ASSOCIATION OF DIARRHEAL CONDITIONS AMONG UNDER-FIVE CHILDREN AND HEALTH SYSTEMS PERFORMANCE IN MIGORI COUNTY, KENYA.

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Award of Doctor of Philosophy Degree in Public Health in the School of Health Sciences of Jaramogi Oginga Odinga University of Science and Technology.

DECLERATION

DECLARATION BY STUDENT.

I hereby affirm the authenticity of this thesis as an original piece of work, which has not been previously submitted for the purpose of obtaining a diploma or degree from any other academic institution or university.

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CERTIFICATION BY THE SUPERVISORS.

I hereby affirm that this thesis is being submitted for examination under my supervision and with my endorsement as the designated supervisor. The research paper bears the title, "Association of Diarrheal conditions among under five children and health systems performance in Migori County, Kenya."

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DEDICATION

This thesis is gratefully dedicated to my parents, Harrison Aranda and Carren Kwamboka, whose unwavering support and constant motivation have been instrumental in ensuring the successful completion of this study. Consistently, they persistently emphasized the importance of promptly completing this study. I would like to express my heartfelt dedication of this study to my beloved wife, Everlyn Kerubo. Her unwavering support and encouragement throughout the entire process of this study have been instrumental in my success. Her constant prayers and motivation have served as a driving force, urging me to complete this study within the designated timeframe. I am forever grateful for the unwavering support and invaluable contributions of our beloved children, Shawn, Shirley, and Shania, throughout the entirety of this profound academic endeavor. Their presence and assistance have truly enriched my experience, allowing for a more profound understanding and meaningful engagement with the subject matter at hand. May the divine bestow an abundance of blessings upon them.

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ABSTRACT

Association of Diarrheal conditions among under five children and health systems performance in Migori county, Kenya

Globally, nearly 1.7 billion cases of diarrhea occur among children under five every year. In Africa it accounts for over 70% of the under five mortality, while in Kenya it remains among the leading cause of mortality and morbidity among under-fives. The study was meant to determine the factors associated with diarrheal conditions among under-five children and health systems performance in Migori County; to determine the effects associated with diarrheal conditions among under-five children and health systems performance in Migori County and to establish the prevention and control strategies associated with diarrheal conditions among under-five children and health systems performance in Migori County. A mixed method approach was used and a total of 334 children under five were sampled using cluster sampling techniques. Descriptive and inferential statistics were generated during data analysis. The findings revealed that factors including latrine ownership ($p < 0.001$); type of latrine ($p = 0.003$); presence of flies on latrine ($p = 0.005$); practicing Open Defecation ($p = 0.006$); time used to fetch water ($p = 0.016$); distance to water source ($p = 0.007$); main source of income ($p = 0.028$); household monthly income ($p = 0.015$) and wealth index ($p = 0.039$) had an influence on occurrence of diarrhea in under five children. Stunting growth ($p = 0.007$); reduction in cognitive development ($p = 0.012$); severe wasting ($p = 0.043$); dehydration ($p = 0.028$) and financial losses ($p = 0.004$) were found to be significant effects of diarrhea. Protection of water sources ($p < 0.001$); container for collecting water ($p = 0.006$); type of container for storing drinking water ($p = 0.007$); treatment of water at the point of use ($p = 0.004$); methods of water treatment ($p = 0.003$); methods of infant feces disposal ($p = 0.016$); methods of food storage ($p < 0.001$) and rotavirus vaccination ($p < 0.001$) were found to be significant prevention strategies for diarrhea. Bivariate analyses revealed that, factors such as latrine ownership ($p = 0.003$); presence of flies on latrine ($p = 0.005$) and practicing OD ($p = 0.006$) were significant in predicting the outcome. The significant effects which predicted the outcome on bivariate analyses were stunting growth ($p = 0.009$); reducing cognitive development ($p = 0.007$); dehydration ($p = 0.018$); financial losses ($p = 0.023$) and productivity losses ($p = 0.014$). Finally the prevention strategies consisting of protection of drinking water source ($p = 0.014$); treatment of drinking water at POU ($p = 0.015$); methods of food storage ($p = 0.024$) and rotavirus vaccination ($p = 0.003$) were significant in predicting the outcome. Regression analyses the factors, effects and prevention strategies had significant prediction performances of $X^2(3, N=334 = 19.75, p=0.003)$, $X^2(5, N=334 = 11.36, p=0.005)$ and $X^2(3, N=334 = 22.02, p=0.004)$ respectively. They further (factors: $R^2 = 0.826$), (effects: $R^2 = 0.862$) and (prevention strategies: $R^2 = 0.893$) proved that they were significantly good predictors of the outcome variable. The Study concluded that diarrheal factors, the effects and prevention strategies significantly predicted the response variable. There should be focused community-based identification of factors attributing to diarrhea and locally addressing them. Earlier management of the effects of diarrhea should be prioritized. Further the county should embrace community health strategy by strengthening prevention strategies through the design of county specific comprehensive diarrhea prevention and control network and framework.

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LIST OF ACRONYMS AND ABBREVIATIONS

AOR : Adjusted Odds Ratio

BCC : Behavioral Change Communication

CBHIS : Community Based Health Information System

CDA : Community Development Officer

CDC : Centre for Disease Control and Prevention

CDD : Control of Diarrhea Diseases

CHA : Community Health Assistant

CHVs : Community Health Volunteers

CLTS : Community Led Total Sanitation

COD : Chairman of Department

COR : Crude Odds Ratio

CSFP : Community Strategy Focal Person

CU : Community Unit

DAZT : Diarrhea Alleviation through Zinc and ORS Treatment

DHIS : District Health Information System

DHS : District Health Systems

EHP : Environmental Health Project

FBO : Faith Based Organization

FGD : Focus Group Discussion

FY : Financial Year

GDP : Gross Domestic Product

GIT : Gastro-Intestinal Tract

GEMS : Global Enteric Multicenter Study

GoK : Government of Kenya

HH : Household

HIF : Hygiene Improvement Framework

HSM : Health Systems Management

IBD : Inflammatory Bowel Disease

ICCM : Integrated Community Case Management of Childhood illnesses

IDP : Internally Displaced Persons

IMCI : Integrated Management of Childhood Illness

IMNCI : Integrated Management of New-born and Childhood Illnesses

JMP : Joint Monitoring Program

KAP : Knowledge Attitude and Practice

KDHS : Kenya Demographic Health Survey

KII : Key Informant Interview

KNBS : Kenya National Bureau of Statistics

LMICs : Low and Medium Income Countries

MCADP : Migori County Annual Development Plan

MICS : Multi-Indicator Cluster Survey

MOH : Ministry Of Health

MNCHW : Maternal Newborn Child Health Week

NACOSTI : National Commission for Science Technology and Innovations

NGO : Non Governmental Organization

OD : Open Defecation

ODF : Open Defecation Free

OOP : Out of Pocket

OR : Odds Ratio

ORS : Oral Rehydration Solution.

ORT : Oral Rehydration Therapy

PATH : Program for Appropriate Technology in Health

PHO : Public Health Officer

PHT : Public Health Technician

POU : Point Of Use

POUZN : Point Of Use Water Disinfection Zinc Treatment

PPP : Purchasing power parity

SCDO : Sub County Development Officer

SHOPS : Strengthening Health Outcome through Private Sector

SPSS : Statistical Package for Social Sciences

SWS : Safe Water System

UN : United Nations

UNFPA : United Nations Population Fund

UNICEF : United Nations International Children's Emergency Fund

USAID : Unites States Agency for International Development

US$: United States Dollar

USD : United States Dollar

WASH : Water, Sanitation and Hygiene

WB : World Bank

WHO : World Health Organization

WKSP : Western Kenya Sanitation Program

DEFINITION OF TERMS

The subsequent terminologies have been elucidated, as they shall be employed within the scope of this investigation.

Cost recovery: Is the method to recovering an expenditure which a business takes on.

Community involvement : Is the active participation of individuals within a given community in projects aimed at addressing and resolving the challenges they face.

Childhood diarrhea: Is the occurrence of three or more bowel movements with loose or watery consistency within a 24-hour period, or a noticeable change in the frequency or liquidity of stool that is deemed abnormal by the mother or caregiver.

Cognitive development: Is the development of cognitive processes, encompassing memory, problem-solving, and decision-making, unfolds from early childhood to adolescence and ultimately into adulthood.

Community-Led Total Sanitation (CLTS): Is a pioneering approach that aims to galvanize communities in their efforts to eradicate the practice of Open Defecation (OD).

Communication: Promoting public awareness regarding healthy behaviors.

Child mortality: Is the deaths of children under the age of five.

Diarrhea: Refers to the frequent passage of loose stool, occurring three or more times within a 24-hour period.

Disease Prevention: Emphasizing preventive measures to mitigate the likelihood of acquiring chronic ailments and other adverse health conditions.

The District Health Information System (DHIS): Serves as a comprehensive open source software platform that facilitates the reporting, analysis, and dissemination of data pertaining to various health programs

Electrolyte imbalance: Refers to the deviation from normal concentrations of electrolytes within the human body.

Ecology: As a fundamental branch of biology, encompasses the intricate study of the intricate relationships and interactions that transpire among organisms and their surrounding environment, which encompasses the presence of other organisms.

Economic burden: This concept pertains to the financial expenses entailed in addressing a particular circumstance, such as the burden of disease. Within the realm of medicine, this term is employed to delineate the challenges experienced by patients in relation to the financial implications associated with their healthcare expenses.

Education: Is an enduring and dynamic system that facilitates continual learning in response to the evolving needs and aspirations of society.

An enabling environment: Refers to a comprehensive framework encompassing established rules, regulations, procedures, and prevailing circumstances that facilitate uninterrupted operations and the very existence of civic associations, as well as other manifestations of civic activism, in strict adherence to legal provisions.

The management of excreta: Is of utmost importance in order to ensure the safe disposal of waste, thereby preventing any potential contamination of the environment, water sources, food supplies, and even human hands. This practice is crucial for maintaining a healthy and sustainable environment, as well as safeguarding personal well-being.

Household: This concept refers to a collective unit comprising individuals who reside within a common dwelling and partake in communal meals.

Household members: Encompass a group of individuals who are interconnected either through consanguinity or matrimonial ties, and who will be residing within the domicile on a permanent basis.

The Health Information System (HIS): Is a comprehensive and sophisticated system specifically developed to effectively manage and organize healthcare data. Its primary objective is to streamline the collection, storage, retrieval, and analysis of crucial information pertaining to various aspects of healthcare. By leveraging advanced technological capabilities, the HIS plays a pivotal role in enhancing the efficiency and accuracy of healthcare data management, ultimately contributing to improved patient care and overall healthcare outcomes.

Health financing: encompasses the strategic allocation and utilization of financial resources to effectively and comprehensively address the diverse health requirements of individuals within a given population.

The healthcare system: encompasses the intricate framework through which healthcare is funded, structured, and provided to a given population. It encompasses a wide array of considerations, including the accessibility of healthcare services to different individuals, the

financial allocations and disbursements involved, as well as the availability of resources such as healthcare professionals and facilities.

The health system: encompasses a comprehensive amalgamation of various resources, intricate organizational structures, robust financial mechanisms, and efficient management strategies, all of which synergistically converge to facilitate the provision of essential health services to the populace.

Health promotion: refers to the dynamic process by which individuals are empowered to enhance their health and exert greater influence over their well-being. This multifaceted approach aims to enable individuals to actively participate in improving their overall health and well-being. It transcends the emphasis on individual conduct and extends its scope to encompass a diverse array of social and environmental interventions.

Health Education: Facilitating transformative shifts in behavior and fostering proactive engagement through enhanced knowledge acquisition. Health education strategies encompass a diverse array of effective modalities, such as comprehensive courses, specialized trainings, and invaluable support groups.

Hygiene: encompasses a set of conditions and practices that are instrumental in preserving one's well-being and mitigating the transmission of diseases.

Inflammatory bowel disease (IBD): encompasses a collection of gastrointestinal disorders characterized by persistent inflammation of the digestive tract.

Institutional strengthening: refers to the process of enhancing the capacity and capability of institutions to effectively carry out their designated functions.

Micronutrients: also known as essential elements, play a crucial role in the overall well-being of organisms by facilitating a diverse array of physiological functions. These vital components are required in relatively small quantities throughout an organism's lifespan. By orchestrating various biological processes, micronutrients contribute to the maintenance of optimal health.

Mortality: refers to the quantification of the occurrence of deaths within a specific cohort of individuals over a defined temporal interval.

Morbidity: pertains to the presence of a disease or manifestation of disease symptoms, or alternatively, it denotes the extent of disease prevalence within a given population.

Malnutrition: encompasses the condition wherein an individual experiences inadequacies, surpluses, or disparities in their consumption of energy and/or essential nutrients.

Malabsorption: is a physiological condition characterized by a diminished capacity to effectively digest and/or assimilate essential nutrients derived from dietary sources.

Open defecation: also known as the act of excreting in the open environment, entails the human practice of defecating outdoors instead of utilizing a designated toilet or latrine facility.

Oral Rehydration Therapy (ORT): refers to the administration of fluids through the oral route, with the aim of preventing and/or rectifying dehydration caused by diarrhea.

Oral rehydration salts (ORS): represent a unique amalgamation of desiccated salts, which, when skillfully blended with potable water, yield a potent solution. The consumption of fluids can aid in replenishing the bodily fluids that have been depleted as a result of experiencing diarrhoea.

Performance: refers to the dynamic and intricate process of executing a task or carrying out a specific function. It encompasses the actions and behaviors undertaken to achieve a desired outcome, showcasing a blend of skill, expertise, and proficiency.

Prevalence: refers to the proportion of individuals within a population who exhibit a specific characteristic during a specified time frame.

Preventive: measures encompass a range of intentional actions aimed at mitigating the occurrence of various phenomena, notably including diseases and their associated consequences. The primary objective is to prevent the occurrence of undesirable events, such as illness or harm.

Policy: The implementation of regulations or mandates by organizations or public agencies aimed at fostering and promoting the adoption of health-conscious behaviors and decision-making.

Quality: Is the level of value provided by any health care resources, as determined by some measurements.

Stunted growth: Also known as low height-for-age, pertains to the condition where a child's stature falls below the expected range for their age, without necessarily implying a state of thinness.

Sanitation: refers to the comprehensive provision of facilities and services that ensure the safe management of human excreta throughout its entire lifecycle. This includes the proper handling of waste from the toilet, its containment and storage, as well as on-site treatment. Alternatively, it may involve the conveyance of waste to a treatment facility, where it undergoes appropriate treatment before being safely utilized or disposed of.

Socio-economic: pertains to the intricate interplay between the social and economic behaviors exhibited by a collective of individuals.

Systems: The Fundamental Components of Organizational Functionality.

The Safe Water System (SWS): is a water quality intervention designed to address the pressing need for affordable and effective methods of water treatment and storage. This household-based system has been specifically developed to cater to populations that currently lack access to safe water sources. By offering a viable solution in the short to medium term, the SWS aims to provide a practical and accessible means of ensuring water safety for these communities.

Vulnerability: refers to the state of being susceptible to potential physical or emotional harm or attack.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information.

According to World Health Organization (WHO), diarrhea is defined as the passage of three or more loose or liquid stools per day because of abnormally high fluid content of stool or an abnormal increase in daily stool frequency. Globally, diarrhea is the second-leading cause of death among under-five children, accounting 9% of all under-five deaths. In developing countries, it has been estimated that 1.8 million people die annually due to diarrheal diseases and more than 80% of them are children aged under-five years [WHO, 2023]. Diarrhea is responsible for the deaths of more than 90% of under-five years of age in low and lower-middle income countries, and regionally, South Asia and sub-Saharan Africa (SSA) accounted for 88% of deaths for the same age group [UNICEF, 2023].

There are three types of diarrhea, namely acute watery diarrhea (diarrhea that lasts several hours or days, usually less than 2 weeks), acute bloody diarrhea also called dysentery (diarrhea containing blood with or without mucus) and persistent diarrhea (a diarrhea with or without blood that lasts 14 days or longer) (CDC, 2024).Diarrhea is caused by a variety of bacterial, viral, and parasitic organisms [UNICEF, 2019].

Socio-demographic factors such as age of child, maternal education, lack of awareness of mothers/caregivers, lower socio-economic status, distance and source of drinking water, latrine and hand washing facilities, breast feeding, place of residence, disposal of children's stool, family size, number of under-five children in the household, maternal age and maternal employment status were found to be the determinant factors of diarrhea among under-five children [Christine M. *et al,* 2021].

