasting: in which weight-for-height z score [WHZ] < 2.00 SD) (Gluning *et al.,* 2021; WHO, 2020). The body mass of under-five was low compared to the weight. In the current study an under five was considered to be wasted if they presented with thinness, swelling of feet, face, feet and limbs.

Improved sanitation: Is a sanitation system whereby feces are disposed of in a manner that they reduce the risk of fecal-oral transmission to the environment and its users. This includes composting toilet, ventilated improved latrine, and pit latrine with a slab "flush or pour-flush to a piped sewer system, septic tank or pit latrine (Muslim *et al.,* 2021)

Improved water-Water from an improved source such as protected well or spring, rainwater, piped into dwelling, piped to yard/plot, public tap/standpipe, and tube well or borehole, piped to neighbor or bottled water. In this study we used the word improved water to mean safe water at the point of use

Moderate-to-severe diarrhea (MSD) –In this study, any under-five presenting with history of passing loose or watery stool more than 3 times in a day and on examination had features associated with dehydration which include: sunken eyes, reduced skin turgor (a long [≤2 s] or very long [> 2 s] abdominal skin pinch recoil), required administration of parenteral re hydration; presence of dysentery blood stained stool or hospital admission as a result of either dysentery or diarrhea (Acácio *et al.,*, 2019), was considered to have MSD.

New episode of diarrhea -In this study new episode was used to mean an under five who presented with a history of experiencing loose or liquid stool 3 or 4 times in a day three days after recovering from the last bout of diarrhea.

Practice-the approach used in the implementation of a process that uses a method, belief, or idea in order to execute a task Kinney, (2023). In this study practice referred to the way

caregivers of under-fives implemented guidelines to infant and young child feeding and sanitation

Severe dehydration- In this study severe dehydration was qualified by the presence of two or more of the following signs among under-fives who presented with history of passing loose or watery stool more than 3 times in a day: tiredness or coma, sunken eyes, inability to drink, and skin returning slowly on pinch (Vega & Avva, 2020)

Some dehydration- The under-five taking part in the current study was considered to have severe dehydration if they presented with one or more of the following signs: restlessness, irritability, sunken eyes, drinks readily, thirst, and skin pinch returns slowly (Vega & Avva, 2020)

Well-nourished any under-five who presented with - Z scores for HAZ, WAZ, and WHZ was equal to or greater than 2.00 SD, was considered to be well nourished (Dukhi, 2020). All the scores were calculated using software recommended by WHO- WHO Anthro-2006.

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CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

Malnutrition and diarrhea are the leading causes of morbidity and mortality among under-five year old children across the globe (Wasihun *et al.,*, 2018). Malnutrition refers to a state of imbalance between nutrients that the body needs and what it gets meaning, one may have overnutrition or undernutrition (Gudu *et al.,*, 2023). Four forms of malnutrition are recognizes: stunting, wasting, overweight and micro-nutrient deficiencies: However, for purposes of clinical management, it is classified as moderate acute, severe acute and chronic malnutrition (Choge, 2020). There is a bidirectional relationship between malnutrition and diarrhea in that both conditions can exacerbate one another. This can lead to a vicious cycle of poor health outcomes. Chronic diarrhea and malnutrition in infants are major public health issues in informal settlements. These challenges are particularly severe in low-resource settings, where access to clean water, adequate sanitation, and proper nutrition is limited. Diarrheal diseases, such as cholera and rotavirus infection, are common in these communities and can lead to severe dehydration and malnutrition (Nemeth & Pfleghaar, 2017). In addition, poor hygiene and sanitation practices can exacerbate the problem, as fecal-oral transmission of pathogens becomes more likely (UN-HABITAT, 2015).

To address these issues, community based interventions such as provision of safe drinking, water at the point of use, improved sanitation, caregiver hand washing at critical points in time (WASH), proper waste disposal, and infant and young child feeding (IYCF) practice have been implemented in an attempt to reduce related morbidity and mortality among children under-fives (Govender *et al.,*., 2021). Education about

these practices, as well as the importance of breastfeeding and a diverse diet, can considerably help reduce the incidence of chronic diarrhea and malnutrition in infants.

Children living in low and middle income countries (LMIC) who have access to safe drinking water have up to 52% reduced risks of diarrhea while improved sanitation is known to reduce the risk of fecal-oral transmission among under-fives (Merid*et al.,*., 2023). Improved sanitation is associated with a 16% reduction in the risk of diarrhea occurrence among under-fives (Muslim *et al.,* 2021; Merid*et al.,*, 2023). Hand washing with soap at five critical points in time prevents up to 40% of diarrhea episodes among under five year old children (Noguchi *et al.,*, 2022; Solomon *et al.,*, 2021). Moreover, adherence to guidelines on IYCF is associated with prevention of almost 19% of all under-five deaths as it promotes healthy growth and development among children thereby improving their survival (Adhikari *et al.,*, 2021; WHO, 2021). Nevertheless, benefits of the community based interventions are reduced among those children living in informal settlements. A multifaceted approach that combines prevention, treatment, and education is essential to reduce the burden of chronic diarrhea and malnutrition in infants living in informal settlements. As yet, there are several knowledge gaps and barriers in the implementation of such multifaceted approach interventions for infant diarrhea and malnutrition in informal settlements in Africa, particularly Kenya (UNICEF, 2020).

In Kenya, more than a third of children in informal settlements are stunted due to inappropriate complementary feeding practices compounded by cultural beliefs like excluding meat from children's diet (Reynolds *et al.,*, 2021). The presence of street vendors in the informal settlements enables poor feeding habits, creating additional barriers to recommended IYFP. In Kisumu county 18% ,0.8% ,and 7% of under-fives

are stunted, wasted and underweight respectively (Kisumu County Health Department, 2022). Only 25% of breastfed children consume food from four different groups and meet the minimum meal frequency as per the guidelines by United Nations Children's Funds (UNICEF) and World Health Organization (WHO). In Manyatta, one of the largest informal settlements of Kisumu County, very few households prepare lunch for children (MOH, 2019). Majority opt to feed their children on fast food such as chips and bhajia sold in the open market areas or kiosks, a clear sign of inappropriate feeding. This kind of meal is mainly carbohydrate and nutritionally inadequate.(WHO, 2021), Ideally a child should be fed on a meal that comprises carbohydrate, protein and vitamin foods, to gain all the required food nutrients.

Child health depends on public health improvements which include providing better nutrition, promoting adequate hygiene behavior such as hand washing, keeping the latrines clean, and keeping the household environment free from human and animal feces while assuring access to safe water at the point of use. The study identified caregiver practices which pose risk for diarrhea, malnutrition and bidirectional diarrhea-malnutrition among under-fives. It also developed and proposed a framework for strengthening the community based interventions.

1.2. Statement of the Problem

Efforts are being made by the Kisumu county government to address the root causes of chronic diarrhea and malnutrition in informal settlements, including through community engagement, policy change, research, and education. Evidence shows that, community based interventions such as safe water at the point of use, access to improved sanitation,

adherence to hand wash at critical points in time with proper infant and young child feeding practice as outlined in the guidelines by UNICEF and WHO help to reduce malnutrition and diarrhea related morbidity and mortality among children under-fives (Govender *et al.,*, 2021; Webb & Cabada 2018; Workie *et al.,*, 2018). However, their benefits still remain low in the informal settlements in Kisumu as in other low and middle income countries (Guillaume*et al.,*, 2022; Akilimali *et al.,*, 2022). A study by Kinoti *et al.*, (2020) indicates that only a fraction of Kisumu County's water demand is met through the piped supply from treated surface water, implying inadequate access to safe water. Secondly, 82% of households in Kisumu are not connected to the sewerage system and rely on pit latrines and or septic systems for fecal waste disposal (KIWASCO, 2017). In the informal settlement of Mathare Kenya, prevalence of diarrhea among under five year old children is 18.7% (Guillaume, 2020). Viwandani and Korogocho informal settlements have a prevalence of 26.3% 6.3% and 13.16% for stunting, wasting and underweight respectively (De Vita *et al.,* 2019). Kisumu County is not different, as 18%, 0.8 % and 7% of children under five years are stunted, wasted and underweight respectively (Kisumu County Government, 2022). In Bandani, one of the informal settlements of Kisumu County, prevalence of diarrhea among under-fives is 40% (Rakewa, 2022). In view of the disease burden among under-fives living in Kisumu County, this study sought to identify caregiver practices that are associated with risks for malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in informal settlements.

1.3 Objectives

1.3.1 Broad objective

To assess caregivers practices associated with malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives and a framework for interventions in the informal settlements

1.3.2. Specific Objectives

i. To determine the occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among children under-five years living in informal settlements.

ii. To determine practices that are associated with risks for malnutrition, diarrhea, bidirectional diarrhea-malnutrition among children under-five years living in informal settlements.

iii. To develop a framework for community-based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in the informal settlement.

1.4. Research Questions

i. What is the occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among the under-fives?

ii. What are the practices associated with the risk of malnutrition, diarrhea, bidirectional diarrhea- malnutrition among children under-five years?

iii. Which is the framework of community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in the informal settlement?

1.5 Justification

In the study, it was intended that a framework for strengthening community based interventions for prevention of malnutrition and diarrhea and bidirectional diarrhea and malnutrition among under-fives from informal settlements of Kisumu County be developed. This topic was preferred because according to UN HABITAT, over 700 million of urban residents live without improved sanitation (UN-HABITAT, 2021). The report also states that 844 million do not access safe drinking water, 892 million practice open defecation and half of those living in low and middle income countries have no access to hand washing facilities. The situation impacts negatively on health of under-fives for example in Kisumu County 18% of under-fives are stunted; 0.8% are wasted and 7% are underweight (Kisumu County Health Department, 2022). Furthermore on the health records of JOOTRH, out of the total number of under-fives admitted with diarrhea, 19% developed malnutrition while the cases of malnutrition that developed diarrhea were 89% (See appendix VII) a strong demonstration of the bidirectional relationship (MOH, 2019). The study findings will provide, to the scientific community, valuable information and body of knowledge regarding epidemiology of malnutrition, diarrhea and bidirectional diarrhea malnutrition. Resultant framework will be proposed for implementation in order to strengthen community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives from informal settlements. In particular, the study set to find out which selected community interventions could be applied to prevent a combination of malnutrition, diarrhea, bidirectional diarrhea and malnutrition, a potentially cost effective approach in resource constraint settings and to demonstrate the bidirectional relationship of diarrhea and

malnutrition among under-fives. After literature review the current study narrowed down to three specific objectives which included: 1) to determine occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives; 2) to identify caregiver practices as risks for malnutrition, diarrhea, bidirectional diarrhea and malnutrition among under-fives and to identify potential interventions by community health assistants in prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in informal settlements.

In finding information that will lead to achieving study objectives, the study relied on reports by WHO, UNICEF USAID and also explored what modern academics think about malnutrition , diarrhea and bidirectional diarrhea and malnutrition among under-fives and community interventions for prevention of the conditions.

1.6 Study Significance

The study was intended to investigate community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives. It is the only study that has focused on the bidirectional relationship between malnutrition and sought to propose a framework that targets to prevent a combination of the two conditions. As such, it is expected to produce hitherto information which is barely available, on cost effective approaches which can be adopted to prevent both malnutrition and diarrhea among under-fives in resource constrained informal settlements. It should therefore provide other researchers and readers with useful information for reference and suggest critical policy ideas through its recommendations. Such recommendations could inform policy formulation in the national and county government of Kisumu County in general.

1.7 Scope of the Study

The study aimed to develop a framework for strengthening community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives living in informal settlements. It was conducted in JOOTRH, KCRH and informal settlements of Kisumu Central, Kisumu East and Kisumu West sub counties using both quantitative and qualitative approaches. The study population was children under five years living in Kisumu County while those targeted were the ones in informal settlements and admitted with malnutrition and diarrhea with the two hospitals. A total of 105 caregivers of under-fives admitted during the study; 6 hospital health care workers (2 pediatricians, 2 pediatric nurses, 2 nutritionists); 20 community health promoters (CHPs) and 2 sub county community health service coordinators (SCCHSCs) took part in the study. Data was collected in two phases: the first phase, a baseline involved 105 caregivers of under-fives and 6 hospital health care workers took place from August 2020 to April 2021 and phase two, involving 20 CHPs and 2 SCCHSCs was conducted in December 2022. A framework was developed and proposed for implementation in order to strengthen community based interventions for prevention of malnutrition diarrhea and bidirectional diarrhea malnutrition among under-fives.

1.8 Assumptions of the Study

The study assumed that occurrence of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives is associated with quality of community based interventions, the informal settlements have various factors that affect community based interventions and that various interventions are applied in order to prevent occurrence of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives. Moreover, the study assumed that data collection tools would evoke reliable feedback and that the study respondents would provide reliable responses.

1.8 Study Limitations

Cross sectional study design which was adopted is known for various weaknesses of bias, from respondent due to social acceptability or recall as well as interviewer bias (Levin, 2006). The study sample size for each outcome was small therefore statistical tests used may have failed to bring out relationships among research variables. Research assistants were taken through a short training to ensure that they understood details of the questions and how to ask them. Caregivers were taken through an explanation regarding the study about why it was conducted and how they would benefit from findings. They were further reassured of confidentiality and anonymity regarding their responses. Some questions required respondents to reflect on things that occurred between 24 hours to two weeks back creating a situation of recall bias. For example, in the feeding pattern, caregivers were asked to state what they fed their children on, in the past 24 hours and recall if their children had suffered diarrhea, two weeks before onset of malnutrition. In this study triangulation was applied to reduce respondents' bias by seeking responses

from different individuals over a similar question. Furthermore because the study sample size was small, alpha level was set at 5% in order to attain rigor and reduce the chances of type 1 error. Data collection period was spread for eight months in order to achieve the desired sample size and during this period any factor could have played out influencing the study results.

1.9 Delimitation

The main objective of the study was to strengthen community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in informal settlements. Malnutrition and diarrhea are of public health concern because they are the leading cause of morbidity and mortality among under-fives. The two conditions are associated with poor sanitation, unsafe water, inadequate hand hygiene facilities, poor hand hygiene, and infant and young child feeding practice. Informal settlements were preferred because they are known for deprivation of facilities such as safe drinking water, improved sanitation and adequate nutrition, as result, under-fives living in such settings are exposed to risks for malnutrition, diarrhea and bidirectional diarrhea malnutrition. This study did not consider formal settlements because they have better facilities than informal settings and including them would take away focus required to improve health status for the underprivileged children.

The current study included children who are under five years because being under five means that body immunity is not fully developed. Underdeveloped body immunity of the children makes them more susceptible to diseases like malnutrition and diarrhea compared to older individuals with developed body immunity. Since the study sample

size was small, a clear definition of malnutrition and diarrhea for cases requiring admission was given, better than their outpatient counterparts.

The study adopted the approach of data triangulation using qualitative questions about specific ideas of interest. Triangulation is a strategy used to enhance credibility and validity of findings by using different methods in a study (Noble & Heale, 2019). The current study included only theories of socio ecological model and multidimensional poverty index as they had been applied to investigate occurrence of malnutrition and diarrhea. Using other theories would have failed to align the variables to those of the current study conceptual framework.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents literature and discusses community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under five year old children. It focuses on access to water and improved sanitation; hand hygiene and IYCF practices through highlighting current situations about the interventions while pointing out gaps. It then presents the burden of malnutrition and diarrhea among under-fives and links them to the community based interventions with focus on the informal settlements. Also, in this chapter there is demonstration of the relevance of theoretical frameworks to the conceptual framework.

2.1. Community based Interventions for Prevention of Diarrhea and Malnutrition

Diarrhea and malnutrition are preventable through simple interventions which include access to safe water, IYCF as per WHO/UNICEF guideline, improved sanitation and hand hygiene (WHO, 2017). These interventions are key in public health as emphasis on them contributes to reduced morbidity and mortality among children under five years (Mshida *et al.,*, 2018). Being below five years of age exacerbates occurrence of diarrhea because of immature body immunity and living in informal settlements poses further risks for malnutrition and diarrhea since such settings are deprived of adequate sanitation, safe drinking water, and hygiene facilities. Informal settlements are inhabited by individuals of poor socio-economic states negatively affecting food security among households (Birhan *et al.,*, 2023; Mkhize *et al.,*, 2023).

Despite several studies stating that access to safe water, improved sanitation, hygiene as well as IYCF compliance could reduce related morbidity and mortality among children

under five years (Wasihun *et al.,*, 2018), reports indicate that half of the world's population still experiences inadequate access to the interventions more so in the low and middle income countries (WHO, 2023). According to findings of a quantitative survey conducted in informal settlements of Nairobi, Kenya, 77.4% and 60.6% of people living in Kibera and Mathare have limited WASH facility accessibility or opportunity, respectively (Kim *et al.,*, 2022).

2.1.1 Hand Hygiene

Hand washing is the most cost-effective, life-saving practice and is within reach of household members (Abebe *et al.,*, 2023). Washing hands with soap at critical times significantly reduces the risk of diarrhea among under-fives through preventing fecal-oral disease transmission (Solomon *et al.,*, 2021; Noguchi *et al.,*, 2021). Globally, the prevalence of hand washing is estimated at 19% despite the fact that inadequate hand hygiene is known to be responsible for about 300,000 deaths per year, mainly occurring among the under-fives. Dirty hands expose children to diarrhea infections (Solomon *et al.,*, 2021; Noguchi *et al.,*, 2021).

Poor hand hygiene practice is widespread among caregivers and presence of knowledge among them does not translate to practice (Almas*et al.,*, 2020). Cross sectional study which was conducted to assess knowledge and practices regarding hand-washing among caregivers of children less than five years of age in rural areas of District Sialkot, India, shows that even though 75% of caregivers involved in the study expressed having good knowledge about hand washing, 25% showed good practice of the same while only 14% washed hands in accordance to technique (Almas*et al.,*, 2020). This finding exposes a gap in health education and behavior changing approaches of hand washing. It is apparent

that even with clear knowledge of the importance of hand washing and prioritizing the actions, numerous studies have found that the majority of people wash hands ineffectively suggesting the need for multi-pronged solutions to partial hand washing practice.

In a study report of a community -based randomized control trial aimed at assessing the efficiency of hand washing on reducing diarrheal disease in children under five years old in rural *kebeles* of Dire Dawa, East Ethiopia, Solomon and others state that occurrence of diarrhea reduced by 41.0% among children who lived in households where caregivers adhered to hand wash practice (Solomon *et al.,*, 2021; Noguchi *et al.,*, 2021).

Elsewhere in the democratic republic of Congo, a cross sectional study conducted by Noguchi *et al.,*, (2021) to determine association between presence of hand-washing facilities with water and soap on diarrhea incidence among children under five years in Lao People's Democratic Republic indicates that children whose households possess hand-washing facilities with both water and soap were significantly less likely to experience diarrhea episodes than those that had hand washing facilities with water alone . The finding implies that access to hand hygiene facilities at household level is associated with hand washing practice hence reduced or increased diarrhea incidences will be experienced.. Children under five years mainly depend on caregivers for activities of daily living and health promotion. Therefore if members of a household maintain clean hands through hand washing then disease-causing agents transmissible from one household member to the child through dirty hands are reduced. Dirty hands either from touching soil or human feces are risks for diarrhea among children under five years. In a study aimed at identifying etiologic agents of acute diarrhea in sentinel surveillance sites

in Vientiane Capital, Lao People's Democratic Republic, 2012-2015, stool samples were collected and analyzed at Lao healthcare facilities. Results showed that the major etiologic agents of acute childhood diarrhea are rotavirus, *Escherichia coli*, and *Salmonella* species which are transmitted from person-to person via contaminated hands in households (Houattongkham *et al.,*, 2020). Also, if caregivers change children's nappies but fail to wash hands immediately after the procedure they are likely to have their hands contaminated with fecal matter (Abebe *et al.,*, 2023). They may end up transmitting diarrhea causing pathogens to children during food preparation, feeding or even while handling the under-fives.

Despite several reports linking hand wash adherence with reduced incidences of diarrhea and malnutrition among children aged under-fives years, adherence remains low (Wolde *et al.,* , 2022). Wolde and others in a cross sectional study investigating determinants of hand washing practice and its associated factors among mothers of under-5 children in Kolladiba town, Northwest Ethiopia found out that only 51% of caregivers practiced hand wash at critical points in time meaning that almost half of under-fives who live in households where hand washing was practiced partially are at risk of suffering diarrhea and malnutrition. Elsewhere, a cluster-randomized controlled trial study conducted in rural Kenya by Pickering et. al, to assess effects of single and integrated water, sanitation, hand washing, and nutrition interventions on child soil-transmitted helminthes and Giardia infectionsreported that WASH interventions were noted to reduce stunting in Bangladesh but not in Kenya and Zimbabwe. While in Bangladesh community health promoters who promote health practice monitored WASH practice by visiting households six times in one month, for Kenya and Zimbabwe the community health promoters

visited households once in a month. This implies that in Kenya and Zimbabwe hand washing practice among members of households monitored by community health assistants sporadically affects compliance. It therefore means that for good compliance to hand washing practice, community health promoters should make routine frequent visits to households.In a study by Baye *et al.,*, (2021), to determine interventions to prevent diarrhea among under-fives of North Eastern Ethiopia that about 43% of caregivers practiced hand washing less than three critical points in time posing risk for diarrhea and malnutrition among their children. In periurban informal settlement of Hosanna town Ethiopia, only 16.8% had hand washing facilities indicating poor access. Poor access to hand washing facilities negatively affects compliance to practice meaning that under-fives living in settings with deprivation are at a higher risk of suffering diarrhea and malnutrition as a result of poor hand hygiene practice (Noguchi *et al.,*, 2021). The practice of hand washing with soap and water seems an easy and simple task to do in countries that have running water (Malaudzi *et al.,*, 2022). However, in developing countries, more so in informal settlements where water is a scarce commodity, the practice is viewed as a luxury that is often impossible to attain.Study reports by Bauza *et al.,*, 2021 indicate that the antiseptic soaps which are ideal for hand washing prove to be too costly for those in the informal settlements. Again, washing hands in the five instances means that an individual is required to do this thirty two times a day using about twenty liters of water, a resource whose access remains a big challenge for the informal settlement dwellers.

2.1.2 Drinking Water

Drinking water that is safe, treated at the point of use either through chlorination or boiling immensely reduces the burden of both diarrhea and malnutrition among under-fives (Webb & Cabada, 2018). Despite efforts to eradicate the burden of diarrhea through promotion of safe water use among other community based interventions, supply of safe water remains inadequate and the condition has remained aleading cause of mortality and morbidity among under-fives in the past two decades (Malatu *et al.,*, 2022) . In relation to this**,** children aged under five years are likely to suffer malnutrition as an indirect consequence of drinking water that is not safe (Mshida *et al.,*, 2018). Therefore it is important to encourage the practice of simple water treatment such as boiling water from wells and springs and storing it in safe containers for drinking**.** According to Mshida and others, malnutrition is linked to diarrheal diseases and intestinal worms; the conditions which are believed to be associated with use of unsafe drinking water. The current study sought to identify prevailing practices which are risks for occurrence of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives in order to propose a framework that would strengthen the community based interventions. The urge to conduct the study was motivated by the fact that consumption of safe drinking water at the household level depends not just on the quality of water "at source" but also at the "point of use" and includes various points from source to storage. At all points, from water source, transportation and storage, there is a risk of contamination by both human and animal waste, and an associated risk of enteric pathogen exposure, infection and disease (Mshida *et al.,*, 2018). Globally, it is estimated that 28% of the population lack access to sufficient safe water whereas in sub Saharan Africa (SSA) the percentage of

children living in households with no access to individual basic water is about 42% (Hanna, 2019; Gaffan *et al.,*, 2023). The study by Gaffan *et al.,* (.2023) went further to elucidate that children living in households which use unsafe water are at risk of dying from diarrhea and malnutrition before reaching the age of five years. In Eastern Ethiopia, a cross sectional study conducted to assess water, sanitation, and hygiene service ladders and childhood diarrhea in Haramaya Demographic and health surveillance site revealed that there was no household with drinking water from an improved source, which is available for use when needed, free from disease -causing contaminants like fecal matter (Wagari *et al.,*, 2022). The state of drinking water revealed by Wagari and others could be the explanation why 25% of under-fives in the surveillance area suffered diarrhea. The under-fives ingest diarrhea causing pathogens when they drink water that is contaminated with fecal matter, therefore there is need to treat the water at the point of use. Elsewhere in Tanzania, a cross sectional study which was done to assess access to safe water, sanitation, and hygiene in Ngoromoro community states that the proportion of households accessing WASH including safe drinking water is only 8.0% (Jacob *et al.,*, 2021). The finding suggests that the majority of children under five years from that region are at risk of developing water borne and sanitation related diarrhea. Elsewhere, according to findings of an analytical cross sectional study done to identify bacteriological and physico-chemical quality of household drinking water in Kisii town, Kenya, 39.13% of water for drinking had coliform while 17. 3% had Escherichia coli, levels which are way beyond WHO acceptable levels of drinking water (Ondieki *et al.,*, 2021). Water in households that participated in the study was contaminated with bacteria and unfit for human consumption because both total coliforms and *E. coli* exceeded the recommended

Kenya Bureau of Standards (KEBS) and WHO standards. These contaminants in drinking water can be eradicated by treating water at the point of use. According to findings of a study done on proximity density assessment and characterization of water and sanitation facilities in the informal settlements of Kisumu County, it was revealed that shallow wells remain critical water sources in the informal settlements (Othoo *et al.,*, 2020). In some settlements such as Nyalenda A, a large number of users, 600, relied on one shallow well during dry seasons, an indication of less opportunity. According to the study, 42.7%, 80.2% and 13.5% of residents used the water for cooking, laundry and cleaning and even drinking respectively. This is despite the fact that there are a high number of pit latrines near such water sources. There are two pit latrines within 15m radius to water sources in the informal settlements. The pressure is even more on springs, as records show in Nyalenda B and Manyatta A. The close proximity of sanitation to water sources means that most pit latrines are poorly constructed hence they frequently get filled and require emptying. Emptying is usually unhygienic since many residents cannot afford exhauster services. Residents would sometimes open an even shallower open pit adjacent to the filled one where contents are directly transferred from the filled pit into the newly opened one. Sometimes the pit content is emptied into an open drainage channel or sewage flow. In this respect adjacent water sources are at great risk of contamination hence household members including under-fives are likely to suffer malnutrition and diarrhea when they drink contaminated such water (Othoo *et al.,*, 2020). A study done by Geremew and others indicates that using chlorine solution at the point of use, to treat stored water, prevented contamination reducing the risks of diarrhea in the

under-fives. This is because it was discovered that there is a high risk zone between collection and consumption of water for drinking (Geremew *et al.,*., 2019).

2.1.3 Sanitation

Improved sanitation, among other WASH interventions, is critical in prevention and control of waterborne diseases such as diarrhea and related malnutrition (Jacob *et al.,*, 2021). Moreover, safe disposal of human and animal feces ought to be practiced so as to achieve SDG 6, however, access to sanitation remains a challenge in many developing countries, more so in informal settlements where residents are of low socioeconomic status (Othoo *et al.,*, 2020). More than half of the world's population, 4.2 billion people, use unimproved sanitation (UNICEF 2021) It is therefore important to identify gaps that exist in the implantation of community based interventions around improving sanitation and address them as the world rallies towards achieving SDG goal 6 by the year 2030. In a community based cross sectional study was conducted in in Dangila district, Northwest Ethiopia with an aim of assessing association of water, sanitation, and hygiene risk factors on the prevalence of diarrhea among under-five children, it was revealed that the total prevalence of diarrhea is 25.3% which was higher than 10.77% of a previous report of Nigeria (Hailu *et al.,* 2021). The study also reports that of all the under-fives included in the study a majority , 84.4% lived in un hygienic environments and explains that environments that are not clean pose risk for diarrhea and malnutrition among children under five years. Children while playing in such dirty environments are likely to touch dirty objects and even eat soil . Also, dirty environments attract flies which carry dirt to food or drink of under-fives. Lack of adequate sanitation facilities has been shown to contribute to high levels of stunting among children in Tanzania. This could be because

almost 70% of the country's entire population practices unimproved sanitation; out of this, 12% practices open defecation (WHO,2019). In the informal settlements of Nairobi, Kenya, less than a 1/3 of the population living there have access to improved sanitation while only 40% of Nairobi is connected to a sewerage system (The World Bank, 2023). This is despite the fact that the government's national development plan, Kenya Vision 2030 is to ensure that all citizens have access to basic sanitation by 2030, in line with SDG 6. In an effort to achieve improved sanitation, the Kenya government through Nairobi sanitation project in collaboration with the world bank set out to improve access to sanitation by leveraging commercial and customer finance to support project financing, as well as by increasing the amount of safely disposed fecal sludge thereby improving the overall environmental health risk. In Kisumu County there is poor waste disposal management system, and sanitation services (Kanoti *et al.,*, 2020). According to a study done by Environmental and Social Impact Assessment (ESIA) with an aim of improving the water and sanitation services within Kisumu city for the benefit of residents of the County, many low-income residents living in informal settlements experience inadequate access to safe and environmentally sound sanitation facilities (ESIA, 2020). In the informal settlements of Kisumu county pit latrines are constructed without any regard to proximity to water points. The latrines which are poorly done and usually not clean pose a health risk, for children under five years.

2.1.4 Infant and young Child feeding

the past three decades global efforts to improve maternal IYCF practices have increased. So far the WHO and UNICEF have initiated the following strategies: 1. the International Code of Marketing of Breast-milk Substitutes 2. The innocent declaration 3. The baby

friendly hospital initiative 4. The millennium development goals, the Global Nutrition Targets 2025 and the SDGs (Ahmed *et al.,*, 2021). The two world bodies have played a critical role in driving the goals of improving maternal IYCF practices in order to protect, promote, and support breastfeeding and child nutrition. For instance, the global nutrition targets 1 and 5 aim to decrease the number of children aged under five years with stunting by at least 40%. It also targets to increase the rate of EB to at least 50% by the year 2025(Ahmed *et al.,*, 2021).

It is worth noting that food that a child is fed on in the first 1000 days of life forms a platform for survival, growth and development (UNICEF, 2022). According to UNICEF and WHO, infants should be initiated on breast milk within the first one hour of birth, they should then be on exclusive breastfeeding (EB) for the first six months of life. From the age of 6 months a child is started on complementary feeding whereby safe, age-appropriate, nutritious solid, semi-solid and soft foods are introduced as breastfeeding continues up to 24 months and beyond (UNICEF, 2022; WHO. 2021). When a child is breastfed exclusively, they are on a balanced source of nutrients, bio active proteins, indigestible oligosaccharides, signaling system components and bi fidogenic bacteria alongside protection against infection (Beril & Socha, 2023). Despite existing evidence about the benefits and importance of IYCF, almost three quarters of the world's infants and young children (aged 0–36 months) are not breastfed as recommended by WHO and UNICEF (Baker *et al.,*, 2021). Moreover, poor adherence to IYCF is associated with with potentially harmful effects on nutrition and health outcomes that are perpetuated across generations. Inappropriate IYCF is predominantly witnessed in India (Dhami *et al.,*, 2020) with only 41.3% of new born babies initiated on breastfeeding within 30 minutes

to one hour of birth, 55% were exclusively breastfed. Moreover, the proportion of Indian women who appropriately introduced solid, semi-solid or soft foods to their infants ranged from 38% in both North and Central India to 61% in Southern India. These inappropriate IYCF practices that are reported may have considerable adverse implications for malnutrition, diarrhea l disease and bidirectional diarrhea-malnutrition burden among under-fives. Most African countries such as Ethiopia are not on track to achieve WHO GNT goal (Ahmed *et al.,*, 2021).

In Ethiopia, only 15.4% are fed in line with IYCF guideline (Tsehay *et al.,* 2021) while in a report of a systematic review done to investigate impacts of various interventions aimed at improving infant and young child feeding pr indicated that the prevalence of new born initiated early on breastfeeding are 59.9% for exclusive breastfeeding (Ahmed *et al.,*, 2021). To make matters worse, when the children developed diarrhea only 13.5% and 6.1% were given more than usual liquid and food respectively, implying that the wasted nutrients are not replaced hence creating risks for malnutrition.

In Kenya, the ministry of health developed a national strategy of IYCF with an aim of improving feeding practices for infants and children (Maingi *et al.,*, 2020). In order to promote appropriate infant feeding, the government explored implementation of the baby friendly community initiative (BFCI). According to Maingi and others, BFCI is a community-based intervention whose purpose is to initiate, protect and promote appropriate infant and young child feeding, that is, both breastfeeding and complementary feeding and optimal child health in the community. The intervention outlines 8 steps as shown in Table 2.1:

Baby Friendly Community Initiative Steps
1. Have a well-documented maternal infant and young child nutrition policy statement that is communicated to healthcare providers, community health workers and community members in a consistent manner 2. Have routine training for health facility and community health workers on the maternal infant and young child nutrition 3. Promote and support optimal maternal nutrition among mothers and their families 4. Educate all pregnant women and lactating mothers and their families on breastfeeding benefits and risks of artificial feeding 5. Support mothers in initiating breastfeeding within the first hour of birth and help them to maintain exclusive breastfeeding up to 6 months. Address any related breastfeeding issues 6. Encourage mothers to continue breastfeeding their children up to 2 years or beyond as well as provide age appropriate, adequate and safe complementary feeding to their children. Provide holistic care and stimulation of children 7. Ensure there is a baby friendly environment that is supportive to breastfeeding families. 8. Promote collaboration among health care workers, community mothers support groups, mother to mother support groups and the respective local communities

Source: Adapted from Ministry of Health Kenya (MOH, 2006)

A cross sectional study conducted in Narok to assess the impact of community-based nutrition on infant nutrition and associated health practices determined that even though 94.8% of mothers were aware about importance of breastfeeding in the first hour immediately after birth, only about 44.4% of the infants were exclusively breastfed (Mapesa,*et al.,*, 2020). The study further revealed that only 60.9% had knowledge about the right time to introduce complementary foods. Mothers who failed to breastfeed

exclusively, either became pregnant soon after delivery, were attending to competing chores or reported having insufficient milk, a clear indication of less emphasis that they gave to IYCF guidelines. Education regarding IYCF usually addresses the issues of family planning since well-spaced pregnancies creates an opportunity for a child to breastfeed up to two years of life. Also mothers are taught about how to ensure there is enough breast milk production, flow as well as availing breast milk to the child in case they have to go to work.

In Kisumu county 18%, 0.8% ,and 7% of under-fives are stunted, wasted and underweight respectively (Kisumu County Health Department, 2022). Only 25% of breastfed children consume food from four different groups and meet the minimum meal frequency as per the guidelines by United Nations Children's Funds (UNICEF) and World Health Organization (WHO). In Manyatta, one of the largest informal settlements of Kisumu County, very few households prepare lunch for children (MOH, 2019) . Majority opt to feed their children on fast food such as chips and bhajia sold in the open market areas or kiosks, a clear sign of inappropriate feeding. This is inappropriate infant feeding which puts children at risk of developing malnutrition and diarrhea.

However, caregiver practices including infant and young child feeding within informal settlements need to be understood. There is an association between diarrhea and malnutrition which in turn leads to increased morbidity and mortality in children under-five (Sambo et al*et al.,*, 2022).

The current study sought to strengthen community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in

informal settlements. Based on the fact that these two conditions have a bidirectional relationship , the study sought to develop a framework of interventions that target a combination of diarrhea and malnutrition which could be applied in resource constrained informal settlement, for prevention of malnutrition and diarrhea among under five year old children.

In conclusion, reviewed literature has asserted that WASH interventions have been implemented in order to reduce the burden of malnutrition and diarrhea among under-fives (Wasihun *et al.,*, 2018). They have gone further to demonstrate how individual strategy can be applied to address either of the conditions (WHO, 2023). The studies have however failed to suggest a cost effective intervention that could be implemented in resource constrained informal settlements. Moreover, insufficient literature exists regarding the bidirectional relationship of diarrhea malnutrition documenting occurrence, risk factors. This study therefore, aims to determine occurrence of malnutrition, diarrhea and bidirectional diarrhea- malnutrition among under-fives living in the informal settlements of Kisumu County.

This study is the first one to document the prevailing situation of association between malnutrition and diarrhea among under-fives living in informal settlements of Kisumu County. It also sought to capitalize on the bidirectional relationship between malnutrition and diarrhea and apply the idea in developing and proposing a framework of interventions that could target a combination of malnutrition and diarrhea in order to prevent occurrence. This may be a cost effective approach in view of informal settlements.

2.2 Occurrence of Diarrhea

Diarrhea is the increase of amount of water in stools because of an imbalance in the normal functioning of physiologic processes of the small and large intestine responsible for the absorption of various ions, other substrates, and consequently water but when diarrhea sets in, the amount of water in stools increases. The normal amount of water in stools is approximately 10 milliliter kilogram body weight daily in infants and young children or 200 grams each day among teenagers and adults (Nemeth & Pfleghaar, 2017). It is also referred to as an abnormal rise in daily stool fluidity, volume and frequency, a deviation from what is considered normal for an individual (Melese, 2019). The increase in the amount of water is attributed to an imbalance in the normal functioning of physiologic processes of the small and large intestine responsible for the absorption of various ions, other substrates, and consequently water. Diarrhea is classified as infectious or noninfectious, acute or chronic based on the type of symptoms or duration (Nemeth & Pfleghaar, 2017). Acute diarrhea is characterized by passage of 3 or more loose stools in a day, which lasts up to two weeks or less. Acute diarrhea is usually as a result of infections, the majority of which are associated with viruses such as Rotavirus and Norovirus. Other pathogens include Campylobacter jejuni Escherichia coli (E. coli), Shigella species; Salmonella species; Giardia lamblia, Entamoeba Histolytica Cryptosporidium species; and Vibrio cholera (Fitzwater *et al.,*., 2019). Persistent or chronic diarrhea is an episode that lasts for more than two weeks. Chronic diarrhea is non-infectious and attributed to malabsorption, inflammatory bowel disease, and medication side effects (Nemeth; & Pfleghaar, 2017). Diarrhea among under-fives mainly causes dehydration, a common complication of illness observed in children presenting to

the emergency department (Vega & Avva, 2023. Table 2.1 below classifies states of dehydration

Table 2.1. *Characteristics of mild to moderate and severe dehydration in an under five with diarrhea. Classification of dehydration based on symptomatic assessment*

Symptoms	**Mild to moderate (3-8% loss of body weight)**	**Severe dehydration more than 8% loss of body weight**
Mental status	Fatigue, restless, irritable , normal mental status	lacks energy and enthusiasm, unconscious
Breathing	Fast	Deep
Eyes	Slightly sunken	Deeply sunken
Tears	Reduced	Absent
Quality of pulse	Normal to decreased	Impalpable, weak, thread
Heart rate	Normal to increased	Rapid(regular/irregular)/slow<60 beats/minute
Thirst	Thirsty and eager to drink	.
Mucous membranes (Mouth and tongue)	Dry	Parched /dried
Urine output	Urinates less frequently	Oliguria
Extremities	Cool	Bluish, cold, peeled
Skin fold on pinching)	Recoils < 2 seconds	Recoils > 2 seconds
Capillary refill	> 2 seconds	>2 seconds

Diarrhea that is due to infection is acquired through fecal-oral transmission route, by person to person contact, through water or food or directly to the mouth (Alemayehu *et al.,*, 2020). Use of unsafe water and living in an environment that is unhygienic promote transmission of such diarrheal disease. Contamination with human or animal feces that has pathogens could be through dirty hands used to handle food while eating, water borne sewage and non-recycling latrines (Daniel, 2022). The pathogens can also be transmitted through flies, soil, surface water or groundwater. The flies would contaminate food or

soil and hands. Surface or groundwater could be ingested during drinking or even bathing and these may result in diarrhea (Daniel, 2022; Parvin *et al.,* 2021).

Globally, diarrhea is the second leading cause of death among under-fives accounting for 1.7 billion cases 525, 000 deaths yearly (Tareke *et al.,*, 2022; Sambo *et al.,*, 2021) with 90% of the deaths occurring in Africa and Asia (Nguyen *et al.,*, 2021; Mulatya, D. M., & Ochieng, C.2020). The report by Tareke *et al.,*, (2022) and Sambo *et al.,*, (2021) concur with that of UNICEF which also indicates that 1.7 million under-fives suffer diarrhea diseases per year, across the globe. Out of this figure, 525 000 children reportedly die from the infection (UNICEF, 2021).

In South Africa, the prevalence of diarrhea among under-fives is 15% based on a report of cross sectional study for risk factors to diarrhea among under-fives living in informal settlements The above position has been supported by WHO report which states that 780 million people lack improved water for drinking while 2.5 billion have no access to adequate sanitation around the world (WHO, 2017).

Eighteen percent of deaths occurring among under-fives result from diarrhea diseases, a majority, 78%, is based in South East Asia and Africa. In a community based comparative cross sectional study by Degebasa *et al.,*, (2018), four billion under-fives living in Africa suffer diarrhea annually. It is estimated that 90% of diarrhea cases recorded in the regions are linked to poor sanitation, hand hygiene practices, and unsafe drinking water, among households. South East Asia and Africa are classified by the World Bank as low and middle income category since their gross national income is USD12, 375 or less (World Bank, 2020). Such areas face poor sanitation, lack of access

to safe disposal of human excreta, lack of awareness of hygienic practices, and use of contaminated water creating risks for diarrhea among the under-fives (Degebasa *et al.,*, 2018).