Risk factors for diarrhea such as low maternal education, lack of safe water supply, poor water-storage practices, younger maternal age, lack of hand washing with soap by caregiver, poor sanitation, visible feces in the yard, indiscriminate disposal of child feces, unsatisfactory garbage disposal and not treating water in the home have been identified at the household levels [Matthai, J., 2022]

Children with diarrhea will face many problems including loss of appetite, electrolyte deficit, malnutrition, increased risk of developing other infectious diseases and delayed physical growth and mental development. Because of its negative impact on the physical and cognitive development, diarrhea is also associated with multiple problems; causing for 72.8 million disability and adjusted life years, and it worsens the economic situation of families and the healthcare system [UNICEF, 2023].

Diarrhea disease also cause a high financial burden to households, with most costs incurred being related to indirect and non-medical like travel to facilities, and loss of income (PATH, 2020).The average cost of management of diarrheal at facility level, is USD 36.56 per patient episode and USD 159.90 per inpatient episode. This cost accounts greater than, or equal to an entire family's monthly income mostly in low and middle income brackets [Baral, *et al* 2020]

A number of interventions are effective in preventing diarrheal diseases, thereby positively impacting the nutritional status of those most vulnerable. These are: Access to safe drinking water (e.g. water safety planning (the management of water from the source to tap); household water treatment and safe storage), Access to improved sanitation facilities, Hand washing with soap at critical times (e.g. after toilet use and before the preparation of food). Hygiene promotion, along

with access to safe drinking water and adequate sanitation should be accessible by all [UNICEF&WHO, 2023].

Effective interventions to target previously identified knowledge and behavioral risk factors for diarrheal disease in children include promotion of hand washing with soap, hygiene education, latrine installation at the household and community level, municipal water connection, water kiosk, household-based chlorination, filtration, solar disinfection, and improved water storage [Deogratias A. *et al*, 2019]

Investments put in Kenya to prevent and treat diarrheal include early administration of ORS and Zinc; integrated management of new-born and childhood illnesses (IMNCI) and Integrated Community Case Management of Childhood illnesses (ICCM); the national diarrhea and pneumonia scale up plan; re-classification of Zinc sulphate from prescription only to over-the-counter product; development of locally produced ORS/Zinc co-pack and introduction to Rotavirus vaccine into the national routine immunization schedule. There has also been an increase in the proportion of household with improved sanitation facilities [KHPC, 2019]

Despite the interventions put in place, diarrheal diseases remain among the top five causes of morbidity and mortality in Kenya. Prevention and management of diarrheal requires multi-sectoral approach including investment in infrastructure to improve access to clean water, proper sanitation and hygiene [Elizabeth and Pepela, 2020].

In Migori county, environmental factors including method of refuse disposal; latrine availability; latrine type; latrine sharing; source of drinking water; water storage; method of drawing water; scooper cleaning; cleaning water container before refilling; and drinking water treatment had an effect on the occurrence of diarrhea in under-five year old children [Collince and Martha, 2019].

Despite diarrhea among under-five years of age being a significant public health problem, there has no study done that investigates its influence on health systems. This study therefore was meant to investigate the association of diarrheal conditions among under five children and health systems performance in Migori County, Kenya.

1.3 Statement of the Problem.

Migori County reported high prevalence (28%) of diarrhea compared to the national (15%) level (DM Mulatya, 2020). In the same period a total of 25% of the children were found to be stunted. The health systems in Migori were found to perform significantly below as accessibility to basic healthcare decreased by 49% (Ondiwa, 2024). Implementation of Water Sanitation and Hygiene programs has achieved an increase in latrine utilization by 23%f 18% among households in Migori County (USAID/WKSP, 2022). Migori Health services spend over four hundred million shillings annually on preventive, promotive health services and disease control (MCADP, 2022/2023). In spite of the diligent endeavors made by the Ministry of Health and various development partners to mitigate the prevalence of diarrheal cases County continued to grapple with a substantial number of reported cases of diarrhea.

1.4 Purpose of the study

The purpose of the study was to investigate the association of diarrheal conditions among under-five children and health systems performance in Migori County.

1.5 Research Questions.

This study was guided by one broad and three specific questions that were used to provide the direction for this study throughout the whole process.

1.5.1 Broad Research Question

What was the association of diarrheal conditions among under-five children and health systems performance in Migori County, Kenya?

1.5.2 Specific Research Questions.

1. What were the environmental, behavioural and socio-economic factors associated with diarrheal conditions among under-five children and health systems performance in Migori County, Kenya?
2. What were the effects associated with diarrheal conditions among under-five children and health systems performance in Migori County, Kenya?
3. What were the prevention and control strategies associated with diarrheal conditions among under five children and health systems performance in Migori County, Kenya?

1.6. Study Objectives

The study was guided by one broad objective and three specific objectives that were used to provide the direction for this study throughout the whole process.

1.6.1 Broad Objective

To establish the association of diarrheal conditions among under five children and health systems performance in Migori County, Kenya.

1.6.2 Specific Objectives

1. To determine the environmental, behavioural and socio-economic factors associated with diarrheal conditions among under-five children and health systems performance in Migori County, Kenya.

2. To determine the effects associated with diarrheal conditions among under-five children and health systems performance in Migori County, Kenya.
3. To establish the prevention and control strategies associated with diarrheal conditions among under-five children and health systems performance in Migori County, Kenya.

1.7 Justification of the study:

Diarrheal conditions significantly contribute to the elevated rates of morbidity and mortality observed among children below the age of five. Episodes of diarrheal illness have the potential to give rise to severe and potentially life-threatening complications, including but not limited to dehydration, imbalances in electrolyte levels, malnutrition, acidosis, and viral myocarditis. In numerous instances, the affliction leads to the demise of individuals within a brief span of hours, primarily due to the depletion of bodily fluids responsible for the transportation of vital nutrients and minerals necessary for the proper functioning of the human body. Generally Diarrheal diseases are prevalent on a global scale and have the potential to elicit a wide array of symptoms, spanning from mild discomfort to fatal outcomes, if prompt treatment is not promptly administered.

1.8 Significance of the study.

Since the study has been done to its logical conclusion, the recommendations of the study will be applied appropriately and effectively. This will enable significant reduction in diarrheal conditions, hence reducing pressure or stress put on health systems during diarrheal treatment and or management, consequently it will save resources which could be utilized to improve the health systems so as to offer satisfactory healthcare services.

1.9 Scope of the study

The study was conducted over a period spanning from March 2019 to February 2020, employing a mixed method research design. The research was carried out among households residing in Migori County. The participants of the study consisted of child-caregiver pairs who were mentally sound and had reached a minimum age of 14 years. Additionally, the index child in each pair had experienced episodes of diarrheal illness. The data was gathered through the utilization of questionnaires, structured interview schedules, and interactive focus group discussions.

1.10 Assumptions of the study

The study was predicated upon a set of assumptions, all of which were duly satisfied:

i. The study was conducted well without interference and achieved its intended objectives.
ii. Respondents gave accurate, truthful and honest responses to the questions during data collection.

1.11 Theoretical framework.

To increase the effectiveness and efficiency, the study applied theory triangulation. The study was guided by a combination of three models; PRECEDE-PROCEED Model, Hygiene Improvement framework and the health system performance framework. However, in adopting them for this study, the researcher was not ignorant of their shortcomings

1.11.1 PRECEDE-PROCEED Model

The research utilized segments of the PRECEDE-PROCEED model (PPM) proposed by Green, L.W. in 1974. The theoretical framework posits that health behaviors and outcomes are influenced by a multitude of factors that necessitate careful evaluation to ensure effective intervention. This framework offers a comprehensive structure for the assessment of health needs and the

development, implementation, and evaluation of health promotion initiatives and other public health programs aimed at addressing those needs. The model's underlying assumption is rooted in the active engagement of its intended audience. Specifically, it posits that participants will play an active role in delineating their own challenges, setting their objectives, and formulating their solutions. In the context of this study, it was ensured that participants were actively engaged, thus satisfying this fundamental assumption.

The study adopted phase one (social assessment), three (ecological assessment) and eight (impact/effects evaluation) of this model. Phase one involved the identification of social correlates of diarrhea, Phase three involved identifying environmental correlates of diarrhea. Consequently phase eight involved identification of the effects (unintended consequences) correlates of diarrhea. In the present context, a correlate is delineated as a contributing factor that is linked to the presence of a specific health ailment, namely diarrhea. To contextualized the model, phase one encompassed an examination of various socio-demographic and socio-economic factors, phase three looked at the environmental and behavioral factors while phase eight delved into a comprehensive analysis of the consequential effects stemming from the occurrence of diarrhea. The social and ecological phases addressed objective one of this study while phase eight addressed objective two of the study. The chosen model is well-suited for this study owing to its meticulous and comprehensive classifications, meticulous analysis of the issues at hand, and comprehensive examination of potential solutions. Consequently, it effectively tackles the problem under investigation. Moreover, this approach focuses singularly on addressing one issue at a time, thereby mitigating the possibility of any case being left unattended. One potential drawback of the model lies in its reliance on precise instructions. Should one deviate from these instructions, there

is a risk of encountering difficulties or necessitating modifications to align the model with the specific problem at hand.

1.11.2 Hygiene Improvement framework:

The research utilized a specific element of the Hygiene Improvement Framework (HIF) that was developed by USAID/EHP in 2004. The primary objective of the framework is to mitigate the prevalence of diarrheal disease and enhance the overall survival rate of children. The Hygiene Framework was applied to address objective three of the study looking at the promotion of good personal and domestic hygiene practices, ensuring access to safe water sources, enhancing nutritional standards, administering vaccinations, and implementing effective case management protocols

1.12.3 Health Systems Performance framework.

The research utilized the Health Systems Performance Framework, which was originally developed by the World Health Organization in 2000. The primary objective of this study was to assist policy makers in conducting a comprehensive analysis of potential factors contributing to and consequences resulting from subpar performance within a specific healthcare system. The dependent variable in this study was the performance of health systems, which was assessed based on three key dimensions: accessibility, quality, and efficiency. Collectively, these factors ascertain the degree to which health outcomes can be realized. The concept of accessibility pertains to the degree to which individuals are capable of obtaining the necessary healthcare services in a timely manner. The concept of quality pertains to the degree to which appropriate care is administered in a manner that aligns with established standards. On the other hand, efficiency refers to the degree to which accessibility and effectiveness are maximized in relation to the resources expended. The

underlying principle of this concept is that a comprehensive evaluation of a healthcare system should encompass an analysis of its various functions, including stewardship or health governance, financing, resource generation, and service delivery. Additionally, it should also consider the performance goals and outcomes of the system, such as equity, responsiveness, and financial protection. The framework's innovation lies in its comprehensive exploration of the four functions of the health system, wherein each function is thoroughly examined and interconnected with five distinct performance goals. Based on the dimensions of health system performance, when the health system performs well it will be referred to as “good health system” whereas when it doesn’t, it will be termed as “poor health system”.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The present chapter delves into an exploration of the scholarly literature pertaining to the various manifestations and implications of diarrhea. It particularly focuses on the Factors, Effects and prevention strategies as variables of Diarrheal conditions. The literature review serves as a crucial tool for researchers to cultivate a comprehensive comprehension and profound insight into prior scholarly works and prevailing patterns that have been documented in relation to the research quandary.

2.2 Factors influencing diarrheal conditions.

In a study conducted by Arifin *et al* (2022), Prevalence and determinants of diarrhea among under-five children in five Southeast Asian countries: Evidence from the demographic health survey. A total of 12,447 children under 5 years of age from five countries in Southeast Asia were included in this study. Binary logistic regression was performed to analyze the data. The factors which were found to be related to diarrhea include individual; environmental and household; health behavior such as stool disposal especially practice of open defecation, breastfeeding mothers, and children's food history; and source of information factors.

In a cross-sectional survey done by Kombat, M.Y *et al* (2024). Prevalence and predictors of diarrhea among children under five in Ghana. A total of 2,547 children under the age of five were included in this study. Logistic regression analysis was performed to establish the factors associated with childhood diarrhea and ascertain explanatory variables. The prevalence of diarrhea was 11.7%. Male children (13.4%) and those living in rural areas (12%), particularly in the Brong

Ahafo region (17%) recorded the highest prevalence of diarrhea. Children aged 6 to 35 months of age, maternal age and education, sex of children and region of residence were the predictors of diarrhea among children under the age of five years in this study.

In their study, Guillaume DA *et al* (2020). Factors influencing diarrheal prevalence among children under five years in Mathare Informal Settlement, Nairobi, Kenya. A total of 324 primary caregivers were included in the study. The study revealed that; Sex, relationship of the primary caregivers, number of children in the households were found to be statistically significant with diarrhea prevalence. Education level of the primary caregivers, renting, presence of flies, feces, and open garbage near or within the compound were found to be associated with diarrhoea prevalence.

A study by Harriet U. *et al* (2021). Diarrhoea among Children Under Five Years in Southwest Nigeria. The study evaluated the association between the risk factors and diarrhea prevalence among children under five years in Lagos and Ogun States, located in Southwest Nigeria. A sample of 280 women aged 15–49 years and children aged 0–59 months was considered for the study. One hundred and eighteen (42%) of the children were male, and 162 (58%) were female. The majority of the children belonged to the age group 0–11 months (166). Age and gender showed no significant association with diarrhea among the children. Multivariate analysis showed that the mother′s level of education and family income were the most significant risk factors for diarrhea among children. Mother’s educational status, mother′s employment, and family income were the factors significantly associated with diarrhea in Southwest Nigeria.

In their study, Bekele D. *et al* (2021) Determinants of Diarrhea in Under-Five Children Among Health Extension Model and Non-Model Families in Wama Hagelo District, West Ethiopia: Community-Based Comparative Cross-Sectional Study. The two-week prevalence of diarrhea among under-five children in model and non-model families was 7.8% and 27.8% , respectively. Unimproved water sources and no vaccination against Rotavirus were associated with diarrhea among under-five children in model families. Family size, using unimproved water sources, not using latrine, child not vaccinated against Rotavirus, child not supplemented with vitamin A, and not being health extension model families predict diarrhea among under-five children in non-model families.

A cross-sectional descriptive study by Maimuna Bashir Ali *et al* (2024). Prevalence of Diarrhea and Associated Risk Factors among Children Aged Under Five Years Presenting at Hoima Regional Referral Hospital, Uganda. Data was collected from 241 mother-child pairs and the prevalence of diarrhea among under 5 years old in this study was 12.4%. The risk of diarrhea was increased in non-working mothers, child's age between 6 and 24 months and unprotected water sources. Christian religion and not using bottle feeding showed a reduced risk of diarrhea.

A study carried out by Juyoung *et al* (2019). Risk factors of diarrhea of children under five in Malawi, where data were drawn from the Malawi Demographic and Health Survey conducted in 2015–2016 and 14,872 children were selected as study samples. Independent variables included social-demographic characteristics, household living conditions and WASH environment. Approximately 20% of children had diarrhea within 2 weeks. In multiple model, demographic characteristics of sex and age of child, size of child at birth, region, mother's age and working

status were associated with the risk of diarrhea. Regarding WASH environment, 30 minutes or longer to get water, unimproved toilet facilities, toilet facilities located in yard/plot and elsewhere and lack of hand-washing facility with water and soap increased the odds of diarrhea.

2.3 Effects of diarrheal conditions.

In reference to WHO (2023), the most severe threat posed by diarrhea is dehydration. During a diarrheal episode, water and electrolytes (sodium, chloride, potassium and bicarbonate) are lost through liquid stools, vomit, sweat, urine and breathing. Dehydration occurs when these losses are not replaced. The degree of dehydration is rated on a scale of 3; severe dehydration (at least two of the following signs); some dehydration (two or more of the following signs) and no dehydration (not enough signs to classify as some or severe dehydration).

According to UNICEF (2019), children who die from diarrhea often suffer from underlying malnutrition, which makes them more vulnerable to diarrhea. Each diarrheal episode, in turn, makes their malnutrition even worse. They affected children experience severe muscle wasting as a consequence and thus diarrhea becomes a leading cause of malnutrition in children under 5 years old.

On a study by Richard L. *et al* (2021).The impoverished gut—a triple burden of diarrhea, stunting and chronic disease. It was noted that more than one-fifth of the world's population live in extreme poverty, where a lack of safe water and adequate sanitation enables high rates of enteric infections and diarrhea to continue unabated. Although oral rehydration therapy has greatly reduced diarrhea-associated mortality, enteric infections still persist, disrupting intestinal absorptive and barrier functions and resulting in up to 43% of stunted growth, affecting one-fifth of children worldwide and one-third of children in developing countries. Diarrhea in children from impoverished areas

during their first 2 years might cause, on average, an 8 cm growth shortfall and 10 IQ point decrement by the time they are 7–9 years old. A child's height at their second birthday is therefore the best predictor of cognitive development or 'human capital'.

In reference to a study by William C. *et al* (2019). Multi-country analysis of the effects of diarrhea on childhood stunting; where they conducted a pooled analysis of nine studies that collected daily diarrhea morbidity and longitudinal anthropometry to determine the effects of the longitudinal history of diarrhea prior to 24 months on stunting at age 24 months. Data covered a 20-year period and five countries. We used logistic regression to model the effect of diarrhea on stunting. The prevalence of stunting at age 24 months varied by study (range 21–90%), as did the longitudinal history of diarrhea prior to 24 months (incidence range 3.6–13.4 episodes per child-year, prevalence range of (2.4–16.3%). The effect of diarrhea on stunting, however, was similar across studies. The odds of stunting at age 24 months increased multiplicatively with each diarrhea episode.

In their study conducted in 2019, David *et al*. determined the potential, long-term deficits associated with early childhood diarrhea and parasitic infections, they studied the physical fitness (by the Harvard Step Test) and cognitive function (by standardized tests noted below) of 26 children who had complete surveillance for diarrhea in their first 2 years of life and who had continued surveillance until 6–9 years of age in a poor urban community in Fortaleza in northeast Brazil. Early childhood diarrhea at 0–2 years of age correlated with reduced fitness by the Harvard Step Test at 6–9 years of age even after controlling for anthropometric and muscle area effects, anemia, intestinal helminths, Giardia infections, respiratory illnesses, and socioeconomic variables. Early childhood cryptosporidial infections (6 with diarrhea and 3 without diarrhea) were also associated with reduced fitness at 6–9 year of age, even when controlling for current

nutritional status. Early diarrhea did not correlate with activity scores, and early diarrhea remained significantly correlated with fitness scores after controlling for activity scores. Early diarrhea burdens also correlated in pilot studies with impaired cognitive function using a McCarthy Draw-A-Design when controlling for early helminth infections), Wechsler Intelligence Scale for Children coding tasks, and backward digit span tests.

A study by Mark *et al* (2020).Early childhood diarrhea is associated with diminished cognitive function 4 to 7 years later in children in a northeast Brazilian shantytown. To assess the potential long-term impact of early childhood diarrhea (in the first 2 years of life) on cognitive function in later childhood, we studied the cognitive function of a cohort of children in an urban Brazilian shantytown with a high incidence of early childhood diarrhea. Forty-six children (age range, 6–10 years) with complete diarrhea surveillance during their first 2 years of life were given a battery of five cognitive tests. Test of Non-Verbal Intelligence-III (TONI) scores were inversely correlated with early childhood diarrhea , even when controlling for maternal education, duration of breast-feeding, and early childhood helminthiasis (Ascaris or Trichuris). Furthermore, Wechsler Intelligence Scale for Children (WISC-III) Coding Tasks and WISC-III Digit Span (reverse and total) scores were also significantly lower in the 17 children with a history of early childhood persistent diarrhea, even when controlling for helminths and maternal education. No correlations were seen between diarrhea rates and Wide Range Assessment of Memory and Learning subtests or WISC-III Mazes. This report (with larger numbers of participants and new tests) confirms and substantially extends previous pilot studies, showing that long-term cognitive deficits are associated with early childhood diarrhea.

The study conducted by Sean R. *et al* (2021) was meant to establish if early childhood diarrhoea and helminthiases were associated with long-term linear growth faltering. They further examined

the magnitude and duration of the association of early childhood enteric infections with growth faltering in later childhood. In specific they investigated associations of early childhood diarrhoea (0–2 years) and intestinal helminthiases with nutritional status from age 2 to 7 years. Twice-weekly diarrhea surveillance and quarterly anthropometrics were followed from 1989 to 1998 in 119 children born into a Northeast Brazilian shantytown. The result showed that diarrhea burdens at 0–2 years old were significantly associated with growth faltering at ages 2–7 years, even after controlling for nutritional status in infancy, helminthiases at 0–2 years old, family income, and maternal education.

A study by Alberto *et al* (2021). Prolonged episodes of acute diarrhea reduce growth and increased risk of persistent diarrhea in children. They conducted a 10-year cohort study of 414 children from a Brazilian shantytown who were followed from birth; data were collected on diarrhea, enteric pathogens, and anthropometry. During 1276 child-years of observation, they recorded 3257 diarrheal episodes. Prolonged Diarrhea was twice as common as Persistent Diarrhea (12% and 5% of episodes, respectively); Prolonged Diarrhea and Persistent Diarrhea together accounted for 50% of all days with diarrhea. Prolonged Diarrhea was more common in infants whose mothers had not completed primary school. Early weaning was associated with earlier onset of Prolonged Diarrhea.

A study by Pinkerton *et al* (2022), assessed the independent contributions of early childhood diarrhea (ECD) and malnutrition on cognitive impairment in later childhood. A cohort of 131 children from a shantytown community in northeast Brazil was monitored from birth to 24 months for diarrhea and anthropometric status. Cognitive assessments including Test of Nonverbal Intelligence (TONI), coding tasks (WISC-III), and verbal fluency (NEPSY) were completed when children were an average of 8.4 years of age (range= 5.6–12.7 years). Multivariate analysis of variance models were used to assess the individual as well as combined effects of ECD and

stunting on later childhood cognitive performance. ECD, height for age (HAZ) at 24 months, and weight for age (WAZ) at 24 months were significant univariate predictors of the studies three cognitive outcomes: TONI, coding, and verbal performance. Multivariate models showed that ECD remained a significant predictor, after adjusting for the effect of 24 months HAZ and WAZ, for both TONI (HAZ, P= 0.029 and WAZ, P= 0.006) and coding (HAZ, P= 0.025 and WAZ, P= 0.036) scores. WAZ and HAZ were also significant predictors after adjusting for ECD. ECD remained a significant predictor of coding (WISC III) after number of household income was considered (P= 0.006). This study provides evidence that ECD and stunting may have independent effects on children's intellectual function well into later childhood.

2.4 Prevention Strategies for Diarrheal conditions.

According to (WHO, 2023), Interventions to prevent diarrhea, including safe drinking-water through water source protection, use of improved sanitation and hand washing with soap, can reduce disease risk. Diarrhoea should be treated with oral rehydration solution (ORS), a solution of clean water, sugar and salt. In addition, a 10–14day supplemental treatment course of dispersible zinc tablets shortens diarrhea duration and improves outcomes.

UNICEF (2023), highlighted the key measures to treat and manage diarrhea which included; water source protection, household water treatment, Rehydration with oral rehydration salts (ORS) solution, Zinc supplements, Rehydration with intravenous fluids in case of severe dehydration or shock, Nutrient-rich foods– including breast milk, exclusive breastfeeding for the first 6 months of life – to children when they are well and consulting a health professional, in particular for management of persistent diarrhea or when there is blood in stool or if there are signs of dehydration.

According to PATH (2020), a number of interventions are effective in preventing diarrheal diseases, thereby positively impacting the nutritional status of those most vulnerable. These are: Access to safe drinking water (e.g. water safety planning and the management of water from the source to tap); household water treatment and safe storage), Access to improved sanitation facilities and Hand washing with soap at critical times (e.g. after toilet/latrine use and before the preparation of food). Hygiene promotion, proper food storage along with access to safe drinking water and adequate sanitation should be accessible by all.

In a study conducted by Buchwald et al (2023). Etiology, Presentation, and Risk Factors for Diarrheal Syndromes in 3 Sub-Saharan African Countries after the Introduction of Rotavirus Vaccines. Moderate-to-severe diarrhea cases among children <5 years old in The Gambia, Mali, and Kenya were analyzed. Among 4606 children with moderate-to-severe diarrhea, 3895 (84.6%) had Watery Diarrhea (WD) and 711 (15.4%) had dysentery. Persistent diarrhea (PD) was more frequent among infants (11.3%) than in children 12–23 months (9.9%) or 24–59 months (7.3%) and higher in Kenya (15.5%) than in The Gambia (9.3%) or Mali (4.3%); the frequencies were similar among children with WD (9.7%) and those with dysentery (9.4%). Compared to children not treated with antibiotics, those who received antibiotics had a lower frequency of PD overall (7.4% vs 10.1%) and particularly among those with WD (6.3% vs 10.0%) but not among children with dysentery (8.5% vs 11.0%). For those with watery PD, *Cryptosporidium* and nor virus had the highest AFs among infants (0.16 and 0.12, respectively).The odds of PD decreased significantly over time in Mali and Kenya while increasing significantly in The Gambia.

In a study conducted by Emily L. *et al* (2023). Diarrhea in Young Children in Sub-Saharan Africa: Adherence to World Health Organization Recommendations During the Global Enteric Multisite

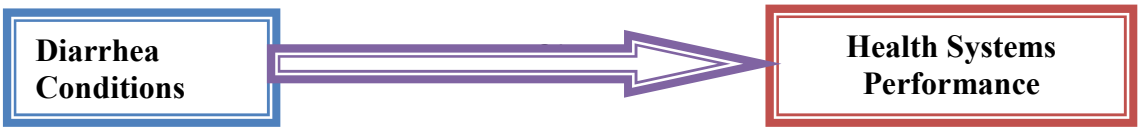
Study(GEMS) (2007–2011) and the Vaccine Impact of Diarrhea in Africa (VIDA) Study (2015–2018).In this case-only analysis, in The Gambia, Kenya, and Mali. A case with no dehydration received adherent care at home and children with diarrhea and some dehydration received oral rehydration salts (ORS) in the facility. The recommendation for severe dehydration is to receive ORS and intravenous fluids in the facility. Adherent care in the facility included a zinc prescription independent of dehydration severity. For home-based management of children with no signs of dehydration, 16.6% in GEMS and 15.6% in VIDA were adherent to guidelines. Adherence to guidelines in the facility was likewise low during GEMS (some dehydration, 18.5%; severe dehydration, 5.5%). The adherence to facility-based rehydration and zinc guidelines improved during VIDA to 37.9% of those with some dehydration and 8.0% of children with severe dehydration.

A study by Asif *et al* (2022). Knowledge and Practices on the Prevention and Management of Diarrhea in Children Under-2 Years Among Women Dwelling in Urban Slums of Karachi, Pakistan. A community-based cross-sectional study was conducted from among mothers of children under 2 years, who were residents of Gadap Town. About 52% of participants were aged between 25 and 34 years. Among all participants, 68%had primary level education or less, compared to 4.7% of women who had graduate-level education. More than half (55%)) of participants reported frequent diarrhea episodes during the 2nd year of their child's life. In this survey, it was found that the knowledge of women regarding, rotavirus vaccination, diarrhea management and how to reduce diarrhea morbidity to be inadequate. However, many women reported appropriate practices which can significantly reduce diarrhea morbidity,

On a study by Camille W. and Miguel C. (2020). A Review on Prevention Interventions to Decrease Diarrheal Diseases' Burden in Children.The review was to provide an overview about childhood diarrhea burden and prevention interventions with demonstrated impact in reducing disease risk. The study revealed that diarrhea incidence and mortality in children is declining, however a few pathogens cause most of the burden (rotavirus, norovirus, *Shigella*, enterotoxigenic *E. coli*, *Campylobacter*, and *Cryptosporidium*). Available rotavirus vaccines have demonstrated to significantly decrease diarrhea hospital admissions and mortality. WASH interventions, especially point of use water safety improvements and hand washing, are effective in decreasing diarrhea burden. Early and exclusive breastfeeding prevents early childhood diarrhea.

2.5 Conceptual framework.

Independent variables ***Dependent variables***



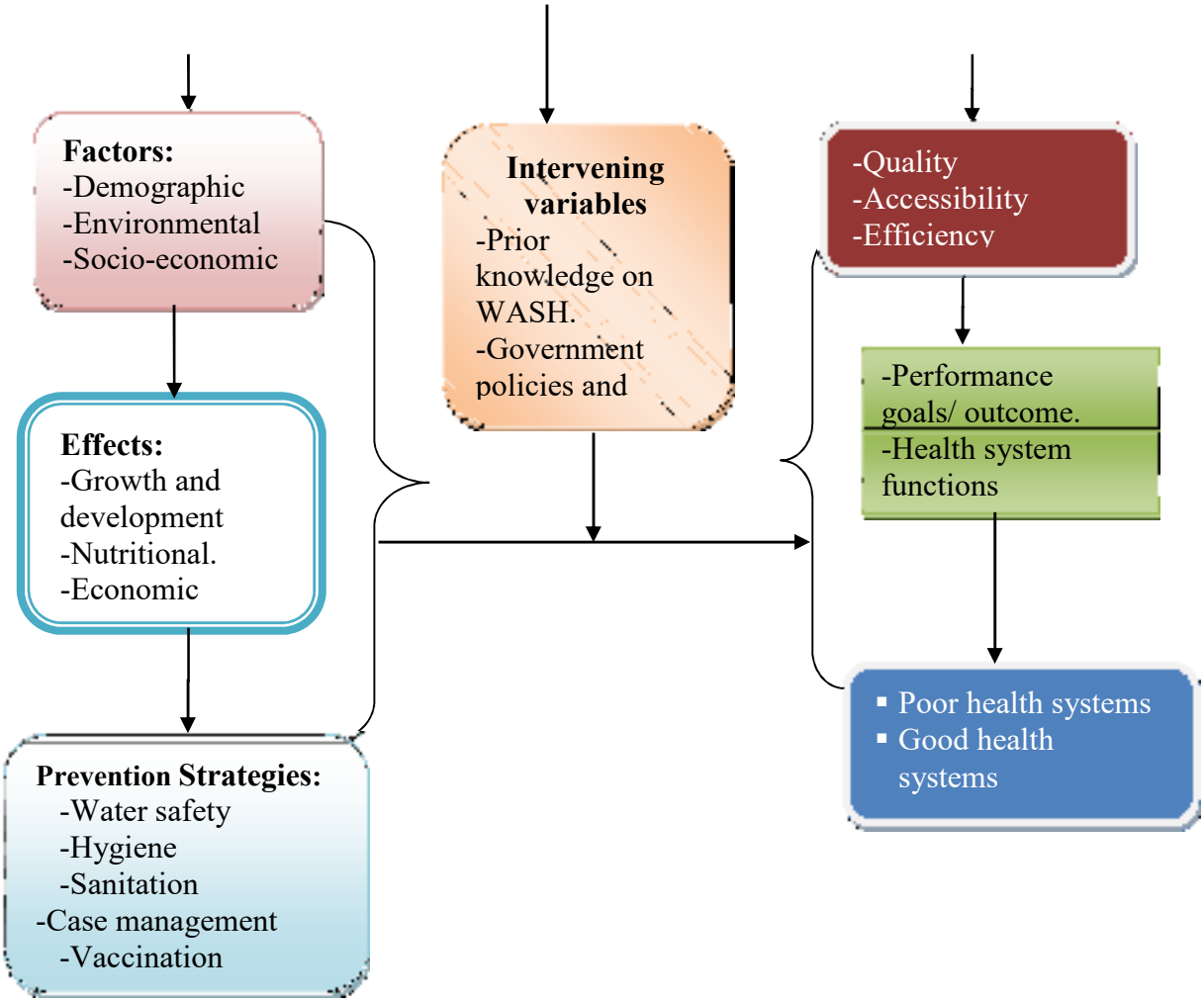


Fig. 2.0 Conceptual framework (Source: Aranda, 2022).

The research was conducted with underlying premise that multiple variables interact to shape performance of health systems, ultimately determining their quality. Diarrheal conditions are believed to influence health systems performance and in this study diarrhea conditions were based on three broad categories of independent variables; factors, effects and prevention strategies. Broadly factors composed of; demographic, environmental and economic factors. The demographic factors were characterized by; age, sex, marital status, level of education, religion, area of residence and occupation, the environmental factors characterized by; latrine ownership, type of latrine, presence of flies, open defecation, refuse disposal, source of water, time and distance to water source. Whereas the economic factors were characterized by; source of income,

household monthly income and wealth index. On the effects, the study investigated about diarrhea causing; stunting growth, reduction in cognitive development, severe wasting, dehydration, financial losses and productivity losses. Concerning the prevention strategies it examined on; water safety, hygiene, sanitation, vaccination and case management.