In a report by WHO, (2017) diarrhea is common among children aged below 24 months as a result of poor complementary feeding practice. During complementary feeding, children are supposed to be fed on safe solid or semi-solid food but in the event of contamination during handling and storage, the children are at a risk of suffering diarrhea (Ogbo, 2018). According to Ogbo and others (Ogbo, 2018), in a study done in Tanzania to determine the association between infant and young child feeding practices and diarrhea reported that 25. 82 % of those who are started on complementary feeding suffered diarrhea, indicating the association between poor complementary feeding and diarrhea among children under five years (Ogbo *et al.,*, 2018). Complementary feeding, which is meant to benefit a child by providing additional nutrients needed for the body's increased demand, (WHO, 2022), is associated with risks for diarrhea if contamination occurs during food handling by caregiver. Moreover, children who do not eat diversified food thus feeds from four groups which include carbohydrates, proteins, milk and products together with fruits and vegetables are more likely to be stunted and present with underweight (Kamenju, 2000); meaning, children on less diverse diets are less likely to meet their energy and nutrient requirements. (Kamenju, 2000). According to Kamenju *et al.,*, to mitigate risks associated with complementary feeding among under-fives, caregivers ought to observe hygiene through washing hands before food preparation and feeding the child; ensure that utensils as well as environment where food is prepared are clean so that children do not become infected as a result of eating or

drinking contaminated fluids. Elsewhere in India, family health survey examined, using multivariate logistic regressions that adjust for clustering and sampling weights reported that diarrhea prevalence was lower among infants who were breastfed within one-hour of birth and those who were exclusively breastfed (Dhami *et al.,*, 2020). Multivariate analyses applied in that study revealed that continued breastfeeding at one and two years, and infants who were introduced to complementary foods had a higher prevalence of diarrhea (Dhami *et al.,*, 2020).

Nigeria experiences disturbing prevalence rates of diarrhea among under -fives with overall prevalence of diarrhea being 12.9% (Awoniyi & Naupane, 2021). The high prevalence of diarrhea among under-fives of Nigeria has been associated with the poor socio economic state of households (Nahalamba, 2019). In Nigeria almost 100 million people live in abject or extreme poverty explaining the high burden of diarrhea among under-fives. Children from poor households are less likely to access improved sanitation, safe water and experience IYCF according to guidelines by WHO/UNICEF (Nahalamba, 2019). Diarrhea is among the first ten causes of illness among under-fives of Kenya with a prevalence of 15% (Mulatya, 2020; USAID, 2018). Separately, Guillaume, (2020) indicates that 1,499,146 cases of diarrhea were reported among under five years in the year 2018 .This report was generated during a study that sought to establish factors influencing diarrheal prevalence among children under five years in Mathare informal settlement, Nairobi, Kenya. In Kawangware, another informal settlement within Nairobi, the prevalence of childhood diarrhea is 37% higher than that of Nairobi, which is at 15.6%. Informal settlements face a higher burden of diarrhea than formal ones because of poor hand hygiene practices, un improved sanitation , poor storage of water for drinking

which characterize such a setting. These characteristics have been associated with occurrence of diarrhea (Mutama, *et al.,*, 2019).

In Kisumu county, the prevalence of diarrhea among under-fives is 15.5% (Owiti *et al.,* 2021), a level that is as high as the national one. This could be attributed to the fact that 62% of Kisumu is under informal settlement (Alushula, 2019) A study report by Anyango indicates that diarrhea is the 4th leading cause of death among under-fives of Kisumu and 89% of caregivers had no knowledge on the danger signs of dehydration. (Anyango, 2018). Even though various governments and non-governmental organizations have come up with several initiatives to reduce the burden of diarrhea among under-fives, the goal is yet to be realized.. Deaths due to diarrhea among under-fives are preventable (Yaya *et al.,*, 2018). Some of the measures of preventing the pathways of transmission of disease causing agents for diarrhea are such as access to improved water and sanitation; availability of hand hygiene facilities and hand washing , proper IYCF practice (Wasihun *et al.,*,2018).

2.3 Occurrence of Malnutrition

Malnutrition refers to a state of imbalance between nutrients that the body needs and what it gets and its ability to digest, absorb and use those nutrients thus meaning overnutrition or undernutrition (Gudu *et al.,*, 2023). Some nutrients are manufactured in the body (nonessential) while others are not (essential) therefore they are acquired from food eaten (Edward *et al.,*, 2023). When the body is in a state of either undernutrition or overnutrition, it is weakened and becomes susceptible to infections and any factor that causes an imbalance in the intake of nutrients and causes the double burden of malnutrition. It is also a condition of low anthropometric values or the presence of

kwashiorkor, an illness characterized by nutritional edema that is accompanied by a pigmented skin and peeling, thinning of hair and inflammation. The current study applied the word malnutrition to mean undernutrition given that informal settlements face a lot of deprivation such as unsafe water, poor hygiene , un improved sanitation as well as food insecurity which are associated with undernutrition (UN-HABITAT, 2015). Malnutrition is subdivided into stunting, wasting and underweight. However, for purposes of clinical management, it is classified as moderate acute , severe acute and chronic malnutrition (Choge, 2020). Malnutrition is basically caused either by environmental, behavioral factors or diseases (Dipasquale, 2020). The environmental factors associated with malnutrition include: Age and sex of a child; type of housing,, source of water, sanitation and food consumption (Edward *et al.,*, 2023). .Behavioral factors or diseases associated with malnutrition include: reduced food intake and absorption of micro and macronutrients, increased energy expenditure and increased losses or altered requirements (Menalu *et al.,*, 2021). Acute malnutrition is a nutritional deficiency arising from inadequate intake of energy or proteins and is categorized into two major domains based on etiology (Dipasquale, 2020). 1. Primary acute malnutrition, usually related to inadequate food supply. Food supply can be altered due to factors such as socioeconomic, political, and environmental factors, and this situation is more common in LMIC. Acute malnutrition in pregnant women, has several implications on the unborn child, under five and household which include intrauterine growth restriction, low birth weight, poor breastfeeding and inadequate complementary feeding, household food insecurity, poverty, frequent infectious illnesses, poor quality of water and hygiene (Dipasquale, 2020). Acute malnutrition can also result from an inflammatory condition of

the gut known as environmental enteropathy (Edward *et al.,*, 2023). The inflammatory condition is associated with a myriad of factors such as inadequate sanitation, unsafe water for drinking and poor hygiene. 2. Secondary acute malnutrition: unlike primary malnutrition which relates to inadequate supply, this condition results from increased energy expenditure, abnormal nutrient loss or reduced food intake especially in the presence of a chronic condition such as organ failures and heart disease (Dipasquale, 2020). Table 2.2 below presents classification of acute malnutrition

Table 2.2. *Characteristics of moderate and severe acute malnutrition among under-fives*

Moderate acute malnutrition	**Severe acute malnutrition**
Weight for height SD score of <-2 but >-3	Mid upper arm circumference < 11.5 cm
MUAC 11.5- 12.5 cm	Weight for height SD <-3
	Bilateral pitting edema

Appropriate nutrition and feeding practices are regarded as very critical to a child's growth and development more so during the first two years of life (Gudu *et al.,*, 2020). In the opinion of Gudu *et al.,*, from conception to two years, there is a rapid growth in body size, length or height; weight and organs as well as neuron-development. During this phase of rapid growth, children need increased amounts of calories to meet high demand by the body and as such, they become more vulnerable to macro- and micro nutrient deficiencies caused by high demand for food , if they do not get the right amount of food. Since their stomachs is small in size, food should be served in small amounts with dense energy (Clark *et al.,*, 2020). Adequate nutrition builds strong body immunity that protects under-fives against infections like diarrhea on the other hand a malnourished child becomes prone to infections since the body immunity is weak, physical growth becomes impaired and cognitive development is derailed (Gudu *et al.,*, 2020; Scott, 2020). Several

factors have been linked to nutrition: they are those that are nutrition-specific and nutrition sensitive (Clark *et al.,* 2020). Nutrition specific factors include inadequate food intake that could be due to reduced appetite, poor care giving and parenting, non-adherence to IYCF practices by caregivers, and infections such as diarrhea. On the other hand, nutrition-sensitive factors which include food insecurity, inadequate economic resources at the individual, household, and community levels. Similar factors include poor access to education by caregivers, healthcare services, infrastructure and poor hygienic environment that adversely affect the children under the age of five years (Clark *et al.,*, 2020; Drammeh *et al.,*, 2019).

Given the importance of nutrition on a child's growth and development, guidelines on infant and young child feeding were developed by WHO and adopted by individual countries (WHO, 2017). Based on the guideline, acceptable infant and young child feeding practices involve initiating breast milk within one hour of normal birth or 4 hours of birth through cesarean section; exclusive breastfeeding from 0-6 months of life, and initiation of nutritionally -adequate and safe complimentary food at 6 months while breastfeeding continues up to two years or beyond (WHO, 2017: WHO, 2021).

Malnutrition among under-fives has been attributed to several factors such as: poor diets especially those low in energy or specific nutrients; various experiences during antenatal and postnatal periods; infection, which is considered as a major cause across the world, chronic illness or even under-fives who have been neglected psychologically (Soboksa *et al.,*, 2021). Furthermore, poor environmental hygiene, unimproved sanitation, hand hygiene and unsafe drinking water are associated with development of diverse infections that relate to under-five malnutrition (Wasihun *et al.,*, 2018). For that matter,

the nutritional status of an under-five can be affected through infestation by intestinal parasites, diarrhea diseases and environmental related inflammatory conditions of the gut, also known as environmental enteropathy (Soboksa *et al.,*, 2021). Lack of or adequate states of WASH facilities can indirectly contribute to an under-fives developing malnutrition. For example, if a caregiver is forced to walk long distances in search of safe water or sanitation facilities, a lot of time is spent in trying to cover the long distance, this can possibly divert attention from the child. Also, whenever under-fives start to crawl and walk while in unhygienic environments, they are likely to ingest human or animal feces by putting contaminated objects in their mouths (Soboksa *et al.,*, 2021). This results in diarrheal infection through intestinal infestation by parasites. Repeated episodes of diarrhea are associated with malnutrition (Soboksa *et al.,*, 2021). Under-fives with severe malnutrition manifest reduced height for age or stunting (Bhutta *et al.,*., 2017) indicating exposure to prolonged nutritional deficit. Stunting, a sign of malnutrition in early childhood, has been associated with unimproved sanitation which badly influences nutritional status of under-fives either through impaired absorption of nutrients (Freeman *et al.,*., 2017). Poor absorption of nutrients is associated with diarrhea and sub-clinical infections with fecal pathogens. Repeated and persistent infection may lead to reduced absorption capacity of the gut, a sub-clinical condition that can lead to growth faltering (Freeman *et al.,*., 2017).

In a study report, infections, specifically diarrhea, causes nutrient deficiency due to reduced dietary intake (Bhatnagar *et al.,*, 2019). Reduced dietary intake results from loss of appetite, nutrient loss during every bout of diarrhea, reduced food absorption because of damaged mucosal lining of the stomach (Bhatnagar *et al.,*, 2019). Diarrhea is the most

common morbidity in children with severe acute malnutrition in a bidirectional association.

Malnutrition predisposes under- fives to increased incidences of diarrhea through reduced body immunity increasing vulnerability to diseases and worm infestation (Mulatya, 2020). Moreover, children with severe malnutrition tend to have osmotic diarrhea because of carbohydrate intolerance caused by villous atrophy. Fluid is lost from the gut because of the sugars in the diet and rehydration fluids, worsening the child's condition (Bhatnagar *et al.,*, 2019). Due to inadequate dietary intake and wastage through diarrhea malnutrition leads to poor physical, behavioral, motor and cognitive development, compromised health and functioning in adulthood. (Wasihun *et al.,*., 2018; Gebre *et al.,*, 2019). The under-fives become stunted, have lower intelligence quotient, are at a higher risk of developing heart disease diabetes and stroke when they become adults (Ghirime *et al.,*, 2020). A prospective study that followed up children who suffered moderate to severe malnutrition during infancy over 40 years concluded that indeed as adults, they had impaired intelligent quotient even with the expected heights (Waber *et al.,*., 2014). It is therefore important to understand the public health aspects of malnutrition for focused and enhanced community based interventions of preventing occurrence of malnutrition.

In 2020, it was estimated that 194 million children under five years suffered malnutrition, globally (WHO, 2021). Out of the population with malnutrition, 149 million and 45 million were reported to be stunted and wasted respectively**.** Furthermore 1/3 of malnourished children end up succumbing to the disease,

In a study conducted to investigate effects of bio demographic factors on malnutrition among under-fives, it was reported that those aged between 6- 23 months suffer

malnutrition more than age groups below 6 and between 24-59 months. (Wainaina, 2019). The study finding is similar to that of Boss and others, which was done to determine prevalence of malnutrition among under-fives. The study reported that 79% of malnourished under-fives visiting maternal child health outpatient clinics were in the age group of 6-23 months (Boss *et al.,*, 2020). The age of 6-23 months is a period of complementary feeding (WHO, 2021). Inappropriate complementary feeding could create risk for malnutrition, if food frequency is not adhered to, or it does not have nutrients of carbohydrates, proteins, Vitamins and minerals as outlined in the guidance of IYCF by WHO, (WHO, 2023). According to WHO, infants 6–8 months of age should be fed on food from four food groups while serving 2–3 meals per day for infants 6- 8 months of age and 3–4 meals per day for those aged 9–23 months of age, with 1–2 additional snacks as required also caregivers should practice good hygiene and proper food handling. Also during illness fluid intake and frequency of breastfeeding should be increased as well as serving soft, favorite food to the child.

Socio- economic factors such as education level of care giver, family monthly income and number of members in a household have been associated with malnutrition among under-fives (Kalu & Ekim, 2018). In a study report, those with no formal or low level of education have their under-fives admitted more due to malnutrition (Manalu *et al.,*, 2021) which could be associated with poor food choices, inability to recognize early signs of disease and mitigate, among others. Results of a similar study done in Thika, Kenya, aiming to determine nutritional status of under-fives, reported that 58.2% of caregivers whose children had malnutrition had attained primary level of education as their highest, Ireri *et al.,*, (2020). Caregivers with low level of education may not be able to make

correct food choices, moreover, they may not engage in occupation that attract necessary income for upkeep, affecting their ability to purchase household requirements in the right quantity and quality. The association between low income and malnutrition is further validated by Ngina M, (2018) who indicated that under-fives whose caregivers earn less than KSH. 10,000 per month are more likely to suffer malnutrition (Ngina M, 2018).

Belonging to a household with 4 members or more has also been linked to occurrence of malnutrition among under-fives (Reddy *et al.,*, 2019). Several studies have alluded to the fact that large families are associated with malnutrition especially of those living in informal settlements (Reddy *et al.,*, 2019; Raji *et al.,*, 2020; Ahmad *et al.,* 2020). Large number households require more resources for upkeep, a situation that may not be attainable in informal settlements. The under-fives would then suffer food and safe water deprivation, because of the large number of members in the household, the environment may not be hygienic while hand wash facilities may be constrained, this may lead to cross infection with diarrhea causing germs through direct contact.

A report by UNICEF, (2019) estimates that in Kenya, 239,446, and 2600 children suffer from moderate acute and severe acute malnutrition respectively while 35000 under five year old children die from malnutrition each year. In formal settlements bear the greatest burden of malnutrition based on data provided by Reynolds *et al.,*. (2021) which shows that a third of under-fives living in informal settlements of Nairobi, Kenya, are stunted. Due to the prevailing burden of malnutrition in Kenya, it is predicted that between 2010 to 2030 the disease will cost approximately USD 38.3 billion in gross domestic product (GDP) due to losses in workforce productivity (USAID, 2018).

In Kisumu County 18% , 0.8% and 7% of under-fives are stunted, wasted and underweight respectively (Kisumu County Health Department, 2022) and the number of exclusively breastfed infants is not clearly understood. Only 25% of under-fives who are breast fed meet minimum meal frequency and eat food from four different groups, a situation which paints a grim picture for the society. Reynolds *et al.,* state that malnutrition is the leading cause of mortality in the informal settlement of Manyatta (Reynolds *et al.,*, 2021). Furthermore, caregivers of households in the informal settlements of Manyatta, Nyalenda and Obunga rarely prepare lunch for under-fives but majorly feed them on chapatis, bhajia and french fries which are bought from road side food kiosks (Nasongo & Okeyo-Owuor, 2017; MOH, 2019). The presence of street vending in such settlements is a factor that impedes good feeding habits by creating additional barriers (Reynolds *et al.,*, 2021). These types of food under-fives are fed on, in the settlements, clearly indicating an unbalanced diet, creating risks to malnutrition.

Even though several studies have expressed the burden of malnutrition and diarrhea among under-fives, they have barely focused on their association and considered how this could be exploited during prevention and control of the conditions. Determining the magnitude to which under-fives with diarrhea developed malnutrition and vice versa could contribute to prevention of malnutrition and diarrhea among children living in informal settlements

2.4 Occurrence of Bidirectional Diarrhea-Malnutrition among Under-Fives in Informal Settlements

Malnutrition and diarrhea have a bidirectional relationship, diarrhea has been associated with poor growth and development of under-fives in a cross sectional study of (Sambo *et al.,*, 2022). Diarrhea among under-fives disease significantly impacts on their nutritional status by interfering with the intestinal absorption of nutrients, while, malnutrition is a predisposing factor to the onset of diarrhea l diseases as it lowers immunity. Diarrhea affects weight and height gains with the most dramatic effects seen in cases of recurrent illness. A study characterizing undernourished children under-five years old with diarrhea in Mozambique reported malnutrition prevalence of 54.1% among under-fives with diarrhea.

The interactions between episodic and chronic diarrhea and malnutrition among under-fives is bi-directional. Children under-five years with malnutrition are at substantially higher risk of suffering diarrhea. Under-fives who are malnourished experience inadequate physical and cognitive development, reduced human performance. Furthermore, malnutrition is associated with heightened frequency, duration and severity of diarrhea among under-fives. Diarrhea is reported to occur more and with increased severity among under-fives who are malnourished, according to a systematic review study by Walson & Berkley, 2018. The risk for an under five developing diarrhea is correlated directly with severity of malnutrition as measured by anthropometry. Under-fives with HAZ or WAZ 3 or less having a 37% increased risk of diarrhea frequency and a 73% increase in average duration of symptoms. Moreover, a meta-analysis assessing the impact of diarrhea among several cohorts of under-fives followed from birth to two

years, demonstrated a 16% increase in stunting for every 5% increase in longitudinal incidence

Reports indicate that under-fives with SAM are more likely to present to hospitals with at least one danger sign of diarrhea and may be more likely to have a bacterial pathogen identified as a potential causative agent of their diarrhea than those who are not malnourished (Walson & berkley, 2018). .Likewise a study conducted in Western Kenya demonstrated that under-fives admitted with moderate-severe diarrhea in, severe acute malnutrition, were four times at a higher risk of dying from an episode of diarrhea than those who are well nourished. The community-based Global Enteric Multicenter Study (GEMS) also involved under-fives with moderate-to-severe diarrhea and those without diarrhea. It was found out that under-fives with diarrhea were associated with stunting and post diarrhea mortality during 90 days, for which each z-score unit of HAZ was linked to a reduction in the risk of death by 26–53% based on age of the under-five.

Bidirectional diarrhea malnutrition was reported to be prevalent in younger under-fives than the older ones. According to a report by Tickell *et al.,*, (2020) 50.6% , 40.8% and 8.7% of under-fives with bidirectional diarrhea malnutrition were in the age brackets of < 6 months, 6-23 months and 24-49 months respectively. The study further showed that the condition was more prevalent in Pakistan, 27% than other countries where the study was done. In the report Kenya had a prevalence of 12.8%.

2.5. Risk Factors for Malnutrition, Diarrhea and Bidirectional Diarrhea-Malnutrition

Under-fives who live in settings that have unimproved sanitation, poor hygiene, and unsafe drinking water with inadequate nutrition are exposed more to diarrhea disease causing agents and a higher risk of malnutrition (Wasihun *et al.,*, 2018). Poor adherence to acceptable IYCF practices poses risks for malnutrition and diarrhea among under-fives (WHO, 2022). For instance, early introduction of complementary foods before the age of six months has been indicated to have an association with diarrhea and malnutrition among under-fives as it may displace breast milk and increase the risk of infections which could contribute to weight loss (Okpala *et al.,*, 2020). Stunting has been observed to correlate with the age at which under-fives started on complementary feeding; children who are started on complementary feeding before six months are prone to stunting (Mekonnen *et al.,*., 2019). Stunting may begin in utero, if a pregnant mother lacks adequate nutrients, and during the first two years of a child's life or the first 1000 days of life (Soesanti*et al.,*, 2020). It occurs due to lack of nutritional intake to support the growth and development of infants and children, making them more susceptible to suffer from infectious diseases during their early life.

Similarly, Mekonnen and others state that age at which a child is born is a predictor to stunting. Children born with low birth weight are highly likely to be stunted. Early introduction of complementary feeds does not have health benefits to an under five because their gastrointestinal and motor systems are still immature (Chiang *et al.,*, 2020), It further prevents compliance to exclusively breastfeeding as it presents as an opportunity for the children. Infants fail to reach the recommended 6 months of exclusive

breastfeeding (WHO, 2022) hence miss out on the benefits presented by optimal breastfeeding.

Initiation of breastfeeding of infants within one hour of birth as is recommended by WHO remains low because only 42% and 55% of mothers initiated infants on breast milk and practiced exclusive breastfeeding respectively. The proportion of under-fives started on complementary feeding at 6 months is 42.7%, with only 9.6 percent of them receiving a minimum acceptable diet (Kapur, 2020; WHO, 2017). Elsewhere reports indicate that most mothers/caregivers introduce milk formula, fluids, and solid foods before six months despite the WHO recommendations of exclusive breastfeeding for 6 months, and continuation for up to two years (Ngaya-an, 2022).

In a study of prevalence and factors associated with malnutrition among under-fives hospitalized in three public hospitals of South Africa, most under-fives included in the study 57.4%, were reportedly breastfed for > 6 months. However, at the time of the study, 74.6% were no longer breastfeeding. 32.2%, majority had stopped because of illness among under-fives, 26.2% of mothers had breast problems. Although supplementary foods were started for 73.6%) of under-fives between 6 and 9 months of age 19.1% were on supplementary feeds before the age of 6 months.

Most under-fives participating in the study, 66.7%, were fed only three to four meals a day and 63.4% had at most one additional snack per day (Itaka, *et al.,* 2020). Early discontinuation of exclusive breastfeeding and early introduction of complementary feeding were linked to childhood diarrhea.

Also, under-fives whose mothers are illiterate are prone to suffer malnutrition (Sambo *et al.,* 2022) as those with no formal education or low level may not understand the importance of nutrition on growth and development of a child. Under-fives who are stunted, underweight or wasted happen to live in households with a large number of members and low family income (Hoque *et al.,*., 2021). Elsewhere, in a study by Wasihun *et al.,*, (2018), under-fives who live in families that have more than four members are prone to wasting more than those that live in households with lower numbers (Wasihun *et al.,*., 2018). Family factors such as low level of income in a household is also associated with stunting and diarrhea (Nshimyiryo *et al.,*., 2019). The wealth of households is a proxy for the purchasing power for food and other nutritional goods needed for the health of the children. Therefore, children in households with low income are less likely to access adequate nutrition, which will lead to stunting; poor nutritional status leads to opportunistic infection such as diarrhea (Wasihun *et al.,*, 2018).

Several studies have associated sex of under-five with malnutrition and diarrhea (Demissie *et al.,*, (2021). In a study by Demissie *et al.,*, of risk factors for diarrhea among under-fives living in 34 selected Sub Saharan countries, it was reported that 50.4% and 49.6% of the under-fives children with diarrhea were male and female respectively. The findings suggest that male children suffer from diarrhea more than female counterparts even though this position remains inconclusive since the difference in proportions is small. In study of Social determinants of malnutrition in Chilean children aged up to five by Alvear *et al.,* (2022) it is reported that was associated with a higher likelihood of suffering malnutrition.

Water of adequate quality and quantity are associated with reduced incidences of diarrhea and malnutrition among under-fives (Geremew *et al.,*, 2018). Furthermore Source of drinking water was independently associated with the occurrence of diarrhea among under-fives (Wasihun *et al.,*, 2018).. In a community based cross-sectional study aimed at assessing Risk factors for diarrhea and malnutrition among children under the age of 5 years in the Tigray Region of Northern Ethiopia.

Those who drank from unimproved sources of water were 3.7 times [AOR = 15.419, 95%CI = 2.02, 117.78] more likely to have diarrhea compared to those who used improved water sources. Water should be properly stored and treated at the point of use as this reduces incidences of diarrhea among under-fives by 36%. Water that is contaminated with fecal matter is a mode of transmission of pathogens responsible for diarrhea diseases. When children drink, wash hands and eat from utensils washed with contaminated water then they are likely to ingest such pathogens (Mbakaya *et al.,*, 2019). Environmental factors that are associated with malnutrition and diarrhea include unsafe water and sanitation (Mulatya & Ochieng, 2020). According to Mulatya & Ochieng, unsafe water such as that from the surface has been associated with increased risks of diarrhea in the under-fives since they contain infectious agents that are responsible for diarrhea .Poor water supply, sanitation, and hygiene (WASH) interventions create perfect conditions for the development of different infectious diseases that are linked to malnutrition (Soboksa *et al.,* 2021). According to Soboksa and others (Soboksa *et al.,* 2021.), poor WASH interventions can affect a child's nutritional status in at least 3 direct pathways: via diarrheal diseases, intestinal parasitic infections, and environmental enteropathy. For example poor access to water may indirectly impact the nutritional

status of children by necessitating caregivers to walk long distances in search of water and sanitation facilities and diverting their time away from childcare.

Children themselves may become affected by environmental contamination as they start crawling, walking, exploring, and putting objects in their mouths, which increases the risk of ingesting fecal bacteria from both human and animal sources (Soboksa *et al.,*, 2021). This leads to repeated bouts of diarrhea and intestinal worms, which in turn deteriorates the nutritional status among them.

Age of the child is also a risk factor (Wasihun *et al.,*., 2018). In the report byWasihun and others, being aged between 36-47 and 12-23 months were predictors to diarrhea and malnutrition respectively. These are periods when children play about and are likely to handle contaminated objects putting them at risk of suffering diarrhea. Age 12-23 is a period of complementary feeding and if not done in line with WHO/ UNICEF guideline, a child's growth may faulted (WHO, 2022) More than half of under-fives with complicated severe acute malnutrition, developed diarrhea whose duration was longer in younger children under five years than their counterpart (Hassen *et al.,* 2019). The younger the child, the more days they suffered diarrhea and vice versa.

Exposure to feces through use of contaminated water, poor hand hygiene practices and inadequate facilities for the same and unimproved sanitation lead to diarrhea (Kamara *et al.,*., 2017). In a study by Wasihun *et al.,* , (2018), the odds of diarrhea among children whose mothers did not wash at all the critical times was 15 times [AOR = 15.4; 95% CI = 2.02, 117.78] higher compared to children whose mothers practiced hand washing at critical time with soap. Hands should be washed with soap and water at critical moments

such as after visiting the toilet or changing nappies; before handling food, before handling the under-five and feeding them (Webb & Cabada, 2018). Hand washing facilities such as running water and antiseptic soap should be constantly available to support the practice. Caregivers play a key role in the health of under-fives and their behavior and practice have a significant effect on maintaining good health. A big proportion of diarrhea associated deaths among under-fives are attributable to insufficient hygiene including that of hands (Taddese *et al.,*, 2020).

A study conducted in In Sub Metropolitan City, Kailali District, Far-Western Nepal whose aim was to assess the knowledge and practice of water, sanitation and hygiene (WASH) among under-five caregivers revealed that the majority, 44.3% and 39.80% had poor knowledge and average level of practice respectively. The educational level was accountable for factors or determinants with practice level. There was a gap between the knowledge and the practice of caregivers posing risk for diarrhea and malnutrition among under-fives.

In Bangladesh, 38% households wash their hands with antimicrobial agents. Furthermore, the household's wealth index was responsible for about 46% of the overall inequality of hand washing with antimicrobial agents while the type of place for hand washing variable contributed 38% of total inequalities (Sarker *et al.,*, 2023).

Regarding malnutrition among under-fives born to mothers who are HIV positive, 45% of such children were reported to be stunted (McHenry *et al.,*, 2019). This suggests that belonging to a mother who is HIV positive is a risk factor for malnutrition among under-fives. Being HIV positive may mean that the mother is too ill to engage in a meaningful

income generating activity. Therefore may be unable to fend for food or provide adequate care for the under-five. Also, family resources may be diverted to treat the sick mother overstretching resources further hence children under five years fail to get adequate food, water and sanitation. Similarly, in a study that sought to determine disease burden and risk factors of diarrhea in children under five years of Migori county by analyzing secondary data from demographic health survey indicated that diarrhea among children under five years has also been associated with HIV infection (Mulatya & Ochieng, 2020). The association, however, was inconclusive therefore further studies may be required to validate the current assertion The virus causes changes in immune system of the gut increasing vulnerability to enteric infections (; (Berger *et al.,* 2019). Furthermore, a study conducted in Uganda linked maternal HIV positive state with malnutrition because of living in an environment with an infected mother (Deichsel *et al.*, 2020). An infected mother due to health status may not be able to maintain a clean environment thereby contributing to contamination with disease causing pathogens. Also maternal HIV-positive status is associated with an increased risk of the child being underweight (Musuka *et al.,* 2021). There is an increased risk of impaired intrauterine fetal growth in HIV-positive mothers leading to underweight children (Matasariu *et al.,* 2022). Newborns to HIV-positive mothers are smaller constitutionally compared to those of mothers without this disease. Therefore, these fetal growth disorders caused by HIV infection result in a much higher rate of higher infant morbidity and mortality.

Breast feeding status and having a comorbidity during the disease of severe acute malnutrition influenced the period of time of illness predisposing the child to diarrhea disease infection (Grenov *et al.,*., 2019).

Study reports have opined that malnutrition among under-fives was associated with being given care by persons who are not biological mothers of such children (Sigdel *et al.,* 2020). Elsewhere, stunting has been observed more in the infants whose primary caregivers were not the biological mothers (Humbwavali *et al.,* 2019). They observed that the primary caregiver not being the mother of children under five increased the prevalence of stunting by 42%. Mothers are believed to be more connected and protective of their children than non-biological caregivers. They are keen and able to detect any health issues among their children taking prompt actions.

Diarrhea and malnutrition have a bidirectional relationship (Wasihun *et al.,* (2018). Both conditions are associated with water, sanitation, and hygiene through different mechanisms. Therefore, determining caregiver practices as related risks and developing a framework of interventions that target a combination of them may be cost effective in resource constrained informal settlement.

2.6. Theoretical Framework of the Study

This study was based on two theoretical frameworks: Social- Ecological Model (SEM) by Urie Bronfenbrenner in the1970s and Multidimensional poverty index (MPI) theory by Ulkire *et al.,* (2011). .The SEM states that health is affected by the interaction between the characteristics of an individual, the community, and the environment that include the physical, social, and political components (Jill, 2017). Bronfenbrenner used circles to place the individual at the center surrounded by other systems which are interrelated. Immediate circle to the individual, the microsystem, has the strongest influences on health. This includes interactions and relationships of the immediate surroundings such as family, caregiver. This level of the ecological model is essential in shaping an

individual's development. Additionally, environmental factors such associoeconomic status, family resources, and neighborhood quality can shape the individual's experiences within this system. Mesosystem is the second circle which looks beyond the immediate surrounding and focuses on those that the individual interacts with such as the neighborhood including health care services. Understanding these complex relationships is crucial in identifying the contextual factors that contribute to an individual's growth and development. The third circle, ecxosystem comprises the community and social environment, and has no direct contact with the child. However, it has positive and negative interactive forces on health, for example, a child living in a neighborhood with limited access to sanitation, they may face health challenges due to these environmental factors. Similarly, a parent's workplace environment and job security can have indirect effects on a child's well-being and development. This level of the ecological model includes factors such as community resources, government policies, and the availability of social services. The fourth circle, macro-system, influences the society, religion, and cultural values. Cultural contexts can influence a child's health. For example some caregivers may withhold certain nutritious food from the child. The last circle is known as chrono-system which includes policy, time and historical contexts. SEM was used by Muli (2018) in a qualitative study which assessed how selected variables impact the incidence of diarrhea among under-fives. The study reported that under-fives who breastfed for a longer period of time had reduced incidences of diarrhea indicating a linear association between breastfeeding and incidence of diarrhea. Increased age of under-five as well as high education level of caregiver were associated with reduced incidences of diarrhea. This is true based on the facts that individual characteristics like

age influence their health as young age is associated with underdeveloped immunity predisposing one to infections such as diarrhea and related malnutrition (Scott, 2020). Exclusive breastfeeding is an optimal method of feeding for infants which provides nutrients required for growth and development also preventing infections like diarrhea.

Multidimensional poverty index (MPI) theory by Ulkire *et al.,* (2011) measures global poverty and uses a household as the unit of analysis. It identifies indicators that a household is deprived of and observes that it is the poor that face a myriad of deprivations. The indicators used in this theory include: Education level, nutrition, improved sanitation facilities, safe drinking water as some of the facilities the poor would lack. Similarly, studies have shown that such deprivations are risk factors for diarrhea and malnutrition among under-fives (Wasihun *et al.,*, 2018)

Application of theoretical frameworks to the study

- Microsystem approach has been applied in the study to represent household factors such as caregiver practices like hand washing, treatment of water for drinking, IYCF, and trimming of a child's finger nails all which are associated with occurrence of diarrhea and malnutrition such as care giver. Care giver practices directly affects health of the under five
- Mesosystem represents healthcare system has been used in the study to represent the position occupied by community health assistants due to their role in implementation of health policies regarding management of diarrhea and malnutrition among under-fives

- Ecxosystem which entails environmental factors has been applied to represent sanitation indicating waste disposal which affects health of under-fives even though this level is not in direct contact with the child
- Chronosystem, a level of SEM that entails policy, has been represented by SCCHSCs who play the role of health care coordination and policy formulation.

2.6.1 The Relationship between Theoretical and Conceptual Frameworks

Four levels of SEM: microsystem, mesosystem, ecxosystem and chronosystem have been embedded in the conceptual framework. Study variables that informed the development of a co-created framework for strengthening community based intervention placed appropriately under each level.

2.7. Conceptual Framework

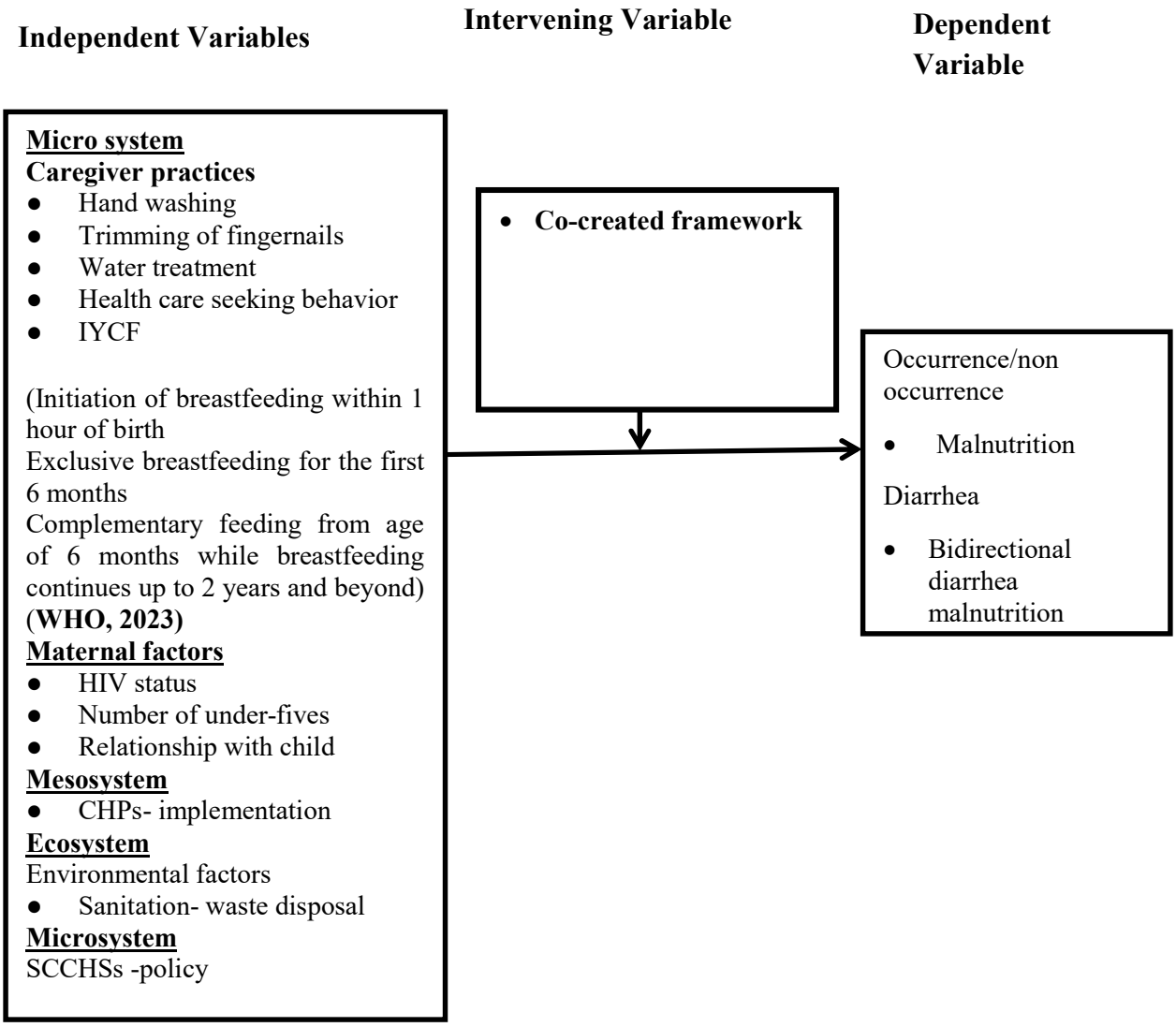

Figure 2.1 Conceptual Framework

Source: (adapted from Ulkire *et al.,* (2011); Wasihun, 2018**)**

In the conceptual framework. Figure 2.1 the multilevel factors the CHPs and SCCHSC have been involved in co creating a framework to be proposed for strengthening community based interventions that appear under micro and ecxosystem so as to improve the outcome of malnutrition and diarrhea among children aged less than five years.

2.7 Summary of Literature Review and Knowledge Gap

Table 2.3 outlines information about each study objective, the identified gap and how the gap was addressed.

Table 2.3: *Summary of Study Gaps and how they were Addressed*

Objective	Gap	How gap has been addressed
1. To investigate the occurrence of malnutrition , diarrhea and bidirectional diarrhea-malnutrition among children under-five years	Occurrence of malnutrition, diarrhea and bidirectional among under-fives living in informal settlements poorly understood	Occurrence of malnutrition, diarrhea and bidirectional diarrhea malnutrition documented
2. Determine practices that are associated with the risk of malnutrition, diarrhea, bidirectional diarrhea and malnutrition among children under-five years	Practices associated with risks of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives poorly understood	Practices associated with risks of malnutrition , diarrhea and bidirectional diarrhea-malnutrition identified and a framework of selected community based interventions which targets a combination of malnutrition, diarrhea and bidirectional diarrhea malnutrition developed
3. To co-create a framework for strengthening community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives living in the informal settlement	Lack of framework for strengthening community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea malnutrition among children under-fives living in the informal settlements	Proposed a co-created framework for strengthening community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea malnutrition among children under-fives living in the informal settlements

CHAPTER THREE: MATERIALS AND METHODS

This chapter explains the study site, research design that was followed, study population, sample size determination, data-collection strategy and method of data analysis methods employed.

3.1 Study Location

The study was conducted in JOOTRH and KCRH and informal settlements of Kisumu Central, Kisumu East and Kisumu West Sub counties within Kisumu County. The two referral hospitals, due to their capacities, were ideal sites to find children with acute, chronic malnutrition and severe diarrhea with signs of dehydration which was the criteria for admission. Informal settlements within the three sub counties include Bandani, Manyatta, Nyalenda, Nyawita and Obunga. Other informal settlements such as Chiga (Kibos), Kaloleni, Kanyakwar and Korando are gradually coming up (Figure 3.1). They have been subdivided into various community units for ease of administration (Table 3.1) Kisumu County was chosen for the study because 62% of its population live in informal settlements (Alushula, 2019). Furthermore Kisumu County is situated on the shores of Lake Victoria, the second-largest freshwater lake in the world however, because of poor investment in the water sector, only a fraction of the County's water demand is met through the piped supply from treated surface water (Kinoti *et al.*, 2020). The limited access to safely managed water and sanitation infrastructure and services compromises public health. Secondly, 82% of households in Kisumu are not connected to the sewerage system and rely on pit latrines and /or septic systems for fecal waste disposal (KIWASCO (2017). In Kisumu county, the prevalence of diarrhea among under-fives is 15.5% (Owiti *et al.,* 2021) making it the 4th leading cause of death among children (Anyango, 2018).

This, however, is lower than that of the neighboring County, Migori, where 18% of under-fives involved in a study of environmental determinants of diarrhea morbidity among children under five years had diarrhea (Odero *et al.,*, 2019). According to Kisumu County health department, (2022), 18%, 0.8% and 7% of under-fives are stunted, wasted and underweight respectively. The figures are lower than those of Siaya County which are 22.0%,10.6% and 13.5% stunting, wasting and underweight respectively (Siaya Maternal and Child Nutrition Nawiri Project, 2019). Only 25% of breastfed children under five years consume food from four different groups and meet the minimum meal frequency as per the WHO and UNICEF guideline (WHO, 2023; UNICEF, 2022). In Manyatta, one of the largest informal settlements of Kisumu County, very few households prepare lunch for children (MOH, 2019). Majority opt to feed their children on fast food such as chips and bhajia sold in the open market areas or kiosks, a clear sign of inappropriate feeding.