The evaluation of the dependent variable (health system performance) in this study was predicated upon three fundamental dimensions: accessibility, quality, and efficiency. These dimensions collectively ascertain the degree of accomplishment in the realm of healthcare. The concept of accessibility pertains to degree to which individuals are capable of obtaining necessary medical treatment in a timely manner. The concept of quality pertains to the degree to which appropriate care is administered in an appropriate manner, while efficiency refers to the degree to which accessibility and effectiveness are maximized in relation to the resources invested.

The underlying principle of this concept is that a comprehensive evaluation of a healthcare system should encompass an analysis of its various components (health governance, financing, resource generation, and service delivery) as well as the performance goals/outcomes of the system, such as equity, responsiveness, and financial protection. The categorization of health system performance is based on a set of dimensions. A health system that demonstrates commendable performance is commonly referred to as a "good health system," while a health system that falls short in meeting expectations is often labeled as a "poor health system."

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Setting

3.1.1 Study site

The research was carried out in Migori County, situated in the western region of the Republic of Kenya. Migori County encompasses a vast expanse of 2,586.4 square kilometers , situated within the latitudinal coordinates of 00 240 and 00 400 South, as well as the longitudinal coordinates of 34 050’ East. From an administrative standpoint, the county is subdivided into eight distinct sub-counties and 41 administrative divisions known as wards. These sub-counties are Suna East, Suna West, Uriri, Awendo, Rongo, Nyatike, Kuria West, and Kuria East. On its northern frontier lies Homabay County, while to the east it shares borders with Kisii and Narok Counties. The County is geographically situated between two international borders, namely Tanzania to the South and Uganda to the West.

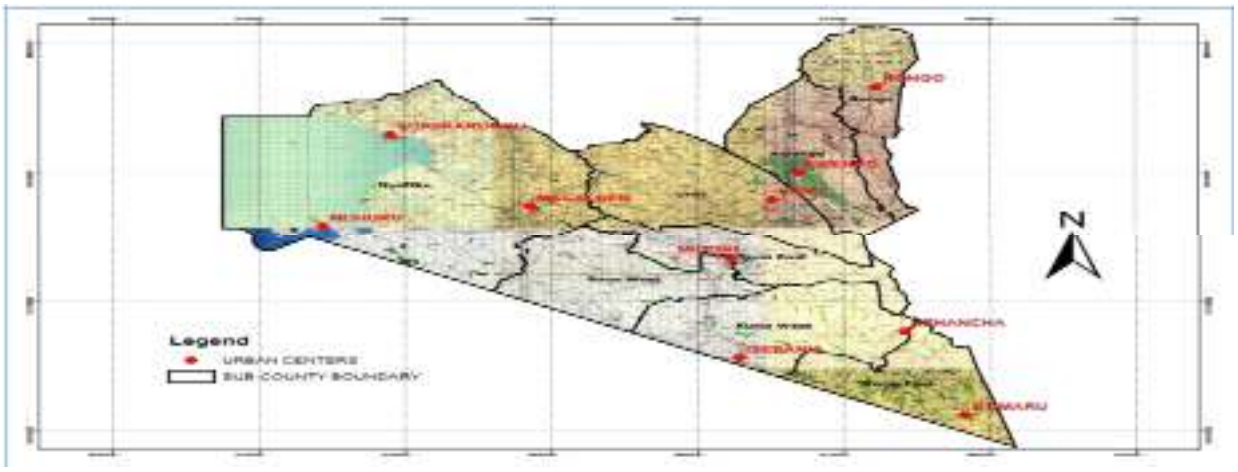


Figure 3.0 : Map of Migori County showing the eight sub counties.

3.1.2 Population

The Migori County population is estimated to be about 1,116,436 individuals with male and female representing 48.6% and 51.4% respectively.

3.1.3 Health networks

The health networks comprise of 282 healthcare facilities, encompassing a wide spectrum of services ranging from esteemed referral hospitals to conveniently accessible community clinics.

3.2 Study design.

The study utilized a mixed methods research approach. The approach entailed Convergent parallel design in which data collection and analysis of both qualitative and quantitative data occurred simultaneously and were analyses separately. The design aimed to create mutually exclusive sets of data that inform each other.

3.3 Population

3.3.1 Study Population.

Migori County reported about 58,188 cases of diarrhea during the year 2018, whereby 29,704 (51.05%) cases of diarrhea were for children under five years and 28,484 (48.95%) cases were above five years (DHIS, 2018).

3.3.2 Target population.

The population that was targeted to be reached by this study was 29,704 (51.05%) children under five years who suffered from diarrheal conditions and visited a health facility for treatment during the completed year 2018.

3.3.3 Sample size determination.

The study's estimated sample size was determined by considering the diarrhea prevalence rate of 28% in Migori County. A confidence interval of 95% (with a corresponding type value of 1.96)

and a random error of 5% (with a corresponding type value of 0.05) were taken into account during the calculation process. The determination of the sample size for this study was based on the statistical formula proposed by Fisher et al. in 1998.

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where:

n= required sample size (minimum size for a statistically significant survey)

p = proportion of diarrhea (assumed prevalence value of diarrhea of 28%)

Z= standard score corresponding to 95% confidence level (and is thus equal to 1.96)

d = margin of error acceptable/ measure of precision (estimated at 5% and is thus equal to 0.05).

$$\text{n} = \frac{1.96^2 \text{x } 0.28 \text{ x } 0.72}{0.05^2}$$

= 309 (add 10%)

= 340

The sample size was carefully determined, accounting for both survey non-response and item non-response, which amounted to approximately 10% of the total sample.

Consequently, the study encompassed a total of 340 cases, thereby establishing the sample size.

3.3.4 Sample Selection criteria.

These included eligible and non-eligible participants in the study.

3.3.4.1 Inclusion criteria

The study included caretakers who had sought treatment for their children under-five who had experienced diarrhea and provided their consent to partake the study.

3.4.4.2 Exclusion criteria.

Caregivers who might have moved out of the study area and those not able to talk or using sign language was not included in the study. Eligible participants who were unwilling to participate.

3.4 Sampling procedures.

The data for the diarrhea cases of under-five children for the year under study was obtained from the hospital registers of the 282 health facilities in Migori County both private and public ranging from the dispensary levels to County referral hospital as summarized in table 3.1. The researcher clustered the County into eight administrative units (Sub Counties) namely; Rongo, Awendo, Uriri, Suna East, Suna West, Nyatike, Kuria East and Kuria West Sub counties, as shown in table 3.2 below. The samples from each cluster were obtained proportionally to form the required sample size. The researcher developed a sampling frame by listing all cases alive in each cluster (sub-counties) by assigning them random numbers. To avoid bias, the researcher wrote the random numbers for each cluster on pieces of paper, folded them to ensure the random numbers are not visible. Thereafter the researcher selected samples for each cluster by placing them in eight different containers representing the eight clusters, shook them and then blindfolded eight different lead community health volunteers who randomly picked the corresponding number of samples for each cluster.

Table 3.1 Distribution of health facilities per Sub County.

S/No.	Sub County	OWNERSHIP				Total Health Facilities
		Public	FBO	NGO	Private	
1	Awendo	16	3	0	13	32
2	Kuria East	20	4	0	7	31
3	Kuria West	26	4	0	23	53
4	Nyatike	69	11	3	10	55
5	Rongo	10	2	1	15	28
6	Suna East	12	2	3	3	20
7	Suna West	13	3	1	16	33
8	Uriri	23	2	0	4	29
	Total	**157**	**26**	**8**	**91**	**282**

Table 3.2 Distribution of sample per Sub County.

S/NO.	SUB COUNTY	POPULATION	PERCENTAGE	SAMPLE

1	Rongo	2568	8.65	29
2	Awendo	3658	12.13	42
3	Uriri	2996	10.09	34
4	Suna East	3534	11.89	41
5	Suna West	3897	13.12	45
6	Nyatike	4891	16.47	56
7	Kuri East	3787	12.75	43
8	Kuria West	4373	14.72	50
	TOTAL	**29704**	**100.00**	**340**

3.5 Piloting / pretesting.

The pretesting of the study instrument was carried out in areas that were not chosen for the main study in order to avoid any potential influence on the study outcomes. It was conducted three months prior to the primary study using the same methodology that were employed in the main study. The research assistant with the guidance of the researcher did the pilot in Ndhiwa Sub County in Homabay County. This particular sub county was chosen due to its homogenous comparable characteristics to the study area. A preliminary pilot study was conducted on a subset comprising 10% of the overall sample size for the main study. In this study, a total of 34 caregivers of children aged below five years, who sought medical treatment for diarrhea within the Ndhiwa Sub County of Homabay county were included.

3.5.1 Reliability

The concept of reliability pertains to the extent to which an instrument can be consistently interpreted across various situations (Field, 2013). The concept of reliability pertains to the extent to which a research instrument consistently yields identical or highly similar outcomes. By utilizing the SPSS application, the researcher employed Cronbach's alpha to ascertain whether the items comprising the scale effectively captured the identical underlying dimension, or construct. Data was collected and analyzed to test the reliability. Cronbach's Alpha produced internal consistencies of more than 70% for all the five scales (alpha= 0.81, 0.79, 0.72, 0.85, 0.88, 0.83). The critical values for internal consistency of the items were good (*alpha* =0.79, 0.72) and very good (*alpha*=0.81, 0.83, 0.85, 0.88). These values indicated that there was high correlation (internal consistency) between the variables (items). Hence, the instrument was deemed a valid and reliable tool for assessing of diarrheal conditions among under-five children, with regards to the performance of health systems. All the alpha values exhibited positivity, which suggests a favorable average covariance among the items. Consequently, these findings align with the assumptions of the reliability model as presented in Table 3.3.

Table 3.3. Reliability of the six scales.

Scales	**Number of items**	**Cronbach's alpha**
Socio-demographic factors	8	0.81
Environmental factors	10	0.79
Economic factors	4	0.72
Effects of diarrheal conditions	6	0.85
Prevention and control strategies	10	0.88
Health systems performance	9	0.83

3.5.2 Validity

The instruments utilized in this study underwent a rigorous validation process, specifically through the application of content validity. This validation method involved seeking expert judgment to assess the relevance and appropriateness of the instruments in measuring the intended variables. The justification for the application of content validity included; checking the contents of the questionnaire, checking if all the aspects of the objectives are fully filled in the questionnaire and is usually done using expert opinions. The researcher implemented a series of procedures in order to ensure the validity of the content. These procedures included the development of a content validation form, the formation of a panel of experts, the execution of content validation, the thorough review of the domain and items, the assignment of scores to each item, and the subsequent calculation of the content validity index. The researcher engaged two review panelists of experts who reviewed the domains and items and awarded scores as per the request on content validation form provided to them in advance. Thereafter the researcher utilized the content validation form to calculate the content validity index as summarized below.

Table 3.4 Content Validity Index

No. of items	**Proportion Relevance for Expert 1**	**Proportion Relevance for Expert 2**	**Proportion Clarity for Expert 1**	**Proportion Clarity for Expert 2**	**S-CVI Average**	**UA Average**
40	0.90	0.93	0.87	0.90	0.87	0.83

***Note**: S-CVI = Score Content Validity Index, UA = Universal Agreement*

The researcher's conclusion regarding the validity was derived from an analysis of the experts involved and its impact on the cut-off score of Content Validity, as presented in Table 3.5.

Table 3.5 Cut-off score of Content Validity.

Number of experts	Acceptable CVI values	Source of Recommendation
Two experts	At least 0.80	Davis (1992)
Three to five experts	Should be 1.00	Polit and Beck (2006), Polit et al.(2007)

Based on the aforementioned calculation, the researcher has reached the conclusion that the Scale-Content Validity Index (S-CVI) average, determined by the Item-Content Validity Index (I-CVI), the S-CVI average based on proportion relevance and clarity, and the S-CVI based on the Universal Agreement (UA) average, all meet the satisfactory level in accordance with the rules and assumptions of Content Validity. Consequently, it can be inferred that the questionnaire scale successfully attained a satisfactory level of content validity.

3.6. Data collection

The study employed the following tool for data collection.

3.6.1 Household Questionnaire.

A designed questionnaire was formulated and employed as a pivotal instrument for gathering data from caregivers of children below the age of five, within the confines of their own households. The study instruments were administered to the participants by research assistants (interviewer-administered).

3.6.2 Key Informant Interview Guide.

The tool was used on 16 key informants who were purposively selected due to their first-hand knowledge about diarrhea and health systems. The guide was loosely structured, relying on issues which were discussed. The interviewer simultaneously framed the questions from the guide, probe for the information and took notes, which were elaborated on later. The guiding questions included; the general situation of diarrhea in Migori county, role of the key informant in regard to prevention, control and management, the burden of diarrhea disease on healthcare systems, challenges encountered during diarrhea incidences, vaccination against rotavirus and any lessons learnt from diarrhea infections in the study area.

The Key informant interviews were conducted at a location that was convenient for the respondents. The key informants opted to have the interviews at their working locations for convenient purposes. A total of four Key Informant Interviews (KIIs) were carried out at the county level, followed by an additional eight at the sub-county level, and finally four at the community level, thus 16 interviews were carried out. The KII guide that was developed underwent a pre-testing phase, during which necessary amendments were made, ensuring its suitability for conducting interviews with the participants selected above.

3.6.3 Focus Group Discussion Guide.

The focus group discussion guide was developed and applied on seventy two focus group discussants that were purposively selected from the eight sub-counties. The sample of the discussants was informed by the number of sub counties in the study area. With 8 sub-counties, eight Focus Group Discussions comprising 9 members each were conducted. The discussion questions revolved around the factors contributing to diarrhea, the effects encountered as a result

of diarrhea, diarrhea control, prevention and management interventions at both the community and household levels and any other emerging issues concerning diarrhea.

The caregivers responsible for the well-being of children aged below five years, who had experienced episodes of diarrhea, were the ones involved in the FGDs. These caregivers were specifically chosen from those who were not initially included in the household interview process. The researchers employed purposive sampling as the method for selecting participants for the focus group discussions (FGDs). This approach ensured that individuals who possessed specific characteristics or experiences relevant to the research objectives were included in the study.

The focus group discussion (FGD) sessions lasted approximately one to one and a half hours. Prior to the commencement of the discussion, the participants were duly apprised of the predetermined objectives. Moreover, the researchers diligently sought to ascertain the participants' enthusiastic willingness and obtained their explicit verbal and written consent to partake in the study. The sessions were conducted at centrally located and easily accessible venues, as recommended by the participants themselves. The research sessions were moderated by two supervisors, one representing the Luo community and the other from the Kuria community. The research assistants from each respective community fulfilled their roles as note takers and audio recorders. The researchers conducted interviews in the native languages of the participants, and subsequently translated them into English to enhance comprehension. After the conclusion of the task, the notes were reviewed and subsequently, the audio recordings were transcribed in order to facilitate analysis.

3.7 Data analysis.

The study utilized the quantitative and qualitative techniques of data analysis.

3.7.1 Quantitative data analysis

The researcher employed Statistical Package for Social Sciences (SPSS Version 25.0) and Microsoft Excel software to conduct data analysis. The study employed Descriptive and Chi-square goodness of fit fitness test analyses to investigate the interplay between the variables, specifically examining the relationship of frequencies or distribution. In order to conduct the univariate analysis, a significance level (p-value) of less than 0.05 was established. A binary logistic regression analysis was performed to examine the relationship between the independent and dependent variables, with a significance level set at less than 0.05. The individuals who demonstrated statistical significance during bivariate analysis and met the necessary requirements and assumptions for multivariate logistic regression were selected to be part of the final logistic regression model.

3.7.2 Qualitative data analysis

The data obtained through qualitative methodologies, namely Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs), were transcribed in their entirety using the Microsoft Word software. In order to uphold the utmost precision of the transcribed documents, the research team diligently verified the congruity between the transcripts and the corresponding audio recordings. The qualitative data underwent rigorous analysis through the method of content analysis, which allowed for the identification and exploration of emerging themes.

3.8 Quality control.

To mitigate the potential impact of selection bias, the researcher employed a randomization technique as part of the sampling procedure. In order to ensure the study's exceptional quality, meticulous attention was given to the recruitment and training of research assistants and supervisors. The researcher and supervisors were present in the field to provide assistance and guidance during the data collection process. At the conclusion of each day, the research team would meticulously examine their progress and meticulously scrutinize their comprehensive notes in order to meticulously address any identified gaps. Prior to entry and analysis, the collected data underwent a manual cleaning process to ensure its completeness.