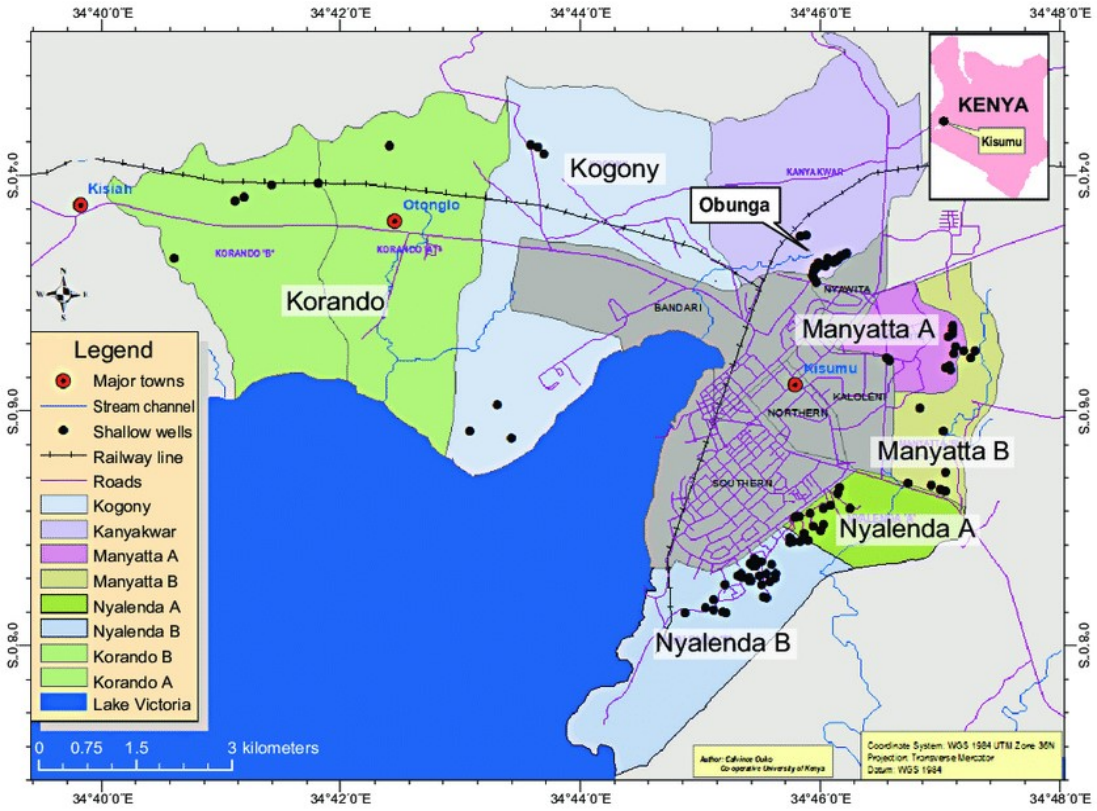

Figure 3.1:*Location of Kisumu County and the major informal settlements* **(Othoo *et al.*,, 2020)**

Table 3.1: *Administrative distribution of the informal settlements within Kisumu County*

	SCCHSC	SETTLEMENT	COMMUNITY UNITS
KISUMU EAST	1	KIBOS	1
		MANYATTA B	10
		NYALENDA A	6
KISUMU CENTRAL	1	OBUNGA	1
		MANYATTA A	15
		NYALENDA B	8
KISUMU WEST	1	BANDANI	1
TOTAL	**3**		**42**

3.2 Research Design

This was a cross-sectional study design applying mixed method approaches to collect data in order to bring out the relationship between independent and dependent variables. The information generated was used to make recommendations for further studies, policies formulation, planning about measures and resources allocation. Cross sectional research design was preferred because it is cheap, quick and easily conducted; information about variables is collected at once (Wang & Cheng, 2020). Also, an analytical approach was applied to establish an association between caregiver risk factors and bidirectional diarrhea- malnutrition. In this study, it was applied to determine factors that were associated with occurrence of diarrhea in a child who was diagnosed with malnutrition and vice versa.The approach was also applied in order to document the bidirectional relationship between malnutrition and diarrhea among children under five years.

A mixed method using both qualitative and quantitative approaches was employed for purposes of breadth and depth of understanding and triangulation (Johnson *et al.,*., 2007, p.123). In this study, it allowed for a greater understanding of relationship that exists between the variables and also compensated for any weakness of one approach with strengths of another hence reducing potential biases. As much as face to face interviews of caregivers through semi structured questionnaires revealed the relationship between community based interventions and health outcomes among under-fives, FGD with community health promoters and in depth interviews involving key informants offered a greater understanding of how and why there was a relationship. This triangulation results in more valid and reliable findings (Dörnyei, 2007; Johnson and Onwuegbuzie, 2004).

3.3 Study Population

The study population was under-five children aged 0-59 months of Kisumu County who, due to their young age are susceptible to malnutrition and diarrhea. It is from this particular population that a sample of children living in informal settlements whose caregivers provided data, was drawn and to which the findings of the current study were generalized. Furthermore pediatricians, pediatric nurses and nutritionists also provided data regarding children occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives admitted to JOOTRH and KCRH. Moreover, CHPs and SCCHSC who were promoting health in the informal settlements also provided data

3.4 Target Population

In the study, the target population was children aged 0-59 months, living in the informal settlements of Bandani, Chiga, Kibos Manyatta, Nyalenda and Obunga within Kisumu County. These were children who were admitted to JOOTRH or KCRH with malnutrition and diarrhea, during the study period and whose caregivers provided information about. Under-fives included in the study were those that met the criteria for admission of having acute or chronic malnutrition and severe diarrhea with signs or risk for dehydration respectively. The information gathered were to answer the research question about occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition, caregiver risk factors for malnutrition, diarrhea and bidirectional diarrhea-malnutrition and proposed framework for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in informal settlements of Kisumu County. According to the hospital attendance register, the two referral hospitals have a combined average population of 240 and 480 under-fives with malnutrition and diarrhea

respectively, getting admitted in the hospitals annually (MOH, 2018). However, the study focused on under-fives children from informal settlements in Kisumu County who were diagnosed with diarrhea and/or malnutrition and admitted at JOOTRH and KCRH. In Table 3.2, 66 and 17 children were admitted due to diarrhea in JOOTRH and KCRH respectively (MOH, 2018). For the malnutrition cases, 60 under-fives were admitted in JOOTRH and 20 were admitted in KCRH (MOH, 2018). The bidirectional aspect was elicited from history of the current illness as given by caregivers and documented in medical records of the admitted under-fives.

Table 3. 2: *Total number of children under five years from informal settlement admitted in JTRH and KCRH due to diarrhea and malnutrition in 2018*

	JOOTRH	KCRH	Total
Diarrhea	66	17	83
Malnutrition	60	20	80

3.4.1: Focus Group Discussion:

Two groups of community health promoters were involved in a focus group discussion in the current study to give information about association of :i) proper infant and young child feeding, ii) hygiene and sanitation and caregiver practices with prevention of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives and iii) practices associated with risks for malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. The first group comprised twelve and the second had eight community health assistants.

3.5 Sample Size Determination

The desired sample size was calculated using the statistical formula for population less than 10,000 (used by Cochran *et al.,.,* 1998)

The formula given by:

$$\mathbf{N} = \frac{Z^2 pq Z^2 pq}{d^2 \quad d^2}$$

Where,

N = the desired sample size, if the population is more than 10,000.

Z = standard normal deviate at required confidence level usually set at 95% giving Z statistical of 1.96.

p = proportion of the study population estimated to have the characteristics being measured 26% for malnutrition and 15% for diarrhea which was the country's prevalence of malnutrition and diarrhea in 2018 ((USAID, from the American people, 2018)

q = **1-p**

d = level of statistical significance set, usually set as 0.05

If the study population is less than 10,000 the required sample size will be smaller. In such cases the final sample estimated (nf) using the formula: the final sample size was then calculated based on the total number of under-fives with malnutrition and diarrhea from informal settlements of Kisumu admitted to JOOTRH and KCRH during the year of 2018.

$$nf = \frac{n}{(\frac{1+n}{N})}$$

Where

nf = final sample size of the population less than 10,000

n = the desired sample size when the population is less than 10,000

N is the estimated study population

Sample calculation was done at the health facility level. The estimated study population, N in JOOTRH 66 and 60 for diarrhea and malnutrition respectively. In KCRH, the estimated population was 17 and 20 for diarrhea and malnutrition respectively. Therefore, N is less than 10,000

Table 3.3: *Sample calculation for under-fives admitted with diarrhea*

Facility			**Diarrhea cases**	
	N	n	nf	nf + 10% non-response
JOOTRH	66	$\frac{(1.96*1.96)(0.15*0.85)}{(0.05*0.05)}$	196/(1+(196/66)) 196/ 3.9697 =49.374	49 +4 =53
		$\frac{(3.8416*0.1275)}{0.0025}$ =196	≈ 49	
KCRH	17	$\frac{(1.96*1.96)(0.15*0.85)}{(0.05*0.05)}$	196/(1+(196/17)) 196/ 12.529412	15 + 1 = 16
		$\frac{(3.8416*0.1275)}{0.0025}$ =196	=15.643192 ≈ 15	
Total	**83**		≈ 64	69

Table 3.4: *Sample calculation for under-fives admitted with malnutrition*

Facility			***Malnutrition***	
	N	n	nf	nf + 10% non-response
JOOTRH	60	$\frac{(1.96*1.96)(0.26*0.74)}{(0.05*0.05)}$	296/(1+(296/60)) 296/ 5.933 =56	56 + 6 =62
		$\frac{(3.8416*0.1924)}{0.0025}$ =296	≈ 56	
KCRH	20	$\frac{(1.96*1.96)(0.26*0.74)}{(0.05*0.05)}$	296/(1+(296/20)) 296/ 15.8 =18.73	19+ 2 =21
		$\frac{(3.8416*0.1924)}{0.0025}$ =296	≈ 19	
Total	**80**		**≈ 74**	**83**

Using 10% possible non-response rate, the final calculated sample size was 83 participants living in informal settlement admitted with malnutrition and 69 participants living in informal settlement admitted with diarrhea

3.6 Inclusion and Exclusion Criteria

3.6.1 Inclusion criteria

i. Health care workers in the pediatric units of JOOTRH and KRCH working as either nutritionist, nurse or doctor in charge

ii. Being a sub-County Community Health Service Coordinator in the informal settlements of Kisumu County

iii. Working as a CHP in the informal settlements of Kisumu County

iv. All caregiver of children aged 0-59 months living in informal settlements of Kisumu county and were admitted to JOOTRH and KCRH with malnutrition and diarrhea during the study period

3.6.2 Exclusion criteria

i. Those who met the inclusion criteria but did not consent to take part in the study

ii. Mentally ill caregivers of children aged 0-59 months

iii. Caregivers who were less than 18 years

iv. CHPs with no training on integrated management of common childhood illnesses

3.7 Sampling Procedures

The study used various sampling designs to pick the county, sub counties and study participants as shown in Table 3.5 below

Table 3.5: *Sampling Design Adopted by the Study*

Serial number	Study respondent	Sampling Design
1	Care givers	Census purposive
2.	CHPs	Census purposive
3.	Hospital health care workers	purposive
4.	SCCHSC	Census purposive
5.	Sub counties	Census
6.	County	Purposive

3.7.1 Sampling Procedure

3.7.1.1 Caregivers

A caregiver in the current study meant a biological mother or father, guardian, good Samaritan, neighbor or any other person that was responsible for care of an under five admitted to JOOTRH and KCRH with malnutrition and diarrhea. All the caregivers of children under five years admitted with malnutrition and diarrhea were involved because the study population was small, based on previous hospitals data and the fact that those admitted with malnutrition and diarrhea met the criteria for admission with malnutrition and diarrhea of having acute or chronic malnutrition and severe diarrhea with signs or risk for dehydration respectively. Furthermore, the census method was suitable for the current study because of the prevailing health situation in the world then, where, due to COVID-19 pandemic, restrictions were placed which hindered movement and access to care. In this respect we were faced with dwindling numbers of caregivers who sought health services in hospitals, for their sick under-fives. Purposive sampling technique was also applied to select caregivers because they were best placed to provide health information about their children.

3.7.1.2 Key Informants

A Key informant is an expert source of information, who, because of his/her personal skills, or position within a community, has the ability to provide more information and deeper insight into what is going on around him or her in the society regarding to an idea under study (Gosan & Johason, 2019*).* In the current study, two categories of key informants were involved. The first category comprised hospital health care providers: these were doctor, nurse and nutritionist in-charges, one, each from pediatric units of JOOTRH and KCRH. The in-charges were selected through a purposive sampling method. Purposive sampling method is an approach that allows the researcher to select participants because of their characteristics. These particular key informants were experts who had more information about malnutrition and diarrhea among under-fives. They were chosen because of their specialization either as pediatric nurse, consultant pediatrician or nutritionist and working in the Pediatric unit in either of the two hospitals. By virtue of their specialization, they were in charge of health service delivery in such units and provided direction of care to under-fives with malnutrition and diarrhea. They were charged with responsibility of giving expert opinion and supervising other health care workers of similar cadre, primarily providing care to under-fives admitted in those units. Moreover, they were willing to participate in the current study by providing insight about the phenomenon of interest (Sandelowski, 2000). The second category of key informants comprised two SCCHSCs, of Kisumu County. There are a total of three SCCHSCs each coordinating community health services in every one of the three sub counties within informal settlements: Kisumu Central, Kisumu East and Kisumu West sub counties. In this study two SCCHSCs of Kisumu Central and Kisumu West were

purposively included, the one of Kisumu East was not included because the SCCHSC had participated during pre-testing of the tool. The SCCHSCs were selected because of their expertise in community health services and they were responsible for coordinating implementation of interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in the informal settlements. Furthermore the county was selected because about 62% of its proportion is covered by informal settlement

3.7.1.3 Co-creation of framework for community based interventions for prevention of malnutrition, diarrhea and Bi-directional diarrhea- malnutrition among under-fives

In order to co create the framework, the study determined practices associated with risks for a combination of malnutrition, diarrhea, bidirectional diarrhea and malnutrition and sought feedback about the proposed framework from community health Promoters through the focus group discussions. Focus group is a type of interview conducted in a set made up of eight -twelve individuals with emphasis on interaction between study respondents so as to generate data (Kitzinger, 1995). Focus groups explicitly use group interaction as part of the method, through encouraging participants to talk with one another by asking questions, exchanging stories as well as commenting on each other's experiences and perspectives. Focus groups are mainly applicable for exploring people's knowledge and experiences and can be used to investigate not only what individuals think but how they think and why they think that way.

In this study however, two focus group discussions were conducted comprising a total of twenty CHPs. The first group comprised eight while the second group consisted of twelve

CHPs (See table 3.6). Group one comprised eight CHPs from Kisumu East Sub County, the sub county comprises four community units: Kibos, Manyatta B, Nyalenda A and Obunga. The total number of CHPs in Kisumu East was eight so all of them were included in the study using the census method. The second FGD comprised twelve CHPs from Kisumu Central Sub County which is made up of: Manyatta A and Nyalenda B. Prior to the main focus group discussions, pretesting of the question guide was conducted whereby two CHPs who were picked through convenience method were involved. Out of the two CHPs, one was from Bandani, Kisumu West and the other from Obunga community unit, Kisumu Central Sub County. The two CHPs who participated in pretesting were not included in the final group discussions but their views used to make appropriate adjustments in the final question guide.

During group discussions, the primary researcher paused questions to respondents while acting as a moderator, so as to ensure balanced participation by all members. The research assistant audio recorded the discussions, and further took hand written notes of verbal responses as well as nonverbal communication. See table 3.5 for distribution of CHPs involved in the study

Table 3.6: *CHPs involved in Focus Group Discussion*

	SCCHSC	**SETTLEMENT**	**COMMUNITY UNITS**	**COMMUNITY HEALTH PROMOTERS(CHPs)**
KISUMU EAST	1	KIBOS	1	**1**
		MANYATTA B	10	4
		NYALENDA A	6	3
KISUMU CENTRAL		MANYATTA A	15	7
		NYALENDA B	8	5
TOTAL	**2**		**40**	**20**

3.8 Pretesting of the Data Collections Tools

Data collection tools of caregivers and pediatric units in-charge were pretested in Kisii Teaching and Referral Hospital and Homa-Bay County Referral Hospital because they are similar levels of JOOTRH and KCRH respectively. The pretest study involved seven and six caregivers for under-fives admitted with malnutrition and diarrhea respectively and 1 unit in-charge. The numbers represent a 10% of sample size for each condition.

For objective two and three, 2 CHPs from Kisumu East and Kisumu West sub counties, Kibos and Bandani community units respectively were involved in testing of the FGD tool; one SCCHSC from Kisumu East Sub County was involved in testing of the key informant guide (See Table 3.7). During the pretest activity, the study respondents were encouraged to make suggestions about the instructions, clarity of questions and relevance.

Data collected during pretest were analyzed and applied to make necessary changes in data collection tools of the main study. Pretest of data collection tools was done to improve the clarity, relevance and reliability of items in the data collection tools. Data was analyzed to confirm if the analysis method proposed was appropriate when data collection of the main study was ended. Findings of the Pretest did not form part of the final report of our main study.

Table 3.7: *CHPs involved in pretesting of Focus Group Discussion question guide*

	SCCHSC	**SETTLEMENT**	**COMMUNITY UNITS**	**COMMUNITY HEALTH PROMOTERS(CHPs)**
KISUMU EAST	1	KIBOS	1	**1**
KISUMU WEST	1	BANDANI	1	**1**

3.9 Data Collection Instruments

Table 3.8: *Data Collection Instruments*

Objective	**Data collection tool**	Variables of interest
Objective 1	Semi structured questionnaire	Prevalence of malnutrition , diarrhea and bidirectional diarrhea malnutrition
	Interview guide	Prevalence of malnutrition , diarrhea and bidirectional diarrhea malnutrition
Objective 2	Semi structured questionnaire Interview guide Focus group discussion	Care giver practices
Objective 3	Interview guide Focus group discussion	Community based interventions

Table 3.8 above presents study objectives, tools used for each objective and what the tool measured according to the specific objectives

3.9 Data Collection Procedures

The data was collected in two phases: this was to allow analysis of data for objectives 1 and 2 first in order to identify practices that could be subjected to validation in the community. The first phase, which was a baseline for developing a framework for strengthening community based interventions, was based in JOOTRH and KCRH. Data collection took place between August 2020 to April 2021, involving 105 caregivers of under-fives admitted with malnutrition and diarrhea. It also included a pediatrician, pediatric nurse and nutritionist unit in charge of the pediatric where the under-fives were admitted. Data collected was used to determine occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition and identify caregiver practices that are associated with risks for malnutrition, diarrhea, bidirectional diarrhea and malnutrition among children under-five years. From results of the second objective, the study identified

practices associated with risks for a combination of malnutrition, diarrhea and bidirectional diarrhea- malnutrition among under-fives. The findings informed the development of a framework for strengthening community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among children under five years living in the informal settlements of Kisumu County.

The second phase of data collection was conducted in December 2022. In this particular phase, data collection delved in depth on topics emerging from objective 2, in phase one. After analyzing data from the second objective, the study developed a framework of three identified practices which included infant and young child feeding; sanitation and hygiene and care giver practices which were associated with risks for a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition. This framework was subjected to validation by CHPs and SCCHSCs in order to co-create a framework for prevention of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives living in the informal settlements. While engaging the CHPs and SCCHSCs it was noted that they had insufficient knowledge regarding how the following interventions could prevent occurrences of a combination of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives. i) infant and young child feeding particularly, initiation of an infant on breast milk within one hour of birth and complementary feeding of under-fives from six to twenty three months of life on age appropriate and safe diet ii) addressing caregiver practices such as hand washing at critical points in time, keeping under-fives finger nails trimmed and treatment of water for drinking iii) improving sanitation and hygiene by constructing any type of latrine where none existed, regular cleaning of latrines shared among households and keeping latrines under lock and key.

Based on the knowledge gap, the study co created a framework that could be proposed to relevant stakeholders for capacity building among CHPs and SCCHSCs who form a critical health workforce that is responsible for promoting health and prevention of childhood illnesses among under-fives living in the informal settlements.

In the second phase, data was collected through focus group discussions (FGD) and Key informant in depth interviews. The responses were recorded using recorders and transcribed using Express scribe into Microsoft Word. Transcripts were exported to NVIVO software. Data in Nvivo was organized into folders for ease of filtering, thematic coding and cord querying performed. Data was visualized in diagrams and frameworks and data exported to Microsoft Word (Fig. 3.2).

Qualitative data was imported into Nvivo software from a password protected spreadsheet. Output displayed in tables in form of percentages.

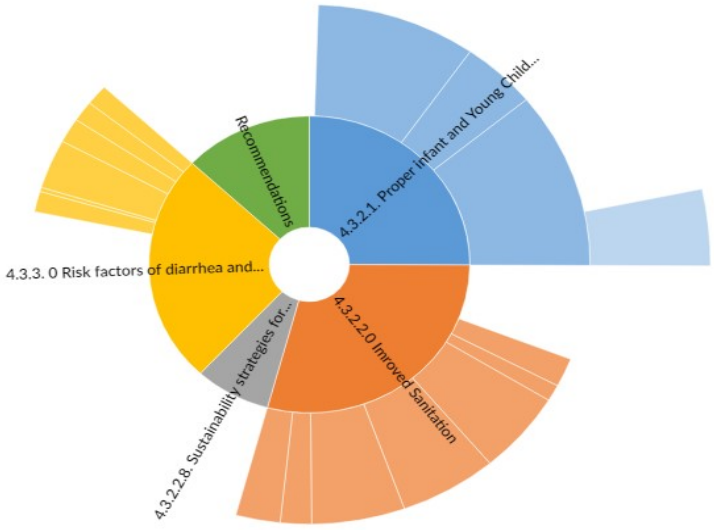

Figure 3.2: *Excerpt of a sunburst graph, an output of thematic analysis used for displaying themes and sub themes in a hierarchical manner*

3.9.1 Semi Structured Questionnaire

A Questionnaire is an instrument for collecting primary data (Quad, 2016). A semi structured questionnaire contains a set of responses that allow participants to choose from, and others that are not planned, to be able to provide appropriate reaction to study questions.

The semi structured questionnaire (Appendix I) was adapted from previous similar studies and customized accordingly. A two-week recall approach was used to test the prevalence of diarrhea. This is a standard which is used in national surveys that measure diarrhea disease (Overbey *et al.,*, 2019). In this study the method was used to determine the relationship between malnutrition and diarrhea whereby care givers were asked to state if their under-fives had experienced episodes of diarrhea two weeks preceding onset of malnutrition. Similarly, a twenty four hour dietary recall method was used to evaluatefood and consumption during the preceding twenty four hours or the previous day in order to assess the type of diet caregivers fed under-fives on (Huang *et al.,*, 2022). Data was collected by research assistants through a face to face interview that lasted 40 minutes, on average, per respondent. Face to face interview was preferred for this study because the personal interaction allows for a naturalistic setting while investigating a social phenomenon (Jalma, 2008). It was also appropriate in the context of diverse education backgrounds where those with no or low level education may not read and write. The other advantage for this approach is that the research assistants posed questions and wrote down responses creating high chances of accuracy and reliability as regards data collection.

The semi structured questionnaire, written in English, was translated by trained research assistants, familiar with English, Kiswahili and local language, Luo, to the care givers in a manner they could understand. A total of 105 questionnaires were applied to caregivers, 52 and 53 were administered to those whose under-fives were admitted with malnutrition and diarrhea respectively. The questionnaires were distributed between JOOTRH and KCRH proportionately as shown in tables 3.9 and 3.10 below.

Table 3.9: *Distribution of questionnaires to JOOTRH and KCRH for malnutrition*

	Malnutrition		
	N	**Proportion**	**Distribution**
JTRH	60	$\frac{60}{80} = 0.75$	0.75*52 = 39
KCRH	20	$\frac{20}{80} = 0.25$	0.25*52 =13
Total	**80**		**52**

Table 3.10: *Distribution of questionnaires to JOOTRH and KCRH for diarrhea*

	Diarrhea		
	N	**Proportion**	**Distribution**
JTRH	66	$\frac{66}{83} = 0.80$	0.80*53 = 42
KCRH	17	$\frac{17}{83} = 0.20$	0.20*53 =11
Total	**83**		**53**

The research assistants took each caregiver through a consenting process before collecting data by explaining in detail why the study was being conducted and whether the under-fives stood to benefit; any potential dangers and assured them of data privacy and confidentiality. Research assistants also listened and answered any arising questions

from caregivers regarding the study and reassured them of their freedom to stop participating at any point of the study, without any intimidation. Data was collected only from caregivers who gave consent to be included in the study and a code, which was in letters and figures, provided for each participant and written on the corresponding questionnaire to ensure confidentiality. For example, participant number 1 from JOOTRH with diarrhea was coded as JRD001 while that with malnutrition from the same facility was coded as JRPM001. Letter J indicated JOOTRH, R symbolized participant, M or D stood for malnutrition or diarrhea and 001 meant participant number one. The codes for each condition followed a serial pattern while altering the first letter only to specify the admitting hospital. For example if the interviewee was admitted at KCRH, the code would have KR followed by a letter M or D based on diagnosis and serial number assigned in line with frequency. All questionnaires were appropriately filled by the research assistants and carried away for safe custody.

Before data collection, the primary investigator conducted an initial training session for research assistants engaged in data collection and management. The training was on the human subject's protection, administration of questionnaires, working with patients to ensure that sensitivity and confidentiality were employed at all times. Since the study was conducted during the peak of COVID-19 pandemic, the research assistants were trained on prevention of transmission and contracting COVID-19. During the training workshop, the purpose and objectives of the study and ethical issues including confidentiality and human subject protection in research were reviewed. The research assistants were taken through the questions one after another to elicit their understanding of the same. Role-

playing was done to ensure comfort with the subject matter. During this process, the questions were modified, where necessary by the research team.

3.9.2 Key Informant Interview Guide

This is a qualitative in-depth approach applied by the researcher to individuals who know what is going on in the area of study. The purpose of the key informant interview was to enable the researcher to collect information from pediatric nurse, nutritionist and doctor in charge of pediatric units of JOOTRH and KCRH who were experts of pediatrics and nutrition. These experts, with their specific understanding and knowledge about pediatric malnutrition and diarrhea and the community health interventions for prevention of the diseases, were able to give insight about the conditions and provide recommendations for solutions (Kumar, 1989).

Two key informant interview guides were used to collect data from the six health workers of pediatric units and two SCCHSCs. The guide applied to health workers from pediatric units was self-administered while that for SCCHSCs was through an in depth face to face interview. The key informants working in pediatric units of JOOTRH and KCRH were nurse, doctor and nutritionist in charge, constituting a mix of experts that could give in-depth and diverse insight regarding malnutrition and diarrhea among under-fives. They had been contacted earlier to request for their participation in the study and secure an appointment with them at their preferred time and venue. The interview was organized in two phases- first phase was conducted on 5th of April 2021 at JOOTRH involving the nurse, doctor and nutritionist in-charges of the pediatric unit. The second phase of interview was conducted on 11th of April 2021 at KRCH, involving the pediatric nurse, pediatrician and nutritionist in charge of the pediatric unit.

For this self-administered interview question guide, the primary researcher distributed one at a time so as to be able to respond to any concerns raised by a respondent with undivided attention. Each respondent was allowed to go through the questions in the guide and write down their responses, a process that lasted up to 1 hour for each. All the six key informants responded and handed in completed interview guides back to the researcher.

The second interview guide was administered through a face to face in depth interaction between the researcher, an assistant and SCCHSCs, lasting one hour for each respondent. The key informants in this regard were two SCCHSCs of informal settlements in Kisumu Central and Kisumu West sub counties who provided an informed consent to participate in the interview. Prior to the days of interview, an appointment to secure an appropriate date and venue for the interview with the prospective respondents was made. On the day of interview, the researcher took each respondent through the process of consenting and ensured data collection started off once every participant consented; any arising questions answered accordingly.

During the interview, all questions were read out loudly by the researcher while giving the participants time to verbally give responses as the research assistant recorded verbal reactions using audio recorders. The questions were derived from three themes-infant and young child feeding, caregiver practices and hygiene and sanitation. The three themes arose from identified practices associated with risks for a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition. The aim of validating the three themes was to develop a framework for strengthening community based interventions for prevention of a combination of malnutrition, diarrhea and bidirectional diarrhea-

malnutrition among children under-fives living in the informal settlements. Basically, from the first and second objectives it was derived that infant and young child feeding, hygiene and sanitation, as well as caregiver practices were associated with prevention of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. (See Appendix III).

The primary researcher coded the interview guides, with unique keys to ensure respondent's confidentiality. The codes were developed by drawing the first initial of hospital followed by letter R symbolizing respondent. The letter R was followed by an underscore then cadre initials for example NS was used to represent nurse; this was followed by an underscore and date of the interview (see Table 3.11). The six interview guides which were adequately filled by respondents were taken away by the primary researcher who kept them in a safe custody to achieve respondent's privacy. For the two SCCHSCs from Kisumu Central and West sub counties, the assigned codes were SCCHSCKC and SCCHSCKW respectively. The letters KC and KW added to the acronym SCCHSC represented first characters of the sub county name.

Table 3.11: *Key Informant Codes*

S/ NO.	HOSPITAL			
1.	JOOTRH	JR_NS_05-04-2021	JR_DC_05-04-2021	JR_NT_05-04-2021
2.	KCRH	KR_NS_11-04-2021	KR_DC_11-04-2021	KR_NT_11-04-2021

3.9.3 Focus Group Discussion Guide

Focus group **is** a method that brings together a group of eight to twelve people from similar background or experience to answer questions in a moderated setting. The group is chosen due to predefined demographic traits, and subjected to questions which are outlined to gather their beliefs, opinions, perceptions, attitudes and ideas on a topic of interest. In FGD, data is collected by a skilled moderator and a research assistant. The

moderator plays a key role of managing the existing relationship within the group as well as creating a relaxed and comfortable environment for all so that respondents feel free to talk openly and give honest opinions. Furthermore, the respondents are actively motivated to express their own opinions, as well as respond to other respondents and questions posed by the moderator.

The role of research assistant in the current study involved observing non-verbal communications and the results of the group dynamics, and documenting the general content of the discussion, thus augmenting the data. The nonverbal communications are based on interactions before, during and after focus group discussions. Data of nonverbal communication provide a more "dense" description and interpretations as opposed to the use of verbal data in its entirety. The nonverbal communications were categorized into: paralinguistic- variations in volume, pitch and quality of voice; kinesics- body displacements and postures; Proxemics-use of interpersonal space to communicate attitudes and chronemics- temporal speech markers such as gaps, silences, and hesitations (Nyumba *et al.,*, 2018).

This study involved two focus groups of twenty CHPs responding to questions around the three themes forming a framework from identified practices associated with risks for a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives, (See Appendix IV) .

3.10 Validity

Study validity is the degree to which an idea under research is accurately measured by use of selected instruments (Heale, 2015). The validity of data collection tools was based on expert opinion and field test. The supervisors, a panel of experts from KEMRI CDC

and clinicians reviewed the tools and recommended appropriate changes which were adopted. Triangulation was also applied to achieve result validity and credibility. Triangulation invokes the use of different research methods, like having response about the same phenomena from varied participants (Noble, 2019). In this study triangulation was applied by using mixed methods of data collection. Quantitative data was collected from caregivers and qualitative data obtained from key informants of the two hospitals and the SCCHSCs Also, FGD was applied to CHPs for obtaining qualitative data about the study questions. During content analysis, results validity was ensured through checking the correctness of codes used.

3.11 Reliability of the Research Instruments

Reliability refers to how consistently the same results would be achieved if the comparable methods are repeatedly used under similar circumstances (Mohajan, 2017). To establish reliability, pretesting of instruments was done at Kisii level five and Homa Bay County Referral hospitals. The reliability of the instrument was estimated using Cronbach's alpha and the coefficient was found to be 0.82 which shows that the tool was reliable.

3.12 Analytical Framework

3.12.1 Occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in informal settlements

Under this first objective data was analyzed through descriptive, inferential statistics and content analysis approaches. Types of descriptive statistics used were frequencies and mean of the variables, derived at 95% confidence interval .Chi square test of association was done at 5% confidence level and p value of <0.05 was considered to be significant. For inferential statistics, bi-variate and multivariate logistic regressions were used and

odds ratio provided at 95% confidence interval with p value of 0.05 and below considered statistically significant. Content analysis data was recorded verbatim, units of analysis were derived, and related ones grouped together to form codes. Related codes formed a category which generated themes and finally frameworks.

3.12.2 Practices associated with risks for malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives

For objective two, descriptive, inferential statistics, and content analysis approaches were used. In particular, frequency and percentages statistics were used to describethe characteristics of the caregivers of the under-fives who were suffering from malnutrition and diarrhea, risks for malnutrition and diarrhea among under-fives , Chi-square tests for assessing or exploring the association between bidirectional diarrhea- malnutrition and care giver's Socio-demographic characteristics was done at 5% confidence level. Also, used were bi variate analysis was applied to predict if there was a relationship between caregiver practices and bidirectional diarrhea-malnutrition or not. Multivariate logistic regression analysis to determine risk factors that best predict occurrence of bidirectional diarrhea- malnutrition, at 5% confidence level, Odds ratios and p values were provided.

In this study Odds ratio of 1.0 or close to 1.0 was applied to imply that the odds of exposure among under-fives that had bidirectional diarrhea-malnutrition was similar to the odds of exposure among those that had either diarrhea or malnutrition meaning that the exposure was not associated with bidirectional diarrhea-malnutrition. Odds ratios which were greater than 1.0 indicated that odds of exposure among under-fives with bidirectional diarrhea-malnutrition was greater than the odds of exposure among those that did not have bidirectional states. The finding implies that the exposure might have

been a risk factor for bidirectional diarrhea-malnutrition. Odds ratio that was less than 1.0 showed that the odds of exposure among those with bidirectional diarrhea-malnutrition was lower than the odds of exposure among under-fives who did not have the states. P value < 0.05 was considered as statistically significant.

On the other hand, the qualitative data collected from the KII guide and FGD respondents was analyzed using content and thematic approaches and verbatim quotes within the text.

3.12.3 Co-creation of a framework for community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in the informal settlements

In the third objective deductive thematic analysis was applied; data was collected through focus group discussions and in-depth Key informant interviews. Deductive thematic analysis was used and a code book developed based on predetermined frameworks and excerpts from data assigned to codes. Table 3.12 indicates objective sand analysis method used.

Table 3.12: *Summary of Data Analysis*

Objectives	Data sources	Data collection methods	Statistics
1.	Care givers	Semi structured questionnaire	Descriptive statistics. Inferential statistics
	Key informants	Key informant interview guide	Content analysis
2.	Care givers	Semi structured questionnaires	Descriptive statistics Inferential statistics
	Key informants Focus group	Key informant interview guide	Thematic and Content analyses
4.	Focus group Key informants	Focus group discussion Key informant guide	thematic analysis Content analysis

3.13 Data Management

Data management began with cleaning, whereby raw data was scrutinized for completeness, inconsistencies, incorrectness, those that were not making any sense and outliers removed (Erdelyl, 2020). In this study all the 105 questionnaires had complete data

3.13.1 Quantitative Data Analysis

Data that was complete was entered in a password protected Microsoft Access, exported to Social Sciences Statistical Package (SPSS version 28) and descriptive analysis performed for all appropriate variables. The analysis output was presented in the form of frequency tables, pie charts and percentages. Chi square test of association was done and results provided at 5% confidence level. Bi variate and multivariate logistic regression statistical analysis were done at 5% confidence level and Odds ratios and p values were provided.

3.13.2 Qualitative Data Analysis

Qualitative data was analyzed using summative content and thematic analyses. Summative content analysis was applied in the current study to objectives one and two. Data for the two objectives was collected from hospital staff working in pediatric wards through key informant guides. This is a detailed systematic quantitative textual analysis which was applied to identify, enumerate and analyze occurrence of particular messages and message characteristics embedded in relevant texts (Neuendorf, 2002). In this study content was carefully examined for key words which were then counted and interpreted; the counts were presented using graphs.

In this study, both inductive and deductive approaches were used to come up with themes and units of analysis respectively. Inductive content analysis is a method of coding that allows data to determine the theme (James & Wooten, 2005) while deductive content analysis is about having a predetermined theme and generating categories, codes and units of analysis (Amart, *et al.,* , 2018). Inductive content analysis was applied to objective one in order to bring out themes which explained occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. The theme was unclear at the beginning of data collection, therefore, using an inductive approach of content analysis and following the seven steps (Table 3.13) in order to develop the theme. Texts were scrutinized carefully so as to determine the unit of analysis

Table 3.13: *General steps of Content Analysis*

S/NO	STEP	DESCRIPTION
1	Decontextualization	Familiarization with data by reading and re reading through the scripts and actively observing meanings and patterns that appear across a data set, identifying units of analysis. Example of excerpt "*during diarrhea there is increased intestinal permeability thus loss of nutrients"*
2	Construction of unit of analysis	Selecting the smallest items in the text and developing first reflections. *"during diarrhea there is increased intestinal permeability thus* ***loss*** *of nutrients"* in the excerpt ***loss*** is an example of unit of analysis for the code *malabsorption* *" in diarrhea all foods taken* ***come out*** *leaving very little absorbed or nothing at all"* *"during diarrhea there is increased intestinal permeability thus* ***loss*** *of nutrients"*
3	Initial coding	Getting a general overview of the data by reading and understanding the units of analysis and developing initial sets of code in line with research objectives. From the excerpt above an example of a code is "***increased intestinal permeability"***
4	Line by line coding	Reviewing data line by line, delving deeper into it, refining codes and assigning additional ones to each line so as to organize it into formalized categories for deriving themes and patterns for qualitative analysis. Example of category from the above excerpt is **nutrient absorption**
5	Validity testing Reliability testing	Checking for correctness of codes ensuring that they are credible, confirmable and generalizable. Checking if independent coders can analyze the same texts using same categorization (coding) schemes and reach the same decisions
6	Results analysis	Creating code categories, organizing data making it rich in order to see new connections. Identification and clearly articulating themes in the data set by synthesizing the codes and categories. Record incidences and frequency of codes and categories example of theme: Caloric needs, intake, bio availability, and nutrition
7	Framework development	Developing a narrative of understanding which summarizes all the categories into a meaningful interpretation that aligns to research purpose, question hypotheses and the analysis method. The framework that was developed is: Infant and young child feeding according to guidelines by WHO, MOH can prevent occurrence of both malnutrition and diarrhea

Steps were adopted from Bartool, (2020) and Atta, (2020)

Unit of analysis is the portion of a text that is relied upon when making a decision to develop a code (Roller, 2016). Units of analysis were identified one after another, as they

evolved and synonyms were put together to form a code. A code is a descriptive label which allows the researcher to identify related content across the data (Roller, 2016). Codes that suggested similar meaning were merged together to form a broader label referred to as category. Categories that were similar either in content or context were merged to come up with themes.

Regarding deductive analysis approach, codes and units of analysis were generated from a predetermined theme and it mainly applied to questions on section B which were about caregiver practices as risks for malnutrition, diarrhea and bidirectional diarrhea - malnutrition.

The text's content was examined by applying both manifest and latent axes of coding. Manifest coding was conducted by paying attention on the visible message at the surface level of text. While latent coding was applied by going further than mere count, to delve into the context within which the text was used and put a meaning to it. The units of interest were counted to explore how frequently they were used in the texts and presented the frequency in numbers and word cloud. The source documents included data inform of texts collected from six key informants who responded to open ended questions on the interview guide.

Thematic analysis is an approach for analyzing qualitative data (Braun and Clarke 2006). It can be inductive or deductive whereas the former involves searching across a data set so as to identify, analyze, and report repeated patterns and generate a theme. The current study applied deductive thematic analysis following steps described in Table 3.14 below

Table 3.14: *Steps of Thematic Analysis*

SERIAL NO	STEP	DESCRIPTION
1	Familiarization	Involves acquainting self with data. In the current study, this was done by listening to the entire video repeatedly and transcribing the content. While taking note of units of analysis
2	Generating initial codes	Getting a general overview of the data by reading and understanding the units of analysis, merging the units to develop initial sets of code in line with study objectives.
3.	Develop themes	Look at the generated initial code list of codes in relation to their extracts and merge related codes into themes
4.	Review themes	Review and refine themes by reading through all the extracts that related to initial codes and figure out if they support the theme, can merge some split or discard
5.	Define and name themes	This step involves defining by formulating the meaning of each theme and its relationship with data Name themes using words that are precise and understandable
6	Produce the report	This is the final step of telling a coherent story about data and analysis involving fully thought out themes and sharing validity data using vivid quotes to back up points. Describe data as well as giving interpretation of analysis

Adopted from Maguire & Delahunt,(2017)

Deductive thematic analysis is whereby the researcher comes up with a code book which includes initial codes arising from a theme that has been predetermined (see table 3.15).

Table 3.15: *Excerpt of a Code Book Developed Using Deductive Method*

THEME	CATEGORIES	CODE	CODE REFERENCE
3.0. Caloric needs intake, bio availability and nutrition	**3.1**. nutrient absorption	**3.1.1**.Mal-absorption	● impair ● loss ● Come out ● Gut motility ● permeability

The current study applied deductive thematic analysis method for objectives two and three, whereby answers to questions arising from the objectives were sought from CHPs and SCCHSCs to co-create a framework for prevention ofmalnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in the informal settlements.

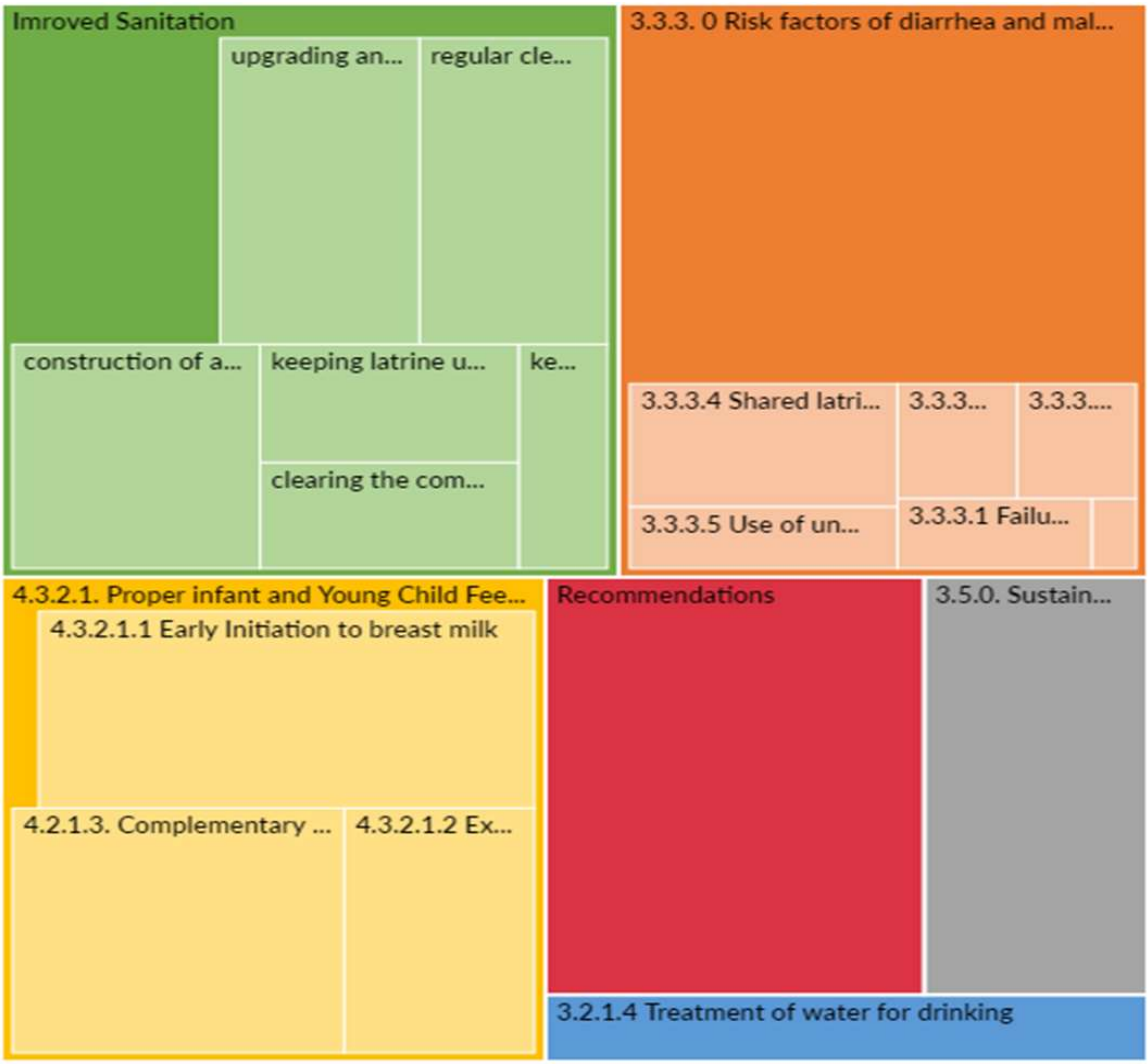

Figure 3.3: *Hierarchy chart showing themes, as compared by number of coding references*

3.14 Study Results Dissemination

Study findings will be shared with ethical review committees of JOOTRH and JOOUST. The results will also be disseminated to JOOTRH and KRCH where the research was

conducted. The report will be shared with the chief officer of Health Kisumu County for planning and policy formulation and published in journals. Two papers have been published from this work in peer-reviewed journals and the findings will also be presented both in local and international conferences.

3.15 Ethical Considerations

Before beginning data collection, permission to conduct research was sought from Jaramogi Oginga Odinga University of Science and Technology and Department of Health, Kisumu County. Ethical approval was granted by Institutional Ethics Review Committee (IERC) of JOOTRH and National Commission for Science, Technology & Innovation (NACOSTI) permit numbers IERC/JOOTRH/203/20 and License No: NACOSTI/P/20/5101respectively. No contact with study participants occurred before the approval was granted (Angell & Dixon-Woods, 2009). The study did not seek information from the children, caregivers who were under the age of eighteen years because they are a vulnerable group and interviewing them amounts to breach of ethical codes. During data analysis, all results were included, there was no fabrication or falsification of data which could lead to misinterpretation by readers hence misleading them. The research assistants provided consent forms for the key informants to read and sign before participation. After explaining the purpose of the study to care givers, the research assistants sought an informed consent from them prior to participating in the study. Participants were informed that their involvement in the study was voluntary and they had a choice to participate, decline or drop off at any point of the study (Miller & Wertheimer, 2010).

Throughout this study, privacy and confidentiality were emphasized and maintained (Lowrance, 2012). All data was collected in a private setting. Confidentiality was ensured by use of unique codes for anonymity and restriction of raw data to only the principal researcher and the research assistants. At the end of this study all data was kept in a password protected software to avoid unauthorized access which could have resulted in breach of participants' privacy.

CHAPTER FOUR: RESULTS

4.1 Introduction

The current study investigated community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in informal settlements. This was in light of the high burden of malnutrition and diarrhea among under-fives in Kisumu County and the fact that benefits of WASH facilities, known to reduce such disease burden are limited in the informal settlements of Kisumu. Data collected was analyzed through descriptive, inferential, content and thematic analysis approaches. This chapter presents results of the analyses.

4. 2 Socio-Demographic Characteristics

4. 2.1 Demographic characteristics of the under-fives

The result in Table 4.1 shows the distribution of demographic characteristics of under-fives admitted with malnutrition, diarrhea and bi-directional malnutrition-diarrhea. For malnutrition, the average age of under-fives was 12.52±10.35 months and 55.77%, (n=29) of them were male.

Table 4. 1: *Demographic characteristics of children under five years admitted with malnutrition, diarrhea and bi-directional malnutrition-diarrhea*

Characteristics	Malnutrition, N=52	Diarrhea, N=53	Bi-directional malnutrition – diarrhea, N=105		
			No	Yes	
	n(%)	n(%)	n(%)	n(%)	p-value
Age in months,					0.248
< 6	7(13.46)	10(18.87)	45(75.00)	15(25.00)	
6-23	41(78.85)	38(71.70)	22(61.11)	14(38.89)	
24 -59	4(7.69)	5(9.43)	5(55.56)	4(44.44)	
Total (%)	**100**	**100**			
Gender of the child					0.853
Male	29(55.77)	36(67.92)	27(67.50)	13(32.50)	
Female	23(44.23)	17(32.08)	45(69.23)	20(30.77)	
Total (%)	**100**	**100**			

For the diarrhea cases, the average age of the under-fives was 12.34± 8.40 months, 67.92%, n=27 of them were male. The prevalence of bidirectional diarrhea-malnutrition increased with an increase in age whereby 25.0% were those aged < 6 months and 44.44% were 24-59 months old. As regards gender, 32.5% and 30.77% of children with malnutrition-diarrhea comorbidity were female and male respectively.

4.2.2 Socio-demographic characteristics of the caregivers

In Table 4.2, 28.85%, (n=15) of the caregivers whose children had malnutrition lived in Nyalenda slum. Almost forty percent (35.85%) of the caregivers whose children had diarrhea were residents of Kibos slum and a high proportion of mothers whose children had bi-directional diarrhea-malnutrition were residents of Chiga. For the caregivers' level of education, 65.38%, (n=34) of the caregivers whose children had malnutrition had primary level as the highest education attained. Out of 53 mothers whose children had diarrhea, 20(37.74%) and 21(39.62%) had primary and secondary levels respectively. Regarding the level of education, 57.58%, (n=19) of the caregivers whose children had bi-directional diarrhea-malnutrition had primary as their highest.

The proportions of married women whose children had malnutrition, diarrhea and bi-directional malnutrition were found to be 73.08%, 71.70% and 72.73% respectively. These were high as compared to the proportions of other marital status. The results further revealed that for the caregivers whose children had malnutrition, 55.77% were earning less than USD 92.34 per month, 50% of them had at least 4 household members and 98.08% of the caregivers were Christians. More than half (64.15, n=34%) of the caregivers whose children had diarrhea were earning below USD 92.34 10,000 per month, (64.15, n=34%) of them had a family size of at least five members and

Christianity was their main religion (100.00%). For the caregivers whose children had bi-directional diarrhea-malnutrition, 58.33%, (n=42) were earning less than USD 92.34 per month, over forty percent (42.42%, n=14) had more than 4 members in the household USD 92.34 and Christianity was their main religion 32(96.97%, n=32).

Table 4.2: *Socio-demographic characteristics of caregivers of under five children with malnutrition, diarrhea and bi-directional malnutrition-diarrhea*

	Malnutrition, N=52	Diarrhea, N=53	Bi-directional malnutrition –diarrhea, N=105	
			No, N=72	Yes, N=33
Characteristics	**n(%)**	**n(%)**	**n(%)**	**n(%)**
Residence				
Bandani	5(9.62)	7(13.21)	8(11.11)	4(12.12)
Chiga	9(17.31)	6(11.32)	7(9.72)	8(24.24)
Kibos	6(11.54)	4(7.55)	5(6.94)	5(15.15)
Manyatta	10(19.23)	19(35.85)	24(33.33)	5(15.15)
Nyalenda	15(28.85)	11(20.75)	19(26.39)	7(21.21)
Obunga	7(13.46)	6(11.32)	9(12.50)	4(12.12)
Total (%)	**100**	**100**	**100**	**100**
Caregiver's level of education				
None	2(3.85)	0(0.00)	0(0)	2(6.06)
Primary	34(65.38)	20(37.74)	36(50.00)	19(57.58)
Secondary	10(19.23)	22(41.51)	23(31.94)	9(27.27)
College/University	6(11.54)	11(20.75)	13(18.06)	3(9.09)
Total (%)	**100**	**100**	**100**	**100**
Marital Status of the caregiver				
Single	9(17.31)	13(24.53)	16(22.22)	6(18.18)
Married	38(73.08)	38(71.70)	52(72.22)	24(72.73)
Separated	2(3.85)	1(1.89)	2(2.78)	1(3.03)
Widowed	3(5.77)	1(1.89)	2(2.78)	2(6.06)
Total (%)	**100**	**100**	**100**	**100**
Monthly income of the Caregiver				
<USD 92.34	29(55.77)	34(64.15)	42(58.33)	21(63.64)
>=USD 92.34	23(44.23)	19(35.85)	30(41.67)	12(36.36)
Total (%)	**100**	**100**	**100**	**100**
Household members				
1- 4	26(51.92)	19(35.85)	27(37.50)	18(54.55)
>4	25(48.08)	34(64.15)	45(62.50)	15(45.45)
Total (%)		100	100	100
Religion				
Christian	51(98.08)	53(100.00)	72(100.00)	32(96.97)
Non-Christian	1(1.92)	0(0.00)	0(0.00)	1(3.03)
Total (%)	**100**	**100**	**100**	**100**

4.2.3 Malnutrition Status of under- fives

Of the 52 under-fives diagnosed with malnutrition, 94.2% (n=49) developed acute malnutrition, while 1.9% (n=1) developed chronic malnutrition and 2(3.9%) developed acute and chronic malnutrition as shown in Figure 4.1

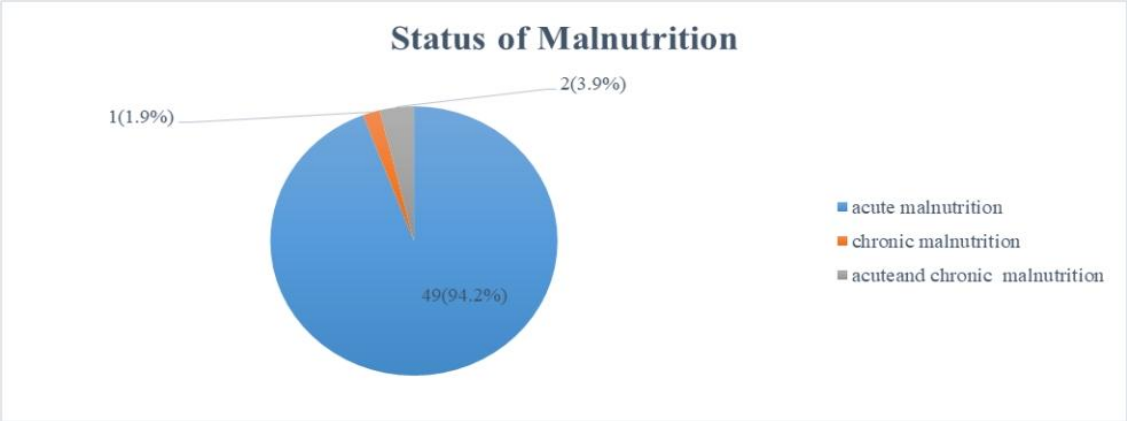

Figure 4.1: *Status of Malnutrition*

4.2.4 Time lived in the settlement

Sixty nine point eight of the under-fives with diarrhea had lived in their area of residence for at most 12 months, 26.4% had lived in the area between 13 to 24 months and 1.9% had lived for 25-36 and 37-48 months each (Figure 4.2). On the other hand, among the under-fives with malnutrition, majority 80.8% had lived in their area of residence for at most 12 months, 13.5% had lived in the area for a period of between 13 and 24 months, 1.9% had lived for 25-36, 37-48 and 49-60 months each (Figure 4.3)

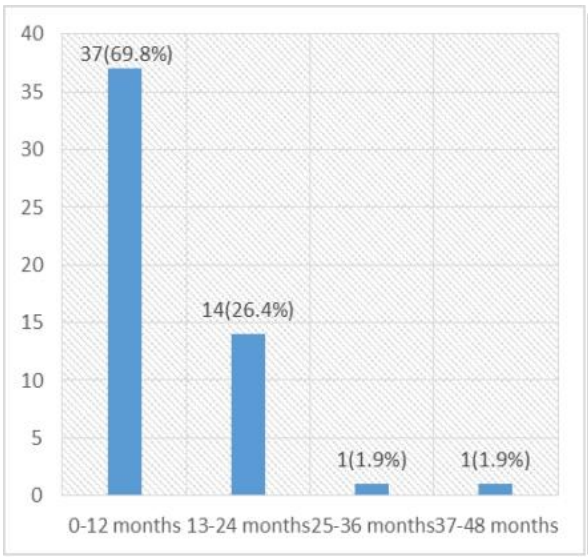

Figure 4.2: *Time lived in the residence by Under-fives with diarrhea*

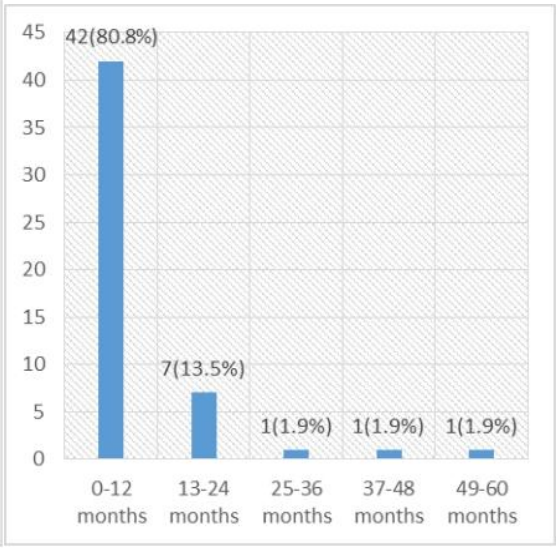

Figure 4.3: *Time lived in the residence by malnourished under-fives*

4.2.5 Anthropometric measures of under-fives with Malnutrition and diarrhea

The analysis of anthropometric measures revealed that among the under-fives diagnosed with malnutrition, the proportion of those with Mid-Upper Arm Circumference (MUAC) less than 115mm, 115mm to 124.9mm and at least 125mm were 66.67 %(95%CI: 51.40 - 79.09), 24.44 %(95%CI: 13.85 - 39.43) and 8.89 %(95%CI:3.28 - 21.90) respectively. Seven children with malnutrition were aged below six months and use of MUAC to elicit malnutrition does not apply in that age category.

Moreover, the proportion of under-fives with Body Mass Index (BMI) below 16.0 was found to be 90.38% (95%CI: 78.52 - 96.03), 16.0-24.9 was 7.69 %(95%CI: 2.85 - 19.15) and 25.0 to 29.9 was 1.92% (95%CI=0.26 - 12.96) (Table 4.8).

Among under-fives with diarrhea, the proportion of those with MUAC of less than 115mm was 32.08% (95%CI: 20.74 - 46.01), 115 to 124.9 mm was 3.77 %(95%CI=0.91 - 14.28) and 125mm to and above was 45.28% (95%CI: 32.24 - 59.01). For Body Mass

Index (BMI), the proportion of under-fives with BMI less than 16.0 was found to be 86.79%. (95%CI: 74.43 - 93.68) for under-fives with BMI between 16.0 to 24.9 was 9.43% (95%CI: 3.90 - 21.10) and for under-fives with BMI between 25 to 29.9 was found to be 3.77% (95% CI: 0.91 - 14.28) (Table 4.3). A two way pretest was used to determine the difference in proportion of anthropometric measures between malnourished under-fives and those with diarrhea at 5% level of significance. Under-fives with MUAC of < 115 mm were more likely to be malnourished than having diarrhea (P-value= 0.0083). Similarly, under-fives with MUAC between 115mm and 124.9mm were more likely to be malnourished than having diarrhea (P-value=0.0069). However, there was no significant difference in proportion of BMI between under-fives with malnutrition and those with diarrhea (P-value> 0.005).

Table 4.3: *Overall Anthropometric measures among children under 5 with severe malnutrition and diarrhea*

MUAC in mm	**Malnutrition, N=52**		**Diarrhea, N=53**		**Difference in proportion**
	Frequency	**Proportion % (95%CI)**	**Frequency**	**Proportion % (95%CI)**	**P-value**
<115	30	66.67(51.40 - 79.09)	17	32.08(20.74 - 46.01)	0.008
115 – 124.9	11	24.44(13.85 - 39.43)	2	3.77(0.91 - 14.28)	0.007
125+	4	8.89(3.28 - 21.90)	24	45.28(32.24 - 59.01)	<0.001
Not applicable	7	0.00(-)	10	18.87(10.31 - 31.99)	-
Total	**52**	**100%**	**53**	**100%**	
BMI					
<16.0	47	90.38(78.52 - 96.03)	46	86.79(74.43 - 93.68)	0.5630
16.0 -24.9	4	7.69(2.85 - 19.15)	5	9.43(3.90 - 21.10)	0.7499
25.0-29.9	1	1.92(0.26 - 12.96)	2	3.77(0.91 - 14.28)	0.1573
Total	**52**	**100%**	**53**	**100%**	

According to the results in Table 4.4, Fisher's exact test of association between malnourished under-five's MUAC and their demographic characteristic revealed that Age

and gender were statistically significant at 5% significance level (P-value < 0.05). Similarly, the results showed that the MUAC of all those under 6 months old were not recorded. Majority (93.33%) of the malnourished under-fives with MUAC of less than 115 mm were between 6 to 23 months and in terms of sex, females comprised 56.67%.of the those admitted with malnutrition and whose MUAC was measured.

Table 4.4: *Association between nutritional status and under-fives demographic characteristics among the malnourished*

	MUAC in mm				**Fishers Exact test**
	<115 n(%)	115 -125 n(%)	>=125 n(%)	Not recorded n(%)	P-value
Age group in months					< 0.001
< 6	0(0.00)	0(0.00)	0(0.00)	7(100.00)	
6-23	28(93.33)	9(81.82)	4(100.00)	0(0.00)	
24-59	2(6.67)	2(18.18)	0(0.00)	0(0.00)	
Gender					0.043
Male	13(43.33)	10(90.91)	2(50.00)	4(57.14)	
Female	17(56.67)	1(9.09)	2(50.00)	3(42.86)	
Total	**30 (100)**	**11(100)**	**4(100)**	**7(100)**	

In Table 4.5, the result shows that there was a significant association between under-five's MUAC and age among the participants who had diarrhea (P-value=0.001). Eighty two point three five percent of the under-fives with MUAC of < 115mm were between 6 to 23 months old and all the under 6 months with diarrhea did not have their MUAC records. In terms of gender, 58.82% of with diarrhea who had MUAC of less than 115mm were male

Table 4.5: *Association between nutritional status and under-fives' demographic characteristics among those with diarrhea*

	MUAC in mm				Fisher's Exact test
	<115 n(%)	115 -125 n(%)	>=125 n(%)	Not Applicable n(%)	P-value
Age group in months					< 0.001
<6	0(0.00)	0(0.00)	0(0.00)	10(100.00)	
6-23	14(82.35)	2(100.00)	22(91.67)	0(0.00)	
24-59	3(17.65)	0(0.00)	2(8.33)	0(0.00)	
Total	17(100)	2(100)	24(100)	10(100)	
Gender					0.602
Male	10(58.82)	2(100.00)	16(66.67)	8(80.00)	
Female	7(41.18)	0(0.00)	8(33.33)	2(20.00)	
Total	**17 (100)**	**2(100)**	**24(100)**	**10(100)**	

4.2.6 Co-morbidity among under-fives with malnutrition and diarrhea

Among the malnourished under-fives, the proportion of anemia condition was found to be 44.23% (95%CI= 31.17 - 58.15) and the proportion of those whose caregivers (mothers) were HIV positive at the time of delivery was 38.46% (95% CI= 26.07 - 52.55) (Table 4.6)

On the other hand, for the under-fives with diarrhea, the proportion of those with anemia was 28.30% (95%CI= 17.63 - 42.12) among the under-fives with diarrhea whose caregivers (mothers) were HIV positive at the time of delivery was 30.19% (95%CI= 19.17 - 44.08). However, there was no significant difference in proportion of anemia and HIV risk status among malnourished under-fives and those with diarrhea (P-value > 0.05) (Table 4.8)

Table 4.6: *Proportion Comorbidity among under-fives with malnutrition and diarrhea*

	Malnutrition, N=52	**Diarrhea, N=53**	**Difference in proportion**
	Proportion %(95%CI)	**Proportion %(95%CI)**	**P-value**
Anemia	44.23(31.17 - 58.15)	28.30(17.63 - 42.12)	0.0895
Mother's HIV status (positive)	38.46(26.07 - 52.55)	30.19(19.17 - 44.08)	0.3719

Table 4.7 shows weight for age and height for age for the malnourished under-fives and those with diarrhea. Among the malnourished under-fives 42.31% had weight for height Z-score of -3SD and 26.92%, 23.08%, 3.85% and 3.85% had Weight for height Z-score of -2SD, -1SD, 1SD and 3SD respectively. The distribution for height for age in Table 4.9 shows that out of the 52 malnourished under-fives, 46.15%, 5.77%, 25.00%, 17.31%, 3.85% and 1.92 had HAZ of -3SD, -2SD, -1SD, 1, 2SD and 3SD respectively.

Out of the under-fives with diarrhea cases, the distribution of WAZ score shows that 16.98% had WAZ score of -3SD, 28.3% had WAZ score of -2SD, 24.53% had WAZ score of -1SD, 24.53% had 1SD, 3.77% had 2SD and 1.89% had 3SD. The distribution of Height for Age Z score (HAZ) in Table 4.7 reveals that 18.87%, 11.32%, 5.66%, 50.94%, 9.43% and 3.77% of the participants with diarrhea had -3SD, -2SD, -1 1SD, 2SD and 3SD respectively.

Table 4.7: *Nutritional parameters*

	Malnutrition=52 n(%)	**Diarrhea, N=53** n(%)
Weight for Age Z score (WAZ)		
-3SD	22(42.31)	9(16.98)
-2SD	14(26.92)	15(28.3)
-1SD	12(23.08)	13(24.53)
1SD	2(3.85)	13(24.53)
2SD	0(0.00)	2(3.77)
3SD	2(3.85)	1(1.89)
Total	**52 (100%)**	**53 (100%)**
Height for Age Z score (HAZ)		
-3SD	24(46.15)	10(18.87)
-2SD	3(5.77)	6(11.32)
-1SD	13(25.00)	3(5.66)
1SD	9(17.31)	27(50.94)
2SD	2(3.85)	5(9.43)
3SD	1(1.92)	2(3.77)
Total	**52 (100%)**	**53 (100%)**

In Fig 4.4, 22 children with malnutrition and 10 with diarrhea with HAZ score of -3. On the other hand 9 of under-fives with malnutrition had HAZ and 27 of those with diarrhea had HAZ 1. Similarly, 22 children with malnutrition and 9 with diarrhea had WAZ scores of -3 whereas 2 of those with malnutrition and 13 of the ones with diarrhea had WAZ of 1.

Figure 4.4: *Height for age and Weight for Age Z score among malnourished children and children with diarrhea*

4.3 Occurrence of Malnutrition, diarrhea and bidirectional diarrhea-malnutrition-among under-fives

4.3.1 Occurrence of Malnutrition and diarrhea

In Table 4.8, the proportion of under-fives below 6 months old with malnutrition was found to be 13.46 % (95%CI: 6.44 – 26.02), for under-fives between 6 to 23 months old the proportion with malnutrition was 78.85% (95% CI: 65.34 – 88.05) and 7.69 % (95% CI: 2.85 - 19.15) for those between 24 to 59 month old. Among the under-fives diagnosed with malnutrition, the biggest proportion was breastfeeding children 55.77 %(95% CI: 41.85 - 68.8). Of 38.46% who had stopped breastfeeding, 45% stopped before 6 months, 45% stopped between 6-23 months, 5% stopped between 24-59 months and 5% did not know when breastfeeding was stopped. There was a higher proportion of male children 55.77 % (95% CI: 41.85 - 68.83) with malnutrition than female under-fives 44.23 % (95% CI: 31.16 - 58.15). With regards to place of residence, Nyalenda slum had the highest proportion of under-fives with malnutrition 28.84 %(95% CI: 17.98 - 42.84) followed by Manyatta slum 19.23 %(95% CI: 10.51 - 32.55).

For the diarrhea cases, there was a higher proportion 18.87% (95% CI: 10.31 - 32.00) of under-fives below 6-month old followed by 71.70% (95% CI: 57.88 - 82.37) of under-fives between 6 to 23 months and 9.43 %(95% CI: 3.90 - 21.10) of under-fives between 24 and 59 months old (Table 4.2). The proportion of breastfeeding under-fives was found to be 60.38 %(95% CI: 46.45 - 72.80) while for those who had stopped breastfeeding was 39.62 %(95%CI: 27.19 - 53.55). For those who stopped breastfeeding, 44.44% stopped before 6 months, 38.89% stopped between 6-23 months and 22.22% stopped between 24-59 months. The proportion of male under-fives with diarrhea was found to be 67.92 %(95% CI: 53.99 - 79.26) while for the female under-fives was found to be 32.08 %(95% CI: 20.74 - 46.01). The results in Table 4.2 further reveal that among under-fives with diarrhea, there was a higher proportion from Manyatta slum 35.85 %(95%CI: 23.93 - 49.82) followed by 20.75 %(95% CI: 11.72 - 34.07) from Nyalenda, 13.21 %(95% CI: 6.32 - 25.57) from Bandani, 11.32 %(95%CI: 5.08 - 23.35) from Chiga, 11.32 %(95%CI: 5.08 - 23.35) from Obunga and 7.55 %(95%CI: 2.79 - 18.82) from Kibos.

Chi-square test of association was also done at 5% confidence level and the results in Table 4.2 reveal that age of the under-fives was statistically associated with the outcome (P-value < 0.001).

Table 4.8: *Occurrence of Malnutrition and diarrhea by Socio-demographic characteristics of under-fives*

	Malnutrition		Diarrhea	
	Proportion (%)	**95% CI**	**Proportion (%)**	**95% CI**
Age group				
< 6	13.46	6.44 – 26.02	18.87	10.31 - 32.00
6-23	78.85	65.34 – 88.05	71.70	57.88 - 82.37
24 -59	7.69	2.85 - 19.15	9.43	3.90 - 21.10
Breastfeeding				
Yes	55.77	41.85 - 68.83	60.38	46.45 - 72.80
No	44.23	31.16 - 58.14	39.62	27.19 - 53.55
Age stopped breastfeeding				
< 6	39.13	20.95-60.93	42.86	22.61-65.81
6-23	47.83	27.83-68.54	42.86	22.61-65.81
24-59	4.35	0.54-27.48	14.29	4.21-38.73
Don't Know	8.70	2.01-30.65	0.00	
Sex				
Male	55.77	41.85 - 68.83	67.92	53.99 - 79.26
Female	44.23	31.16 - 58.15	32.08	20.74 - 46.01
Place of residence				
Bandani	9.62	3.97 - 21.48	13.21	6.32 - 25.57
Chiga	17.31	9.11 - 30.41	11.32	5.08 - 23.35
Kibos	11.54	5.17 - 23.77	7.55	2.79 - 18.82
Manyatta	19.23	10.51 - 32.55	35.85	23.93 - 49.82
Nyalenda	28.84	17.98 - 42.84	20.75	11.72 - 34.07
Obunga	13.46	6.43 - 26.02	11.32	5.08 -23.35

In Table 4.9, 92.31% of the under-fives with malnutrition had suffered the condition for a period of less than 30 days while the remaining 7.69% had suffered from malnutrition for at least 30 days. Out of the 52 malnourished under-fives, 38.46% (n=20) had been treated for diarrhea in the past two weeks while 61.54% had not been treated for diarrhea before. With regards to malnutrition treatment, 11.54% had been treated for malnutrition before, 75.00% of the under-fives with malnutrition were receiving home based treatment, according to the results in Table 4.3

Table 4.9: *Duration of malnutrition, recurrence, association with diarrhea and whether treatment was sought while at home*

	Frequency (n)	**Percentage (%)**
Duration since the diagnosis of malnutrition was made		
less than 30 days	48	92.31
at least 30 days	4	7.69
Total	**52**	**100**
Treated for diarrhea before		
Yes	20	38.46
No	32	61.54
Total	**52**	**100**
Treated for malnutrition before		
Yes	6	11.54
No	46	88.46
Total	**52**	**100**
Treatment for the current illness while at home		
Yes	39	75.00
No	13	25.00
Total	**52**	**100**

From table 4.9, It is evidenced that 38. 46% of under-fives who were admitted with malnutrition had suffered diarrhea two weeks preceding the current malnutrition, an indication of bidirectional relationship between malnutrition and diarrhea.

The bidirectional relationship between malnutrition and diarrhea is further reported by key informants as follow in verbatim and units of analysis, code, category and theme identified (Table 4.10):

"During diarrhea there is increased intestinal permeability thus loss of nutrients" [KI 2], "nutrients are not absorbed properly" [KI 1] and another one stated that:

"in diarrhea all foods taken come out leaving very little absorbed or nothing at all" [KI1]

"Diarrhea promotes loss of excess water, mineral and gut flora which intern impairs nutrient absorption" [KI3] while the last one stated that:

"*Diarrhea causes movement in the large or small intestine faster than usual resulting in malabsorption"[KI2]*

"Increased *gut motility; no time allowed for absorption, destruction of absorptive gut epithelium". [KI2]*

Table 4.10: A*ssociation of diarrhea with nutrient absorption*

THEME	CATEGORY	CODE	UNIT OF ANALYSIS
3.0. Caloric need, intake, bio availability and nutrition	**3.1**. nutrient absorption	**3.1.1**. Mal-absorption	• impair • loss • Come out • Gut motility • permeability

Interpretation*: During diarrhea there is increased gut permeability and motility resulting in fluids and nutrient malabsorption. Fluid and nutrients are lost with every bowel motion, consequently, under-fives develop malnutrition.*

4.3.2 Occurrence of bidirectional diarrhea-malnutrition among under-fives

In Table 4.11, the prevalence of bidirectional diarrhea-malnutrition among under-fives in informal settlement of Kisumu County was found to be 31.43% of the 105 under-fives in the study, 12(11.43%) had malnutrition followed by diarrhea and 21 (20.00%) had diarrhea then followed by malnutrition.

Table 4.11: *Prevalence of bidirectional diarrhea-malnutrition among under five years*

	Frequency (n)	Percentage (%)
Overall bi-directional diarrhea-malnutrition	33	31.43
Malnutrition followed by Diarrhea	12	11.43
Diarrhea followed by Malnutrition	21	20.00

The symbiotic relationship or inter-current nature between diarrhea and malnutrition is further reported by key informants as captured verbatim.

. **"***Diarrhea is associated with refusal or inability to breastfeed thus reducing caloric intake"[KI 4]*
"Diarrhea allows calories taken to come out, leading to reduction of the calories taken". [KI4]
Also shared was the loss of appetite associated with diarrhea making the under-five unable to feed adequately or at all. A perfect example is the participant who wrote

"*Often, due to loss of appetite during diarrhea a child does not feed"*[KI 6]

*"Some mothers do not seek medical attention promptly therefore a child who has diarrhea and feeds poorly is likely to develop malnutrition. Prolonged malnutrition in turn leads to diarrhe*a" [KI1]

" *it makes a child to feed more so that it gets and retain lost nutrients" [KI4] , diarrhea results in increased energy needs against reduced dietary intake leading to energy deficit", [KI 2] "increases nutritional need by creating a deficit" [KI 3]* and another one wrote *"diarrhea increases nutrients needs due to loss of nutrients" [KI4]*

Interpretation*: Diarrhea among under-fives is associated with reduced appetite. Caloric intake by under-fives is negatively affected leading to less nutrients supplied to the body. Less nutrients in the body makes under five develop malnutrition. Diarrhea leads to loss of nutrients during every time an under five opens bowels. This creates nutritional deficit to the body therefore increases need for nutrients in order to replace those lost and*

maintain normal body function,, prevent severity of disease and complications like malnutrition

4.4 Practices associated with risks for malnutrition, diarrhea and bidirectional diarrhea- malnutrition among under-fives.

4.4.1 Maternal risk factors for malnutrition, diarrhea and bidirectional diarrhea-malnutrition

In Table 4.12, Descriptive statistics for the characteristics of the caregivers of the under-fives who were suffering from malnutrition, diarrhea and bidirectional diarrhea-malnutrition were done using frequency and percentage. For the under-fives with malnutrition, majority 55.77% of their caregivers reported that they had 1 under five years old in their household. Of the total 52 respondents whose under-fives were suffering from malnutrition, 46(88.46%) were mothers, 2(3.85%) were guardians, 3(5.77%) were fathers and 1(1.92%) other. With regard to whether care givers sought treatment for the current condition while at home, 39(75%) and 13(25%) said Yes and No respectively. For the 39 who sought treatment while at home, 31(80%) sought treatment from the hospital, 2(5%) sought treatment from herbalist, none sought treatment from religious leaders and 6(15%) sought treatment from any other (over the counter drugs, both hospital and herbalists). For those with bidirectional diarrhea- malnutrition states, 21% did not seek treatment for their illness. On HIV testing and HIV status of the mothers, majority (98.08%) of them were tested for HIV and 38.46% tested positive, 59.62% tested negative 1.92% did not know their HIV status. Of the mothers who were positive, majority (80.0%) were on comprehensive care.

On the other hand, for under-fives with diarrhea, 52.83 % of the caregivers reported that there was 1 under-five in their household. Of all the 53 under-fives with diarrhea, 47(88.68%) were taken to the facility by their mothers, 5(9.43%) by their caretakers and 1(1.89%) by the father. Regarding whether care givers sought treatment for the current condition while at home, 36(69.92%) and 17(32.08%) said Yes and No respectively. Out of those who sought treatment while at home, 30(83.3%), 4(11.1%), 0(0%) and 2(5.6%) sought treatment from hospital, herbalists, religious leaders and any other (hospital and herbalists) respectively.

Majority (94.34%) of the mothers were tested for HIV and 30.19% of them tested HIV positive while 66.04% were tested HIV negative. Among the mothers who tested HIV positive, 93.33% were on comprehensive care.

Table 4.12: *Maternal risks for malnutrition, diarrhea and bidirectional diarrhea-malnutrition*

	Malnutrition N=52 n(%)	**Diarrhea N=53 n(%)**	**Bi-directional diarrhea-Malnutrition cases N=33 n(%)**
Number of under five years old in the household			
1	29(55.77)	28(52.83)	14(42.42)
2	16(30.77)	22(41.51)	13(39.39)
3	6(11.54)	3(5.66)	5(15.15)
4	1(1.92)	0(0.00)	1(3.03)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Relationship with the child			
Mother	46(88.46)	47(88.68)	28(84.85)
Care taker	2(3.85)	5(9.43)	3(9.09)
Father	3(5.77)	1(1.89)	2(6.06)
Other	1(1.92)	0(0.00)	0(0.00)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Sought treatment			
Yes	39(75.00)	36(67.92)	26(78.79)
No	13(25.00)	17(32.08)	7(21.21)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Where treatment was sought			
Hospital	31(79.49)	30(83.33)	21(80.77)
Herbalist	2(5.13)	4(11.11)	1(3.85)
Religious leader	0(0.00)	0(0.00)	0(0.00)
Any other (Herbalist, over the counter,)	6(15.38)	2(5.56)	4(15.38)
Total	**39(100%)**	**36(100%)**	**26(100%)**
Mother tested for HIV when pregnant			
Yes	51(98.08)	50(94.34)	32(96.97)
No	0(0.00)	2(3.77)	1(3.03)
Don't know	1(1.92)	1(1.89)	0(0.00)
Total	**52(100%)**	**53(100%)**	**33(100%)**
HIV status			
Positive	20(38.46)	16(30.19)	9(27.27)
Negative	31(59.62)	35(66.04)	23(69.70)
Don't know	1(1.92)	2(3.77)	1(3.03)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Mother on Comprehensive care			
Yes	16(80.00)	14(93.33)	8(88.89)
No	3(15.00)	0(0.00)	1(11.11)
Don't know	1(5.00)	1(6.67)	0(0.00)
Total	**20(100%)**	**15(100%)**	**9(100%)**

In Table 4.12 number of under-fives in household as a risk factor is corroborated by a report from key informants who mentioned child spacing as a risk factor:

" *poor child spacing, mother's body mass index, parent education status, breastfeeding status, environmental factors" [KI 2], "loss of appetite, eating disorder, diarrhea, socio economic status" [KI4]*

Yet another one reported that seeking care from herbalist is risk factors to malnutrition and diarrhea

"Late medical attention for the diarrhea, duration and frequency of the diarrhea, low socio economic status seeking traditional interventions e.g. herbs, associated comorbidity e.g. HIV" [KI 5]. The responses are captured in Figure 4.6 below, as a word cloud. Word cloud was used to bring out which maternal risk factors for malnutrition and diarrhea among under-fives were mentioned repeatedly by the respondents such that the recurring words appearing in large letters were associated more with the diseases. The word cloud was generated entering texts from respondents into a word cloud generator software.

Interpretation*: Poor child spacing is a risk factor for malnutrition among under-fives as the caregiver's attention is divided and constrained resources get shared among under-fives in the household.*

Also, poor health seeking behavior self-treatment while at home or seeking care from herbalists are risk factors to malnutrition and diarrhea diseases as well as bidirectional state.

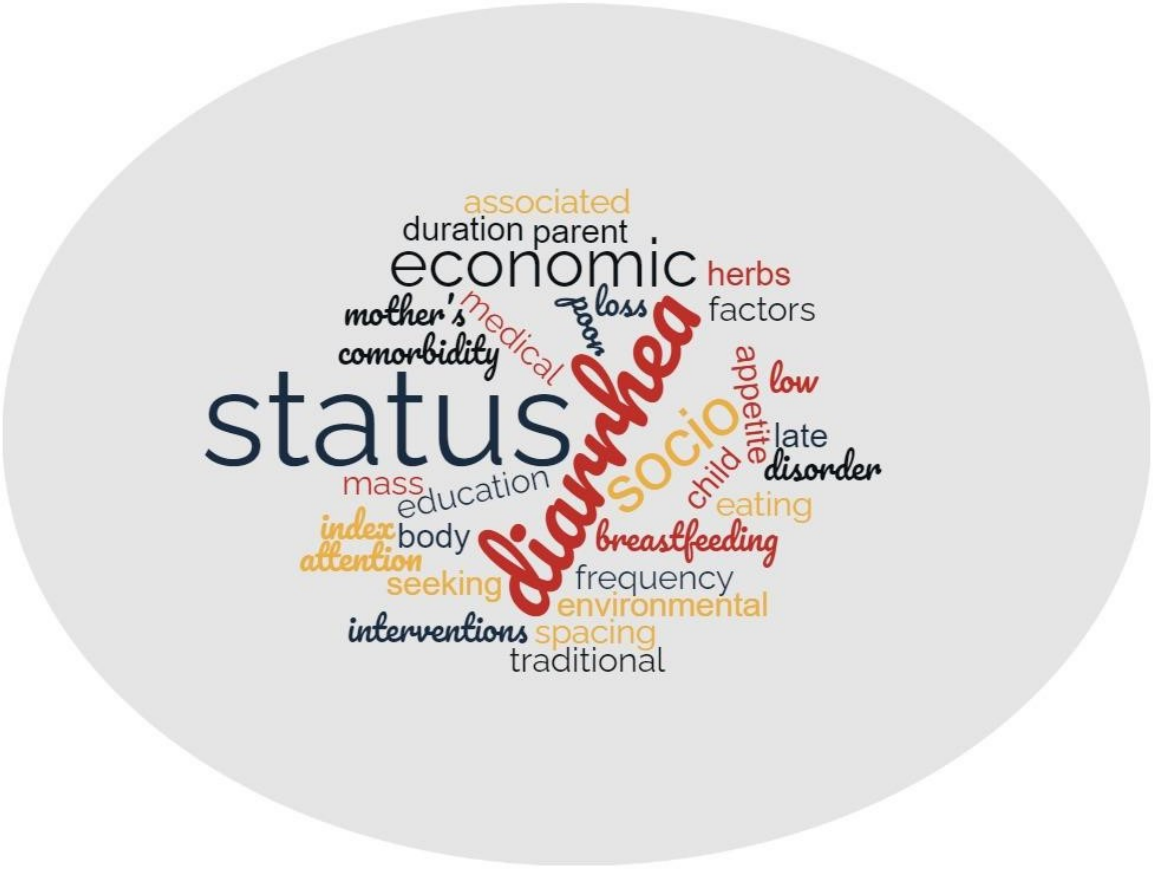

Figure 4.5: *Word cloud on risk factors for malnutrition among under-fives*

The word (Figure 4.5) shows the specific risk factor for malnutrition as stated by key informants. Most of the key informants stated that socioeconomic status of caregivers was the main risk for malnutrition among under-fives, followed by infections among under-fives, imbalanced diet, early initiation on complementary feeds, maternal factors like stature , weight during delivery , low birth weight in that order.