3.9 Ethical Considerations.

The study ensured that all participants were adequately informed about the objectives and purpose of the study, thereby enabling their participation from an informed standpoint. The research participants were randomly selected to ensure that they had equal opportunity for being selected, hence avoiding selection bias. The researcher conducted an analysis of the data in a manner that upheld professional standards, ensuring that no preconceived notions influenced the findings. In order to ensure the confidentiality of the participants, the data was presented in a consolidated manner, this was to embrace the principle of anonymity. The researcher diligently sought and successfully obtained the requisite approvals from the JOOUST School of Postgraduate Studies, as well as from a reputable ethical review authority. The researcher successfully acquired the research permit from the National Commission for Science, Technology, and Innovation (NACOSTI), in addition to obtaining authorization from the County Health department. These measures were taken to ensure strict adherence to ethical requirements and prevent any violations during the course of the study. Ultimately, the researcher diligently ensured that the utmost importance was placed on preserving the privacy and confidentiality of all the information

provided. No circumstances arose in which any information was disclosed to a third party without obtaining explicit written consent from the original source. The researcher ensured that there was no potential for harm as any physical, social, psychological and all types of harm were kept to an absolute minimum.

CHAPTER FOUR

RESULTS

4.1 Introduction

The study provides an analysis of the independent and dependent variables. A chi-square goodness of fit fitness test was employed to ascertain the association between the frequencies and distribution of variables. Individuals with a p-value < 0.05 had statistical significance and were included in the bivariate analysis. Bivariate and multivariate logistic regression analysis was done for each research question and results presented.

4.2 Response Rate

A total of 340 under five children were sampled for this study. However, data was collected from 334 of them, achieving a response rate of 98%.

4.3 Factors associated with diarrheal conditions.

4.3.1 Socio-demographic characteristics of the study participants.

Out of the total (n=334) children under five, 58% were identified as female with a statistically significant association between their sexes ($p = 0.003$). The average age of under fives was found to be 31.9 months (SD=0.67). The range of ages observed in this group was 50 months.

Age distribution revealed that 25% of children fell within the range of 35 to 47 months with a statistically significant among the age groups ($p = 0.014$). The caretakers mean age was 32.8 years (SD=0.86) with a range of 38 years ($p = 0.021$). The large number 241 (72%) were married ($p = 0.054$) with more than a half (56%) having no formal education ($p<0.001$). A higher proportion (90%) of the respondents belonged to Christianity ($p=0.073$). A significant percentage (76%) resided in the rural areas ($p=0.004$). Concerning occupation, more respondents (74%) were housewives ($p = 0.063$) (Table 4.1).

Table 4.1: Socio-demographic characteristics of the study participants.

Variable	**Category**	**n(%)**	**df**	**X^2**	***p-value***
Sex of child	Male	140(42)	1	11.04	0.003
	Female	194(58)	4	13.61	0.014
Age (months)	0-11	43(13)			
	12-23	51(15)			
	24-35	81(24)			
	36-47	84(25)			
	48-59	75(23)			
Age of caretaker (Years)	<20	25(7)	4	18.77	0.021
	20- 29	56(17)			
	30-39	73(22)			
	40-49	82(25)			
	>49	98(29)			
Marital status	Married	241(72)	2	10.59	0.054
	Single	84(25)			
	Others	9(3)			
Highest level of education	No formal education	187(56)	3	14.88	<0.001
	Primary education	96(29)			
	Secondary education	38(12)			
	Tertiary education	13(3)			
Religion	Christians	302(90)	2	11.64	0.073
	Muslim	22(7)			
	Others	10 (3)			
Area of residence	Urban	80(24)	1	9.32	0.004
	Rural	254(76)			
Occupation	House wife	248(74)	4	21.28	0.063
	Privately employed	31(9)			
	Civil servant	41(12)			
	NGO employed	9(3)			

Others	5(2)

4.3.2 Environmental and socio-economic characteristics of study participants.

More than three quarters (82%) of the respondents owned a latrine ($p<0.00$) however a significant percentage (71%, n=275) utilized traditional type of latrine ($p=0.003$). Presence of flies in or around the latrine was high (93%, n=275) among the households owning latrines ($p=0.002$.). Despite majority of the respondents owning a latrine, open defecation (96%) was observed to be significantly high ($p<0.001$). The study revealed that majority of the respondents (75%) did not have hand washing facilities/stations at their household levels ($p=0.066$). On the methods of refuse disposal, more than a half (59%) practiced open field or crude dumping ($p=0.082$). More than a half (53%) of the respondents used springs as their main source of drinking water ($p=0.058$) as the majority (89%) takes more than 30 minutes to collect water from the source ($p=0.016$). On the kilometers travelled to fetch water, more than a half (62%) travel more than one kilometer ($p=0.007$).The study established that the highest number (83%) of respondents experience intermitted water supply throughout the year ($p=0.074$).

More than a half (55%) of the respondents were casual laborers ($p = 0.028$). Regarding monthly income per household head, the study established that more than a third (44%) were earning below ksh.10, 000.00 (p=0.015). Finally a large proportion (63%) of the households were categorized as 'poor' ($p=0.039$). (Table 4.3)

Table 4.3: *Environmental* and socio-economic *characteristics of study participants.*

Variables	Category	n(%)	df	x^2	*p-value*
Ownership of latrine	Yes	275(82)	1	12.87	<0.001
	No	59(18)			
Type of latrine	VIP latrine	65(24)	3	42.05	0.003
	Traditional pit	194(71)			
	pour flush	8(3)			
	Others	8(3)			
Presence of flies	Yes	256(93)	1	11.84	0.002
	No	19(7)			
Open defecation	Yes	264(96)	1	12.05	<0.001
	No	11(4)			
Provision of hand washing facility	Yes	85(25)	1	13.06	0.066
	No	249(75)			
Methods for refuse disposal	Compost pit	81(24)	3	26.87	0.082
	Open field	197(59)			
	Burning	51(15)			
	Burying	5(2)			
Main source of drinking water	Rain catchment	23(7)	7	56.33	0.058
	Piped system	7(2)			
	Spring	176(53)			
	Shallow well	76(23)			
	Borehole	7(2)			
	River	21(6)			

	Lake	18(6)			
	Others	6(2)			
Time taken to fetch water	< 30 Minutes	36(11)	1	9.08	0.016
	>30 Minutes	298(89)			
Distance to the water source	< 0.5 KM	51(15)	2	13.12	0.007
	0.5-1.0 KM	75(23)			
	>1.0 KM	208(62)			
Status of water supply	Intermitted	276(83)	1	12.61	0.074
	Continuous	58(17)			
Main source of income	Earned income	57(17)	3	21.86	0.028
	Self-employment	75(23)			
	Casual laborers	184(55)			
	Others	18 (5)			
Household monthly income (Ksh)	< 10,000	148(44)	5	43.13	0.015
	10,000 –19,000	123(37)			
	20,000 – 29,000	24(7)			
	30,000 – 39,000	19(6)			
	40,000 – 49,000	13(4)			
	>50,000	7(2)			
Wealth index.	Poorer	43(13)	2	15.01	0.039
	Poor	120(63)			
	Middle	81(24)			

4.4 Effects of diarrheal on health systems performance.

The majority of the respondents (66%) agreed (M=4.13, SD=0.73, X^2 = 31.39, p=0.007) that diarrhea conditions has an effect on health systems performance through the stunting growth of children under five years. On the reduction of cognitive development as an effect on health systems performance caused by diarrheal conditions, (55%) of the respondents strongly agreed (M =4.43, SD=0.79, X^2 =46.22, p=0.012). Concerning the severe wasting, (66%) of the respondents agreed (M=4.11, SD= 0.73, X^2 =75.18, p=0.043) that it has effects on health systems performance. Dehydration was strongly agreed (M=4.44, SD=0.79, X^2 = 63.09, p=0.028) by the majority (56%) of the respondents that it is an effect on the health systems performance. The study revealed that more than a half (55%) of the respondents strongly agreed (M=4.43, SD=0.79, X^2 =23.67, p=0.004) that financial losses is an effect on health system performance as a result of diarrheal conditions. Finally 37% of the respondents agreed (M=3.87, SD=0.91, X^2 =54.15, p=0.018) that diarrhea conditions cause productivity losses and consequently affect the health systems performance.

Table 4.3: Effects of diarrhea on health systems performance.

Variables/Statement	**Response**	**n**	**%**	**Mean**	**SD**
Stunting growth	Strongly Disagree	6	2	4.13	0.73
	Disagree	10	3		
	Neutral	12	4		
	Agree	221	66		
	Strongly agree	85	25		
X^2 =31.39, p=0.007	Total	334	100		
	Strongly Disagree	9	3	4.43	0.79

Reducing cognitive development	Disagree	6	2		
	Neutral	14	4		
	Agree	121	36		
	Strongly agree	183	55		
X^2 =46.22, p=0.012	Total	334	100		
Causing severe wasting	Strongly Disagree	14	4	4.11	0.73
	Disagree	6	2		
	Neutral	10	3		
	Agree	220	66		
	Strongly agree	84	25		
X^2 =75.18, p=0.043	Total	334	100		
Causes dehydration	Strongly Disagree	6	2	4.44	0.79
	Disagree	6	2		
	Neutral	10	3		
	Agree	125	37		
	Strongly agree	187	56		
X^2 =63.09, p=0.028	Total	334	100		
Causes financial losses	Strongly Disagree	6	2	4.43	0.79
	Disagree	9	3		
	Neutral	13	4		
	Agree	121	36		
	Strongly agree	185	55		

X^2 =23.67,	p=0.004	Total	334	100		
Causes losses	productivity	Strongly Disagree	8	2	3.87	0.91
		Disagree	9	3		
		Neutral	100	30		
		Agree	123	37		
		Strongly agree	94	28		
X^2 =54.15,	p=0.018	Total	334	100.0		

***Note**: 5 Strongly agree, 4 Agree, 3 neutral, 2 Disagree, 1 Strongly disagree.*

4.5 Prevention strategies on health system performance.

There was a statistically significant relationship among the protection status of water sources (X^2 = 7.55; df=1; p <0.001) with more than a half (65%) being protected and the rest (35%) unprotected. Collection of drinking water from the source was mainly done using uncovered containers, (66%) with a statistically significant relationship among the containers (X^2 = 9.12; df=1; p = 0.006). With a statistically significant relationship (X^2 = 54.34; df=5; p = 0.007) , a great percentage (56%) of the respondents were using containers with a wide mouth, no lid and no tap to store drinking water . Treatment of water for drinking at the Point of Use (POU) was confirmed by less than a half (40%) of the respondents with a statistically significant relationship (X^2 = 8.63; df=1; p <0.001). Despite majority (60%) not treating water at the point of use, a few who did applied boiling (13%), use of chemicals (12%), filtration (9%) among others with their relationship being statistically significant, (X^2 = 61.89; df=5; p = 0.004). Response on the method of disposal of infant feces revealed a minimal number (19%) practiced the correct method of disposing into pit latrine with a significant relationship (X^2 = 37.43; df=4; p = 0.016) among the variable. More than a half (57%) of the respondents indicated that covered containers were used to store remaining

foods. Their relationship was found to be statistically significant ($x^2 = 9.07$; df=1; $p < 0.001$).Three quarters of the respondents (75%) revealed that re-heating stored food before feeding the child was practiced, however the relationship was statistically insignificant, ($X^2 = 11.45$; df=2; $p = 0.055$).Regarding the common diarrhea management practiced by caregivers, the study established that majority (78%) practiced oral rehydration solution, however the relationship was statistically insignificant, ($X^2 = 15.29$; df=2; $p = 0.062$). Rotavirus vaccination status was based on the three doses; 2nd, 4th and 6th month, which showed a large number (64%) of the children being partially vaccinated and the relationship among the variables found to be statistically significant, ($X^2 = 8.75$; df=2; $p < 0.001$).Partially vaccinated children were those who had received at least one but not all of the required vaccinations.

Table 4.4 Prevention strategies on health systems performance.

Variable	**Category**	***n(%)***	***df***	***x²***	***p-value***
Protection of water source	Yes	218(65)	1	7.55	<0.001
	No	116(35)			
Container for collecting water	Covered container	113(34)	1	9.12	0.006
	Uncovered container	221(66)			
Type of container for storing drinking water	wide mouth, a tap and a lid	29(9)	5	54.34	0.007
	wide mouth, a tap and no lid	24(7)			
	wide mouth, a lid and no tap	10(3)			
	wide mouth, no lid , no tap	187(56)			
	narrow neck, a tap and lid	66(20)			
	narrow neck, a tap and no lid	18(5)			
Treatment of water at POU	Yes	135(40)	1	8.63	<0.001
	No	199(60)			
Methods of water treatment at POU	No treatment	199(60)	5	61.89	0.004
	Boiling	44(13)			
	Filtration	33(10)			
	SODIS	6(2)			
	Use of chemicals	41(12)			
	Others	11(3)			
Method of disposal of infant feces	Taking to a pit latrine	64(19)	4	37.43	0.016
	Burying	79(24)			
	Giving to pets	57(17)			

	Left to dry and washed a way	110(33)			
	Others	24(7)			
Methods of food storage	Covered container	190(57)	1	9.07	<0.001
	Uncovered container	144(43)			
Re-heating food before feeding	Yes	251(75)	1	11.45	0.055
	No	83(25)			
Diarrhea management practice	Increased fluids	89(27)	2	15.29	0.062
	Oral Rehydration Solution	194(58)			
	Continuous feeding	51(15)			
Rotavirus vaccination	No vaccination	95(28)	2	8.75	<0.001
	partial vaccination	213(64)			
	Full vaccination	26(8)			

4.6. Bivariate analysis.

Bivariate analysis was performed on each of the chosen covariates in relation to the dependent variable, with the aim of assessing the correlation between each predictor variable and the performance of health systems.

4.6.1 Environmental and socio-economic factors and health systems performance.

Bavariate analysis was conducted to determine the associations between environmental and health systems performance variables and the results were summarized in table 4.5 below.

Ownership of a latrine had a statistically significant association with performance of health systems. The children whose household did not own a latrine were 1.56 times more likely to experience poor health systems than those who owned a latrine (*COR* = 1.56; *CI* = 1.14, 1.79; *p*=0.003). At 95% CI, it shows that not owning a latrine is a significant risk factor contributing to poor health systems.

The association between the type of latrine and health systems performance had mixed findings. Referring to a VIP latrine, children whose household owned traditional pit latrines were 1.49 times more likely to experience poor health systems than those who own a VIP latrine (*COR* = 1.49; *CI*

= 0.88, 1.97; *p*=0.067). The study reveals that at 95% CI, using traditional pit latrine is a potential risk factor for poor health systems but not statistically significant. Children utilizing pour flush latrines were 0.54 times less likely to experience poor health systems compared to those who own a VIP latrine (*COR* = 0.57; *CI* = 0.32, 0.85; *p*=0.013).This indicates that at 95% CI, using a pour flush latrine is a statistically significant factor for good health systems. Finally those who own other types of latrines were 1.54 times more likely to experience poor health systems than those who own a VIP latrine (*COR* = 1.54; *CI* = 0.96, 1.68; *p*=0.059). This shows that at 95%CI, owning other types of latrine is potential risk of poor health systems but not statistically significant.

Presence of flies in or around the latrine was significantly associated with the performance of health systems. The odds of poor health systems among children whose latrines did not have flies in or around the latrines were reduced by 62% compared to those who had flies in or around the latrines (*COR* = 0.22; *CI* = 0.11, 0.67; *p* = 0.005).This is an indication that at 95% CI, latrines free of flies is a statistically significant factor for good health systems.

Practice of Open Defecation (OD) was significantly associated with the performance of health systems. The odds of poor health systems among children whose households did not practice OD were 0.38 times less than those who practiced OD (*COR* = 0.38; *CI* = 0.24, 0.53; *p*=0.006).This is an indication (95% CI) that Open Defecation Free (ODF) environment is a statistically significant factor promoting health systems performance.

Time taken to fetch water from the main source was not significantly associated with health systems performance. Comparing with <30 minutes, those who took>30 minutes were 1.65 times more likely to experience poor health systems than those who travel for < 30 minutes (*COR* =

1.65; *CI* = 1.41,1.92; *p*=0.008). This is an indication that travelling more than 30 minutes to fetch water is a significant risk for poor health systems.

The distance to the water source was significantly associated with the performance on health systems. In reference to < 0.5 KM, those who travel between one and one and half kilometers to fetch water were1.63 times more likely to experience poor health systems than those who travel less than a kilometer (*COR* = 1.63; *CI* = 1.45, 1.73; *p*=0.014). Those who travel more than 1.0KM were 1.78 times more likely to experience poor health systems than those who travel less than a kilometer (*COR* = 1.78; *CI* = 1.53, 1.89; *p*=0.012). The study shows that at 95% CI, travelling more than a half a kilometer to fetch water is a potential risk of poor health system.

The main source of income for the household head was significantly associated with health systems performance. In reference to salaried income, children whose head of household were self-employed were 1.32 times more likely to experience poor health systems than those who were salaried (*COR* = 1.32; *CI* = 1.27, 1.61; *p*=0.011). The casual labourers were 1.53 times more likely to experience poor health systems than those who were salaried (*COR* = 1.53; *CI* = 1.38, 1.78; *p*=0.014). Those with other sources of income were 1.69 times more likely to experience poor health systems than those who were salaried (*COR* = 1.69; *CI* = 1.46, 2.04; *p*=0.023). This shows that at 95% CI, source of income is statistically significant risk of poor health systems.

Household monthly income (Ksh) was significantly associated with health systems performance. In reference to < Ksh 10,000.00, as the household monthly income increased, the likelihood of health systems being poor decreased significantly. Among the household with monthly income of between ksh.10, 000.00 to 19,000.00, the *COR* was 0.68 (*CI* =0.51, 0.94; *p*=0.007). *COR* for households with monthly income range of ksh.20, 000.00 to 29,000.00 was 0.54(*CI* = 0.45, 0.69;

p=0.005). *COR* for households with monthly income between of ksh.30, 000.00 to 39,000.00 was 0.42(*CI* = 0.31, 0.56; *p*=0.003).*COR* for households with monthly income of ksh.40, 000.00 to 49,000.00 was 0.31(*CI* = 0.27, 0.43; *p*=0.003) and finally the *COR* for households with monthly income over ksh.50, 000.00 was 0.28(*CI* = 0.23, 0.37; *p*<0.001). This shows that at 95% CI, household monthly income is a promoter factor on good health systems and it is statistically significant.

Wealth index for the household had a statistically significant association with health systems performance. In reference to poorer, those children whose households were considered to be poor were 0.87 times less likely to experience poor health systems than those who were poorer (*COR* = 0.87; *CI* = 0.62, 0.97; *p* = 0.018). Those considered to be middle were 0.62 times less likely to experience poor health systems than those who were considered poorer (*COR* = 0.62; *CI* = 0.55, 0.69; *p*<0.001). The study indicates that wealth index is significant factor that promotes good health systems.

Table 4.5: Association between environmental and socio-economic variables and health systems performance.

Variables	**COR**	**95% C.I for EXP(B)**		***p-value***
		Lower	**upper**	
Ownership of latrine				
Yes(ref)	1.00			
No	1.56	1.14	1.79	0.003
Type of latrine				

VIP latrine(ref)	1.00			
Traditional pit latrine	1.49	0.88	1.97	0.067
Pour flush	0.57	0.32	0.85	0.013
Others	1.54	0.96	1.68	0.059
Presence of flies in the latrine				
Yes(ref)	1.00			
No	0.22	0.11	0.67	0.005
Practice of open defecation.				
Yes(ref)	1.00			
No	0.38	0.24	0.53	0.006
Time taken to fetch water from the source				
< 30 Minutes(ref)	1.00			
>30 Minutes	1.65	1.41	1.92	0.008
Distance to the water source				
< 0.5 KM(ref)	1.00			
0.5-1.0 KM	1.63	1.45	1.73	0.014
>1.0 KM	1.78	1.53	1.89	0.012
Main source of income.				
Salaried (ref)	1.00			
Self-employment	1.32	1.27	1.61	0.011
Casual labourer	1.53	1.38	1.78	0.014
Others	1.69	1.46	2.04	0.023
Household monthly income (Ksh)				
< 10,000 (ref)	1.00			
10,000 –19,000	0.68	0.51	0.94	0.007
20,000 – 29,000	0.54	0.45	0.69	0.005

30,000 – 39,000	0.42	0.31	0.56	0.003
40,000 – 49,000	0.31	0.27	0.43	0.003
>50,000	0.28	0.23	0.37	<0.001
Wealth index for the household				
Poorer (ref)	1.00			
Poor	0.87	0.62	0.97	0.018
Middle	0.62	0.55	0.69	<0.001

4.6.2 Effects of diarrhea on health systems performance.

Stunting growth had a statistically significant association with poor health systems. As stunting growth increases by one unit, the log odds of experiencing poor health systems increased by 0.47. That is, the odds of experiencing poor health systems increased by 47%, (COR=1.47;*CI* =1.12, 1.87; *p*=0.009). This is an indication that stunting growth affects the health systems. Indeed it is a statistically significant threat to functioning of health systems thus affecting its performance.

A robust correlation was observed between reduced cognitive development and the performance of health systems, with statistical significance. For every one unit increase in reduced cognitive development as an effect of diarrhea, the log odds of experiencing poor health systems increased by 0.42. That is, the odds of experiencing poor health system increased by 42% (COR=1.42; *CI* =1.15, 1.79; *p*= 0.008). The study shows that a diarrhea condition is a statistically significant risk factor for poor health systems.

The association between severe wasting and health systems performance was statistically insignificant. As severe wasting increases by one unit, the odds of experiencing poor health systems increases by 16% (*COR* = 1.16; *CI* =0.88, 1.34: *p*=0.059).This is a confirmation that severe muscle wasting caused by diarrheal condition is a possible risk factor for poor health systems but not statistically significant.

Dehydration as an effect of diarrhea had a statistically significant association with the performance of health systems. As dehydration increased by one unit, the probability of experiencing poor health systems increased by 51% (*COR* = 1.51; *CI* =1.13, 2.15: *p*=0.018). The study reveals that dehydration caused by diarrhea is a statistically significant risk factor interfering with effectiveness of health systems.

The association between the financial losses and health systems performance was statistically significant. As financial losses increased by one unit, the likelihood of experiencing poor health systems increased by 57% (C*OR* = 1.57; *CI* = 1.33, 2.24: *p*=0.023).This is an indication that financial losses as a result of treating diarrhea conditions is a statistically significant risk factor for poor health systems.

Productivity losses had a statistically significant association with health systems performance. As productivity losses increased by one unit, the odds of experiencing poor health systems increased by 39% (COR = 1.39: *CI* = 1.08, 1.84: *p*=0.014). This shows that a productivity loss due to diarrheal is a statistically significant risk factor determining the effectiveness of health systems in terms of their performance.

Table 4.6: Effects of diarrheal variables on health systems performance.

Variable/statement	***p-value***	***COR***	**95% CI for EXP(B)**	
			Lower	**Upper**
Stunting growth	0.009	1.47	1.12	1.87
Constant		1.00		
Reduced cognitive development.	0.007	1.42	1.15	1.79
Constant		1.00		
Severe wasting	0.059	1.06	0.88	1.34
Constant		1.00		

Dehydration	0.018	1.51	1.13	2.15
Constant		1.00		
Financial losses	0.023	1.57	1.33	2.24
Constant		1.00		
Productivity losses	0.014	1.39	1.08	1.84
Constant		1.00		

4.6.3 Prevention strategies on health systems performance.

A bivariate logistic regression analysis was conducted to examine the relationship between prevention strategies and the performance of health systems.

The correlation between safeguarding water sources and inadequate health systems was found to be statistically significant. Those who fetch water from unprotected source were 1.67 times more likely to experience poor health systems than those who fetch water from protected source 1.67(*CI* = 1.18, 1.88; *p*=0.014).Based on the 95% CI, the study reveals that non protected water sources are statistically significant risk factor for poor health systems.

Type of container for collect water from main source was significantly associated with health systems performance. Those who used covered container to collect water from main source were 0.24 times less likely to experience poor health systems than those who use uncovered containers to collect water from the main source 0.24 (*CI* = 0.13, 0.35; *p*=0.005).At 95% CI, the study indicated that using covered containers to collect water is a statistically significant factor for promoting good health systems.

There were mixed findings between the type of container used for storing drinking water and the performance of health systems. In reference to a container with a wide mouth ,a tap and a lid, the those using containers with wide mouth and a tap only were 1.45 times more likely to experience poor health systems than those who used containers with a wide mouth , a tap and a lid for storing drinking water 1.45 (*CI* = 0.88, 1.76; *p*=0.082). This indicated that at 95% CI, using containers

with wide mouth and a tap only is a potential risk for poor health systems but not statistically significant. The ones using containers with a wide mouth and a lid only were 1.61 times more likely to experience poor health systems than those who used containers with a wide mouth , a tap and a lid for storing drinking water 1.61 (*CI* = 1.23, 1.69; *p*=0.012). Those using containers with a wide mouth only were 1.72 times more likely to experience poor health systems than those who used containers with a wide mouth, a tap and a lid for storing drinking water1.72(*CI* = 1.42, 2.04; *p* = 0.043). From these findings {1.61 (*CI* = 1.23, 1.69; *p* = 0.012), 1.72(*CI* = 1.42, 2.04; *p*=0.043)} at 95%CI, indicates that their corresponding containers' usage was a statistically significant risk factor for poor health systems. Those who used containers with narrow mouth, tap and a lid were 0.05 times less likely to experience poor health systems than those who used containers with a wide mouth, a tap and a lid for storing drinking water 0.05 (*CI* = 0.03, 0.09; *p*<0.001). Those who used containers with narrow mouth and a tap only were 0.12 times less likely to experience poor health systems than those who used containers with a wide mouth, a tap and a lid for storing drinking water 0.12 (*CI* = 0.07, 0.22; *p* = 0.002).Those who used containers with narrow mouth and a lid only were 0.17 times less likely to experience poor health systems than those who used containers with a wide mouth, a tap and a lid for storing drinking water0.17 (*CI* = 0.09, 0.26; *p*=0.004).From these findings {0.05 (*CI* = 0.03, 0.09; *p* < 0.001), 0.12 (*CI* = 0.07, 0.22; *p* = 0.002) and 0.17 (*CI* = 0.09, 0.26; *p* = 0.004)} at 95% CI, the study indicates that their corresponding containers' usage is a statistically significant factor for promoting good health systems. Finally, those who used containers with narrow mouth only were 0.43 times less likely to experience poor health systems than those who used containers with a wide mouth, a tap and a lid 0.43 (*CI* = 0.15, 1.02; *p* = 0.063).The study indicated that using the said type of container is a possible promoter of good health systems but not statistically significant.

Treatment of water for drinking at the Point Of Use (POU) was significantly associated with performance of health systems. Those who did not treated water at the point of use were 1.78 times more likely to experience poor health systems than those who treated water at POU 1.78 (*CI* = 1.45, 2.16; *p*=0.015).The study shows that at 95% CI, not treating drinking water at the POU is a statistically significant risk factor for poor health systems.

Methods of water treatment at Point of Use (POU) were significantly associated with health systems performance. Those boiling water at the POU were 0.56times less likely to experience poor health systems than those who do not treated water at Point Of Use 0.56 (*CI* = 0.51, 0.67; *p*<0.001). Filtration as a method of water treatment had odds of 0.51 (*CI* = 0.45, 0.62; *p*<0.001). SODIS, use of chemicals and other methods of water treatment at POU had odds of 0.43 (*CI* = 0.27, 0.55; *p*=0.005), 0.23 (*CI* = 0.18, 0.31; *p*<0.001) and 0.57 (*CI* = 0.48, 0.82; *p*=0.008) respectively. On a 95% CI, the study shows that boiling, filtration, SODIS, use of chemicals and other water treatment methods is a statistically significant factor promoting good health systems.

Methods of disposal of infant feces had no statistically significant association with health systems performance. Those who buried the infant feces were 1.17 times more likely to experience poor health systems than those who disposed of to the pit latrine 1.17 (*CI* = 0.83, 1.56; *p*=0.065). Those who gave the infant feces to pets were 1.33 times more likely to experience poor health systems than those who disposed of to pit latrine 1.33 (*CI* = 0.87, 1.62; *p*=0.074).Those who left the infant feces to dry and get washed away were 1.78 times more likely to experience poor health systems than those who disposed of to pit latrine 1.78 (*CI* = 1.52, 2.32; *p*=0.028). Finally those who used other disposal methods for infant feces were 1.53 times more likely to experience poor health systems than those who disposed of to pit latrine 1.53 (*CI* = 0.91, 2.44; *p*=0.059).This indicates that at 95% CI, burying, giving to the pets and other methods of disposing infant feces are potential

risk factors for poor health systems but not statistically significant. Meanwhile leaving the infant feces to dry and washed away is statistically significant risk factors for poor health systems.

In regard to methods of food storage, those who used to store food in uncovered containers were 1.53 times more likely to experience poor health systems than those who used to store foods in covered containers 1.53 (*CI* = 1.22,1.98; *p*=0.024). The association between methods of food storage and health systems performance was statistically significant. This shows that at 95% CI, not covering foods during storage is a statistically significant risk factor for poor health systems.

Rotavirus vaccination had mixed findings. The children who were partially vaccinated against diarrhea were 0.84 times less likely to experience poor health systems than those who were not vaccinated 0.84 (*CI* = 0.78, 1.24; *p*=0.061). This indicated that at 95% CI, partial vaccination is a potential factor for good health systems but not statistically significant. Those children who were fully vaccinated against diarrhea were 0.14 times less likely to experience poor health systems than those who were not vaccinated 0.14 (*CI* = 0.11, 0.63; *p*=0.003). This indicated that at 95% CI, fully vaccination is a statistically significant factor for good health systems.

Table 4.7 Prevention strategies on health systems performance

	COR	**95% CI for EXP(B)**	***p-value***

Variables		Lower	Upper	
Protection of water source				
Yes (ref.)	1.00			
No	1.67	1.18	1.88	0.014
Type of container for collecting water				
Uncovered container (ref.)	1.00			
Covered container	0.24	0.13	0.35	0.005
Type of container for storing water;				
With a wide mouth a tap and a lid (ref)	1.00			
With a wide mouth and a tap only	1.45	0.88	1.76	0.082
With a wide mouth and a lid only	1.61	1.23	1.69	0.012
With a wide mouth only	1.72	1.42	2.04	0.043
With narrow mouth, tap and a lid.	0.05	0.03	0.09	<0.001
With narrow mouth and tap only.	0.12	0.07	0.22	0.002
With narrow mouth and lid only.	0.17	0.09	0.26	0.004
With narrow mouth only.	0.43	0.15	1.02	0.063
Treatment of water Point Of Use (POU)				
Yes(ref)	1.00			
No	1.78	1.45	2.16	0.015
Methods of water treatment at POU				
No treatment (ref)	1.00			
Boiling	0.56	0.51	0.67	<0.001
Filtration	0.51	0.45	0.62	<0.001
SODIS	0.43	0.27	0.55	0.005
Use of chemicals	0.23	0.18	0.31	<0.001
Others	0.57	0.48	0.82	0.008
Method of disposal of infant feces				
Disposal to pit latrine(ref)	1.00			
Burying	1.17	0.83	1.56	0.065
Giving to pets	1.33	0.87	1.62	0.074
Leaving it to dry/ washed a way	1.78	1.52	2.23	0.028
Others	1.53	0.91	2.44	0.059
Methods of food storage				
Covered container(ref)	1.00			
Uncovered container	1.53	1.22	1.98	0.024
Rotavirus vaccination (doses at 2,4,6 months)				
No vaccination(ref)	1.00			
Partial vaccination	0.84	0.78	1.24	0.061
Full vaccination	0.14	0.11	0.63	0.003

4.7 Multivariate logistic regression analysis

Multicollinearity diagnosis was carried out and the coefficients of collinearity statistics revealed a mean tolerance value of 0.89 while that of VIF (Variance Inflation Factor) was 1.24, thus there were no important multicollinearity.

Table 4.8 Collinearity diagnostic coefficients of factors associated with outcome variable.

Variable	VIF	Tolerance
Ownership of latrine	1.25	0.79
Presence of flies in or around the latrine	1.33	0.97
Practice of open defecation	1.26	0.85
Mean value	1.24	0.89

VIF(Variance Inflation Factor)

After accounting for all other variables, the relationship between the factors and the outcome variable was appropriately modified within the variables. This was evidenced from the variations of Adjusted Odds Ratio (AOR) values compared to Crude Odds Ratio (COR) values by over 10% cutoff.