4.4.2 Nutritional Risk Factors for Malnutrition and Diarrhea

Nutritional risk factors for malnutrition and diarrhea among under-fives were assessed using frequency tables. Among the under-fives with malnutrition, 46.15% were feeding on family diet, 34.62% were on complementary feeding 13.46% were on exclusive breastfeeding and 5.8% were on alternative diet (NAN, cow milk) (Table 4.15). Majority

(67.31%) of the under-fives had been introduced to complementary feeding and 34.29% of them were initiated on complementary feeding at an age below 6 months while 60.0% of them were initiated on complementary feeding at an age of at least 6 months. Of the with malnutrition, 7.69%, 46.15% and 46.15% always, sometimes and never respectively eat vegetables (Table 4.13)

On the other hand, among the under-fives with diarrhea, 4(7.55%), 33(62.26%), 13(24. 53%), 3 (5.66%) were on exclusive breastfeeding, complementary feeding, family diet and alternative feeding respectively. (Table 4.13). Similarly, 83.02% of the under-fives with diarrhea had been or were currently on complementary feeding. Twenty three point two six percent of those who had been introduced to complementary feeding started below the age of 6 months while 74.42% of them were introduced to complementary feeding at an age of 6 months and above. The results further reveal that 9.62% of the children with diarrhea always eat vegetables, 59.62% sometimes eat vegetables and 30.77% never eat vegetables.

Table 4.13: *Nutritional risk factors for malnutrition and diarrhea*

	Under-fives with malnutrition, N=52		**Under-fives with diarrhea, N=53**	
Type of diet which the child is on			Frequency	Percentage
Exclusive breastfeeding	17	32.69	4	7.55
Complementary feeding	15	28.85	26	49.05
Family diet	17	32.69	17	32..08
Alternative Feeding (<6 months)	3	5.8	5	9.43
Total	**52**	**100%**	**53**	**100%**
complementary feeding practiced				
Yes	32	61.54	44	83.02
No	20	38.46	9	16.98
Total	**52**	**100%**	**53**	**100%**
Age complementary feeding initiated				
< 6 months	12	34.29	10	23.26
>= 6 months	21	60.00	32	74.42
Don't know	2	5.71	1	2.33
Total	**35**	**100%**	**43**	**100%**
Habit of eating vegetables				
Always	4	7.69	5	9.43
Sometimes	24	46.15	31	58.49
Never	24	46.15	17	32.07
Total	**52**	**100 %**	**53**	**100 %**

Table 4.13 indicates that 32.69% of under-fives with malnutrition were on family diet, 34.29% started on complementary feeding ≤ the age of six months, 46. 15% % ate vegetables sometimes and 46.15% never ate vegetables.

On the other hand, 49% of under-fives with diarrhea were currently on complementary feeding, 23.26% were started on complementary feeding before six months of life and 58% ate vegetables sometimes.

Complementary feeding practice being associated with risks for diarrhea and malnutrition is further reiterated by key informants as follows:

……"beginning of complementary feeding early before six months" [FGD 2]
……."Yes, it is. Let's say you start a child on complementary feeding when the child is still three months or four months definitely it is going to be… is causing this child to malnutrition and diarrhea because we will be introducing foods that the child is not ready to take or digest. On the other side, introducing complementary feeding when the child is eight months, definitely, is going to put this child at a risk of being malnourished……[FGD1]"

……."I may not have much on the same but I'll still may be echo. When a child has not reached the age of now there is supposed to be complemented with the food. Automatically, the system of the child is not that properly organized so that it can take some of these kinds of meals we are giving to the child. Then automatically there are those spans towards growth or towards the system will not help the baby. In fact, we shall be endangering the baby, endangering the life of the baby. So, when the baby reaches the appropriate age of now starting the complementary food at least it will get the system of this particular child has now fully developed. He can now comprehend some of these meals as we introduce it gradually. So, I think timing and the age is also a factor…….[FGD2]"

Figure 4.6: *Word cloud showing caregiver feeding practices as risk factors for diarrhea among under-fives*

Figure 4.6 displays words that were expressed by key informants as risks for diarrhea among under-fives. Word that appeared more in the texts are prominent in the cloud as opposed to the ones that occurred less.

Interpretation: Poor complementary feeding is associated with malnutrition and diarrhea among under-fives. Risks arise when a child is fed on food that is not safe, complementary feeding is initiated before or after six months of a child's life, frequency of feeding amount and food consistency is not age appropriate as outlined in the IYCF guideline (WHO, 22, UNICEF, 2023)

4.4.2.2 Relationship between continued feeding during episode of diarrhea and the under-five nutritional status

The study sought to determine the association between continued feeding among under-fives during episodes of diarrhea and malnutrition. From the responses the code restored lost nutrients evolved five times from units of analysis within texts by respondents. Some of the responses are captured below:

> "*it reduces risks of dehydration, promotes increased weight gain - mitigates weight loss. [KI4] Breastfeeding reduces severity duration and negative consequences of diarrhea" [KI2], "continued feeding improves caloric intake hence improved nutritional status"[KI6]* yet another respondent stated: *"the more a child loses nutrients through diarrhea the more feeding to replace nutrients is needed lest they develop malnutrition"[KI4]*

On the other hand one code under nutrition evolved from unit of analysis from text as stated in verbatim below

> "*Continued feeding without resolved diarrhea leads to under nutrition since absorption is reduced as a result of loss of electrolytes which help in conduction of electrical impulse"[KI1]*

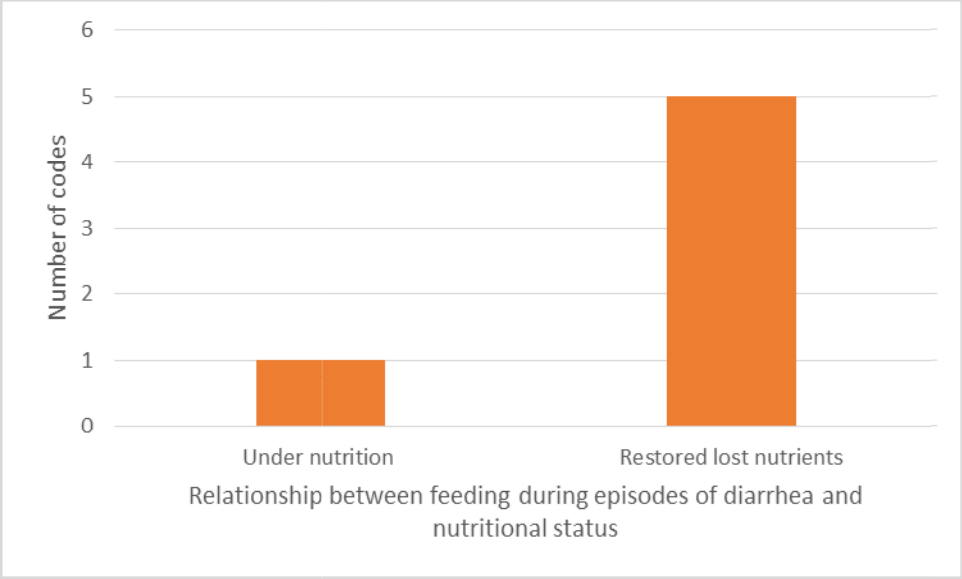

Figure 4.7: *Relationship between continued feeding during an episode of diarrhea and nutritional status of under-fives*

In Figure 4.7 five respondents stated that with continued feeding among under-fives during an episode of diarrhea , there was experienced restored nutrients while 1 respondent stated that with continued feeding during an episode of diarrhea, under-fives experienced under nutrition.

This finding agrees with caregivers' feeding practice during the period of diarrhea among under-fives. (Table 4.14)

Interpretation*:Continued feeding of under-fives during a period of diarrhea episode replaces nutrients lost with every bowel motion promoting recovery while preventing subsequent related complications.*

The results in Table 4.14 reveal that 50% of caregivers promoted exclusive breastfeeding during the episode of diarrhea among under-fives aged 0-6 months, 61.54% of the caregivers promoted complementary feeding during an episode of diarrhea among under-fives aged 6-23 months and 64.71% of caregivers promoted, on family diet during episodes of diarrhea among under-fives aged 24-59

As regards care givers promoting alternative feeding of under-fives during an episode of diarrhea (for < 6 months not on exclusive breastfeeding), 60% were promoting alternative feeding during an episode of diarrhea, while 40% were not. . Caregivers of under-fives with diarrhea were asked the number of times their children passed diarrhea and according to the results in Table 4.6, 60.38% of the under-fives passed diarrhea between 1 to 3 times after 24 hours, 35.85% passed diarrhea at least 4 times after 24 hours.

Table 4.14: *Feeding among under-fives during an episode of diarrhea*

	Frequency (n)	**Percentage (%)**
Promote exclusive breastfeeding during an episode of diarrhea for those <6 months		
Yes	2	50
No	2	0.0
Total	**4**	**100**
Promote complementary feeding for under-fives during an episode of diarrhea for those aged 6-23 months		
Yes	17	63.00
No	10	37.00
Total	**27**	**100**
Promote feeding during an episode of diarrhea (for under-fives who have stopped breastfeeding)		
Yes	11	64.71
No	6	35.29
Total	**17**	**100**
Promote alternative feeding during diarrhea (< 6 months not on exclusive breastfeeding)		
YES	**3**	**60**
NO	**2**	**40**
Total	**5**	**100**
No of times the under-five passed diarrhea in the last24 hours		
0	2	3.77
1 to 3	33	62.30
4 times and above	19	35.85
Total	**53**	**100**

4.4.2.3. Theme: Caloric need. Intake, bio availability and nutrition

Under the theme caloric need, intake, bio availability and nutrition several categories were explored leading to various codes and units of analysis (Table 4.15).

Caloric intake: Majority, 4, of the key informants stated that under-fives either on exclusive breastfeeding, complementary, family diet or alternative feeding experienced reduced caloric intake. **"***Diarrhea is associated with refusal or inability to breastfeed thus reducing caloric intake" [KI4] "Diarrhea allows calories taken to come out, leading to reduction of the calories taken"*.[KI1]

Also shared was the loss of appetite associated with diarrhea making the under-five unable to feed adequately or at all. A perfect example is the participant who wrote:

"*Often, due to loss of appetite during diarrhea a child does not feed"*[KI6**]**

Minority stated that diarrhea among under-fives on exclusive breastfeeding leads to increased caloric needs

"With diarrhea caloric needs are increased" [KI5] yet another one stated "*with diarrhea caloric needs are increased therefore a child should be breastfed exclusively frequently to provide extra fluids and to meet energy requirements" [KI3]*

Table 4.15: *Association of diarrhea and caloric intake*

THEME	CATEGORY	CODE	UNIT OF ANALYSIS
1.0. Caloric need, intake, bio availability and nutrition	**1.1**.Caloric intake	**1.1.1.** Reduced Caloric intake **1.1.2**. Increased caloric need	• refusal • inability • appetite • frequently • breastfeed • increased

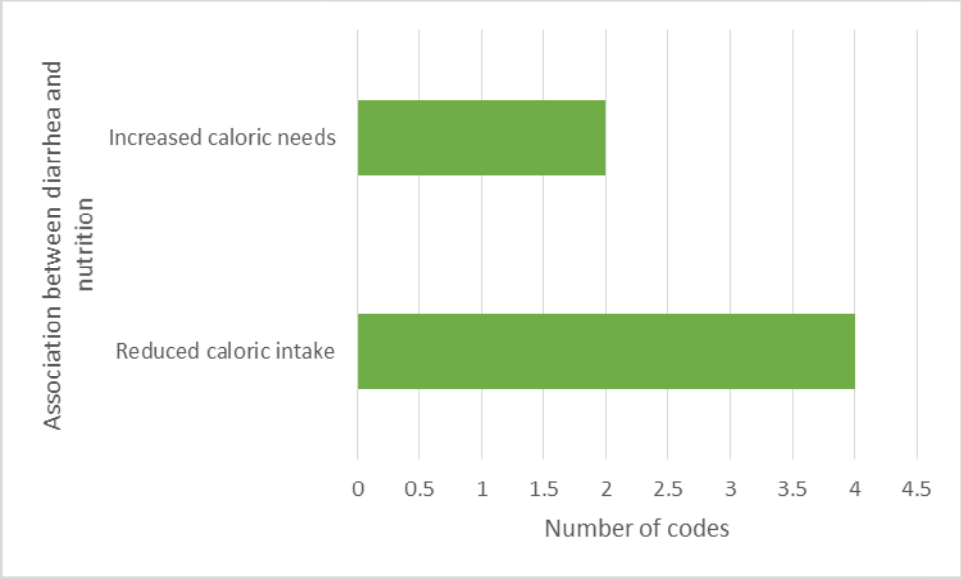

Figure 4.8: *Association of diarrhea and nutrition among under-fives*

Figure 4.8 shows that 4 of key informants stated that most under-fives who suffered diarrhea experienced reduced caloric intake as a minority stated that the under-fives have an increased need of calories, during diarrhea.

These findings corroborate the report in table 4.6 which states that among under-fives admitted with diarrhea only 40 % of those on exclusive breastfeeding continued feeding during an episode of diarrhea. Similarly, only 47% of those on complementary types of feeding continued feeding during episodes of diarrhea while 50% on family diets continued feeding during the episode of diarrhea.

> ***Interpretation****: Under-fives who suffer an episode of diarrhea and are either on exclusive breastfeeding, complementary feeding experience reduced caloric intake since they lose appetite. Therefore, the under-fives should be fed frequently to meet the body's nutritional needs.*

4.4.2.4 Association between diarrhea and under-five's nutrients needs

Regarding impact of diarrhea on the under-five nutrients needs, all the participants stated that diarrhea results in increased nutritional needs. They reported that diarrhea causes nutrient deficit to the body through loss, with every bowel motion.

> " *it makes a child to feed more so that it gets and retain lost nutrients" [KI4], diarrhea results in increased energy needs against reduced dietary intake leading to energy deficit" [KI 5] "increases nutritional need by creating a deficit" "KI 2]* and another one wrote *"diarrhea increases nutrients needs due to loss of nutrients" [KI3]*

Interpretation:*Diarrhea leads to loss of nutrients every time an under five opens bowels. Essentially, this results in wastage of nutrients thereby creating a deficit to the body and increases need for the same. The increased nutrients need allows for replacement of those lost during each bowel motion and restore normal body function, prevent severity of disease and complications like malnutrition*

4.4.3 Hygiene and Sanitation risk factors for malnutrition, diarrhea and bidirectional diarrhea-malnutrition

In Table 4.16, hygiene and sanitation were assessed as risk factors for malnutrition and diarrhea using descriptive statistics. For the malnourished under-fives, 31(59.62%) had trimmed nails while 21(40.38%) had untrimmed nails. Availability of domestic animals at home was assessed as a risk factor for malnutrition. However, 61.54% of the respondents did not keep domestic animals at home while 38.64% kept domestic animals. Majority (65.38%) of the caregivers used piped water as the main source of water in their household, 26.92% used borehole, 1.92% used rain water and 5.77% used other sources of water. With regards to availability of water and time taken to fetch water, 88.46% of the caregivers took less than 30 minutes to fetch water and 5.77% took 31-59 minutes and 60 – 120 minutes respectively. Majority (61.54%) of the caregivers were experiencing

water shortage and 55.77% of them were experiencing water shortage for less than three days and 9.62% were experiencing water shortage for at least one week. With regards to treatment of water, 61.54% of the caregivers were treating drinking while 36.54% were not treating drinking water. Also assessed as risk factorsfor malnutrition included care giver's hand washing practice, access to latrine or toilet facilities, type of disposal system used, number of households that share a latrine/toilet facility, and disposal of under-five feces. The study found that 59.62% practiced hand washing at critical times (before holding the child, after cleaning the child, before preparing food, before eating and after visiting the toilet) and 40.83% practiced partially. As for access to latrine or toilets, 100% of caregivers of under-fives with malnutrition accessed such facilities, 88.46% of caregivers used pit latrines while 11.64% used flash toilets. Regarding sharing of latrine or toilets as a risk factor to malnutrition, 69.23% lived in households that shared the facilities while 30.77% did not share. As regards disposal of under-five feces, 75% disposed of feces in latrines, 11.45% disposed of the feces in open yard and open drains each while 1.92% disposed of in other ways (garbage collection bins).

Regarding diarrhea and factors assessed for risks, presence of untrimmed fingernails of under-fives was at 73.58% while 26.42% had trimmed fingers. On whether living in households that kept domestic animals was a risk factor to diarrhea among under-fives, the under-fives lived, 58.49% of under-fives lived in households that kept domestic animals while 41.51% lived in households that did not keep domestic animals. Regarding source of water, 64.15 %, 30.19%, 5.06% and 0% used water from pipes, bore holes, rain and others respectively. As regards time taken to fetch water, 90.57% of caregivers took less than 30 minutes, 7.55% took 31-59 minutes, and none took 60-120 minutes while

1.89% did not provide a response to the question. On water availability, 52.85% of caregivers whose under-fives suffered malnutrition experienced water shortage, 43.4% did not experience shortage and 7.69% experienced water shortage some times. As regards frequency of water shortage. On how long the water shortage lasted, 45.38%, 37.74% and 16.98% said that water shortage lasted for less than 3 days, more than one week and none of the above, respectively.

As regards to treatment of drinking water, 45,28% of caregivers with under five treated water for drinking, 37.74% did not treat while 16.98% did not know if water for drinking was treated. Furthermore, 41.51% of caregivers reported practicing hand wash at all critical times and 58.49% practiced hand wash partially. Regarding availability of latrine or toilet facilities, 98.11 % of the caregiver accessed such facilities and 1.89% did not access the facilities. Majority, 82.69% of caregivers to under-fives with diarrhea used pit latrine for human waste disposal while 17.31% used flush toilets. As regards the number of house-holds that use the same latrine, 73.58% of caregivers used latrines that were shared by more than one household, 24.53% used latrines that were not shared by more than one household and 1.89% did not respond to the question. On disposal of under-five feces, 86.79%, 9.43%, 3.77% and 0.0% disposed of under-five feces in latrines, open yards, open drains and others respectively.

Table 4. 16: *Hygiene and Sanitation risk factors for malnutrition, diarrhea and bidirectional diarrhea-malnutrition*

	Malnutrition N=52 n(%)	Diarrhea N=53 n(%)	Bi-directional malnutrition and diarrhea cases N=33 n(%)
Finger nails of the child			
Trimmed	31(59.62)	14(26.42)	8(24.24)
Untrimmed	21(40.38)	39(73.58)	25(75.76)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Domestic animals at home			
Yes	20(38.46)	31(58.49)	19(57.58)
No	32(61.54)	22(41.51)	14(42.42)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Water source			
Piped	34(65.38)	34(64.15)	16y(48.48)
Borehole	14(26.92)	16(30.19)	10(30.30)
Rain water collection	1(1.92)	3(5.66)	3(9.09)
Other	3(5.77)	0(0.00)	4((12.12)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Time taken to fetch water in minutes			
<30 minutes	46(88.46)	48(90.57)	19(57.58)
31-59 minutes	3(5.77)	4(7.55)	10(30.30
60-120 minutes	3(5.77)	0(0.00)	4(12.12)
No response	0(0.00)	1(1.89)	0(0.00)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Water shortage			
Yes	32(61.54)	28(52.83)	29(87.88)
No	16(30.77)	23(43.4)	3(9.09)
Sometimes	4(7.69)	2(3.77)	1(3.03)
Total	**52(100%)**	**53(100%)**	**33(100%)**
How long does water shortage last			
Less than three days	29(55.77)	24(45.28)	13(39.39)
More than one week	5(9.62)	20(37.74)	2(6.06)
None of the above	18(34.62)	9(16.98)	18(54.55)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Treat water for drinking			
Yes	32(61.54)	24(45.28)	11(33.33)
No	19(36.54)	20(37.74)	22(66.67)
Don't know	1(1.92)	9(16.98)	0(0.00)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Mother hand washing			
All practiced	31(59.62)	22(41.51)	11(33.33)
Partially practiced	21(40.38)	31(58.49)	22(66.67)
Total	**52(100%)**	**53(100%)**	**33(100%)**
Access to Latrine/toilet facility			
Yes	52(100.00)	52(98.11)	32(96.97)
No	0(0.00)	1(1.89)	1(3.03)
Total	**52(100%)**	**53(100%)**	**33(100%)**

From Table 4.16, 36.54% of caregivers to under-fives with malnutrition were not treating water for drinking, and 40.38% were partially washing their hands (hands should be washed at critical moments: before preparing under-five's food, after removing diapers, before holding the under-five, after visiting the toilet and before feeding the under-five) . Similarly, 37.74% of caregivers whose under-fives were admitted with diarrhea were not treating water for drinking and 58.49% partially practiced hand washing. The report of table 4.12 is corroborated by key informants as follows:

"Using in-purified water for drinking and cooking, not washing of hands before feeding a child by caregiver" [FGD 2]

On caregiver poor hand hygiene practice as a risk factor for malnutrition, respondents had this to say:

"…Uh...Yes. Because of contamination. so when diarrheal diseases come in I believe the appetite will be compromised so the child might not be able to feed well and there will be also a lot of wastage through diarrhea, a lot of water and food will be wasted, uh yes, all these ones I believe can cause diarrhea and can cause malnutrition in a young child…. [FGD 1]"

….."that is very true because you talk of critical points where you need to wash our hands, let's say this caregiver doesn't wash their hands after changing the child doesn't wash her hands after visiting the toilet doesn't wash her hands during food preparation and all this put together and then you have the child. The child feeds on food that has been handled with the same hands, the child will have diarrhea….. [FGD1]"

……"You might find that washing hands is also a factor. Another thing this caregiver or the mother, if she herself is not hygienically good then even that breast is also a factor that can contribute to diarrhea cases because if the mother is not hygienically good, is not washing her hands properly even the nipple already has an infection. …… [FGD2]"

Interpretation: *Unsafe water for drinking and poor hand hygiene practice among caregivers are risks for malnutrition and diarrhea among under-fives.*

4.3.4 Practices and Care-Giver risks for bidirectional diarrhea -malnutrition among under-fives

In **Table** 4.17, bi variate analysis for binary logistic regression was done to determine risk factors for bidirectional diarrhea-malnutrition among under five in informal settlement at 5% level of confidence. Number of under-fives living in the same household and finger nails hygiene were found to be statistically significant factors. Having one under five in a household was found to be 0.22 times less likely to suffer from bidirectional diarrhea-malnutrition as compared to at least 3 under-fives in one household (COR=0.22, 95%CI=0.05-0.88, P-value=0.033). With regards to under-five fingernails, 40.98% of those with untrimmed fingernails had bidirectional diarrhea-malnutrition and 18.18% of under-fives with trimmed fingernails suffered bidirectional diarrhea and malnutrition. Under-fives with trimmed fingernails was found to be 0.32 times less likely to have bidirectional diarrhea and malnutrition (COR=0.32, 95%CI=0.13-0.80, P-value=0.15). (Table 4.17).

In Table 4.18, bi variate analysis for the effect of waste disposal on bidirectional diarrhea- malnutrition revealed that disposal of under-five's feces was a significant risk factor for bidirectional diarrhea-malnutrition. The under-fives whose caregivers were using open yard to dispose under-five's feces were 4.68 times more likely to have bidirectional diarrhea- malnutrition as compared to those whose caregivers were using pit latrine (OR=4.68,95%CI=1.52-14.47, P-value=0.007)

Table 4.17: *Bi variate logistic regression analysis for risk factors associated with bidirectional diarrhea-malnutrition among under-fives*

	Bi-directional diarrhea - malnutrition		Total (%)	Bi variate logistic regression		
	No n(%)	Yes n(%)		COR	95%CI	P-value
Number of under 5 years						
1	43(59.72)	14(42.42)	100	0.22	0.05-0.88	**0.033**
2	25(34.72)	13(39.39)		0.35	0.08-1.45	0.147
3 and above	4(5.56)	6(18.18)		Ref	-	-
Total	**72(100)**	**33(100)**				
Mother HIV status						
Negative	43(65.15)	23(34.85)	100	Ref	-	-
Positive	27(75.00)	9(25.00)	100	0.62	0.25-1.55	0.308
Don't know	2(66.67)	10(33.33)	100	0.93	0.08-10.87	0.957
Comprehensive care						
Yes	22(73.33)	8(26.67)	100	Ref	-	-
No	2(66.67)	1(33.33)	100	1.38	0.11-17.32	0.805
Don't Know	2(100.00)	0(0)	100	1.00		
Diet child						
Exclusive breastfeeding	16(76.19)	5(23.81)	100	Ref	-	-
Complementary feeding	15(75.00	5(25.00)	100	1.07	0.26-4.44	0.929
Family diet	40(63.49)	23(36.51)	100	1.84	0.56-5.68	0.289
Start complement feeding						
Yes	53(67.95)	25(32.05)	100	Ref	-	-
No	18(75.00)	6(25.00)	100	0.71	0.25-2.00	0.513
Eat vegetables				Ref	-	-
Yes	7(77.78)	2(22.22)	100			
Sometimes	35(63.64)	20(36.36)	100	2.00	0.39-10.57	0.414
Never	29(72.50)	11(27.50)	100	1.33	0.24-7.39	0.746
Child fingernails						
Trimmed	36(81.82)	8(18.18)	100	0.32	0.13-0.80	**0.015**
Untrimmed	36(59.02)	25(40.98)	100	Ref	-	-
Domestic animals						
Yes	32(62.75)	19(37.25)	100	1.70	0.74-3.90	0.213
No	40(74.07)	14(25.93)	100	Ref	-	-

Table 4.18: *Association of Waste management system on bidirectional diarrhea and malnutrition among under 5 years*

	Bi-directional diarrhea - malnutrition		Total (%)			
	No	Yes		Bi variate logistic regression		
	n (%)	n (%)		COR	95%CI	P-value
Access to latrine				Ref		
Yes	72(69.23)	32(30.77)	100			
No	0(0)	1(100)	100	1.00	NA	NA
Type of disposal system						
Flush	12(80.00)	3(20.00)	100	0.52	0.14-1.97	0.335
Pit latrine	60(67.42)	29(32.58)	100	Ref		
Dispose of children's feces						
Latrine	59(73.75)	21(26.25)	100	Ref		
Open yard	6(37.50)	10(62.50)	100	4.68	1.52-14.47	**0.007**
Open drain	6(75.00)	2(25.00)	100	0.94	0.18-5.00	0.939
Other	1(100.00)	0(0)	100	1.00	NA	NA

4.3.5 Water and Sanitation

Under bi variate logistic analysis to determine the association of water and sanitation on bidirectional diarrhea-malnutrition among under- fives, water shortage, drinking untreated water and caregivers' hand washing were found to be statistically significant. Under-fives of the caregivers who were experiencing water shortage were 5.4 times more likely to have bidirectional diarrhea-malnutrition as compared to those who did not experience water shortage (OR=5.40, 95%CI=1.49-19.59, P-value=0.01). With regards to drinking water, under-fives who were drinking treated water were 0.4 times less likely to have bidirectional diarrhea-malnutrition than those who were drinking untreated water (OR=0.40, 95%CI=0.17-0.95, P-value=0.037). About 43% of caregivers who were not practicing hand washing at all the critical five moments (before holding the child, after

cleaning the child, before preparing food, before eating and after visiting the toilet) had their under-fives suffer from bidirectional diarrhea-malnutrition. Under-fives whose caregivers were practicing hand washing were 0.34 times less likely to have bidirectional diarrhea-malnutrition as compared to those whose mothers were not practicing all the five critical hand washing moments ((OR=0.34, 95%CI=0.14-0.80, P-value=0.014).

Table 4.19: *Association of water and sanitation on bidirectional diarrhea - malnutrition among under 5 years*

	Bi-directional diarrhea - malnutrition		Total (%)			
	No n (%)	Yes n (%)		Bi variate logistic regression COR	95%CI	P-value
Water shortage						
Yes	43(59.72)	29(40.28)	100	5.40	1.49-19.59	**0.010**
Sometimes	5(83.33)	1(16.67)	100	1.60	0.14-18.72	0.708
No	24(88.89)	3(11.11)	100	Ref	-	-
Treat water for drinking						
Yes	40(78.43)	11(21.57)	100	0.40	0.17-0.95	**0.037**
No	32(59.26)	22(40.74)	100	Ref	-	-
Mother's hand washing						
Yes	43(79.63)	11(20.37)	100	0.34	0.14-0.80	**0.014**
No	29(56.86)	22(43.14)	100	Ref	-	-

Under multivariate logistic regression analysis in Table 4.19, the number of under-fives in a household, disposal of under-five feces, water shortage, treatment of drinking water and care giver's hand washing at all five critical moments were found to be significant risk for bidirectional diarrhea-malnutrition among under-fives in informal settlement of Kisumu County. The results in Table 5 show that one under five in a household was 0.14

times less likely to have bidirectional diarrhea-malnutrition as compared to 3 and above in one household (OR=0.14, 95%CI=0.02-0.78, P-value=0.025).

For the disposal of under-five feces, those whose caregivers were disposing under-five's feces in open yard were 7.48 times more likely to have bidirectional diarrhea-malnutrition as compared to those who were using pit latrine (OR=7.48, 95%CI=1.71-32.78, P-value=0.008). The under-fives of caregivers who were experiencing water shortage in their residence were found to be 12.14 times more likely to have bidirectional diarrhea- malnutrition as compared to those who had water (OR=12.14, 95%CI=2.40-61.50, P-value=0.003). For treating drinking water, under-fives whose caregivers were treating drinking water were found to be 0.26 times less likely to have bidirectional diarrhea- malnutrition as compared to those whose caregivers were not (OR=0.26, 95%CI=0.08-0.80, P-value=0.019). Of the caregivers who were practicing proper hand washing, the odds of their under-fives having bidirectional diarrhea and malnutrition was calculated to be 0.28 less than those whose caregivers were not fully practicing hand washing (OR=0.28, 95%CI=0.08-0.96, P-value=0.43) (Table 4.20)

Table 4.20: *Multivariate logistic regression analysis of risk factors for bidirectional diarrhea - malnutrition among under five years*

	Bi-directional diarrhea - malnutrition					
	No n(%)	Yes n(%)	Total (%)	Multivariate logistic regression AOR	95%CI	P-value
Number of under-fives						
1	43(59.72)	14(42.42)		0.14	0.02-0.78	**0.025**
2	25(34.72)	13(39.39)		0.28	0.05-1.60	0.153
3 and above	4(5.56)	6(18.18)		Ref	-	-
Total	100	100				
Under-five's fingernails						
Trimmed	36(81.82)	8(18.18)	100	0.68	0.20-2.39	0.552
Untrimmed	36(59.02)	25(40.98)	100			
Dispose of under-five feces						
Latrine	59(73.75)	21(26.25)	100	Ref	-	-
Open yard	6(37.50)	10(62.50)	100	7.48	1.71-32.78	**0.008**
Open drain	6(75.00)	2(25.00)	100	1.07	0.14-8.39	0.951
Other	1(100.00)	0(0)	100	1.00		
Water shortage						
Yes	43(59.72)	29(40.28)	100	12.14	2.40-61.50	**0.003**
Sometimes	5(83.33)	1(16.67)	100	12.91	0.67-247.18	0.089
No	24(88.89)	3(11.11)	100	Ref	-	-
Treat water for drinking						
Yes	40(78.43)	11(21.57)	100	0.26	0.08-0.80	**0.019**
No	32(59.26)	22(40.74)	100	Ref	-	-
Mother's hand washing						
Yes	43(79.63)	11(20.37)	100	0.28	0.08-0.96	**0.043**
No	29(56.86)	22(43.14)	100	Ref	-	-

On if untrimmed fingernails was a risk factor to bidirectional diarrhea-malnutrition among under-fives.

……``Yes. One thing is for sure: diarrhea is one of the links that will lead to malnutrition. If we cut off this one link of diarrhea then we cannot get malnourished children. So, the moment we have diarrhea you be sure if it is not properly prevented it is going to lead to malnutrition because it is one of the pathways leading to malnutrition. So the moment the nails are kept long such that they can harbor the germs and use our hands to feed we'll still be diarhearing like every day and like I said it is one of the ways leading to malnutrition. Long fingernails also affects malnutrition……. [FGD2]"

Interpretation: *Malnutrition and diarrhea have a bidirectional relationship where contamination of food as a result of untrimmed nails lead to diarrhea which results in malnutrition when nutrients are wasted with every bowel motion of food intake is decreased due to reduced appetite among under-fives.*

4.5 Co creation of a framework community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives

Based on the findings of objective two, the current study identified three practices that are associated with risks for a combination of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives living in informal settlements. The three identified practices included i) infant and young child feeding which has the following components: early initiation of breastfeeding, exclusive breast feeding and complementary feeding, ii) hygiene and sanitation, comprising of: construction of any type of latrine where none exists, upgrading latrines from low to higher levels, clearing the compound of animal feces, regular cleaning of shared latrines by households and keeping latrine doors under lock and key. iii) Caregiver practices which includes : caregiver hand washing, keeping under five nails trimmed and treatment of drinking water (Figure 4. 9)

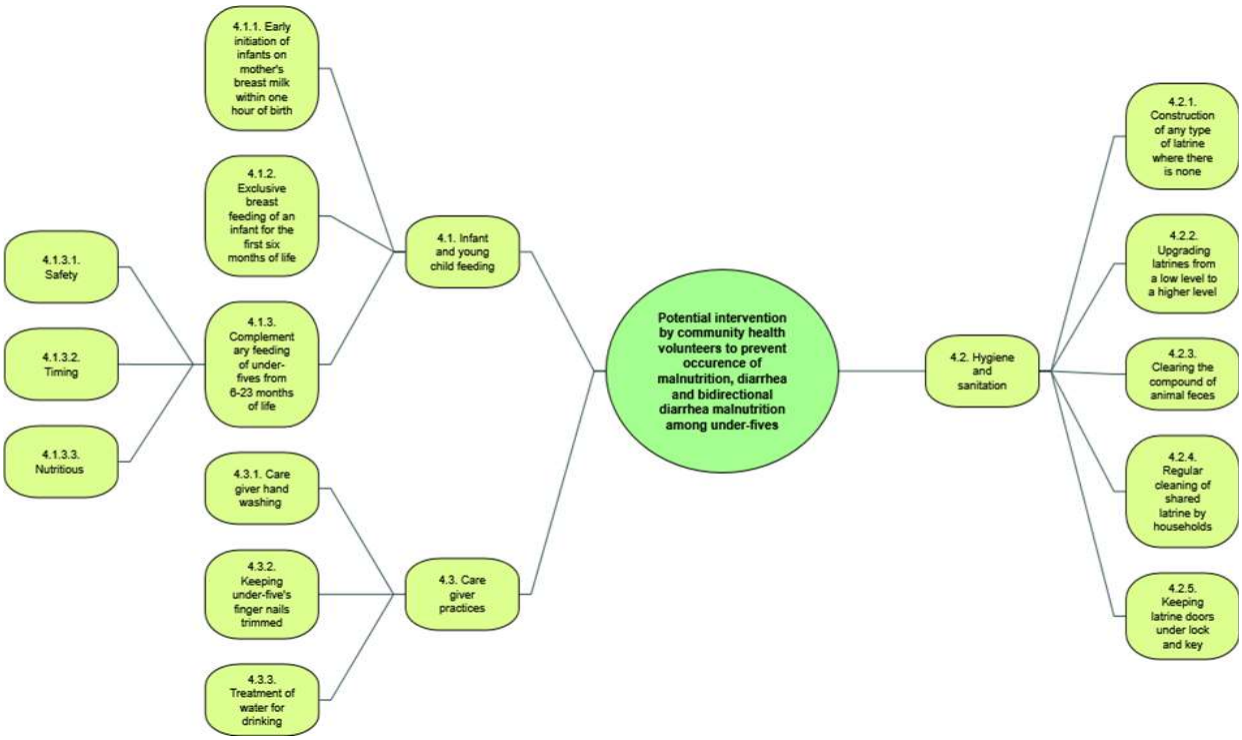

Figure 4.9: *The proposed framework of practices associated with risks for a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition*

Figure 4.10 shows words that were frequently used during feedback from community health promoters, to co-create a framework for strengthening community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in the informal settlements.

Figure 4.10: *Word Cloud showing words that were frequently used by the respondents*

4.5.1 Infant and young child feeding

The current study found out that complementary feeding was associated with risks for both malnutrition and diarrhea among under-fives. Further still, the caregivers of under-fives withheld or served inadequate amounts of feeds to under-fives during episodes of diarrhea.

4.5.1.1 Early Initiation of Breast Milk Within One Hour Of Birth

The study sought to validate if initiation of a new born baby on breast milk within one hour of birth can prevent occurrence of a combination of malnutrition and diarrhea and bidirectional diarrhea-malnutrition among under-fives. Majority of the participants agreed saying that breast milk is clean therefore cannot introduce any diarrhea causing germs to the infant, it also provides the baby with all nutrients required preventing malnutrition. The first milk, colostrum, strengthens the newborn's immune system making them able to fight off diarrhea causing germs. Initiating the infant early on breast milk also establishes milk flow implying that breast milk will be readily available on demand. Feeding a newborn baby on demand provides sufficient nutrients required for

growth and development hence preventing malnutrition among under-fives. The responses were as follows:

"...Does it mean that the nutrients change after an hour or something? I think that first breast milk, even if it's after 1 hour, will still do something to the baby's immunity (laughs). I don't know... [FGD1]
".... When initiation to breast milk after an hour fails, the child might develop a poor breastfeeding habit and this means that the baby might get malnutrition as this baby will not breastfeed... [FGD1]"
".... So, this will also make the baby go hungry and will lead to malnutrition. It will not lead to diarrhea unless if it has to do with hygiene... [FGD2
"...Not giving the child breast milk within the first hour will not lead to malnutrition since breastfeeding within the first hour is meant to enhance that bond... [FGD2]"
"...It is safe and very clean... [FGD1]"
".... It has all the nutrients... [FGD2]"
"...I think breast milk is free from any other hygienic condition that might get into the baby's body... [FGD2]"
"...No because you can initiate but may be with time the mother does not give this child breast milk... [KII1]"
"...Which we are at times terming as first immunization... [KII1]"
"...through this you realize that it is advisable that uh early initiation also promote milk production and the first milk uh colostrum is very key for...for the child and for clearing the system and... [KII2]"

All the responses per variable have been quantified and presented in percentage as captured in table 4.21

Table 4.21: *Number respondents saying YES/NO per variable*

SERIAL NUMBER	VARIABLE	RESPONDENT FEEDBACK	
1	Early initiation of breast milk within one hour of birth	YES(%)	NO(%)
		64	36
2	Exclusive breastfeeding	100	0
3	Complementary feeding	92	8
4	Construction of any type of latrine where there is none	73	27
5	Upgrading latrines from a low level to higher level	100	0
6	Clearing the compound of animal feces	100	0
7	Regular Cleaning of Shared Latrine by Households	86	14
8	Keeping Latrine Doors under Lock and Key	40	60
9	Clearing the Compound of Animal Feces	100	0
10	Caregiver Hand Washing	91	9
11	Keeping Under-Five's Finger Nails Trimmed	75	25
12	Treatment of water for drinking	83	17

4.5.1.2 Exclusive Breast Feeding

On if exclusive breastfeeding of under-fives prevents occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives., majority of the participants agreed it does. They expressed that breast milk is hygienic. This means that it is not contaminated with germs that cause diarrhea hence exclusively breastfeeding under-fives implies that for the first six months they will feed on safe food. Breast milk contains all nutrients therefore for the first six months the under-five will feed on adequate nutrients provided on demand preventing occurrence of malnutrition. Some of the setbacks observed is that caregivers' poor personal hygiene can create a

chance of contamination of the breast. When under-fives are put on contaminated breast they will ingest breast milk with diarrhea causing germs hence occurrence of diarrhea.