At multivariable analysis, latrine ownership still had a statistically significant association with odds ratio adjusted from 1.56 (*CI* = 1.14, 1.79; *p*=0.003) to 1.25 (*CI* = 1.08, 1.67; *p*=0.002). This finding indicates that children residing in households without access to a latrine were 1.25 times more susceptible to encountering inadequate health conditions in comparison to their counterparts who had latrines in their households. Based on the 95% CI, this indicates that not owning a latrine is a statistically significant risk factor for poor health systems.

Odds ratio (OR) for the presence of flies in or around the latrine was adjusted to 0.17 (*CI* = 0.09, 0.52; *p*=0.003) from a COR of 0.22 (*CI* = 0.11, 0.67; *p*=0.005) and the association with health

systems performance remained statistically significant. This meant that at 95% CI, absence of flies in or around the latrine is a statistically significant factor for good health systems.

Odds Ratio (OR) for open defecation practices was adjusted to 0.21(*CI* = 0.18, 0.47; *p*=0.005) from 0.38 (*CI* = 0.24, 0.53; *p*= 0.006) and the association remained statistically significant. This revealed that those children whose households ensured open defecation free (ODF) environment were 0.21 times less likely to experience poor health systems than those who practiced open defecation (OD). In addition, the study shows that ODF environment is a statistically significant factor for good health systems (table 4.16).

Table 4.9: Multivariate analysis on association of factors with outcome variable.

Variable	**Bivariate regression**			**Multivariate regression**		
	COR	**95%CI**	***p-value***	**AOR**	**95%CI**	***p-value***
Ownership of latrine	1.56	(1.14,1.79)	0.003	1.25	(1.08,1.67)	0.002
Presence of flies on latrine	0.22	(0.11,0.67)	0.005	0.17	(0.09,0.52)	0.003
Practice of OD	0.38	(0.24,0.53)	0.006	0.21	(0.18,0.47)	0.005

The evaluation of the significance of the full model was conducted using the Omnibus Tests of Model Coefficients. The results indicated a chi-square value of 19.75, with a corresponding p-value of 0.003. The aforementioned findings indicate that the comprehensive model exhibited a noteworthy level of predictive accuracy, as evidenced by the statistically significant performance of [x^2(3, N=334 = 19.75, *p* = 0.003). The research findings indicate that the comprehensive model exhibited a significant deviation from a model that only includes a constant or lacks any predictors.

Consequently, the model demonstrated a noteworthy capacity to forecast the outcome variable, as evidenced by the statistical analysis presented in table 4.10.

Table 4.10: Omnibus Tests of Model Coefficients

Description		**Chi-square**	**df**	**Sig.**
	Step	19.75	2	0.003
Step 1	Block	19.75	2	0.003
	Model	19.75	2	0.003

Evaluation of the strength of association between the model was performed based on **Nagelkerke's* R^2. The strength of the association composed of three independent variables (ownership of latrine, presence of flies around or in latrine and practice of open defecation) and the dependent variable (health systems performance). The prediction on the outcome variable had an R^2 of .83. This revealed that 83% of the variance in health systems performance was predicted by independent variables, 17% of the variance in outcome variable was unexplained by the regression model and the predictor variables had a large effect on the outcome variable. Based on the findings, the researcher has reached the conclusion that the model exhibits a noteworthy capacity to predict the dependent variable. However, it is plausible that there exist additional independent variables that could potentially serve as significant predictors (refer to table 4.11).

Table 4.11: *Model Summary*

Step	*-2 Log likelihood*	*Cox & Snell R Square*	*Nagelkerke R Square*

1	127.753	0.798	0.826

*[*I used Nagelkerke's R^2 because it is normalized to produce values between 0 and 1, as in R^2 used in conventional regression analysis.]*

The model has demonstrated a strong level of fit, as evidenced by the inability of the Hosmer and Lemeshow Test to reject the hypothesis of model appropriateness (Ho: The model adequately fits the data). The chi-square value of 15.112 and a p-value of 0.104 further support this finding. The obtained p-value of 0.104, as indicated in table 4.12, suggests that the model exhibits a reasonable fit to the observed data.

Table 4.12: Hosmer and Lemeshow goodness of fit test/statistics.

Step	**Chi-square**	**df**	**Sig.**
1	15.112	2	.104

The process of assessing the magnitude of the relationship between each independent variable and the dependent variable was conducted by utilizing the Variables in the Equation table. The regression equation was computed by utilizing the Wald ratio (slope) for each of the independent variables.

Y=mx+b , (where; Y= Dependent variable, m=slope, x=Independent variable, b=constant)

Y=(21.776*1.25+22.439) + (24.113*0.17+22.439) + (18.348*0.21+22.439)

Y= 102.489

Therefore, the regression analysis for this set of independent variables and dependent variable proved that independent variables were good predictors of the variable of interest as the value for the coefficient of determination was significantly sufficient (R^2 = 0.826) thus 83% of the changes

in outcome variable is predicted by the independent variable and hence the model is a good fit for the given data (table 4.13)

Table 4.13. Model 1: Predicting the Likelihood of Diarrheal Factors influence on Health Systems performance.

Variables in the equation	B	S.E.	Wald	95%CI	sig.
Ownership of latrine	1.25	.104	21.776	(1.08,1.67)	.002
Presence of flies on latrine	0.17	.161	24.113	(0.09,0.52)	.003
Practice of open defecation	0.21	.107	18.348	(0.18,0.47)	.005
Constant	0.88	.119	22.439	(0.46,0.95)	.008

Research Question 2: Is there a correlation between the effects of diarrhea-related conditions, such as stunted growth, impaired cognitive development, and dehydration, and the overall performance of health systems, characterized by either poor or good health systems? Multivariate logistic regression was used to examine whether the effect variables were associated with the likelihood of experiencing poor health systems. Multicollinearity diagnosis was carried out and the coefficients of collinearity statistics revealed a mean tolerance value of 0.89 while that of VIF (Variance Inflation Factor) was 1.18, thus there were no important multicollinearity and the variables significantly contributed to the model.

Table 4.14: Collinearity diagnostic coefficients of effects associated with outcome variable.

Variable	VIF	Tolerance

Stunting growth	1.21	0.82
Reducing cognitive development	1.26	0.97
dehydration	1.14	0.88
Mean value	1.18	0.89

After accounting for all other variables, the relationship between the effects and the outcome variable was appropriately adjusted within the given variables. This was evidenced from the variations of Adjusted Odds Ratio (AOR) values compared to Crude Odds Ratio (COR).

Stunting growth at multivariable analysis had a statistically significant association with health systems performance. The AOR was 1.53 (*CI* = 1.27, 1.93; *p*=0.014) from 1.47 (CI = 1.12, 1.87; *p*=0.009). The study revealed that for every one unit increase on stunting growth, children were1.53 times more likely to experience poor health systems. The study further indicated that at 95% CI, stunting growth is a statistically significant risk factor for poor health systems.

The AOR for reducing cognitive development increased to 1.49(*CI* = 1.18, 1.88; *p*=0.011) from the COR of 1.42(*CI* = 1.15, 1.79; *p*= 0.007). The association remained statistically significant. The study established that for every increase in reducing cognitive development, children were 1.49 times more likely to experience poor health systems. The study further indicated that at 95% CI, reducing cognitive development was a statistically significant risk factor for poor health systems.

The association on multivariate analysis between dehydration and health systems performance was statistically significant. The odds of dehydration was adjusted to 1.59 (*CI*= 1.23, 2.39;

p=0.021) from 1.51(*CI* =1.13, 2.15: *p*= 0.018).The study established that for every increase in dehydration, children were 59% more likely to experience poor health systems. The study further indicated that at 95% CI, dehydration is a statistically significant risk factor for poor health systems.

Table 4.15: Multivariate analysis on association of effects with outcome variable

Variable	**Bivariate regression**			**Multivariate regression**		
	COR	**95%CI**	***p-value***	**AOR**	**95%CI**	***p-value***
Stunting growth	1.47	1.12,1.87	0.009	1.53	1.27,1.93	0.014
Reducing cognitive development	1.42	1.15,1.79	0.007	1.49	1.18,1.88	0.011
Dehydration	1.51	1.13,2.15	0.018	1.59	1.23,2.39	0.021

Evaluation of the significance of the full model using the Omnibus Tests of Model Coefficients indicated; X^2 =11.362, p = 0.005. This reveals that the full model had a significant prediction performance[X^2(4, N=334 = 11.362, p=0.005)]. The study concluded that the full model was significantly different from a constant-only or null model (even odds); therefore, the model was a significant predictor of the dependent variable (table 4.16).

Table 4.16: Omnibus Tests of Model Coefficients

Description		**Chi-square**	**df**	**Sig.**
	Step	11.362	4	0.005
Step 1	Block	11.362	4	0.005
	Model	11.362	4	0.005

Evaluation of the strength of association of the model was performed based on **Nagelkerke's* R^2. The strength of the association composed of five independent variables (stunting growth, reduced cognitive development and dehydration) and the dependent variable (health systems performance). The prediction on the outcome variable had an R^2 of .86. This revealed that 86% of the variance in health systems performance was predicted by independent variables while 14% of the variance in outcome variable was unexplained by the regression model. The study established that the predictor variables had a large effect on the outcome variable (table 4.24).

Table 4.17: *Model Summary*

Step	*-2 Log likelihood*	*Cox & Snell R Square*	*Nagelkerke R Square*
1	24.834	.783	.862

*[*I used Nagelkerke's R^2 because it is normalized to produce values between 0 and 1, as in R^2 used in conventional regression analysis.]*

The model had also good fit since *Hosmer* and *Lemeshow* Test could not reject the hypothesis of model appropriateness (*Ho*: The model adequately fits the data), as chi-square value was 12.083 and $p = 0.127$.The insignificant *p-value* (p=0.104) suggests that the model fits the data reasonably well (table 4.18).

Table 4.18: Hosmer and Lemeshow goodness of fit test/statistics.

Step	**Chi-square**	**df**	**Sig.**
1	12.083	4	.127

The assessment of the magnitude of the relationship between each independent variable and the dependent variable was conducted by utilizing the Variables in the Equation table. The regression equation was formulated by utilizing the Wald ratio (slope) for each of the independent variables.

Y=mx+b , (where; Y= Dependent variable, m=slope, x=Independent variable, b=constant)

Y=(11.743*1.53+15.005) + (14.217*1.49+15.005) + (13.322*1.59+15.005)

Y= 105.347

Therefore, the regression analysis for this set of independent variables and dependent variable proved that independent variables were good predictors of the variable of interest as the value for the coefficient of determination was significantly sufficient ($R^2 = 0.862$) thus 86% of the variation in independent variable is predicted by the independent variables and hence the model is a good fit for the given data (table 4.19)

Table 4.19. Model 2: Logistic Regression Results for Effects and Health Systems performance.

Variables in the equation	**B**	**S.E.**	**Wald**	**95%CI**	**Sig.**
Stunting growth	1.53	0.332	11.743	1.27,1.93	0.014
Reducing cognitive development	1.49	0.731	14.217	1.18,1.88	0.011
Dehydration	1.59	0.147	13.322	1.23,2.39	0.021
Constant	1.21	0.787	15.005	1.18,2.16	0.018

Research Question 3: Is there a correlation between the implementation of preventive measures and the overall performance of health systems?

Multicollinearity diagnosis was carried out and the coefficients of collinearity statistics revealed a mean tolerance value of 0.90 while that of VIF (Variance Inflation Factor) was 1.15, thus there were no important multicollinearity.

Table 4.20 Collinearity diagnostic coefficients of prevention strategies associated with outcome variable.

Variable	VIF	Tolerance
Protection of drinking water source	1.17	0.87
Treatment of drinking water at POU	1.24	0.94
Methods of food storage	1.05	0.82
Rotavirus vaccination	1.15	0.98
Mean value	1.15	0.90

Protection of water source showed significant association with health systems performance. The AOR was 1.73 (*CI* = 1.29, 2.07, *p*=0.021) from 1.67(*CI* =1.18, 1.88; *p*=0.014).At multivariable analysis level the result indicated that the children whose households fetch water from unprotected sources were 1.73 times more likely to experience poor health systems compared to those who fetch water from protected sources. The study further indicated that at 95% CI, unprotected water sources are statistically significant risk factor for poor health systems.

Regarding treatment of water for drinking at the Point Of Use (POU), the association still remained statistically significant at multivariable analysis level. The odds of poor health systems increased from 1.78(*CI* = 1.45, 2.36; *p*=0.005) to 1.86(*CI* = 1.51, 2.53; *p*= 0.018). This was an indication that children whose households don't treat water at point of use were 1.86 times more likely to experience poor health systems than those who treat water at the POU. At 95% CI, the study further reveals that lack of water treatment at POU is a significant risk factor for poor health systems.

The methods of food storage remained significantly associated with poor health systems at multivariable analysis (*AOR*=1.62; *CI* = 1.27, 2.04; *p*=0.031 vs *COR* = 1.53;*CI* = 1.22, 1.98;*p*=

0.024). The result indicated that children whose foods were stored in open containers had more odds (*AOR*=1.62) of experiencing poor health systems than those whose foods were stored in covered containers. The study further reveals that at 95% CI, uncovered foods are significant risk of poor health systems.

On rotavirus vaccination status as the main predictor variable, there were statistically significant association with the outcome variable. The AOR for full vaccination against diarrhea was significant and adjusted from 0.14 (*CI* = 0.11, 0.63; *p*=0.003) to 0.17(*CI* = 0.14, 0.68; *p*=0.006). This indicated that full vaccination of children would reduce the likelihood of experiencing poor health systems up to 83% in reference to unvaccinated children. The study further reveals that at 95% CI, full vaccination of children against diarrhea infections is a significant factor for promoting good health systems (table 4.21).

Table 4.21 Association of prevention strategies with outcome variable

Variable	**Bivariate regression**			**Multivariate regression**		
	COR	**95%CI**	***p-value***	**AOR**	**95%CI**	***p-value***
Protection of drinking water source	1.67	1.18,1.88	0.014	1.73	1.29,2.07	0.021
Treatment of drinking water at POU	1.78	1.45,2.36	0.015	1.86	1.51,2.53	0.018
Methods of food storage	1.58	1.22,1.98	0.024	1.62	1.27,2.04	0.031
Rotavirus vaccination	0.14	0.11,0.63	0.003	0.17	0.14,0.68	0.006

Evaluation of the significance of the full model using the Omnibus Tests of Model Coefficients indicated; X^2 = 22.02, p = 0.004. This reveals that the full model had a significant prediction performance[X^2(3, N=334 = 22.02, p=0.004)]. The study concluded that the full model was

significantly different from a constant-only or null model (even odds); therefore, the model was a significant predictor of the dependent variable (table 4.22).

Table 4.22: Omnibus Tests of Model Coefficients

Description		**Chi-square**	**df**	**Sig.**
	Step	22.02	3	0.004
Step 1	Block	22.02	3	0.004
	Model	22.02	3	0.004

Evaluation of the strength of association of the model was performed based on **Nagelkerke's* R^2. The strength of the association composed of four independent variables (protection of water sources, treatment of water at point of use, methods of food storage and rotavirus vaccination) and the dependent variable (health systems performance). The prediction on the outcome variable had an R^2 of .89. This revealed that 89% of the variance in health systems performance was predicted by independent variables, 11% of the variance in outcome variable was unexplained by the regression model and the predictor variables had a large effect on the outcome variable (table 4.23).

Table 4.23: *Model Summary*

Step	*-2 Log likelihood*	*Cox & Snell R Square*	*Nagelkerke R Square*
1	165.954	0.845	0.893

The model has had a good fit since *Hosmer* and *Lemeshow* Test could not reject the hypothesis of model appropriateness (*Ho*: The model adequately fits the data), as chi-square value was 17.21

and p = 0.116.The insignificant *p-value* (p=0.116) suggests that the model fits the data reasonably well (table 4.24).

Table 4.24: Hosmer and Lemeshow goodness of fit test/statistics.

Observations	**Chi-square**	**df**	**sig.**
334	17.211	3	.116

The process of assessing the degree of correlation between each independent variable and the dependent variable was conducted by utilizing the Variables in the Equation table.

The regression equation was formulated by utilizing the Wald ratio (slope) for each of the independent variables.