Below are some of the responses:

"…. It does because the first six months huh the child… uh when the child takes breast milk um issues of…uh hygiene are taken care of because the breast milk is in proper form, is good, is healthy and is the right mixture, right temperature and also the…the stomach of the young infants accept the… it naturally, its naturally given so I…I think…. [KII 1]"

"…young children or infants always rely on the mother's breast milk that is exclusive breast feeding and through the mother's milk we have we realize that almost all the nutrients are available… [KII 1]"

"…Yes, because if you exclusively give the child breast milk, it will prevent him from getting diseases… [FGD1]"

"…but a child who is exclusively breastfed rarely suffers from diarrhea rarely suffers from diarrhea and diarrhea you know diarrhea is one of the diseases which also lead to malnutrition… [KII1]"

Some of the concerns raised regarding exclusive breastfeeding include mother's personal hygiene:

"…Because uh the environmental factors of uh or and the in unhygienic environment can lead to contamination of the breast , one mothers cloths, mothers bra and even the water the mother is using can still be contaminated which will in turn uh contaminate the mothers breast and as the child is breast feeding then uh…germs can get into the child's system and you remember the child's system is still weak and the… his or her defense mechanism are also not fully developed and this can predispose the child to diseases like the diarrhea disease and any other….[KII2]

4.5.1.3 Complementary Feeding

The sought to validate if complementary feeding of under-fives prevented occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition. Under this sub theme the study highlighted ideas such as timing of complementary feeding, which should begin at 6 months in life of an under five, safety of feeding to include preparation and handling feeds in a hygienic environment and manner and age appropriate feeding of nutritious solid, semi-solid and soft foods. According to results from the interviews and FGDs, the majority of the respondents agreed complementary feeding prevents

occurrence of both malnutrition and diarrhea among under-fives. They stated that complementary feeding ought to begin from six months after birth. Providing complementary feeds from this point in the life of an under five ensures that they get a sufficient amount of nutrients preventing occurrence of malnutrition. From the age of six months nutritional needs of under-five increases because they are active and grown in body size therefore they cannot rely on breast milk alone for nutrition. To support proper growth and development they require additional feeds besides mother's breast milk. They further stated that in order to prevent malnutrition complementary feeds must be balanced, comprising the food groups thus energy giving , body building and protective foods for adequate nutritional status of an under five, the food should be handled in an hygienic manner so that it is kept free from contamination. Contaminated food has germs that are responsible for occurrence of diarrhea. Furthermore, the frequency of feeding under-fives should be observed.in order to prevent occurrence of malnutrition. For adequate nutrition for under-fives , complementary feeding should be 2-3 meals a day for under-five aged 6-8 months, 3-4 times daily from 9-24 months. Below are the responses provided by participants?

"...yes, it can if food is handled well but most of the time um there is diarrhea due to other issues maybe not even feeding because now the child is crawling gets anything and puts in the hand into the mouth... [KII2]"

"...I think if complementary feeding if done from six months and very well yes malnutrition and diarrhea will be minimized... you see after six months, the child has grown and does not get enough nutrients on breast milk alone. I think…..... [KII1]"

"...I think it that it prevents because complimentary feeding is adding new food to the diet of a baby... [FGD1]"

"...Yes, complementary feeding at six month because after six months the child does need more than just breast milk, needs other foods even the stomach has enlarged there is a lot

of energy and the child needs more energy than before and the child is more active, so the child needs to walk start crawling, running, playing a lot so the child needs a lot of complementary foods… [KII1]"

"…To me complementary feeding does not stop the children from passing diarrhea only if we practice the safety of the food and the quality at that time… [FGD1]"

"…. Since this is taking other food apart from breast milk, this can prevent since the child will get nutrients from various food like porridge and etc.… [FDG2]"

"…Complimentary feeding can prevent malnutrition since some other nutrients now being added to the baby apart from breastfeeding... [FGD1]"

"…Yes. Complimentary feeding at six months is very essential because at this time, you find that the nutrients that the child was getting from the mother is not sufficient… [FGD1]"

"...I believe if a child is fed well huh given the correct classes or groups of food especially the…from the ten groups if the child can get at least five per meal um that child can eat a well-balanced meal and this can avoid malnutrition coupled with breast feeding yes… [KII2]"

"…Because hygiene comes in very important and also the food texture yes and also may be the frequency of feeding if also the frequency is too much the stomach might not accept it the way, because this is a child who is still now picking up huh…[KII1]"

"…Because if you feed the under 5 with correct food, they will get al.,l the nutrients hence may not be malnourished…. [FGD2]"

"…When we talk of proper then it means uh it is hygienic in preparation in the process and uh…um the environment safety and uh it is hygienically done… [FGD1]"

4.4.2 Hygiene and Sanitation

As regards hygiene and sanitation, the study found out that unimproved pit latrine is associated with risks for a combination of malnutrition and diarrhea among under-fives. Also, shared pit latrines among households was noted to be associated with risks for malnutrition and diarrhea.

4.5.2.1 Construction of any type of latrine where none existed

The study sought to validate if constructing any type of latrine where none existed prevents occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. Majority agreed having any type of latrine reduces surface contamination with feces. Environments where there are latrines, feces are not scattered everywhere, and the under-fives cannot get into contact with them as they play around with soil or eat the same. Moreover, when it rains where there are no pit latrines the feces is spread all over and also washed into open water bodies. The under-fives while playing may end up drinking such contaminated water or it may be kept by a household for drinking. When under-fives drink contaminated water, they ingest. The responses are captured as below:

"…Yes, it will prevent malnutrition. Because in a community or a society where we have open defecations, it will contaminate maybe some areas or homes who are still using: boreholes and wells, the same water maybe feces carried when it is raining it will carry all he feces to our boreholes and it is the same water used in cooking, drinking…[KII1]"

"…Yes, it will prevent malnutrition. Because in a community or a society where we have open defecations… [KII2]"

"…So when we have a constructed latrine in the land it will prevent malnutrition… [FGD2]"

"…I don't see the connection between the latrine and malnutrition… [FGD1]"

"…even if lots of latrines are constructed and a child doesn't eat a balanced diet, he/she will be malnourished… [FGD1]"

"…It depends with the condition of the latrine; some are not in good condition and still we need to use them… [FGD2]"

"…Its 100% achievement because we will do away with the diseases, and more so diarrhea disease and contamination from flies and also the latrine, so that's why I said constructing a latrine is the key thing in the community and we must make sure it is used properly. Yeah… [FGD2]"

"…. Yes. if it is disposable in the latrine or in toilet then we reduce chances of diarrhea or diarrhea l related disease such as malnutrition occurrence by reducing contamination with the surfaces and this will also lead to the child growing and learning that faces need to be in the right place and at the right place is in the sanitation facility… [KII1]"

"...The waste is being controlled, they are not scattered everywhere, so children cannot easily get into contact with the waste. This can easily prevent them from contracting diarrhea and malnutrition… [FGD1]"

"….Yes, once you have a pit latrine I think it will help in controlling some of the diarrhea cases because you might find some irresponsible people might be disposing some of the feces around. So, when it rains and you know the nature or children they like playing a lot in dirty waters and when it rains the rains sweep everything and ensure the whole area is contaminated. It might not be visible but it is contaminated. So, pit latrine helps to control some of these cases because those fecal oral of those under-fives they might not take easily such things. But once it is an area where there are no pit latrines, you might find that those kinds of stuff are quite rampant and the children like eating soils and that one again is also a contributing factor that whenever they eat soil there is high cases there will be diarrhea … [FGD 2]"

"….if it is disposable in the latrine or in toilet then we reduce chances of diarrhea or diarrhea l related disease occurrence by reducing contamination with the surfaces and this will also lead to the child growing and learning that faces need to be in the right place and at the right place is in the sanitation facility…[KII1]"

4.5.2.2 Upgrading of Latrines

On if improving any type of latrine to a higher level (ladder) prevented occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives, majority of participants agreed, expressing that modernized latrines with conventional systems such as water facilities minimize the chances of malnutrition and diarrhea occurrence among under-fives. Such facilities provide a chance for anyone visiting the latrines/toilet to wash hands soon as they leave the facility. This means that

contaminated hands are washed at the point of contact with feces therefore caregivers would not transmit disease causing organisms to feeds of under-fives. Hands that are free from fecal contamination do not transmit germs that cause diarrhea among under-fives. Prolonged episodes of diarrhea result in malnutrition due to wastage of nutrients in every bowel motion and depletion of stored fat as well as burning down muscles leading to wasting. When latrines are improved to a conventional level like the flush-able toilets chances of coming into contact with feces is reduced. Unimproved latrines attract flies which can transmit disease causing germs to feeds of under-fives. If such contaminated feeds are ingested by under-fives, they develop diarrhea. Flush-able toilets are free from feces, reducing the presence of flies thereby hence occurrence of malnutrition, diarrhea, and bidirectional diarrhea-malnutrition among under-fives. Unimproved, dilapidated latrines may cause contamination of drinking water when floods occur and destroy them by sweeping fecal matter into water bodies. If under-fives play or drink such contaminated water they will develop diarrhea. On the other hand, some observed that even though the latrines may be improved, the under-fives still have to be fed on balanced diet in order to prevent occurrence of malnutrition: Below are some of the responses from participants:

"… Yes, upgraded latrines can prevent diarrhea. When you look at modernized latrines like maybe the VIP or the conventional system where- by you flush and so, chances of…uh of…of one… coming into contact with the excreta are minimized… [KII 2]"
"…so the better the latrines in terms of modernity the lesser chances of contracting diarrhea and to the… an extent mm minimize malnutrition… [FGD2]"
"…upgrading uh…of the existing facility led to serious reduction of diarrheal diseases… [FGD2]"
"…Yes, in the community we also talk of sanitation ladder… [FGD1]"
"…Yes. It prevents. If it's upgraded, then it means that there are kind of some safety in it. Upgrading might mean that we have introduced a sink on top of the latrine, then it means everybody will be accessing water to rinse themselves, most or sanitize and therefore upgrading also means that if it was not clean, it has now been made to e clean

or maybe there were some ways that it was exposing children to the contamination, now it has been improved… [KII1]"
"….I think an improved latrine like may be in the informal settlements they are latrines that their status are so bad we see the flies all over. So when we talk of pit latrine may be there will be reduction of the feces, extraction of the feces so they'll be reduction of flies and as we know the flies contribute much into causing diarrhea… [FGD2]
"…It can. Like in the informal settlements where by latrines are destructed by flood and water volumes, if we don't have modern latrines, the waste will be washed into the rivers which will be unhygienic hence causing diarrhea… [FGD1]"
"…when you look at modernized latrines like maybe the VIP or the convectional system where- by you flush and, chances of…uh of…of lat… coming into contact with the excreta are minimized…[KII1]"
"…so the more the modern the latrine I think the… the lesser chances of contracting diseases... [FGD1]
"…Yes. If it's upgraded, then it means that there are kind of some safety in it. Upgrading might mean that we have introduced a sink on top of the latrine, then it means everybody will be accessing water to rinse themselves, most or sanitize and therefore upgrading also means that if it was not clean, it has now been made to clean or maybe there were some ways that it was exposing children to the contamination, now it has been improved… [KII2]"
"…It can. Like in the informal settlements where by toilets are destructed by flood and water volumes, if we don't have modern latrines, the waste will be washed into the rivers which will be unhygienic hence causing diarrhea… [FGD1]"

4.5.2.3 Disposal of Animal Feces

Feces, whether from humans or animals can be a source of diseases causing germs. Clearing animal feces from the surrounding of under -fives is one way that is considered to disrupt the chain of infection. In this sub theme, the study validated that the clearing of animal feces from the environment is a way of preventing occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under –fives. Majority of the participants agreed, saying, "a waste is a waste and any waste can cause diarrhea in children "therefore clearing them from where under-fives live is a way of reducing contamination and preventing occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. Some of the responses included:

"… I agree it prevents because - uh disease free environment is uh hygienically free environment uh…and most of these things are sanitation related and all these wastes will

result in the water bodies in our environment hence the environment is polluted… [FGD2]"
"…I say yes because a waste is a waste and any waste can course diarrhea in children...uh... Some of these wastes are very harmful and that is why they are causing diarrhea cases .If they are cleared then diarrhea cases are prevented …."[FGD 1]."
"…Yes. If the hygiene of the caregiver is poor or the surrounding isn't safe, the child will develop diarrhea… [FGD2]"

4.5.2.4 Regular Cleaning of Shared Latrine by Households

Cleaning latrines regularly is among the major practices that are considered to prevent occurrence of malnutrition and diarrhea among under-fives. Clean latrines are not visited by flies, which transport disease-causing organisms to feeds of under-fives, and reduce chances of under-fives and caregivers coming into contact with feces. Most participants agreed that regular cleaning of shared latrines by households can prevent occurrence of a combination of malnutrition, and diarrhea among under-fives. If shared latrines are cleaned regularly, the chances of infection like diarrhea, cholera among under-five will be so low because cleaning acts as disinfection. If the under-fives do not suffer diarrhea they are less likely to develop malnutrition that is related to diarrhea. Regular cleaning of latrines shared by households also creates a sense of ownership and accountability.

Some of the challenges that hinder regular cleaning of shared latrines include confusion as members will not stick to the responsibility; failure to reach a consensus on who is to clean the latrine.

The responses are captured as below:

"…I agree, uh... An example a family will wake up very early and will make the toilet clean every day for seven days, Monday to Sunday and another family will pick up. Latrine are clean preventing contamination… [KII1]
"…Yes, because ownership…ownership and uh sustainability of the hygienic practices of a given population or a given community health extension workers and focal people will in turn uh improve on…communal understanding… [KII2]"

"…If the latrines are cleaned regularly, the chances of infection to the children will be so low unlike those not cleaned regularly and diarrhea leads to malnutrition… [FGD2]"

"…cleaning will act as disinfection… [FGD2]"

"…Yes, the toilets that are cleaned always have few flies as compared to the other uncleaned. This will reduce the cases of infection… [FGD1]"

"…It will not prevent because it will bring a lot of confusion as they might complain on the shared responsibility… [FGD1]"

"…Yes, cleaning regularly can prevent diarrhea and diseases like cholera… [FGD2]"

"…Cleaning toilets frequently can prevent a child from diarrhea because our environment will be free from flies and any dirt that can cause diarrhea… [FGD1]"

4.5.2.5 Locking Latrine Doors

Under this sub theme, the study validated if keeping latrines under key and lock prevented occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea among under-fives. Majority of the participants agreed. Keeping latrines under lock and key minimizes flies and reduces contamination of under-five feeds hence reduced occurrence of diarrhea. It also creates a sense of responsibility among users. Those using a latrine that is kept under lock and key become accountable, they remain focused on maintaining cleanliness of the facility. With clean facilities, flies are reduced, chances of contamination are minimized reducing occurrence of diarrhea and bidirectional diarrhea- malnutrition among under-fives.

Some of the challenges observed with keeping latrines under lock and key include inadequate ventilation otherwise they will attract flies; those who don't have latrines resort to open defecation because they are unable to access the facility; the locked latrines are at times vandalized by other community members in order to gain entry and dilapidated facilities still attract flies. The responses are as below:

"…True and it depends from many perspectives that you view it but uh if you go lock the…the latrines or the toilets then you realize that uh modernized and well-constructed adapted structures will work because the flies will not move in and move out …[KII2]"
"…maybe it is a latrine which is dilapidated that even though you have closed it, (laughter) flies will still get in maybe if it is a…a latrine where by it is not well ventilated and improved so flies can get in and get out…[KII 2]"
"…okay locking to some extent that one is also true because it can bring a sense of responsibility to the people using it, once they lock it anybody who goes there to use it at least can be responsible to use it well…[KII2]
"…only unless if every household has a pit latrine or has a sanitation facility… [KII1]"
"…locking it can also lead to people using… abusing the same sanitary facility including vandalizing then… [KII1]"

4.5.3 Caregiver practice

As concerns caregiver practices, this study found that untrimmed fingers of under-fives was associated with risks for bidirectional diarrhea-malnutrition. Furthermore, drinking water that is not treated water and partial hand washing among caregivers were also associated with risks for a combination of malnutrition and diarrhea among under-fives.

The three identified interventions that could prevent occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition (Figure 4.10) were subjected to validation by CHPs and SCCHSCs and feedback presented as below:

4.5.3.1 Caregiver Hand Washing

This sub theme validated whether caregiver hand washing compliance prevented occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. Most of the respondents agreed hand washing prevents the occurrences. They said caregivers should practice hand washing before breastfeeding the baby, after removal of nappies, after visiting the toilet, while preparing food for the under-fives. Hand washing "prevents small viruses". Care giver's hands may "get into contact with under-five's feces, while changing baby's nappies. If a caregiver fails to wash hands at critical times the under-fives "might ingest dirty food hence getting

diarrhea". The participants also expressed the relationship between malnutrition indicating that diarrhea can lead to malnutrition "can lead to diarrhea hence causing malnutrition" The responses were as below:

"…but generally we encourage hand washing because even during COVID when we were washing our hands frequently, we had a reduction on some diseases like flue, diarrhea.… [FGD1]"
"…Yes. We have them changing the baby's nappies. And when doing that, they might get in contact with the child's feces… [FGD1]"
"Assuming, they immediately breastfeed the baby without hand washing. The child might ingest dirty food from the caregiver hence getting diarrhea and this comes with a side effect that is malnutrition…… [KII2]".
"…Malnutrition is lack of enough nutrients in the body, not hand washing… [FGD]"
"…without washing hands after visiting the toilet, she goes picks up the baby and feeds her. That one also can lead to diarrhea hence causing malnutrition… [FGD2]"
"…when a caregiver is preparing the baby's food, then, before and after they should also clean their hands and even the children's utensils should be well cleaned If not, then diarrhea will occur…[FGD1]"
"…. Yes, it prevents because washing my hands in critical times prevents these small viruses. Viruses are small organisms that we cannot see unless with a microscope… [FGD2]"
"…I think hand hygiene goes hand in hand with malnutrition… [FGD1]"
"…. She might face diarrhea since she might contaminate food with the dirty hands…" [FGD 2]
"…if the hygiene of the caregiver is poor or the surrounding isn't safe, the child will develop diarrhea… [FGD1]"

4.5.3.2 Trimming Under-fives Fingernails

In this sub theme, the study validated if trimmed fingernails prevented occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. Majority of the participants agreed trimmed fingernails prevent occurrence of such diseases because short nails do not harbor dirt which attract germs "long nails can attract germs". Long finger nails of under -fives tend to keep dirt which attracts germs, if an under five ingests food that is contaminated as a result of harbored dirt they will

develop diarrhea and lose the nutrients through frequent opening of bowels hence malnutrition. The responses were as follows:

"…Yes, it will prevent occurrence of malnutrition and diarrhea, in that the child with untrimmed nails would play anywhere and play anyhow and most of the time their hands are not clean and they'll tend to put the fingers in the mouth… this… they swallow germs and get infection like diarrhea that is not treated late leads to malnutrition…..[FGD2]"
"…they will not remove the dirt from their hands, so if u keep it short, shorter it will prevent diarrhea… [FGD1]
"…long nails prevents a child from eating well and this can lead to malnutrition… [KII1]" l
"…remember Under-fives tend to do everything using their hands so keeping their nails short is one of the ways to reduce infection causing diarrhea but not to prevent….[FGD1]"
"…Keeping their nails will prevent diarrhea as nails keep germs since long nails can attract germs which can cause diarrhea… we know that a child diarrheas all the nutrients they eat leading to malnutrition [FGD2]"
"…And if their nails are not kept short, some remains of germs will remain in their nails… [FGD2]"
"…when we keep the under 5 nails clean, it will reduce the rate, but it will not prevent, may be the nails are clean but their hands are dirty…. [FGD]"
……"Yes. One thing is for sure diarrhea is one of the links that will lead to malnutrition. If we cut off this one link of diarrhea then we cannot get malnourished children. So, the moment we have diarrhea you be sure if it is not properly prevented it is going to lead to malnutrition because it is one of the pathways leading to malnutrition. So the moment the nails are kept long such that they can harbor the germs and use our hands to feed we'll still be diarhearing like every day and like I said it is one of the ways leading to malnutrition. Long finger nails also affects malnutrition…… [FGD 2]"
"…hey will not remove the dirt from their hands, so if u keep it short, shorter it will prevent diarrhea… [FGD]
"…when we keep the under 5 nails clean, it will reduce the rate, but it will not prevent, may be the nails are clean but their hands are dirty…. [FGD]"

4.5.3.3 Treatment of Drinking Water

Under this sub theme the current study sought to validate if treating water for drinking prevented the occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition. Most participants agreed the practice prevents the occurrence of such conditions saying that safe water is part of meals, clean water is free from

contamination therefore prevents under-fives from suffering diarrhea which is likely to lead to malnutrition, if the episode is prolonged. Below are some of the responses

"..Drinking treated water prevents malnutrition under five children….. [FGD1]"

"…drinking treated water prevents malnutrition under five children. Because direct water from the lake is contaminated……. [FGD2]"

"…Yes it prevents, because under the feeding program water is part of our meals because we are told in a day we must drink at least eight glasses…. .[FGD1]"
"…So, when its clean it will prevent malnutrition but if the water is contaminated the child will be affected with diarrhea which lead to malnutrition… [FGD1]"
"…drinking treated water cannot prevent malnutrition… [FGD2]"

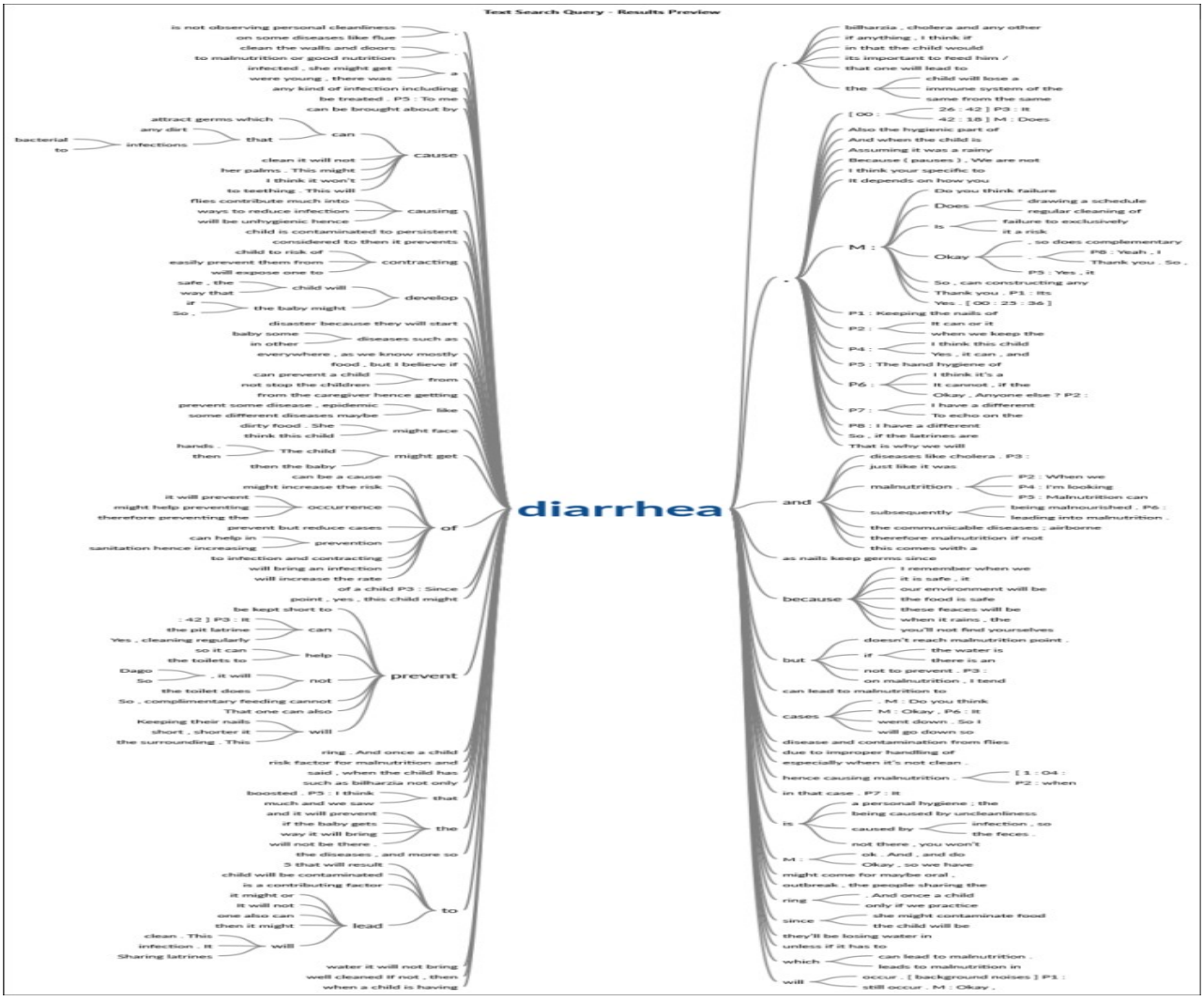

Figure 4.11: *Text Search: Word tree showing the connection of words related to diarrhea as expressed in verbatim*

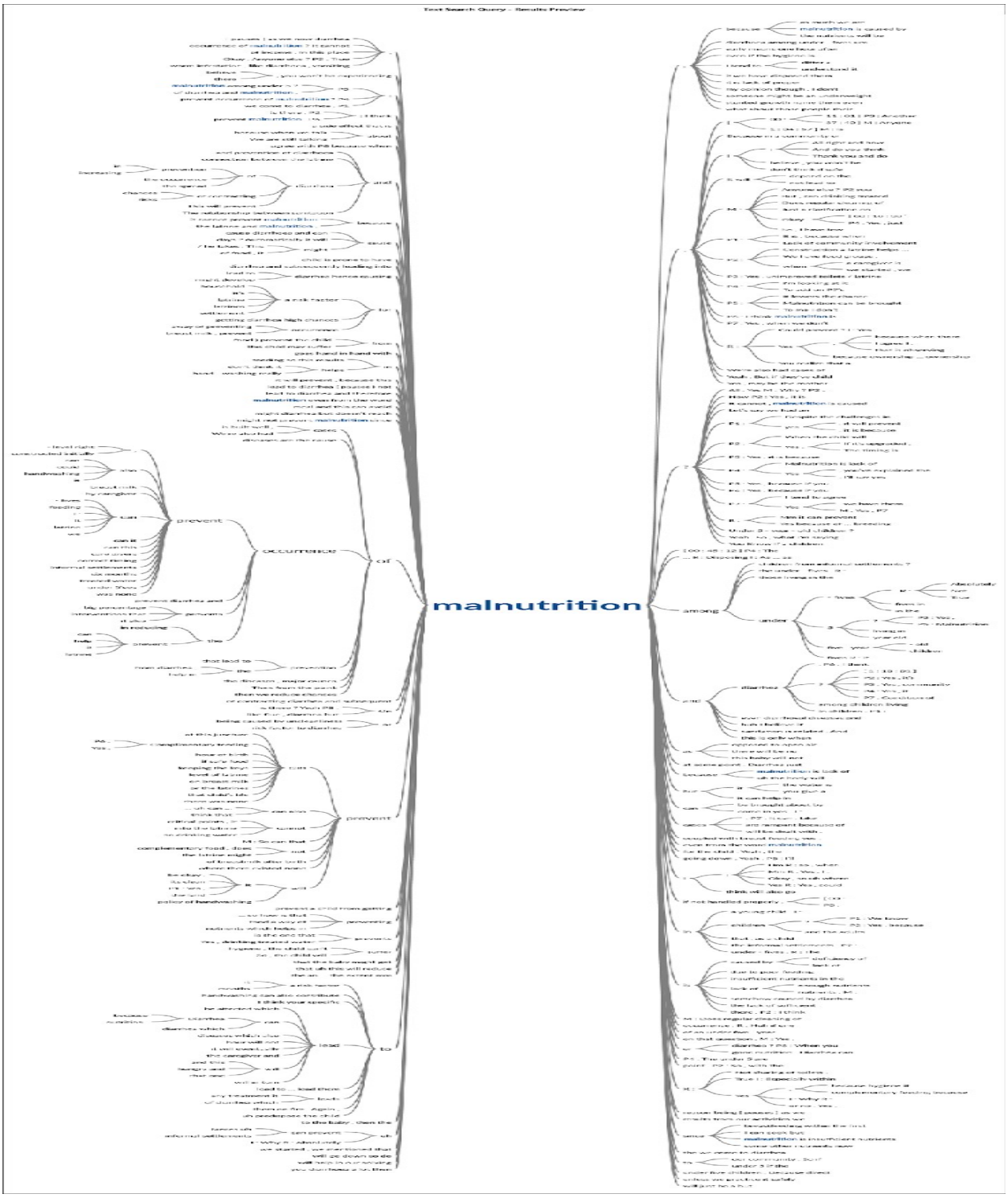

Figure 4.12: *Text Search: Word tree showing the connection of words related to malnutrition as expressed in verbatim during data collection from FGDs and KII*

Based on the discussion and interview of CHPs and SCCHSCs respectively, two word trees (Figures 4.11 and 4.12) for malnutrition and diarrhea were generated. They display connection of words related to malnutrition and diarrhea as expressed by the respondents

4.5.4. Challenges to proper infant and young child feeding

Generally, the challenges that were mentioned by respondents regarding proper infant and young child feeding in the informal settlements included lack of awareness about proper infant and young child feeding practices. This includes poor knowledge on timing of initiation of breastfeeding after birth, exclusive breastfeeding: how long it should be practiced and complementary feeding (the composition of feeds, the extent to which the food given to under-fives is balanced, frequency of feeding based on age and food safety). The respondents reported that caregivers mostly feed under-fives on mashed potatoes, they rarely prepare lunch and instead opt to buy fast food from street vendors. Such food more often than not are not balanced or safe thereby predisposing the under-fives to malnutrition and diarrhea respectively. Poverty situation in the informal settlement affects the ability of caregivers to feed the under-fives on a balanced diet due to reduced purchasing power thereby leading to malnutrition. Due to lack of money, caregivers are not able to afford health care when under-fives become sick leading to chronic states of the diseases and resulting in malnutrition. Below are statements from participants:

…….”Ignorance, two lack of awareness. Three; poverty and availability of food supply and other options. People tend to think that conventional foods are the best and especially the informal settlement where farming is not being done then everything has to be bought. So, somebody tends to think that all that they want they have to buy from the supermarket, already cooked food, street food……. [KII]”
Regarding how proper infant and young child feeding could be sustained in the informal settlements in order to prevent occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition.

4.5.5 Strategies for promoting proper infant and young child feeding

As regards proper infant and young child feeding the following strategies were recommendations by respondents for overcoming the challenges faced in practicing proper infant and young child feeding among caregivers : stakeholder involvement- caregivers of under-fives need to be involved in i) mapping out food resources at their disposal for mitigating insecurity. This means exploiting the option of locally available cheap food like "omena", beans, green grams, ground nuts, eggs which are rich sources of protein ii) coming up with kitchen garden for readily available vegetables that are sources of vitamins and also provide protection to the body, ii) poultry farming for eggs and meet; goat rearing for milk and meat iv) awareness creation about early initiation of infants on breast milk within an hour of birth, exclusive breastfeeding of an under five for the first six months of life and complementary feeding from the sixth month of life. Moreover partnership with the department of nutrition and other health related partners also reinforce proper infant feeding. The following are responses from participants:

……"before there were cases of diarrhea among under five and the general population especially in the informal settlement but through stakeholder involvement, through capacity building through household awareness, through mapping and walking in the household with under five and engaging with them we've seen a reduction in under 5's diarrheal cases……[KII 2]"

……" the nutrition department and other partners which have channeled their support in the informal settlement have done a good work including the community within those informal settlements, they have done a great work…. .[KI 1I]"

4.5.6 Sustainability strategies for proper infant and young child feeding

On sustainability strategies for proper infant and young child feeding in the informal settlements, the respondents mainly pointed out the need for community empowerment, initiating mentor-ship programs on under five feeding practice, peer support group of

young mothers, enhanced male involvement in feeding strategies of an under five and high standard of hygiene in the environment . The responses were as follows:

"…the caregivers including the parents, the mother and the sisters are empowered with the knowledge to understand that the environment of a child needs to be safe, needs to be clean and need to be protected so that the child can develop uh to realize his full potential within the first 1000 days…[FGD]"

"…give them the information first, information is power…. .[FGD]"
"…have them weekly or biweekly forums whereby they are mentored by s…the mentor mothers and what they expect and the importance of what they need to do and how they need to do it….[FGD]"
……"through awareness and ensuring that we have young mothers support groups and also male involvement is key here so that at the end of it they can know what type of food are required where do they get them and of nutritive value are they. Now we are advocating for nutritious food and food groups and how are you feeding the child and what quantity and in what form does this food need to be……. [KII]"

4.5.7 Challenges to Hygiene and sanitation

Even though having any type of latrine is promoted there exist challenges to ownership, like lack of awareness where the community does not understand the health benefits of owning a latrine or sanitation; inadequate space due to poor planning- the landlord's prioritize building rental units that generate money but not latrines. Another challenge is poverty, lack of money to buy the necessary materials for constructing latrines. The responses were as below:

> *…."Space, poor planning, lack of knowledge. Four; inadequate for technology and lack of varied options because in the informal settlements you realize that ownership of the space and maintenance that is the artisans the skills and poverty is also at play. They think they cannot afford but they can afford food but where they are taking the feces they don't plan, people are just money minded. They only think of doing doors for people to occupy but they don't know where the feces will be, they don't know how the waste will be taken care of. …. .[KI1I]"*

The challenges that are experienced as regards upgrading latrines to higher levels include landlord leaving their plots to be taken care of by an agents who cannot make decisions about upgrading a facility – implying that tenants may continue using un-improved facilities. Such facilities which may lack hand washing facilities, adequate ventilation, dilapidated and have poor hygiene become a source of contamination. They attract flies which transmit disease causing organisms to feeds of under-fives. Because of such poor states the under-fives may touch the dirty environment within the latrines while playing and fail to wash hands before handling food, ingesting diarrhea causing germs with food. They may fear to use such poor state facilities and opt to defecate in the open.

The facilities are sometimes vandalized by people thereby degrading their states. They become unlock-able, can be accessed by anyone, and can be misused hence it becomes difficult to keep flies away. The flies will move in and out of the facilities, carrying organisms that are responsible for diarrhea, contaminate feeds for under-fives. The under-fives or caregivers can come into contact with feces yet would not wash hands at the latrine /toilet if hand washing facilities may have been vandalized. When caregivers, after visiting the latrines, handle food for the under-five without washing hands, they become a source of contamination leading to diarrhea among under-fives. The responses from caregivers are as follows:

> *....."You realize that somebody relies more on agents which are not the decision maker in a given plot. So, at the end of it the issue of latrine, the issue of sanitation, and the issue maintenance becomes a big one.*
> *Vandalizing is also key in the informal settlement. People tend to vandalize anything intentionally or by design then they take them for scrape..... {KII2]"*

4.5.8 Sustainability strategies for Hygiene and sanitation in the informal settlements

To sustain improved sanitation in the informal settlements the following strategies were proposed by the respondents: i) building communal toilets- public toilets are built in the informal settlements for ready access by residents. This promotes improved sanitation through correct human waste disposal reducing flies in the surrounding. With reduced flies, food contamination incidents are decreased, under-fives will not ingest disease causing organisms with their food and occurrence of diarrhea and bidirectional diarrhea-malnutrition is reduced ii) Strengthening activities such as community led total sanitation- community members are sensitized and allowed to be on the front line in advocating for use of toilets/latrines . They are encouraged or facilitated to construct latrines using locally available materials as well as monitor compliance. Involving community members in their health issues promotes buy in, they own the process and appreciate the importance of using latrines as well as encourage other members to use latrines. When community members develop the habit of using latrines as opposed to open defecation, contamination with feces is reduced. The incidences of contamination among under-fives, as they play in the open is reduced. When the under-fives contaminate hands while playing, eat without washing hands, they ingest disease causing organisms hence develop diarrhea. Since nutrients and water are lost during diarrhea the under-fives become malnourished if the incidence is not treated in time.

The responses were as follows:

"…through interventions of having the communal toilets, shared sanitation options and uh upgrading uh…of the existing facility led to serious reduction of diarrhea diseases… [FGD]"

"…we used to have what we called uh community led total sanitation where-by the community are triggered uh to realize that their… their sanitation is not good, they

realize that they are going to the toilet in the open so they are triggered to…to look for a way of having latrine on their own rather than being given subsidies… [FGD]"

"…when they come together and use the locally available resources to build toilets, there will be no open defecation. When they team up, these feces will not be anywhere in the surrounding. This will prevent diarrhea and malnutrition… [FGD]"

"…where the community decided to construct community toilets [Fresh life]. They formed groups and within these groups, they decided to have group/community toilets. That one can also prevent diarrhea… [FGD]"

Based on the feedback from CHPs and SCCHSCs, the study found out that there was inadequate knowledge among the community health workers on certain aspects of infant and young child feeding, caregiver practices,and hygiene and sanitation (see Figure 4.11). CHPs had inadequate knowledge regarding how the following interventions could prevent a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition:

4.5.9 Infant and young child feeding:

Community health promoters and SCCHSCs had inadequate knowledge about how initiation of breastfeeding within one hour of birth and complementary feeding from 6-23 months- could prevent both malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives.

4.5.9.1 Initiation of breastfeeding within one hour of birth

On if initiating breastfeeding within one hour of birth can prevent occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition, below is the excerpt from CHPs and SCCHSCs response:

"…Does it mean that the nutrients change after an hour or something? I think that first breast milk, even if it's after 1 hour, it will still do something to the baby's immunity (laughs). I don't know… [FGD1]

"…No because you can initiate but may be with time the mother does not give this child breast milk… [KII1]"

Interpretation

Community health promoters have insufficient knowledge regarding how initiation of early breastfeeding within one hour of birth is associated with malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives

4.5.9.2 Complementary feeding

On complementary feeding, below is a response from one of the respondents:

"…To me complementary feeding does not stop the children from diarrhearing only if we practice the safety of the food and the quality at that time… [FGD1]"

Interpretation

Some CHPs do not understand how complementary feeding is associated with diarrhea among under-fives.

4.5.10 Hygiene and sanitation

Further still, the study noted that CHPs and SCCHSCs did not have adequate knowledge about how constructing a toilet where none existed, regularly cleaning of latrines that are shared among households and keeping latrines under lock and key could prevent occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives.

4.5.10.1 Constructing any type of latrine

On whether construction of a latrine where none existed could prevent malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives, below were some of the responses:

"…I don't see the connection between the latrine and malnutrition… [FGD1]"

"…even if lots of latrines are constructed and a child doesn't eat a balanced diet, he/she will be malnourished… [FGD1]"

"…It depends with the condition of the latrine; some are not in good condition and still we need to use them… [FGD2]"

Interpretation

CHPs do not understand the association between improved sanitation and malnutrition among under-fives

4.5.10.2 Regular cleaning of latrines shared among households

On regular cleaning of shared latrines, a respondent stated that:

"…It will not prevent because it will bring a lot of confusion as they might complain on the shared responsibility… [FGD1]"

Interpretation

Some CHPs do not clearly understand the association between regular cleaning of latrines shared among households and malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives.

4.5.10.3 Keeping latrine doors under lock and key

Asked if keeping the doors of latrine under lock and key could prevent occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives in informal settlements, below were the responses:

"…maybe it is a latrine which is dilapidated that even though you have closed it, (laughter) flies will still get in maybe if it is a…a latrine where by it is not well ventilated and improved so flies can get in and get out…[KII 2]"

"…only unless if every household has a pit latrine or has a sanitation facility… [KII1]"

"…locking it can also lead to people using… abusing the same sanitary facility including vandalizing then… [KII1]"

Interpretation

SCCHSCs do not have sufficient knowledge on how keeping latrine door under lock and key is associated with malnutrition, diarrhea and bidirectional malnutrition among under-fives

4.5.11. Caregiver practices

The study also found out that CHPs and SCCHSCs had in adequate knowledge about the association between caregiver practices such as hand washing before preparing food, feeding an under five, touching the under-five, after removing diapers from under five, and visiting the toilet; trimming nails of an under five and treating water for drinking and occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition. The following are some of excerpts from their responses regarding caregiver:

4.5.11.1. Hand washing:

On if caregiver hand hygiene practice at critical times could prevent malnutrition, diarrhea and bidirectional diarrhea malnutrition, below is a response from one of the participants:

"…Malnutrition is lack of enough nutrients in the body, not hand washing… [FGD 2]"

Interpretation

Some CHPs have insufficient knowledge about how caregiver hand washing is related with malnutrition among under-fives

4.5.11.2 Trimming of under-five finger nails

Regarding caregiver practice of trimming under five fingernails, CHPs had the following responses

"…remember Under-fives tend to do everything using their hands so keeping their nails short is one of the ways to reduce infection causing diarrhea but not to prevent….[FGD1]"

"…when we keep the under 5 nails clean, it will reduce the rate, but it will not prevent, may be the nails are clean but their hands are dirty…. [FGD 1]"

Interpretation

CHPs have insufficient knowledge on the association between caregiver practice of trimming under five finger nails and occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives

4.5.11.3 Treating of drinking water:

"…drinking treated water cannot prevent malnutrition… [FGD2]"

Interpretation

CHPs have insufficient knowledge about how safe water for drinking is associated with malnutrition among under-fives.

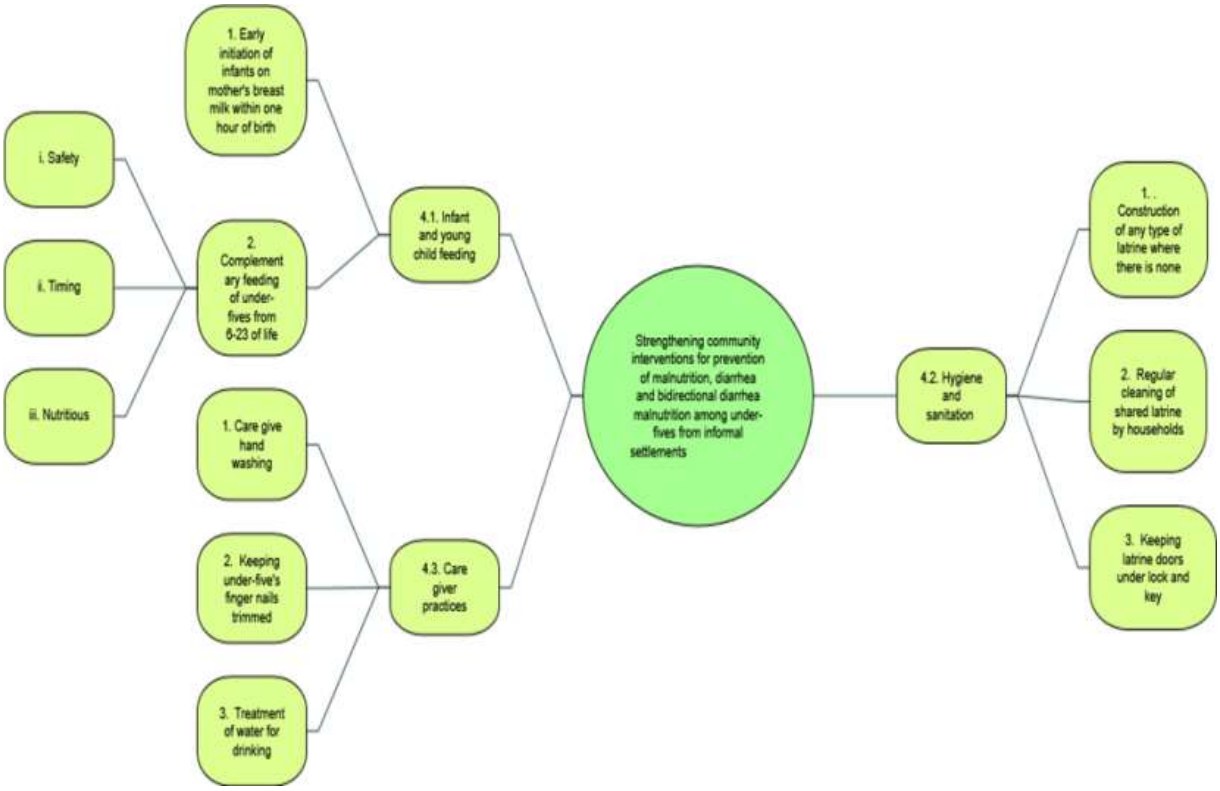

Figure 4.13: *A co created framework for strengthening community based interventions.*

Figure 4.13, a co-created framework comprises three community based interventions. It is different from proposed framework in objective two by the listed:

1. It was developed from the proposed framework generated from objective two.

2. It comprises of reduced number of themes as compared to the proposed framework, as follows: infant and young child feeding which fundamentally has three sub themes has two in the co-created framework that is: early initiation of breast milk

and complementary feeding, ii) hygiene and sanitation comprises construction of any type of latrine where there exists none, regular cleaning of shared latrines by households and keeping latrine door under lock and key however, caregiver practices includes all the components as captured under this same theme of the proposed framework.

3. This framework outlines interventions whose association with malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives, were not clearly understood by CHPs and SCCHSCs.

4.5.12 Summary of the results

The current study purpose was to strengthen community based interventions for prevention of malnutrition diarrhea and bidirectional diarrhea-malnutrition among under-fives in informal settlements of Kisumu County, Kenya. Results of the study indicate that 52 and 53 under-fives had malnutrition and diarrhea respectively. The high occurrence of malnutrition and diarrhea ranging between 71.7% and 78.85% was in the ages 6-23 months; other groups had 13.46- 18.87% < 6 and 7.69- 9.43% 24-59 respectively; 56.67% with MUAC < 115mm were females. Fisher's exact test of association between malnutrition and gender revealed a statistically significant relationship at 5% significance level (P-value < 0.05). Of the 33 cases with bidirectional diarrhea-malnutrition, n=28 (84.85%) were aged 6-23 months and 21 (63.64 %,) were diarrhea to malnutrition; 38% with malnutrition and 73.58% with diarrhea had their fingernails untrimmed; under-fives of caregivers who experienced water shortage were 5.4 times more likely to have bidirectional diarrhea -malnutrition (OR=5.40, 95%CI=1.49-19.59, P-value=0.01; 67.3% -83.02% of under-fives with malnutrition and diarrhea respectively were on complementary feeding, 36.54% and 37.7% with malnutrition and diarrhea respectively

lived in households not treating drinking water. Community health promoters had inadequate knowledge on early initiation of breast milk, Complementary feeding, and construction of any type of latrine where there is none.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter presents a summary of the study in the following order: discussion of study findings per objective, conclusion, study recommendations and suggestion for further studies.

5.2.1 Socio-Demographic Characteristics of Under-Fives and their Care-givers

In the current study, 78.85% of under-fives with malnutrition were aged between 6-23 months. Findings of this study agree with a report by Wainaina (2019) that under-fives aged between 6 -23 months form the biggest proportion of malnutrition cases. Study report by Boss *et al.,* (2020) reiterates findings of the current study and states a proportion of 79% were in the age group of 6-23. At the age of 6 months, under-fives are expected to be started on complementary feeds to make up for their increased energy requirement because of advancing age. If the transition is either delayed or done earlier than expected, the growth of under-fives may falter. Furthermore complementary feeds should be safe, well balanced and age appropriate. Poor handling of food leading to contamination predisposes under-fives to diarrheal diseases and complications such as malnutrition (WHO, 2023).

Severe or frequent episodes of diarrhea are likely reasons for having more of this age group suffer malnutrition. At this stage under-fives start crawling or walking and may play about with contaminated objects, ingesting disease causing organisms.

It is important to note that the current study was conducted during the COVID-19 pandemic when countries experienced shut down of economic activities, this could have led to food insecurity more so in the informal settlements. It therefore means that more

attention should be given to under-fives in the age period of 6-23months when certain restrictions that impact on economic activities are to be rolled out.

In this study, male under-fives formed a larger proportion, 55.77%, of those admitted with malnutrition. This finding is however higher than that of Gahvi *et al.,* (2020) where the proportion of males was 50.2%. Alvear and others also state that there is a greater probability of male under-five suffering malnutrition than female counterparts (Alvear *et al.,*, 2022).

In this study, 65.38% of caregivers to under-fives with malnutrition had primary level or no formal education. A study of factors related to malnutrition among under-fives indicates that caregivers who had no formal or low education level had their under-fives admitted with malnutrition more than those with high education level (Menalu *et al.,*, 2021). The current proportion is almost the same as that of Ireri *et al.,* (2020) which states that 58.2% of caregivers whose under-fives suffer malnutrition have primary education level.

Low education level may negatively affect health decisions taken by caregivers such as where to seek health care and the kind of diet to feed under five on. Low level of education could also translate to meager family income, affecting its purchasing power. Majority, 55.77% of caregivers to under-fives with malnutrition earned less than USD 92.34 per month. This result is consistent with that of Ngina (2018) which states that under-fives belonging to caregivers whose monthly income is less than USD 92.34 are more likely to suffer malnutrition. Low income implies that purchasing power of caregivers, for items like food and its required varieties is reduced. It also translates to

poor affordability of healthcare and this could make malnutrition and diarrhea diseases become severe and complicated.

According to this study finding, the majority, 71.70% of under-fives admitted with diarrhea belonged to the age group 6-23 months. The proportion in the current study is however higher than one by Mulatya *et al.,* (2020) which states that under-fives in the age range of 6- 23 months that suffer diarrhea is 51.3%. The difference in proportions between these two studies could be due to different sample sizes as the current study included 53 participants while Mulatya *et al.,* reviewed data of 2906 with diarrhea. The high proportion observed in the age group of 6-23 months could be because from the age of 6 months under-fives are introduced to complementary feeds that are likely to be contaminated during handling. Furthermore, the under-fives could directly come into contact with animal or human feces from a poor sanitation environment when they play about. Also during this period, under-fives are either crawling or walking and are likely to come into contact with contaminated objects which they end up putting in their mouths hence ingesting diarrhea causing organism. Moreover, antibodies from the mother tend to reduce because of partial breastfeeding as other feeds are provided and the child does not entirely depend on mother's breast milk alone. When complementary is poorly done and a balanced diet not provided immunity of under-five may be reduced making them susceptible to gastrointestinal infections (WHO, 2021).

In this study, findings revealed that male under-fives formed the highest proportion of those admitted with diarrhea at 67. 92%. The current study reports a higher proportion of males compared to 50.4% which is stated by Demissie *et al.,*, (2021). This difference could be because the latter study included many countries and the percentage could have

been influenced by the effect of average. The reason as to why more male under-fives suffer diarrhea than their female counterparts still remains speculative. This study report indicates that the majority, 38.8% of under-fives live in the informal settlement of Manyattta followed by Nyalenda with a proportion of 20.75%. These two are the largest informal settlements of Kisumu County.

Out of the total number of caregivers of under-fives admitted with diarrhea, who participated in the current study, 64.15% earned a monthly income of less than USD 92.34. The current finding is lower that of Guillaume *et al.,*, (2020) which states that 79.9% of caregivers whose under-fives suffer diarrhea earn a monthly income of or less. The difference could have been due to the fact that the current study was conducted during the time when the world was hit by COVID-19 pandemic and guideline restricting movements was in place. This may have reduced caregiver involvement in income generating activities and the number that would have bought any goods. It implies that caregiver income will be reduced and this affects their purchasing power for food items and access to health services in case a child suffers malnutrition and diarrhea

This study reported that 64.15% of under-fives with diarrhea lived in households with 4 members or more. The finding is consistent with that of Guillaume *et al.,* (2020) which states that diarrhea occurred more in households that are crowded. It therefore implies that under-fives living in large households tend to suffer diarrhea more than those in households with less than 4 members. This could be because maintaining hygiene in crowded environments is a challenge and this situation predisposes under-fives to contamination. Also large amounts of hygiene facilities would be needed for adequate compliance with guidelines, by household members. Residents of informal settlements

face a myriad of constraints and may not afford and sustain hygiene facilities such as hand washing soap especially for large households.

5.2.3 Malnutrition Status among under-fives

In this study,94.2% suffered acute malnutrition which is inconsistent with a report by Khan *et al.,*, (2019) indicating that only 10.68% of under-fives suffer acute malnutrition. The current study may have documented a high proportion of acute malnutrition because it was conducted during COVID-19 pandemic. During the period of COVID-19 pandemic measures such lock down and curfew were enforced interrupting businesses while some employees were laid off. These measures are believed to have had far reaching economic effects on the already disadvantaged caregivers and their under-fives living in informal settlements.

According to this study, severe acute malnutrition, MUAC of < 115mm, occurred more, 93.33%, among under-fives aged 6-23 months. The current study finding is higher than that of Elnadif (2020) which reports that about 67% of under-fives with severe acute malnutrition were aged 24 months and below. The difference in proportions could be because during the current study, there was marked food insecurity, inadequate economic resources at individual, household, and community levels as a result of worldwide pandemic at that time. The pandemic state resulted in a lockdown restricting human economic activities.

In this study, it was determined that 56.67% of under-fives admitted with malnutrition and whose MUAC <115mm were females. Fisher's exact test of association between malnutrition and gender revealed a statistically significant relationship at 5% significance level (P-value < 0.05). The finding is different from that of Okari *et al.,*, (2019) which

states that males formed the highest proportion of 52.9% of those with MUAC < 115mm. Furthermore, Thrstans *et al.,*, (2020) also report that males have 26% higher odds of wasting compared to females

According to findings of our study, 66.67% of under-fives admitted with malnutrition had MUAC of < 115mm, severe acute malnutrition. This finding is higher than that reported by Haq UI *et al.,*, (2021) .From Haq and others' study which was conducted in flood-hit regions of Khyber Pakhtunkhwa, Pakistan, 46% of under-fives had MUAC related malnutrition.

The study found that, among the under-fives with malnutrition, 44.23% and 38.46% had anemia and were born to mothers who are infected with HIV respectively. The finding of the current study regarding anemia and malnutrition among under-fives suffering malnutrition is corroborated by a report of Baraki *et al.,* (2021) which states that about 41.43% of under-fives with malnutrition suffer anemia. In addition, Rahman *et al.,*, (2019) state that the prevalence of anemia is found to be higher among stunted under-fives as compared to their counterparts who are not at a relative proportions of 56% and 48% respectively. Since stunting is a result of chronic malnutrition, the under-five may have suffered nutritional deficiencies of iron, folic acid, or vitamin B12. Regarding malnutrition among under-fives born to mothers who were HIV positive, 45% of them were stunted (McHenry *et al.,*, 2019). Overall health of a caregiver is critical to that of an under five as a sick care giver is unable to involve in meaningful economic activities as well as pay close attention to nutritional needs of an under five. On the other hand the findings in the current study could be inconclusive because there may have been other

factors that influenced the nutritional status other than anemia and HIV positive state of mothers.

The current study also found out that 38.46% of the under-fives with malnutrition had been treated for diarrhea two weeks preceding the current condition, a confirmation of bidirectional relationship between diarrhea and malnutrition. Children with who suffer prolonged episodes of diarrhea lose appetite affecting the amount of food they eat, nutrients are also wasted with bouts of diarrhea making them develop malnutrition (Wasihun *et al.,*, 2018).

Majority, 75% of caregivers reported treating the under-fives at home before seeking medical attention. The current finding is however higher than that reported by Ahmed*et al.,*, (2021) which asserts that the overall prevalence of self-medication of under-fives by caregivers is 58.82%. The difference seen between the current study and that of Ahmedet *et al.,* could be because our research was conducted during lock down as a measure to curb the spread of COVID-19, suggesting that caregivers may have opted to explore accessible options. Treating under-fives at home may have explained why 38. 83% of those with malnutrition had been treated for diarrhea as well.

5.2.4 Anthropometric measures of children with severe Malnutrition and diarrhea

In the current study it was discovered that of all under-fives admitted with malnutrition, 66.67%, had mid-upper arm circumference (MUAC) of < 115mm. This finding is higher than that reported by Haq UI *et al.,*, (2021) from a study which was conducted in flood-hit regions of Khyber Pakhtunkhwa, Pakistan stating that 46% of under-fives had MUAC related malnutrition. The difference between the two study findings could be because the current study was done during a time when the whole world was facing travel

restrictions, lock down and social distancing making it impossible to mitigate food insecurity. For Pakistan, it may have been possible to relocate the families of under-fives affected by flood to areas that were not flood hit and provide relief food, resulting to a lower proportion.

Among the under-fives with diarrhea, 32.88% had MUAC of < 115mm suggesting a bidirectional relationship between diarrhea and malnutrition. This finding confirms that of Wasihun *et al.,*, (2018) and Dipasquale *et al.,*, (2020) which state that diarrhea and malnutrition have a bidirectional relationship. However, the low proportion observed in the current study could have been due to small sample size. The use of MUAC to demonstrate malnutrition among under-fives with diarrhea is an interesting approach of the current study as other studies that documented use of MUAC among under-fives with diarrhea sort to find out the accuracy of detecting malnutrition among dehydrated under-fives (Modi *et al.,*, 2015). Use of MUAC could be reliable in eliciting malnutrition among under-fives with diarrhea and identifying those with high mortality risk as compared to use WHZ or WAZ (Kumar *et al.,*, 2018).

This study revealed that 93.33% of malnourished under-fives with MUAC of < 115mm, were at the age of 6-23 months. A statistical analysis of the association between age and severity of malnutrition among under-fives revealed a significant relationship between the two variables. The current study finding was higher than that of Elnadif, (2020) which reports that about 67% of under-fives with severe acute malnutrition were aged 24 months and below. The difference in proportions could be because during the current study, there was marked food insecurity, inadequate economic resources at individual, household, and community levels as a result of worldwide pandemic at that time.

In this study, it was found that the majority, 56.67% of under-fives admitted with malnutrition and whose MUAC < 115mm were females. Fisher's exact test of association between malnutrition and gender revealed a statistically significant relationship. The finding is different from that of Okari *et al.,*, (2019) which states that males formed the highest proportion of 52.9% of those with MUAC < 115mm. Furthermore, Thrstans *et al.,*, (2020) also report that males have 26% higher odds of wasting compared to females. The difference between proportions seen in current study is small and may not be conclusive.

In this study, 82.35% of under-fives with diarrhea, aged between 6-23 months, had MUAC of < 115 mm. A statistical test of association conducted at 5% confidence level was significant. This finding shows that under-fives with diarrhea also presented with malnutrition. It corroborates that of Wasihun *et al.,*, (2018) which states that there exists a bidirectional relationship between diarrhea and malnutrition. Moreover, Mulatya & Ochieng (2020) also state that diarrhea and malnutrition have a bidirectional relationship which is statistically significant. Diarrhea leads to malnutrition by causing loss of appetite, thereby reducing caloric intake. Essential nutrients are also lost with every passage of loose stool and through malabsorption. Malnutrition on the other hand weakens the under-fives' body immunity that makes them vulnerable to infectious diseases such as diarrhea. Majority, 58.82% of those with MUAC < 115mm were males implying that being male and and having diarrhea makes an under-five more likely to develop wasting.

Regarding malnutrition among under-fives born to mothers who were HIV positive, 45% of them were stunted (McHenry *et al.,*, 2019). The findings are however inconclusive

because there may have been other factors that influenced the nutritional status other than anemia and HIV positive state of mothers.

This study reported that the majority, 42.31% of under-fives with malnutrition had weight for age Z-score of -3SD, indicating severe undernutrition. This finding is inconsistent with that of Gudu *et al.,* (2020) which states the proportion with severe undernutrition is 9%. The difference could have been due to severe food insecurity, inaccessible and in-affordable health care experienced during the COVID-19 pandemic.

Furthermore, the current study was done in two high volume hospitals where several cases of malnutrition could have been seeking health services, while the later was conducted in a low level four hospital. Population of study sites are all different with the current study being conducted in a site with the population of 1,155,574 while the one by Gudu and others was done in a site of 34,321.

The current study also reported that 46.15% of under-fives with malnutrition had HAZ-score of -3 indicating severe stunting. This proportion is higher than that of Olack *et al.,* (2011) which states that the proportion of under-fives with severe stunting is 23.4%. The difference in proportions is because while our study site was the whole of Kisumu county, the study by Olack only considered two villages, Gatwikira and Soweto, in the informal settlements of Kibera, Nairobi, with an approximate population of 140,000 people against that of 1,155,574 for Kisumu County. Informal settlements are known to experience inadequate sanitation facilities, unsafe drinking water and poor environmental hygiene, factors that are associated with stunting (De Vita, 2019).

While the study relied on height and age to determine stunting, the results could be confounded by factors such as maternal or paternal hereditary traits of stature.

5.2.2 Occurrence of Malnutrition, Diarrhea and Bidirectional Diarrhea-Malnutrition

In the current study, occurrence of malnutrition was high, 78.85%, among under-fives aged 6-23 months. The finding is consistent with a report by Hall which states that under-fives in the age group of 6-23 suffer malnutrition more (Hall *et al.,*, 2020). Age period of 6-23 months is nutritionally, a significant phase in the life of under-fives. Complementary feeding begins at six months since an under-five requires increased amounts of nutrients over and above those offered by breast milk. Those in the informal settlement face various socio economic challenges that could affect timing, type of complementary feeds leading to malnutrition (Reynod's *et al.,*, 2021).

Current study report shows that 45% of under-fives admitted with malnutrition stopped breastfeeding before attaining 23 months. The finding is however concurs with that of La leche league International, 2021) which states that globally, 41% of under-fives are exclusively breastfed as 59% are not while 45% continue to breastfeed up to 23 months and 55% do not. The differences in proportions of the two reports could be because the current study site was smaller than that of La leche league International. This study finding implies poor adherence to infant and young child feeding guidelines by caregivers, according to the guideline, under-fives should be exclusively breastfed for the first 6 months of life then continue breastfeeding alongside other feeds up to 23 months (UNICEF, 2019).

According to the current study, occurrence of malnutrition was higher among male under-fives, 55.77% . Finding of the current study reiterates a report by Hall *et al.,*, (2020) that 52.1% and 47.9% of under-fives suffer malnutrition are males and females respectively. The difference in proportions of male and female under-fives that suffered malnutrition is too small to be conclusive. However, other studies have provided different findings which are often speculative rather than informed by direct evidence.

The study also found that occurrence of malnutrition was not predicted by a particular settlement where an under five lived except for Manyatta informal settlement. A statistical test of association done revealed lack of relationship between place of residence and occurrence of malnutrition among under-fives. This suggests that the settings experience similar limitations which have been considered to define informal settlement. It therefore means that any difference reported could have been due to setting size. The difference of occurrence in malnutrition among under-fives observed between Manyatta and the other five settlements could be because the former is relatively larger than the rest

Among 33.69% of under-fives admitted with diarrhea, who had stopped breastfeeding, 44.44% were < 6 months and 38.89% were between 6 -23 months. This report implies poor adherence to exclusive breast feeding and complementary feeding among mothers of under-fives infants. Breast milk is known to supply hormones that boost a child's immunity. Moreover, it has all the nutrients required and failure to exclusively breastfeed or continue breastfeeding up to two years and beyond makes an under five susceptible to malnutrition and diarrhea diseases.

The current study further revealed that diarrhea occurred more among male under-fives, 67.92%. The difference in occurrence of diarrhea by sex is speculative as no scientific reason has been documented.

The current study found out that 31.43% of the total under-fives admitted had bidirectional diarrhea-malnutrition. The finding is congruent with that of Walson & Berkley, (2018) which states that under-fives with severe acute malnutrition are more likely to present to hospitals with childhood diarrhea. Furthermore, diarrhea cases were also associated with stunting.

A study that was done by Sambo *et al.,* in Mozambique, to characterize undernourished under-fives with diarrhea, 54.1% were undernourished (Jambo *et al.,*, 2022). Also in an analytical cross sectional study done by The community-based Global Enteric Multicenter Study (GEMS) , it was determined that under-fives with diarrhea were associated with stunting (Walson & Berkley, 2018).

In the current study, bidirectional diarrhea, malnutrition occurrence was reported to increase with advancing age of the under-fives. The current study reported that 25%, 38.89% and 44.44% for <6, 6-23 and 24-59 months respectively. The current study finding is congruent to that of Wasihun *et al.,*, (2018) which states that the prevalence of moderate to severe dehydration was more severe in malnourished under-fives aged 24–59 months, than those who are younger implying that malnourished under-fives aged 24–59 months were more susceptible to severe diarrhea disease compared to their counterpart who is well nourished Increasing prevalence of bidirectional diarrhea malnutrition with increase in the age of under-fives could be associated to reduced immunity because of cessation of breastfeeding. Breast milk is a source of antibodies that protect against

malnutrition and diarrhea among under-fives. This finding is however contrary to that of Tickell et a l (2020) in a study of effect of acute malnutrition on enteric pathogens, moderate-to-severe diarrhea, and associated mortality in the Global Enteric Multi-center Study cohort: a post-hoc analysis, which states that 50.6%, 40.8% and 8.7% were in the age brackets of < 6-23 and 24-59 months respectively.

According to the present study, one under five in a household was found to be 0.22 times less likely to suffer from bidirectional diarrhea-malnutrition as compared to at least 3 individuals in one household.

5.3 Practices Associated with Risks for Malnutrition, Diarrhea and Bidirectional Diarrhea-Malnutrition among Under-Fives.

5.3.1 Maternal Risk Factors for Malnutrition and Diarrhea

Regarding malnutrition and its association with the number of under-fives in a household the study reported that 44.33 % of under-fives lived in households with more than one under five suggesting less association. This is contrary to a report by Ghimire *et al.,*, (2020) that household with household with more children were statistically associated with malnutrition. Low proportion shown in the current study could imply that mothers have adopted family planning methods enabling birth spacing. Data in the current study was collected through a face to face interview with care givers and there could have been as a result of social desirability bias.

In the current study, it was found out that 41.51% of under-fives with diarrhea belonged to households that had 2 children who were below five years. This is however higher than findings by Guillaume *et al.,*, (2020) conducted among caregivers of Mathare informal settlements which states that 32.9% lived in households with 2 children who are under five years. The findings imply that having more than one under five in a household is a

risk factor for diarrhea. This is likely to happen because caregivers' divided attention in care of the under-fives.

The current study sought to find out if the relationship between under-five and caregivers was a risk factor for malnutrition and diarrhea. We found out that 88.46% and 88.68% were mothers for under-fives with malnutrition and diarrhea respectively. This finding is lower than that reported by Nor, (2019). According to Nor, 90.1% of under-fives were given care by their mothers. The current finding is however higher than that of Sigdel *et al.,*, (2020) which reports that 83.9% of under-fives were being given care by their mothers. This study finding does not conform to our assumption that under-fives were at a lower risk of developing malnutrition if they received care from their mothers. It is assumed that mothers are more connected and protective of their children as compared to other caregivers.

This study further found out that 38% of under-fives with malnutrition were born to mothers who were HIV positive. This finding is lower than one indicated by Musuka *et al.,*, (2021). In the report by Musuka and others, 58% of under-fives were born to HIV positive mothers. The implication of being HIV positive as a mother is a risk factor for malnutrition among under-fives as it impacts directly and indirectly the socio-economic indicators and by extension, health of under-five. If the mother's overall health is poor, they are unable to care for needs of under five year old children appropriately, they may fail to involve in income generating activities thus reducing their purchasing power

Of all the under-fives admitted with diarrhea 30.19% were born to mothers who were HIV positive. This finding is similar to that presented by Deichsel *et al.,*, (2020) which

states that under-fives who are HIV exposed are likely to be at an increased risk for diarrhea due to exposure while in utero and subsequently becoming immunocompromised as a result of increased enteric pathogen exposure from living with HIV infected mothers.

5.3.2 Care Give Practices Regarding Feeding of Under-fives

In this study, it was determined that the majority, 67.31% of under-fives with malnutrition had been started on complementary feeding. This finding corroborates that of Reynolds *et al.,*. (2021) which states that more than a third of under-fives living in informal settlements of Nairobi are malnourished due to inappropriate complementary feeding practices because of cultural beliefs. The high proportion could be confounded by other risk factors other than complementary feeding. The other suspected con founders may have been maternal level of education and socio-economic status.

The study also found out that 83.02% of under-fives with diarrhea were on complementary feeds implying that complementary feeding is a risk factor for diarrhea among under-fives. This finding is however higher than that of a study done in Tanzania to assess the association between infant and young child feeding practices and diarrhea which states that 25. 82 % of those started on complementary feeding suffered diarrhea (Ogbo *et al.,*, 2018). The difference may have been because the later, only included under-fives aged 6-8 months while the current study included under-fives from 6-23 months

This study sought to find out the habit of eating vegetables among under-fives with malnutrition, who were already on complementary or family diets. The study found that the majority, 46.15%, were fed on vegetables sometimes. This finding is however lower

than that of Machira (2020) which found that 69.4% of under-fives fed on inadequate amounts of vegetables, a practice that poses a risk for malnutrition. The difference of proportions in these two studies could be that our study sample size was smaller than that of Machira (2020). Furthermore, our study was a face to face interview which is likely to attract framing bias. Framing bias is the idea that the way an information is presented is more important than the actual information being discussed. Machira (2020) on the other hand reviewed hospital records. While our study was done mainly in urban informal settlements, Machira (2020) study was done in rural settings. In this regard, the level of care-givers' understanding of child feeding may be lower in the rural setting than urban informal settlements.

Regarding nutritional practices among caregivers, 47.06% of under-fives with malnutrition and 62.26% of those admitted with diarrhea were on a family diet respectively. The proportions of under-fives on family diet, that were admitted with malnutrition and diarrhea suggests poor infant and young child feeding practices by caregivers. The children admitted with malnutrition may not have been fed appropriately leading to nutritional deficiency. Others may have developed diarrhea due to poor food handling during preparation or feeding leading to contamination with diarrhea causing organisms.

5.3.3 Caregiver Practices of Trimming Under-Five Finger Nails, Water Treatment and Hand Hygiene

This study reported that out of the under-fives admitted with diarrhea 73.58% had their fingers untrimmed. A cross-sectional study that sought to determine the prevalence and associated risk factors of intestinal parasites among diarrhea under-fives attending Bahir Dar and Han health centers, Northwest Ethiopia reports that 20.3% had finger nails not

trimmed (Mohammad *et al.,*, 2022). The huge difference seen between the two studies could be because the letter was done in the capital city of a region in Ethiopia. A capital city may have more resources including health care facilities resulting in health promotion services. Bahir's population is far much lower than Kisumu County 218, 429, which may enable better health service delivery.

As regards the household's source of water 65.38% and 64.15% of under-fives with malnutrition and diarrhea respectively used piped water while 26.92% and 30.15% of those with malnutrition and diarrhea respectively lived in households that used bore hole water

In the current study we found out that 36.54% of under-fives with malnutrition lived in household where drinking water was not treated. The proportion documented in our study is lower than the one which Mashida *et al.,* (2018) reported where 90% of under-fives that suffered malnutrition belonged to households which never treated drinking water at the point of use. The difference seen could be because the study by Mashida and others (2018) involved pastoralists who may not have a well-organized way of handling and storing water safely. Furthermore they may depend a lot on surface water for drinking during the time they are on transit. It is important to note that our study sample size was 52 while that of Mashida *et al.,* (2018) was 354 and this could have resulted in the difference.

The study found out that 37.74% of under-fives who were admitted with diarrhea lived in households which did not treat water for drinking. A study by Nguyen *et al.,* (2021) states that 42.7% belonged to informal settlement households that treated water while 57.3% did not treat water for drinking. The difference between the two studies could be due to

varying sample sizes. While our study involved 52 participants, Nguyen *et al.,* (2021) study involved 543 participants. Under-fives who live in households that don't treat water are more likely to develop diarrhea than those who live in households that treat water. Untreated drinking water is likely to increase the risks of getting diarrhea diseases among the under-fives.

This study found that 58.49% of under-fives with diarrhea belonged to care givers who practiced hand washing partially or sometimes. The finding is similar to that of Wasihun *et al.,* (2018) which states that 56.4% of caregivers practiced hand washing sometimes. This finding is however lower than one published by Hailu *et al.*, (2021) which reports that 84.6% of caregivers do not wash hands. This difference could be alluded to the small sample size of 52 in our study against 422 for Hailu *et al.,* (2021) study. In the current study, we discovered that 88.46% of under-fives with malnutrition lived in households that use pit latrines as a type of fecal disposal system. Our finding is higher than that of Soboksa *et al.,* (2021) which states that 35.7% of households which had under-fives diagnosed with malnutrition used pit latrines. In a study by Khan *et al.,* (2021) it is stated that pit latrines are associated with even higher adjusted odds of underweight severe and moderate and severe stunting among under-fives. The study findings suggest that caregivers failed to wash hands at critical points in time creating risks for contamination with diarrhea causing pathogens.

5.3.4 Hygiene and Sanitation

This study found that 58.49% of under-fives with diarrhea live in residences that kept domestic animals. The figure in this study is higher than that of Degebesa *et al.,*, (2018) which reports that 39% of under-fives who suffer diarrhea lived in residences that kept

domestic animals. In a study by Wasihun *et al.,* (2018) 79.7% of under-fives diagnosed with diarrhea lived in residences with domestic animals. This is far much higher than our study finding. Wasihun *et al.,* (2018) study could have recorded higher proportions because it was community based so those collecting data made observations and this increased accuracy. This particular study relied on verbal reports by caregivers, a response that could have been influenced by desirability bias, Desirability bias occurs when participants over-report on good behaviors and under-report on bad behaviors (Cole, 2022). Also, the Wasihun *et al.,* (2018) study had a sample size of 610 while our sample size was 53. The current finding is consistent with that of Omona *et al.,* (2020) which reports that the presence of domestic animals in residences is extremely associated with diarrhea among under-fives. Under-fives become exposed to infections when they place objects contaminated with animal feces and soil in their mouth. This exposure results in diarrhea originating from a disease causing agent.

In the current study, it was discovered that out of 61.54% of under-fives with malnutrition lived in households that experienced water shortage. This finding is congruent with one reported by Nounceu *et al.*,,(2022) which states that inadequate access to water at the household level is associated with poor hygiene and sanitation practices, which are risks for malnutrition among under-fives . Key to note is that limited studies have directly linked inadequate water supply to malnutrition among under-fives.

The current study also found out that 52.83% of under-fives with diarrhea lived in households that experienced water shortage. This finding agrees with that of Wang *et al.,* (2022) which states that reduced amounts of water may increase the risk of diarrhea

disease among under-fives. This could be because there may be inadequate amounts of water for hand hygiene or for maintaining environmental cleanliness.

In the current study, 82.69% of under-fives admitted with diarrhea lived in households that used pit latrines as a waste disposal system. A study by Wasiq *et al.,* (2020) states that use of pit latrines was more associated with higher risks of diarrhea than toilets with a flush to the septic tank, sewer, or pit latrine and traditional dry vaults with a lower risk 16% and 17% respectively.

In the current study, 73.58% of under-fives with diarrhea belonged to households where latrines were shared. The finding is contrary to that of Saha *et al.,*, (2022) who carried out a study to identify the socio demographic and environmental predictors associated with diarrhea among under-five children in rural India which states that 17.16% of households for under-fives with diarrhea shared toilet facilities.

In the current study, we found out that 69.23% of under-fives with malnutrition lived in households that shared pit latrines suggesting that sharing pit latrines is a risk factor for malnutrition.

5.2.3 Risk Factors for Bidirectional Diarrhea -Malnutrition among Under-Fives

According to the present study findings, the number of under-fives in a household had a statistically significant influence on bidirectional diarrhea-malnutrition. One Under five in a household was 0.22 times less likely to suffer from bidirectional diarrhea-malnutrition as compared to at least 3 under five year children in one household, this suggests that having one under five allows for more attention and care givers are able to detect any health deviations and act promptly mitigating complications,

The current study further revealed that 40.8% of under-fives with untrimmed fingernails suffered bidirectional diarrhea-malnutrition18.18% with trimmed fingernails suffered bidirectional diarrhea-malnutrition, and 0.32 less likely to suffer the condition. This finding is in line with that of Wasihun *et al.,*, (2018) which states that the odds of suffering bidirectional diarrhea-malnutrition among under-fives with untrimmed fingernails is 1.576 suggesting that untrimmed fingernails is a risk factor for bidirectional diarrhea- malnutrition. Untrimmed fingernails may harbor disease causing organisms and prevent the child from feeding well.

In the present study bi-variate analysis for the association of human waste management system on bidirectional diarrhea and malnutrition revealed that disposal of under-five's feces was a significant risk factor for bidirectional diarrhea and malnutrition. The under-fives whose feces were disposed of by caregivers in the open yard were 4.68 times more likely to have bidirectional diarrhea and malnutrition as compared to those whose caregivers were using pit latrine .

According to findings of the current study, using bi-variate logistics analysis under-fives whose caregivers were practicing hand washing were 0.28 (OR=0.28, 95%CI=0.08-0.96, P-value=0.43) times less likely to have bidirectional diarrhea-malnutrition as compared to those whose caregivers were not practicing all the five critical hand washing moments. The finding is in line with that of Wasihun *et al.,*, (2018) which states that under-fives whose mothers did not wash their hands at all the critical times were 15.4 times [AOR = 15.4; 95% CI = 2.02, 117.78] more likely to develop diarrhea compared to those whose caregivers washed at the critical times.

Bi-variate logistic analysis was used to determine the association of water and sanitation with bidirectional diarrhea-malnutrition among under-fives, water shortage, drinking untreated water and mothers' hand washing were found to be statistically significant. Under-fives of the caregivers who were experiencing water shortage were 5.4 times more likely to have bidirectional diarrhea -malnutrition as compared to those who did not have water shortage. With regards to drinking water, under-fives whose caregivers treated drinking water were 0.4 times less likely to have bidirectional diarrhea-malnutrition than those who were drinking untreated water. This finding is similar to that of Wasihun *et al.,* (2018) who reported that under-fives who drank unsafe water were 3.7 times more likely to have diarrhea compared to those who use safe water. The finding implies that safe drinking water use is less associated with diarrhea or malnutrition. Therefore occurrence of bidirectional diarrhea- malnutrition is less likely to affect under-fives compared to if they used unsafe drinking water .

5.4 A framework for Strengthening Community Based Interventions for Prevention of Malnutrition, Diarrhea and bidirectional Diarrhea-Malnutrition among Children UnderFiveYears Living in the Informal Settlements

5.4.1 Infant and Young Child Feeding

The current study findings which associates infant and young child feeding with occurrence of a combination of malnutrition diarrhea and bidirectional diarrhea-malnutrition is corroborated by a report of WHO, (2021) and findings of Ahmed (2020); Ogbo *et al.,*, (2018) which state that breastfeeding is beneficial to infants because it prevents occurrence of gastrointestinal infections and provides sufficient energy and nutrients required by the body. Moreover, complementary feeding provides additional nutrients required by under-fives to meet increased body demands. Poor infant and young

child feeding is likely to lead to malnutrition and diarrhea among children under five years and if not addressed then complications such as malnutrition leading to diarrhea or vice versa may occur.

5.4.2 Hygiene and Sanitation

The current study reported that hygiene and sanitation are associated with risk for a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition. Similarly a study conducted by Soboksa; Shrestha and others reiterate that poor hygiene and sanitation provide a favorable environment where infectious diseases like diarrhea, linked to malnutrition, develop (Soboksa, *et al.,*, 2021; Shrestha *et al.,*, 2020). Poor hygiene practices among caregivers of under-fives and living in an environment where there is poor sanitation imply risks for contamination (Wasihun *et al.,*, 2018) predisposing to diarrheal diseases which may result in malnutrition playing out the association between the two.

5.4.3 Caregiver practices

This study found that caregiver practices such as water treatment and trimming of under-five finger nails were associated with risks for a combination of malnutrition, diarrhea and a combination of diarrhea malnutrition among under-fives. In a study by Obondi, (2021), drinking water and fecal contamination are associated with childhood illness. Children generally depend on their caregivers for livelihood as well as health promotion. A caregiver who does not adopt health behaviors like hand washing, treating of water for drinking are likely to have their children suffering malnutrition and diarrhea

5.4.4 Feedback from community health promoters about the proposed framework for prevention of malnutrition, diarrhea and bidirectional diarrhea malnutrition among under-fives living in the informal settlements

5.4.4.1 Infant and Young Child Feeding

As regards proper infant and young child feeding, early initiation of infants on breast milk within one hour of birth was notably associated with prevention of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. The infants whose immune system was still immature were fed on colostrum, which contains mother's antibodies hence got protection against diarrhea causing organisms (Kunde, 2022). The infants who were initiated on breast milk within one hour of birth did not suffer malnutrition as they received a complete source of hydration, protein, lipids and carbohydrates, a complete nutrition that supports growth of an infant. Initiating infants on breast milk early impacts positively on milk production and flow thereby ensuring sustained availability to the new born.

Under-fives who were exclusively breastfed for the first six months of life did not suffer malnutrition, diarrhea and bidirectional diarrhea-malnutrition since they benefited from the nutritious value of breast milk and showed proper physical growth implying good nutritional status. Furthermore they did not suffer diarrhea as breast milk provided adequate immunity and was free from contamination (WHO, 2021).

The under-fives who had been started on complementary feeding that was safe and age appropriate had un-faltered growth and did not suffer diarrhea. Under-fives who were started on complementary feeding from the age of six months received additional nutrients necessary for their body size and enough energy to support the increased activities they engaged in, like playing. Safe handling of the feeds prevented occurrence

of diarrhea by keeping away disease causing organisms (WHO, 2021). Poor infant and young child feeding denies a child the right food in amounts and frequency and may introduce diarrhea causing pathogens, through ingestion. Diarrhea if prolonged may deplete and deny the child body nutrients resulting to malnutrition.

5.4.4.2 Hygiene and sanitation

Availability of any type of latrine where none existed prevented occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition through reduced surface contamination (drinking water bodies, surrounding environment) with human feces. This implies that under-fives may not come into contact with the feces while playing hence hands would not be contaminated. Hands that are contaminated with feces can transmit diarrhea causing organisms if the under-fives don't wash hands before eating (CDC, 2021). Chronic or repeated episodes of diarrhea among under-fives can lead to malnutrition (Wasihun *et al.,*, 2018).

Upgrading latrine facilities prevented occurrence of a combination of malnutrition diarrhea and bidirectional diarrhea-malnutrition among under-fives. For instance installing hand washing facilities means that individuals visiting the latrines would wash hands soon after leaving the facility promoting hand hygiene. Regularly cleaning of latrines improved their state and kept flies away. Upgrading a facility from any type of latrine to availing hand washing facilities or having conventional ones with a water system made human waste disposal safe and minimized contact with human feces (Hailu *et al.,*, 2021). Communities where exposure to human feces is reduced have low episodes of diarrhea among under-fives. Diarrhea disease results in poor appetite, reduces nutrient absorption through loss in stool with every bowel motion.

Clearing the compound of animal feces prevented occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition. Animal waste just like human waste is a source of disease causing organisms. Under-fives who ingest contaminated food suffer diarrhea and become malnourished due to loss of appetite associated with the former. Under-fives who suffer repeated infection related to poor disposal of animal feces becomes stunted in the long run as available nutrients are used for fighting the infection instead of growth. Environments where wastes of animals and humans are poorly disposed experience malnutrition, diarrhea and poverty (WHO, 2022).

5.4.4.3 Caregiver Practices

Caregiver hand washing was associated with prevention of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition. Under-fives whose caregivers practiced hand washing at critical points in time did not experience episodes of malnutrition, diarrhea and bidirectional diarrhea-malnutrition. According to Soboska *et al.,*, (2021), lack of hand washing practices at a critical point in time significantly increased the likelihood of malnutrition among under-fives suggesting that hand washing prevented occurrence of malnutrition among under-fives. A community-based cluster randomized controlled trial study reports that there was 41% reduction in diarrheal incidence among under-fives whose caregivers adhered to recommended hand wash practice (Solomon et. al, 2021). Hand washing clears hands of contaminants that are capable of causing diarrhea infection. Under-fives with diarrhea lose appetite hence they fail to feed adequately; nutrients are wasted with every opening of bowel motion, all these lead to malnutrition.

Trimmed fingernails prevented occurrence of a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. A study by Wasihun *et al.,*, (2018) of risk factors for diarrhea and malnutrition among children under the age of five years in the Tigray Region of Northern Ethiopia, result indicate that 48% of them had untrimmed fingernails. Dirty fingernails harbor dirt which contains disease causing organisms. Such dirt contaminates food of under-fives' feeds resulting in diarrhea and bidirectional diarrhea malnutrition..

5.4.4.4 A co-created framework for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in the informal settlements

The current study has essentially established existence of knowledge gap among CHPs and SCCHSCs regarding infant and young child feeding, specifically about early initiation of infants on breast milk within one hour post-delivery and complementary feeding; caregiver practices such as hand wash, trimming of under-five nails and treatment of water for drinking ; also there is insufficient knowledge regarding hygiene and sanitation on areas such as constructing a latrine where none existed, regular cleaning of latrines that are shared among households and keeping latrine doors under lock and key, in relation to occurrence or prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives living in informal settlements. This position is reiterated by a systematic review of literature in Iran, whose aim was to identify performance challenges faced by community health promoters which deduced that one of the major challenges is insufficient competency (Gharibi *et al.,*, 2023). On specific issues including:

5.4.4.1 Infant and young child feeding

5.4.4.1.1 Early initiation of breast milk within one hour of birth

In this study it was noted that CHPs and SCCHSCs had inadequate knowledge about association between early initiation of breast milk within one hour of birth. Similarly in a cluster-randomized longitudinal study assessing the effectiveness of community health promoters in improving early initiation and exclusive breastfeeding rates in a low-resource setting, it was found out that there is no significant difference in survival between under-fives whose mothers received health education on infant and young child feeding from antenatal through postnatal period, by community health promoters who made home visits, besides the regular maternal child health (MCH) clinic attendance and the caregivers that only visited MCH (Mungiria *et al.,*, 2020).

5.4.4.1.2 Complementary feeding

The study found that some of the CHPs and SCCHSCs had inadequate knowledge about how complementary feeding of under-fives from 6-23 months could prevent occurrence of diarrhea. Appropriate complementary feeding reduces infant morbidity and improves nutritional status, growth and cognitive development. The phase of life that begins from 6-23 months is critical because infants tend to develop malnutrition in the period and one of the complications to that is diarrhea. Study report indicate that 57.7% of CHPs are poor at delivering messages about complementary feeding with regard to age at which particular feeds should be given, the amount to be served and frequency of feeding (Kivaya, 2022)

5.4.4.2 Caregiver practices

5.4.4.2.1 Hand washing

This study found that CHPs and SCCHSCs had insufficient knowledge about whether caregiver hand washing could prevent malnutrition, diarrhea and bidirectional malnutrition among under-fives. The finding is similar to that of a cross sectional study by Chi *et al.,*, (2023) which sought to assess the knowledge, attitude and practices of community health promoters on managing and preventing childhood malaria and diarrhea in Fako Division, South West region, Cameroon in which more than half of respondents stated that one of the consequences of diarrhea is weight loss and therefore mothers should always wash hands before breastfeeding their infants. In the study, the report indicates that high prevalence of diarrhea in the study area was associated with poor knowledge among health care assistants regarding prevention and management of diarrhea. On the contrary, in the study by Chi and others, 90% of the community health promoters stated that drinking unsafe water was associated with diarrhea among under-fives.

The study considered inadequacy of knowledge among CHPs and SCCHSCs as counterproductive to implementation of community based interventions for prevention of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among children under-fives. CHPs and SCCHSCs are entrusted with the task of promoting children's health through providing accurate health messages, promoting and supporting appropriate practices among caregivers of under-fives. Such practices align to community based interventions therefore a community health promoter with inadequate knowledge about the health interventions is unlikely to contribute towards prevention of malnutrition,

diarrhea and bidirectional among children aged below five years. There arises a need to address such knowledge gap in order to strengthen the community based interventions which are associated with improved malnutrition and diarrhea states. The identified interventions have been used to co create a framework (Figure 4.13) that is proposed for strengthening community based interventions.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The conclusions are as listed:-

6.1.1 Occurrence of malnutrition, diarrhea and bidirectional diarrhea malnutrition

a) Occurrence of malnutrition and diarrhea among under-fives is high between ages 6-23 months. More male under-fives suffer diarrhea while females suffer severe acute malnutrition more. Malnutrition and diarrhea occur more among children whose caregivers have low monthly income; severe acute malnutrition occurs a lot among those aged 6-23 months. Poor health seeking habits among caregivers is associated with occurrence of malnutrition. The study also concludes there is an association between suffering anemia and being born to a mother who is HIV positive.

6.1.2 Practices as risks for malnutrition, diarrhea and bidirectional diarrhea-malnutrition

On thepractices associated with risks for malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives, the study concludes that:

Caregiver practice of complementary feeding is a risk for both malnutrition and diarrhea among under-fives. Untrimmed fingernails of under-fives is a risk for bidirectional diarrhea- malnutrition. Furthermore, partial hand wash practice and failure to boil water for drinking among caregivers are risks for malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives.

Presence of domestic animals in residence where under-fives live is a risk for diarrhea, use of un improved latrines and sharing of such facilities are risks for both malnutrition and diarrhea.

6.1.3 Co-created framework for strengthening community based intervention

There exists insufficient knowledge among CHPs about early initiation of breastfeeding, complementary feeding, building of latrines and regular cleaning of share ones, caregiver hand wash, trimming of under-five finger nails infant and their association with a combination of malnutrition, diarrhea and bidirectional diarrhea-malnutrition.

6.2. Recommendation

Based on the findings and conclusions presented, the study recommends the following:

6.2.1 Action

a) National and County governments to put in place strategies that focus on prevention of bidirectional diarrhea-malnutrition among under-fives

b) The framework should be further validated or feedback be received from a much higher level stakeholders

c) Caregiver practices are the potential risks for malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives and should be targeted for intervention.

d) The implication is that there exists bidirectional diarrhea-malnutrition and intervention should be put in place to targ*et al.,*so bidirectional diarrhea-malnutrition.

6.2.2 Further research:

a) Further study be conducted to determine if the practice of complementary feeding among caregivers is associated with malnutrition and diarrhea among under-fives

b) A study be conducted to investigate caregiver health seeking behavior and its association with severe states of malnutrition and diarrhea among under-fives

c) A prospective study be conducted to further determine risks for bidirectional diarrhea- malnutrition among under-fives

d) There is need for future studies to seek feedback from key decision makers such as the county chief officer of health, head of public health and sanitation and other stakeholders in the private sector about the community based interventions.

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APPENDICES

APPENDIX I: INFORMATION AND CONSENT FORM

STUDY TITLE:

COMMUNITY BASED INTERVENTIONS FOR PREVENTION OF MALNUTRITION AND DIARRHEA AMONG CHILDREN UNDER-FIVE YEARS IN INFORMAL SETTLEMENTS**.**

INSTITUTION:

JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

LOCATION: KISUMU COUNTY

INVESTIGATOR: MILKA OGAYO

SUPERVISORS:

1. **George Ayodo, PhD**
2. **Damaris Ochanda, PhD**

INFORMED CONSENT

INTRODUCTION

You are asked to participate in a research study conducted by Milka Awuor Ogayo a PhD student at Jaramogi Oginga Odinga University of Science and Technology in partial fulfillment of Doctor of Philosophy in Public Health. Before you decide if you wish to be in this study, you need to know about any things that could happen if you decide to join; good or bad. This form tells you about the study. You can ask any questions you have at any time. Being in the study is your choice: This consent form will give you information about the study and the risks. These will be explained to you. Once you understand the study, and if you agree to take part, you will be asked to sign your name on this form or thumb print. Before you learn about the study, it is important that you know the following:

Your participation in this study is entirely voluntary

You may decide not to answer questions or withdraw from the study at any time.

PURPOSE OF THE STUDY

This study aims to investigate the community based interventions for prevention of malnutrition and diarrhea among the under-fives in the informal settlements of Kisumu County. This findings and their applications will add up to the current role of community health care workers or volunteers in extending public health education on the control and prevention of diarrhea and malnutrition in the informal settlements even up to the household level.

Also, study findings will inform policy formulation and frameworks to prevent diarrhea and malnutrition in the under-five year old children from the high burden informal settlements of Kisumu County, in the country and elsewhere in sub-Saharan Africa. The study is expected to provide recommendations that could inform future research and upscale interventions.

STUDY GROUPS:

The study groups will comprise caregivers, the under-fives, nurse, doctor, nutritionist in charge and their deputies within JOOTRH and KCH. All the groups are very important to this study.

QUESTIONNAIRE

If you participate, I will ask you some questions.

POTENTIAL RISKS AND DISCOMFORTS

The study has no risks to the participants. The study will cover the under-fives, their caregivers in charges and deputies of children's wards in JOOTRH and KCH

BENEFITS OF THE STUDY

It will generate information which will be useful to the government in formulating necessary policies to put in place in order to strengthen the community involvement in prevention, and control of diarrhea and malnutrition and offer universal health coverage and support universal healthcare for all.

COSTS TO YOU

There will be no cost for participating in this study.

DATA SECURITY AND CONFIDENTIALITY

All the information gathered by the researcher will be used in confidence for the sole purpose of this research only. No names of individuals will be written down at any time. Data will be in folders, which will be locked in cabinets for storage throughout the study period. Computer documents will have passwords only accessible to the researcher. The strict data management procedures are intended to ensure confidentiality of the study subjects. Consent will be sought from participants.

NEW FINDINGS

Results will be shared internally with study Supervisor and disseminated in Jaramogi Oginga Odinga University of science and Technology and Healthcare stakeholders from Kisumu County

PROBLEMS AND QUESTIONS

If you ever have questions about this study, you should contact the Principal Researcher, Milka Awuor Ogayo **+254 713657537.**

Your rights as a study participant:

This research will be reviewed by Jaramogi Oginga Odinga University of Science and Technology and forwarded to JOOTRH and KCH b before commencing.

If you have any questions about your rights as a research participant you may contact the Jaramogi Oginga Odinga Teaching and Referral Hospital ERC (a team of professionals who will review the research to protect your rights) Telephone number **-057-2020801/2020803**

Your statement of consent and signature:

If you have read the informed consent, or had it read and explained to you and understands the information, voluntarily agree to join this study, please carefully read the

statements below and think about your choice before signing your name or making your mark below. No matter what you decide, it will not affect anything:

I have been given the chance to ask any questions I may have and I am content with the answers to all my questions.
I know that my records will be kept confidential and that I may leave this study at any time.
I have been told the name, phone number and address of the person to contact in case of an emergency, and this information has also been given to me in writing.
I agree to take part in this study as a volunteer, and will be given a copy of this informed consent form to keep.

_____	_____
Participant name	Participant signature and date
_____	_____
Name of Researcher	Signature and date
_____	_____
Name of witness as appropriate	Witness signature and date

NOTE: You are not giving up any legal rights by signing this informed consent document.

□ Participant received a copy.

APPENDIX II: Interview guide for the nurse, doctor nutritionist in charge their deputies (objectives 3 and 4)

Introduction

The interview will be conducted in the departments of pediatrics of JOOTRH and KCH. The information we will obtain from the participants will be handled with confidentiality and only used for the purposes of this study. Anonymity will be guaranteed by using code numbers given to the interviewee. The purpose of the interview is to collect in depth information for understanding the risk factors for diarrhea, malnutrition and developing malnutrition when suffering diarrhea and vice versa. During the interview we will obtain information about the participants' experience of diarrhea and malnutrition in the under five years in the pediatric units.

Given code Number.....

Job title: ..... Qualifications: .....

INTRODUCTION

INSTRUCTIONS TO THE RESPONDENTS

This questionnaire is solely for research purposes. Any information that you provide will be treated with strict confidentiality. No other person will be able to access it. Do not fill in your name and for questions with alternative responses, circle or put a tick at the appropriate response, while those requiring your comments please fill in your considered opinion. We require your cooperation to assist us in understanding the risk factors for malnutrition and diarrhea in the under-fives.

Section A: Occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives

(Tick /circle the right answers where choices have been provided and insert the correct response in the spaces appropriately)

1. Child's code number……..
2. Date of birth.....
3. Age (in months).....…
4. Sex of the child
    1. Male
    2. Female

5. Status of malnutrition (confirm with the child's file)
    1. acute malnutrition [ ]
    2. chronic malnutrition [ ]
    3. Acute and chronic malnutrition [ ]
6. Measurements
    1. Weight (in Kgs)……..
    2. Height /length (in cm)……..
    3. Mid upper arm circumference (in cm)……..
7. Residence…….
8. For how long has the child lived in the current residence?
    1. 0-12 months [ ]
    2. 13-24 months [ ]
    3. 25-36 months [ ]
    4. 37-48 months [ ]
    5. 49-60 months [ ]
9. Diagnosis at the time of the admission (check notes)
    1. Diarrhea only [ ]
    2. Malnutrition only [ ]
    3. Previously with malnutrition then followed by diarrhea [ ]
    4. Previously with diarrhea then followed by malnutrition [ ]
    5. Both diarrhea and malnutrition [ ]

10. i) Are there any other illnesses that the child is experiencing apart from the present one?
    1. YES [ ]
    2. NO [ ]
11. If YES in 20 above, (Please state the kind of illness) ……..
12. Is the child still breastfeeding?
    1. YES
    2. NO

ii) If NO in 12 above, at what age did the child stop breastfeeding? (Please state)…….

13. Does the child continue breastfeeding during the period of an episode of diarrhea?

1. 1. YES [ ]
2. 2. NO [ ]

14. Do you promote complementary feeding for children during an episode of diarrhea?

1. YES [ ]
2. NO [ ]

15. Do you promote feeding during an episode of diarrhea (for children who have stopped breastfeeding)

1. YES [ ]
2. NO [ ]

16. How many times has the child passed diarrhea in the last24 hours (please state)……..

17. For how long has the child been experiencing this episode of diarrhea? (Please state)……..

18. i) Was the child's stool tested in the laboratory for causative organisms?

a) YES
b) NO

ii)If yes in i) above what was the laboratory findings? (Confirm with child's file).....

19. How long has it been since the diagnosis of malnutrition was made? (Please state the duration in days)

……

20. Has the child been treated for diarrhea before? …

1. YES [ ]
2. NO [ ]

21. Has the child been treated for malnutrition before?

1. YES [ ]
2. NO [ ]

Section B: Risk factor for diarrhea, malnutrition and bidirectional diarrhea and malnutrition (Please circle the correct answer for questions with options a, b, c……. or insert the right answer in the spaces provided)

22. i)Did you seek any treatment for this illness while at home?

1. YES [ ]
2. NO [ ]

ii) If YES in i) above where did you seek treatment from?

1. Hospital [ ]
2. Herbalist [ ]
3. Religious leader [ ]
4. Any other (state)……

23. How many under five year old children do you have? (Insert the answer)

.....

24. What is your relationship with the child

1. Mother [ ]
2. Caretaker [ ]
3. Others (Specify) …. ……

25.i) Did the mother test for HIV when pregnant with this child?

1. YES [ ]
2. NO [ ]
3. Don't know [ ] .

ii). If YES to question 23 above, what was the mother's HIV status?

1. Positive [ ]
2. Negative [ ]
3. Don't know [ ]

iii) If POSITIVE in (ii), is the mother on comprehensive care

1. YES [ ]
2. NO [ ]
3. DO NOT KNOW [ ]

26.What diet do you feed the child on

1. Exclusive breastfeeding [ ]

2. Complementary feeding [ ]
3. Family diet [ ]

(Food for all family members but soft enough for the baby)

27. i) Has the child been started on complementary feeding (no longer feeding on breast milk alone)? …

1. YES
2. NO

ii). If YES in i) above, at what age was complementary feeding initiated?

28. What food type was the child introduced to as complementary? (**please list):**

1. Protein……
   ……
2. Carbohydrates
   ……
3. Vitamins…….....
   .....

29. What did you feed the child on in the last 24 hours for:

1. Breakfast……..
2. Lunch…….
3. Supper ……..

30. What is the child's habit of eating vegetables and fruits?

a) Always [ ]
b) Sometimes [ ]
c) Never [ ]

31. How are the fingernails of the child (observe)?

1. Trimmed [ ]
2. Untrimmed [ ]

32. i) Are there domestic animals in the home?

1. YES [ ]
2. NO [ ]

ii) If YES in 31 above please specify…….

Background information on education and socio-economic status

33. What is care-giver's level of formal education? (Tick appropriately)

    1. None [ ]
    2. Primary [ ]
    3. Secondary [ ]
    4. Diploma [ ]
    5. Degree [ ]

34. Marital Status of mother/caretaker

    1. Single [ ]
    2. Married [ ]
    3. Separated [ ]
    4. Divorced [ ]
    5. Widowed [ ]

35. What is the mother's occupation?

    1. Housewife [ ]
    2. Government employee [ ]
    3. Self-employed [ ]
    4. Other (specify)…….

36. What is the family's monthly income? (in Kenya shillings)

    1. <USD 92.34 [ ]
    2. ≥USD 92.34 [ ]

37. How many members are in the household?

1. >4 [ ]
2. <4 [ ]

38. What is the religion of the parents?

1. Christian [ ]
2. Non-Christian [ ]
3. Others (Specify)…….

Water supply and hygiene practices

39. What is the main source of water in your household?

1. KIWASCO [ ]

2. Borehole [ ]
3. Rainwater collection [ ]
4. Water vendor [ ]
5. Others (list)……

40. Time taken to fetch water in minutes
    1. <30 minutes [ ]
    2. 31-59 minutes [ ]
    3. 60-120 minutes [ ]

41. Do you experience water shortage/ rations?
    1. YES [ ]
    2. NO [ ]
    3. Sometimes [ ]

42. How frequent is the water shortage?
    1. Less than three days [ ]
    2. More than one week [ ]
    3. None of the above [ ]
    4. Any other……..

43. Do you treat water for drinking?
    1. YES [ ]
    2. NO [ ]

    i. Please explain the method used to treat water……

44. Mother's hand washing at all the critical five moments (before holding the child, after cleaning the child, before preparing food, before eating and after visiting the toilet)
    1. All practiced [ ]
    2. Partially practiced [ ]

45. Cleaning materials used to wash hands….

1. Water only [ ]
2. Soap and water [ ]
3. Others [ ]
4. Specify…….

46. Mother's habit of eating vegetables and fruits

1. Always
2. Never [ ]
3. Sometimes [ ]

47. What are some of the benefits of hand washing? (Please list down).....

.....

Latrines/Toilets and Excreta Disposal

48. Do you have access to Latrine/toilet facility?

1. YES [ ]
2. NO [ ]

49. If Yes in 45 above, which type of disposal system do you use?

1. Flush [ ]
2. Pit latrine [ ]

50. i) How many house-holds use the latrine/toilet facility? (Tick/circle appropriately).

1. One [ ]
2. More than one [ ]

. ii) If more than one in (i) above, explain how you ensure that the facility always remain clean

……

……

51. How do you dispose of children's feces?

1. Latrine [ ]
2. Open yard [ ]
3. Open drains [ ]
4. Others specify……

APPENDIX II: KII

Participant's Code……..

Carder…….

Facility name……

Date……..

Section A: Occurrence of malnutrition, diarrhea, bidirectional malnutrition-diarrhea among under-fives

Briefly explain

1. 1) How diarrhea affects caloric intake of a child who is on exclusive breastfeeding
   ……
   ……..
   ……
   …….

   2.How diarrhea affects caloric intake of a child who is already started on complementary feeding
   ……
   ……
   …….
2. 1) How dietary source affects absorption of nutrients in a child of under-five years……
   ……

   2) How diarrhea affects absorption of nutrients in a child of under-five years
   ……
   …….
3. How diarrhea affects a child's nutrients needs ……..

Section B: Risk factors for malnutrition, diarrhea, directional malnutrition-diarrhea among under-fives

1. How continued feeding during an episode of diarrhea affect a child's nutrition status……
   ……..
2. The risk factors for malnutrition among the under-fives----------
   ----

   ----
3. Risk factors for diarrhea among the under-fives----------

   ----
4. Risk factors for a child developing diarrhea then malnutrition----------
   ----

   ----
5. Risk factors of the child developing malnutrition then diarrhea----------
   ----

APPENDIX III: KEY INFORMANT INTERVIEW SCHEDULE

TITLE: COMMUNITY BASED INTERVENTIONS FOR PREVENTION OF MALNUTRITION, DIARRHEA AND BIDIRECTIONAL DIARRHEA-MALNUTRITION AMONG UNDER-FIVES IN INFORMAL SETTLEMENTS

STEP 1: LIST OF PARTICIPANTS AND PARTICIPANT ATTRIBUTES.

No.	Unique participant identifier	Age	Sex	Marital Status	Education Level	Residence	Ethnicity
1							
2							
3							

INTRODUCTION AND CONSENT:

My name is Milka Ogayo and my colleagues are ...…… …..... I am a PhD student at JOOUST. Do you know what a PhD program is? (If not, explain –a PhD program). As part of requirements for my program, I am conducting a study about occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives from informal settlements of Kisumu County. By speaking to you today, we wish to gather your views on improved sanitation and proper infant and young child feeding as strategies for preventing the occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. As SCHCs, you play a role in the implementation and coordination of interventions that prevent malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives at community and household levels of informal settlements. The knowledge you share will help us improve service delivery and to make guidelines for improved sanitation and proper infant and children nutritional care.

I want to assure you that all information provided here will be confidential and will only be shared with the relevant people at the hospital and university. We would like, with your permission, to record this discussion so that no information is missed out. All information will be secured by the PI and will only be accessed by key research team members and local Ethical and Review Committee. We will only use first names in this discussion therefore there will be no way someone can identify you or your contribution to the discussion.

Before we start, let me say that your opinions are very important, there is no right or wrong answer and everyone is encouraged to participate. This session is expected to last for 45 minutes to 1 hour. We are going to try to keep time.

Note time discussion starts……...hr.……minutes.

STEP 2 : KII QUESTIONS

1. Do you agree that proper young infant feeding can prevent occurrence of Malnutrition
   Yes or No
   If yes, why?
   Diarrhea
   Yes or No
   If Yes, Why?
   Probe
   Early initiation on breast milk
   Exclusive breast feeding (timing, frequency,)
   Complementary feeding (timing, frequency, composition, safety)
2. Do you agree that improved sanitation can prevent occurrence of:
   Malnutrition
   Yes or No
   If Yes, why?
   Diarrhea
   Yes or No
   If Yes, why?
   Probes
   Having a latrine where there was none
   Upgrading the level of latrine
   Locking latrine doors and keeping the key
   Households developing a schedule for routine cleaning
   Disposing under- fives feces in the latrine
   Washing hands after visiting the toilet
   Trimmed fingernails
   Not sharing latrines
   Clearing the compound of animal feces

3. Where do you see success/challenges in those approaches?
4. What are the major challenges to latrine ownership in the community?
5. How can the above challenges be best addressed?
6. What are the major challenges to proper infant and young child feeding
7. How can the challenges be overcome?
8. In your opinion, what are the sustainability strategies of improved sanitation and proper infant and young child feeding in the informal settlements?

APPENDIX IV :FGD GUIDE

TITLE: COMMUNITY BASED INTERVENTIONS FOR PREVENTION OF MALNUTRITION AND DIARRHEA AMONG CHILDREN UNDER-FIVE YEARS IN INFORMAL SETTLEMENTS

STEP 1: LIST OF RESPONDENTS AND THEIR ATTRIBUTES.

No.	Unique participant identifier	Age	Sex	Marital Status	Education Level	Residence	Ethnicity
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

INTRODUCTION AND CONSENT:

My name is Milka Ogayo and my colleagues are ...…… …..... I am a PhD student at JOOUST. Do you know what a PhD program is? (If not, explain –a PhD program). As part of requirements for my program, I am conducting a study about occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives from informal settlements of Kisumu County. By speaking to you today, we wish to gather your views on improved sanitation and proper infant and young child feeding as strategies for preventing the occurrence of malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives. As CHAs you play a role in the implementation and coordination of interventions that prevent malnutrition, diarrhea and bidirectional diarrhea-malnutrition among under-fives at community and household levels of informal settlements. The knowledge you share will help us improve service delivery and to make guidelines for improved sanitation and proper infant and children nutritional care.

I want to assure you that all information provided here will be confidential and will only be shared with the relevant people at the hospital and university. We would like, with your permission, to record this discussion so that no information is missed out. All information will be secured by the PI and will only be accessed by key research team members and local Ethical and Review Committee. We will only use first names in this discussion therefore there will be no way someone can identify you or your contribution to the discussion.

Before we start, let me say that your opinions are very important, there is no right or wrong answer and everyone is encouraged to participate. This session is expected to last for 45 minutes to 1 hour. We are going to try to keep time.

Note time discussion starts……...hr.……minutes.

STEP 2: FGD QUESTIONS
PROPER INFANT AND YOUNG CHILD FEEDING

1. Can early initiation of an under five on breast milk prevent occurrence of?

   Malnutrition

   Yes/No

   If Yes, how?

   Diarrhea

   Yes/No

   If Yes, how?

2. Can exclusive breast feeding of an under five for the first six months of life prevent occurrence of

   i. Malnutrition

      Yes/No

      If Yes, how?

   ii. Diarrhea

   Yes/No

   If YES, how?

3. Does hand washing by caregivers of under-fives prevent occurrence of:

   Malnutrition

   Yes/No

   If Yes, how?

   Diarrhea

   Yes/No

   If Yes, how?

   Probe..

   Critical moments:

   -before touching the under-five,

   -feeding the under-five

   -Preparing under-five's food,

   -after visiting the toilet

-After removing under-five's diapers

4. Is feeding an under five on safe food a way of preventing occurrence of:

i. Malnutrition

Yes or No

If Yes, how

ii. Diarrhea

Yes or No

If Yes, how?

Probes

-Food handling

-Food preparation

5. Does complementary feeding prevent occurrence of

i) Malnutrition among under-fives

Yes or no

If yes how

ii) Diarrhea among under-fives

Yes or no

If yes how

Probes

-Timing

-Frequency (6-8 months, 9-23 months)

-Food groups-vegetables/vitamins; carbohydrates, protein

-Snacking

6. Does drinking treated water prevent occurrence of:

Malnutrition among under-fives

Yes or No

If Yes, how?

Diarrhea among under-fives

Yes or No

If Yes, how?

b) IMPROVED SANITATION

1. Can constructing any type of latrine for households that had none prevent occurrence of:
    i) Malnutrition among under-fives

        Yes or no

        If yes, how?

    ii) Diarrhea among under-fives

        Yes or no

        If yes, how?
2. Does upgrading latrines from a low level to a higher level one prevent occurrence of:
    i. Malnutrition among under-fives

        Yes or No

        If Yes, how?

    ii. Diarrhea among under-fives

        Yes or No

        If Yes, how
3. Does caregiver hand washing with soap and water after visiting the latrine prevent occurrence of:
    i) Malnutrition among under-fives

        Yes or no

        If yes how

    Ii Diarrhea among under-fives

        Yes or no

        If yes how
4. Does regular cleaning of shared latrine by households prevent occurrence of
    i. Malnutrition among under-fives

        Yes or no

        If yes how

    ii. Diarrhea among under-fives

        Yes or no

        If yes how

5. Does drawing a schedule of when each household should clean the latrine prevent occurrence of :

i. Malnutrition among under-fives?

Yes or no

If yes how

ii. Diarrhea among under-fives

Yes or no

If yes how

6. Do you think keeping under-five's finger nails trimmed can prevent occurrence of : malnutrition

Yes or no

If yes how

Diarrhea

Yes or No

If Yes, how?

7. Do you think disposing of under-fives feces in the latrine will prevent occurrence of

i. Malnutrition

Yes or no

If yes how

ii. Diarrhea

Yes or no

If yes, how?

8. Do you think not sharing latrines among households can prevent occurrence of

    i. Malnutrition among under-fives?

    Yes or no

    If yes, how?

    ii. Diarrhea among under-fives

    Yes or no

    If yes, how?

9. Do you think clearing the compound of animal feces can prevent occurrence of

i. malnutrition among under-fives

Yes or no

If yes how

ii. Diarrhea among under-fives?

Yes or no

If yes how

STEP 3: RISK FACTORS FOR MALNUTRITION AND DIARRHEA AMONG UNDER-FIVES

1. Is sharing of latrines among households a risk factor to :

i. Malnutrition among under-fives

Yes or No

If Yes, how?

ii. Diarrhea among under-fives

Yes or No

If Yes, how?

2. Is failure of a caregiver to wash hands at critical points a risk factor to:

i. Malnutrition among under-fives

ii. Yes or No

If Yes, how?

iii. Diarrhea among under-fives

3. Is lack of any type of latrine facility in the settlement where under-fives live a risk factor to:

i. Malnutrition

Yes or No

If Yes, how?

ii. Diarrhea

Yes or No

If yes, how?

4. Is failure to exclusively breast feed an under five less than six months old, a risk factor to

i. Malnutrition

ii. Yes or No

iii. If Yes, how?

iv. Diarrhea

5. Is lack of community involvement in advocating for any type of latrine where none exists a risk factor to

i. Malnutrition among under-fives

Yes or No

If Yes, how?

ii. Diarrhea among under-fives

Yes or No

If Yes, how?

6. Do you think failure to initiate an infant on breast milk within the first hour of birth is a risk factor to:

i. Malnutrition among under-fives

Yes or No

If Yes, why?

ii. Diarrhea among under-fives

Yes or No

If Yes, why?

7. Do you think failure to start complementary feeding at sixth month of life is a risk factor to:

i. Malnutrition among under-fives

ii. Yes or No

iii. If Yes, Why?

iv. Diarrhea among under-fives

Yes or No

If Yes, Why?

Probe

Initiating feeds before six months

Initiating feeds after six months

8. Do you think that unimproved latrine is a risk factor for:

i. malnutrition among under-fives

Yes or No

If Yes, how?

ii. Diarrhea among under-fives

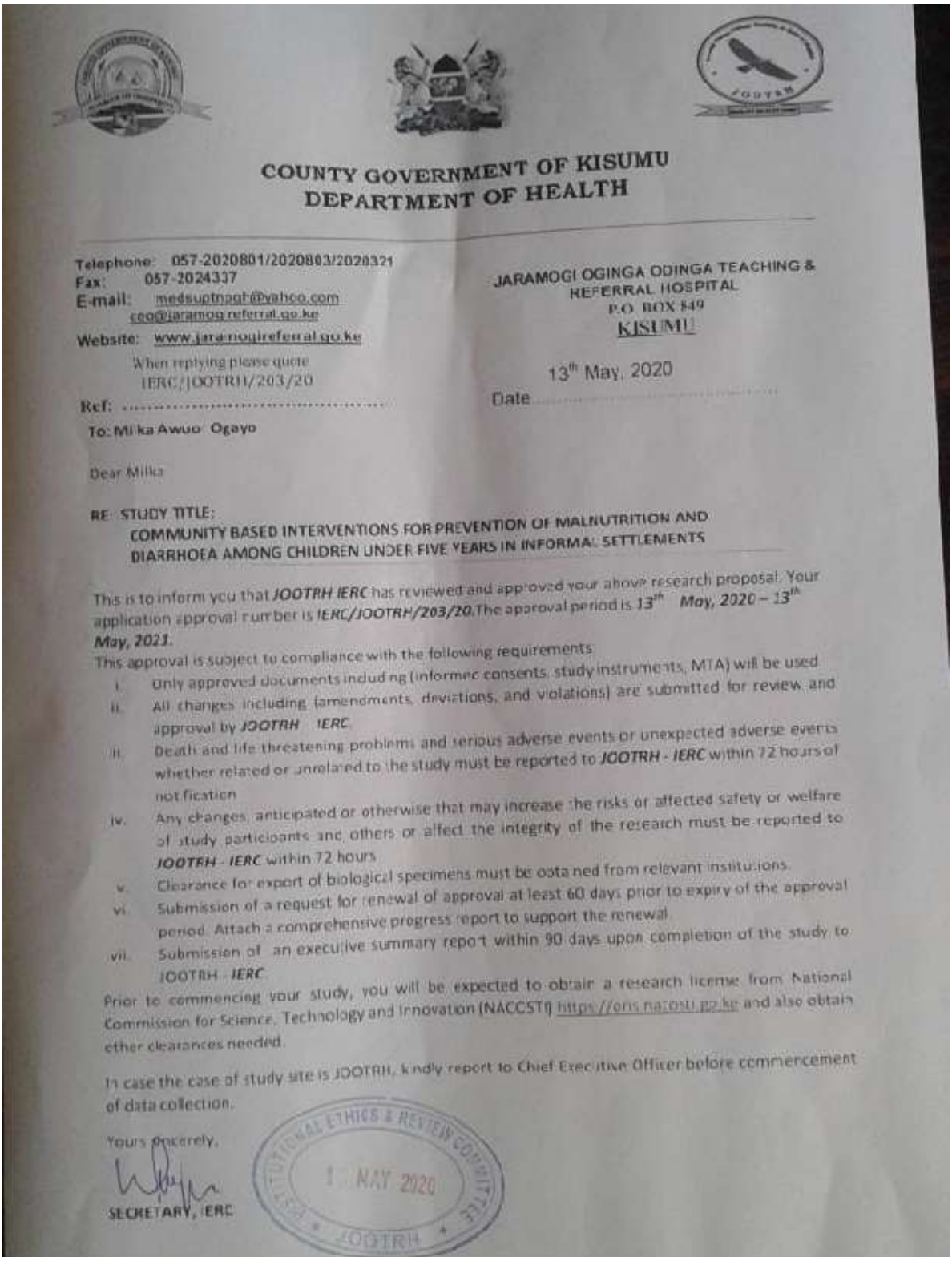
Yes or No

If Yes, how?

Appendix V: Preliminary Report

	Health status 1st to 31st November 2018	**Number**	**Percentage**
1.	Diarrhea to Malnutrition	5	19%
	Those who didn't develop malnutrition	21	81%
	Total	**26**	**100%**
2	Malnutrition to diarrhea	8	89%
	Those that didn't develop diarrhea	1	11%
	Total	**9**	**100%**

APPENDIX VI: RESEARCH APPROVAL FROM COUNTY GOVERNMENT OF KISUMU



COUNTY GOVERNMENT OF KISUMU
DEPARTMENT OF HEALTH

Telephone: 057-2020801/2020803/2020321
Fax: 057-2024337
E-mail: medsuptnpgh@yahoo.com
ceo@jaramog.referral.go.ke
Website: www.jaramogireferral.go.ke

JARAMOGI OGINGA ODINGA TEACHING & REFERRAL HOSPITAL
P.O BOX 849
KISUMU

When replying please quote
IERC/JOOTRH/203/20

Ref: .....

13th May, 2020

Date .....

To: Mi ka Awuo Ogayo

Dear Milka

RE: STUDY TITLE:
COMMUNITY BASED INTERVENTIONS FOR PREVENTION OF MALNUTRITION AND DIARRHOEA AMONG CHILDREN UNDER FIVE YEARS IN INFORMAL SETTLEMENTS

This is to inform you that ***JOOTRH IERC*** has reviewed and approved your above research proposal. Your application approval number is ***IERC/JOOTRH/203/20***.The aparoval period is 13th ***May, 2020 – 13th May, 2021.***

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 ***JOOTRH IERC***
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 ***JOOTRH - IERC*** 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 ***JOOTRH - IERC*** 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 JOOTRH - ***IERC***

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

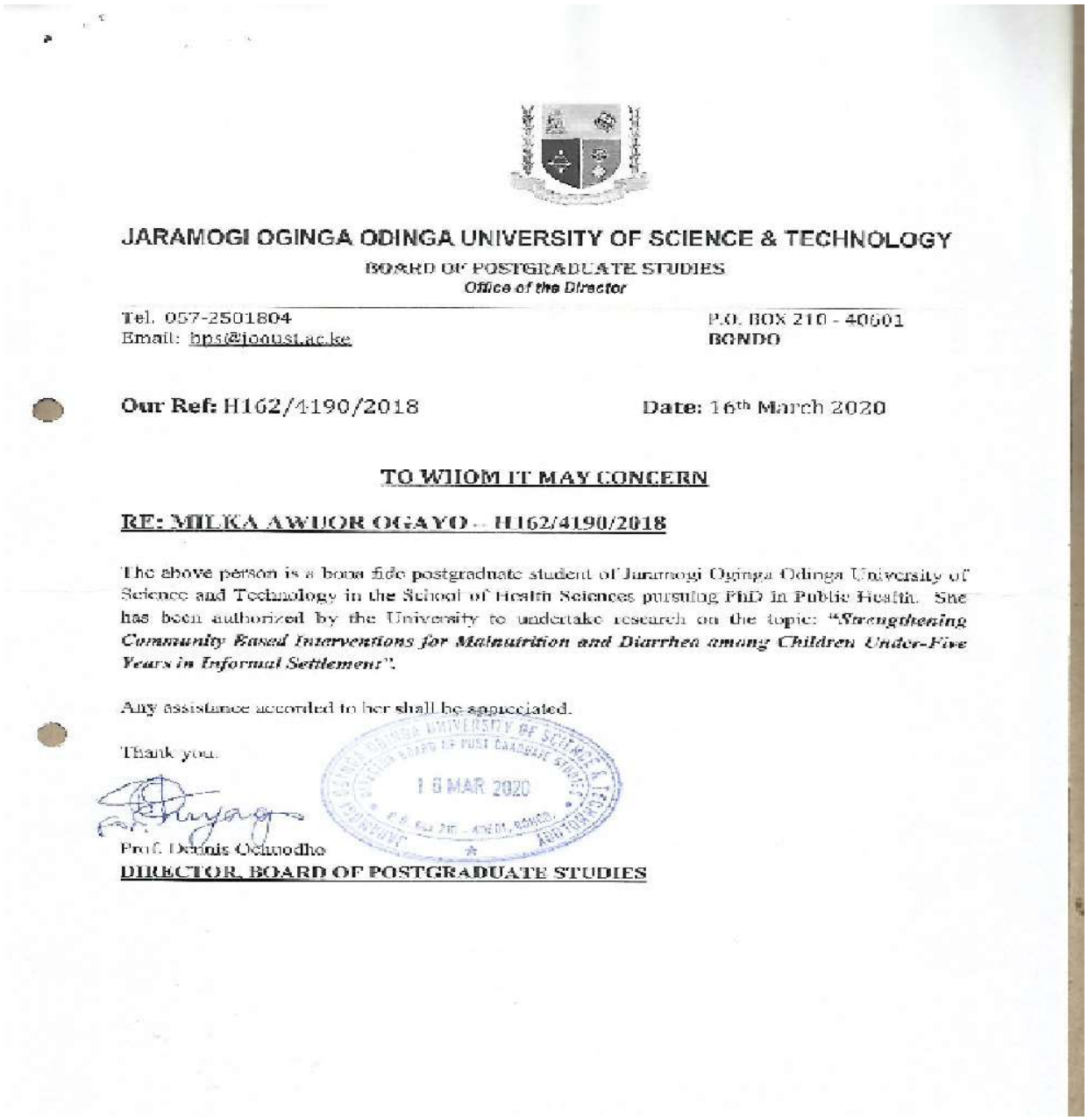
In case the case of study site is JOOTRH, kindly report to Chief Executive Officer before commencement of data collection.

Yours Sincerely,

SECRETARY, IERC

INSTITUTIONAL ETHICS & REVIEW COMMITTEE
1 MAY 2020
JOOTRH

APPENDIX VII: RESEARCH AUTHORIZATION FROM JOOUST



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE & TECHNOLOGY

BOARD OF POSTGRADUATE STUDIES
Office of the Director

Tel. 057-2501804
Email: bps@jooust.ac.ke

P.O. BOX 210 - 40601
BONDO

Our Ref: H162/4190/2018 **Date:** 16th March 2020

TO WHOM IT MAY CONCERN

RE: MILKA AWUOR OGAYO – H162/4190/2018

The above person is a bona fide postgraduate student of Jaramogi Oginga Odinga University of Science and Technology in the School of Health Sciences pursuing PhD in Public Health. She has been authorized by the University to undertake research on the topic: ***"Strengthening Community Based Interventions for Malnutrition and Diarrhea among Children Under-Five Years in Informal Settlement"***.

Any assistance accorded to her shall be appreciated.

Thank you.

16 MAR 2020

Prof. Dennis Ochuodho
DIRECTOR, BOARD OF POSTGRADUATE STUDIES

APPENDIX VIII: RESEARCH LETTER OF AUTHORIZATION FROM NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **808548**

Date of Issue: **11/June/2020**

RESEARCH LICENSE

This is to Certify that Ms.. MILKA AWOUR OGAYO of Masinde Muliro University of Science and Technology, has been licensed to conduct research in Kisumu on the topic: COMMUNITY BASED INTERVENTIONS FOR PREVENTION OF MALNUTRITION AND DIARRHEA AMONG CHILDREN UNDER-FIVE YEARS IN INFORMAL SETTLEMENTS. for the period ending : 11/June/2021.

License No: **NACOSTI/P/20/5101**

808548

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

CONDITIONS

1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearence from relevant Government Agencies
5. The License does not give authority to tranfer research materials
6. NACOSTI may monitor and evaluate the licensed research project
7. The Licensee shall submit one hard copy and upload a soft copy of their final report (thesis) within one of completion of the research
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice

National Commission for Science, Technology and Innovation
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