Y=mx+b, (where; **Y**= Dependent variable, m=slope, x=Independent variable, b=constant)

Y=(12.182*1.73+15.672) + (14.371*1.86+15.672) + (10.354*1.62+15.672)+ (18.769*0.17+15.672)

Y= 130.457

Therefore, the regression analysis for this set of independent variables and dependent variable proved that independent variables were good predictors of the variable of interest as the value for the coefficient of determination was significantly sufficient (R^2 = 0.893) thus 89.3% of the variation in independent variable is predicted by the independent variables and hence the model is a good fit for the given data (table 4.25)

Table 4.25 : *Model 3* : *Logistic Regression Predicting the Likelihood of prevention strategies of diarrheal on health systems performance.*

Variables	B	S.E.	Wald	95%CI	Sig.
Protection of drinking water source	1.73	0.003	12.182	1.29,2.07	0.021
Treatment of drinking water at POU	1.86	0.005	14.371	1.51,2.53	0.018
Methods of food storage	1.62	0.104	10.354	1.27,2.04	0.031
Rotavirus vaccination	0.17	0.009	18.769	0.14,0.68	0.006
Constant	1.69	0.174	15.672	1.22,2.18	0.014

4.11 Results on Qualitative analysis.

4 .11.1 Response on demographic information.

A set of eight (8) Focus Group Discussions (FGDs) and eleven (16) Key Informant Interviews (KIIs) were systematically carried out across the eight sub-counties of Migori County. Table 4.26 displays the socio-demographic characteristics of the participants.

Table 4. 26 Focus Group Socio-demographic factors.

Description		Frequency (N=89)	(%)
Sex	Male	05	5. 6
	Female	8 4	94. 4
Age (Years)	< 18	2	2.3
	19-24	9	10.1
	25-29	13	14.6
	30-34	14	15.7
	35-39	25	28.1
	40-44	10	11. 2
	45-49	9	10.1
	>50	7	7.9
level education	None (Not formal)	29	32.6
	Primary	33	37.1
	Secondary	18	20.2
	Tertiary	9	10.1
Marital status	Married	83	93.3

	Single	4	4.5
	Others	2	2.2
Religion	Muslim	5	5.6
	Christian	76	85.4
	Others	8	9.0
Occupation	House wife	85	95.5
	Privately employed	1	1.1
	Government employed	3	3.4
Area of residence	Rural	81	91.0
	Urban	8	9.0

4.11.2 Factors contributing to diarrhea occurrence.

4.11.2.1 Perceived causes of diarrhea in children

It was noted that a large number of respondents had a perception , diarrhea is as a result of poor sanitation and hygiene . They added that drinking contaminated water also causes diarrhea. This indicates that the participants really understood the causes of diarrhea in children. A male respondent during FGD noted:

> *'Our water points are not protected and thus get contaminated and if we don't boil the drinking water our children will have diarrhea'.*

A KII respondent added:

> *"Some household don't own latrines and they are attempted to practice open defecation which when it rains, the feces are washed away and end up at water bodies such as rivers and unprotected wells. This indeed makes water to be contaminated. More so many households don't consider treating water and thus cause diarrhea to the children".*

The same sentiments were verified by another KII respondent who emphasized that:

> '*Some household have designated areas for Open defecation especially for children and vulnerable groups. During household visits we observed that children defecate around the houses and kitchen gardens. We also observed open defecation in small bushes near*

the houses, which we noted that they were being used by adults to practice OD'.

FGD participant noted that:

'Not washing hands before feeding the child can cause diarrhea. Some of us we eat without washing our hands even after visiting the latrine. Dirt hands can easily bring diarrhea to our children'.

A KII respondent stated:

'Poor refuse disposal, lack of hand washing facilities at the household level, poor food hygiene such as not covering foods are factors that contribute to causes of diarrhea not only to children but also to adult population'.

4. 13 Prevention strategies.

4.13.1 community level WASH interventions.

Number of local and international partners such as UNICEF, World Bank, World Vision, CARE Kenya, AMREF Africa among others were mentioned as some of the organizations having interventions focusing on WASH interventions at community level. This was reiterated during the KIIs by a respondent, who reported:

'A number of community water points such as water kiosks have been built, springs have been protected, shallow wells have been protected and other provisions geared towards community safe water systems but still there are high cases of diarrhea infections'

FGD male noted:

'Diarrhea cases can occur if water points are having contamination, during transportation of water from sources, at storage and during drawing for

drinking. Some people transport water using open containers and in most cases drop leaves which are not clean on the open containers to avoid spills as they carry on their heads. Others dip their fingers as they transport using open containers. The storage of drinking water in most household is poor and this result to diarrhea infections as most household store their water in containers with wide mouth and to a large extent without covers. This gives room for household members to dip drawing containers into the water storage containers, thus contaminating water'.

FGD with female respondent noted:

'Majority of the household members don't treat water at the point of use. However some boil before drinking, during rainy season we take water without boiling as we believe that rain water has been blessed by God'.

Another FGD female respondent echoed:

'*Due to scarcity of firewood I normally don't boil water for drinking but preserve firewood for cooking food. As I cook food I usually place drinking water near the fire to kill germs and by the time food is cooked, the drinking water is also heated'.*

This was supported by one KII respondent who said:

'Many people don't boil water to the boiling point but just warm the water thinking that they have treated water'.

A KII respondent added:

'*Maintenance of the water points is difficult since the development partners usually complete the projects and leave it to the community management without sustainability plans in place*.'

During FGD, an adult female respondent indicated that:

'*Household members are contributing to diarrheal infections due to non-compliance*

with sanitation and hygiene requirements at the household levels thus encouraging the spread of diarrheal diseases.

One of the male respondents during FGD said:

'In this community some household members do not use pit latrine and they normally dig shallow pits which are filled within a short time but takes a long time to dig another one.'

FGD female respondent said:

'*Households near where I reside do not use latrines more so the children and in most cases they don't have hand washing stations thus end up not practicing hand hygiene and at long last diarrhea infections do occur"*

A female KI emphasized that;

'There is need for the households to be sensitized on proper hand washing procedure since many don't install hand washing facilities at household level and even those with the hand washing facilities still large numbers don't use soap for washing their hands and thus exposed to diarrhea infections.'

A KII with a female respondent also reported:

'Most of the household members don't have latrines, thus are forced to practice open defecation which is later washed a way to water sources as majority of the water sources are unprotected. This end up contaminating the water and causing diarrhea infections.'

A KII with a male respondent also lamented:

'I may want to state that, many houses in this area practice open defecation as there are those with designated areas for OD such as near their houses and also done near water sources.'

4.13.2 Rotavirus vaccination.

More than 70% of the participants were of the opinion that diarrhea in children can be prevented through Rotavirus vaccination. This was echoed by another respondent who said that:

> *'When I was informed of the childhood diarrhea vaccination, I took my child to hospital and she got vaccinated , since the child finished the three doses, I usually don't experience much diarrhea from the child but in minimal occasions.*

A female respondent elaborated:

> '*Diarrhoea in children is a very serious condition for young children since they can lose a lot of water and end up dying. Rotavirus vaccination would help prevent the diarrhea'.*

Same sentiments during KII stressed:

> *'It is very serious because diarrhea can kill if not treated or prevented. Rotavirus vaccine is scientifically proven to prevent diarrhea in childhood. It has been noted that majority of the children who frequently visits the health facilities for diarrhea treatment are those who never received the three doses of Rotavirus vaccination'*

4.13.3 Food safety.

Many participants agreed that food safety is very critical in prevention of diarrhea in children and covering of foods during storage should be practiced all the time. Also they emphasized that re-heating foods before feeding the child kills micro-organisms in food. The same was noted during KII, respondent who reported that:

> *'I always cover the foods for the child to avoid germs from accessing it because uncovered foods will make my child to diarrhea'.*

Another female respondent said:

> '*Whenever I used to feed my child on cold and uncovered foods he used to*

experience diarrhea till we were informed by the community health volunteer to re-heat foods before feeding the child and also cover remain foodstuffs'. Since then I usually not experience problems with covered foodstuffs and re-heated foods'.

A male KII respondent noted,

'We always sensitize the mothers or caregivers of children on the importance of covering foods during storage as well as re-heating foods before feeding the children. We always emphasize that the uncovered food and lack of re-heating remain foodstuff harbor microorganisms which makes the children to diarrhea'.

4.13.4 Diarrhea case management.

More than 50% of the participants were aware of the management of diarrhea cases as a prevention approach. Male respondent said:

'I was taught by the CHV on preparation of ORS (Oral Rehydration Solution) at household level and whenever my children have diarrhea I always prepare ORS and administer to them. ORS is simple to formulate and works effectively in diarrhea management.'

'In addition to that, we were also sensitized on the continuous feeding of the children with diarrhea and also giving plenty of fluids to them .'

During the KII many participants knew diarrhea case management as a prevention strategy. They said that most health facilities are offering the diarrhea case management services and the community health volunteers have been trained on the same. A male respondent said:

'We trained the CHVs on how to prepare ORS at household level and have already trained the household members who are practicing the intervention. Indeed the CHVs do household visits and encourage the caregivers of children less than five

years who experience diarrhea to increase fluids, practice continuous feeding as well as prepare the ORS'.

Another KII respondent echoed that:

'Majority of the health facilities have ORT (Oral Rehydration Therapy) corners at the maternal child health clinics, where they demonstrate on how to prepare and administer oral rehydration treatments on diarrheal cases especially under five years'.

CHAPTER FIVE

5.0 DISCUSSIONS.

5.1 Introduction

This study identified significant variable that could predispose children under the age of five to diarrhea occurrence. They key factors identified under objective one were; ownership of latrine, presence of flies on latrines and practice of open defecation. Objective two variables included; stunting growth, reduced cognitive development and dehydration. Finally objective three identified variables such as protection of drinking water sources, treatment of water for drinking at household level, food storage methods and rotavirus vaccination status. The salient findings are discussed as follows.

5.2 Ownership of latrine.

At multivariable analysis, latrine ownership had a statistically significant association with the outcome variable. The study revealed that those households which did not own a latrine were at risk of experiencing diarrhea .This is attributed to the fact that when one doesn't own a latrine they are likely to practice open defecation where fecal matter is exposed to the open grounds or environment. The feces are then likely to be washed away during rain runoff and will access water sources thus causing water source contamination. In the event that water for drinking is not subjected to any form of treatment, definitely the household members are prone to diarrhea infections. When they are sick they will seek medical services at health facilities and at this point in time the health systems are subjected to unnecessary pressure of handling the diarrheal cases and this will negatively affect performance of the systems regarding quality of service offered, accessibility and efficiency. Once all these happens then the health systems becomes weak in terms of its functions and goals, hence termed as poor health system. This indicates that not owning a

latrine is a statistically significant risk factor for poor health systems. This finding concurs with a study by Bekele *et al*. (2021), whereby latrine usage was a predictor of diarrhea among under-five children. Lack of latrine may be attributed to economical status of the household, collapsing soil or hard rocks hindering its digging and construction.

5.3 Presence of flies on latrines.

The presence of flies on latrines had a statistically significant association with the outcome variable. The study confirmed that households free of or without flies on their latrines were less likely to experience poor health systems. Flies are very important component in faecal-oral transmission route as they accelerate the transmission of the diarrhea causing agents. They carry pathogens from the latrines, access uncovered foods and deposit the pathogens on the food. When the food is consumed without re-heating to kill the microorganisms then the consumers will have diarrhea infection which will force them to visit health facilities for management or treatment. These treatment and management events will end up straining the health systems, hindering its proper functioning and thus becomes a poor health system in reference to its functionality and goals/outcomes. Contrary if there are no flies on latrines it means no diarrhea infections are likely to occur through the mentioned process but instead the health systems performance will be maintained. This means that absence of flies on latrines is a statistically significant factor for promoting good health system. Concurrence with this is the study of Guillaume DA. e*t al*.(2020) which found out that diarrhea infections had an association with the presence of flies on the latrine floors. Absence in this context implies good cleanliness of the latrines hence absence of smell. The VIP latrine is a good example of latrines that can minimize smell and hence don't attract flies. When the latrines are not hygienically kept they become sources of infections.

5.4 Practice of open defecation.

Open defecation practices had a statistically significant association with the outcome variable. The study revealed that those households with open defecation free (ODF) environment were less likely to experience poor health systems than those who practiced open defecation (OD). Open defecation free environment will not attract flies which are agents of transmission of diarrhea infections. This means household members will not contract the disease and hence will not exert any pressure to the health systems. However if open defecation is practiced it means fecal matter will finally contaminate water sources and drinking the water without treatment will result to diarrheal infection. The sick population will have to visit health facilities for treatment and on the process exert unnecessary pressure on the health system causing it to strain so as to handle extra load thus reducing its efficiency, accessibility and quality of service delivery. This indicates a risk factor emanating from diarrhea due to open diarrhea, which in turn will have an influence on heath systems performance. The findings are in line with Arifin *et al*. (2022) whose findings revealed that practice of open defecation (OD) was one of the environmental factors contributing to diarrhea. This showed that those households with presence of feces had a high chances of having diarrhea than those without feces at their compounds. Practice of open defecation could be attributed to lack of latrine, fear of children to use the latrine due to unfriendly size of the aperture and even distance from the house to the latrine especially when one need to use the latrine at night. All these and many more hindrances lead to open defecation.

5.5 Stunting growth

Stunting growth at multivariable analysis had a statistically significant association with the outcome variable. The study revealed that for every unit increase on stunting growth, result into a more likely experience of poor health system. Stunting growth of children results into various consequences such as poor development, hindrance in capacity to learn, high chances of acquiring

infections among other conditions. All these conditions will require medical interventions from health facilities which will make the facilities to experience unnecessary pressure exerted on them as it handles these conditions. To cope with all these, the system will need extra resources in terms of human capital, time, infrastructures and medical equipments, financial capacity among others. If the extra required resources will not be availed, the system will fail to address the problem effectively and in this context, the system will be referred to as poor health system. This is an indication that indeed stunting growth caused by diarrhea is a risk factor for poor health system. In concurrence are the studies by; Richard *et al* (2021) and William C. *et al* (2019), whose studies revealed that prolonged diarrhea result into stunting growth of children.

5.6 Reducing cognitive development.

Reducing cognitive development had statistically significant with the outcome variable. The study revealed that for every unit decrease in cognitive development was likely to cause poor health system. Poor school performance is associated with poor development of the cognitive abilities and this is indeed a negative consequence of diarrhea which in turn causes poor health systems. This is in concurrence with studies Pinkerton *et al* (2022), which showed that, diarrhea in children, will interfere with cognitive development. Also in agreement is the study by Mark *et al* (2020) whose study showed that long term cognitive deficits are associated with diarrhea. In order to prevent cognitive impairment as an effect of diarrhea, the health system should deal with the root cause such as addressing nutritional related issues. This calls for extra efforts on health systems to deal with it effectively, thus putting more pressure on the health system. The study therefore found poor development in cognitive status as being a statistically significant risk factor for poor health systems.

5.7 Dehydration

The study found out that dehydration had an association with the response variable. Study established that for every increase in dehydration, there was a likely of experiencing poor health systems. Dehydration is mainly caused by diarrheal and entails getting rid of water from the body and this can cause someone to feel thirsty, headaches, lethargy, having dark yellow and strong smelling pee, sunken eyes, dry mouth, lips and tongue among others. Dehydration needs management to reverse the situation i.e rehydrating the body. It involves the intervention of embracing ORS (Oral Rehydration Solutions), continuous feeding as well as increased fluids for mild diarrhea. For severe diarrhea the patient will have to receive intravenous rehydration. All these management and treatment interventions will subject the health system into unanticipated strenuous situation thus interfering with its functions and goals. This is in concurrence with WHO (2023), which indicates that dehydration occurs during episodes of diarrhea as there is loss of water and electrolytes such as chloride, potassium and sodium.

5.8 Sources of drinking water Protection.

The study found protection of the source to have a significant association with the outcome variable. This shows that water obtained from unprotected sources could be a source of diarrheal infections. In agreement is the study by WHO (2023), which highlighted that interventions to prevent diarrhea included safe drinking through protection of water sources. Equally UNICEF (2023) indicated that prevention of diarrhea include the water source protection. The findings showed that water from protected sources are not necessary or always safe for drinking and thus clean water is different from safe water. This shows that when safe water is consumed then it reduces probability of acquiring diarrhea and thus will spare the health systems from pressure associated with treatment services. When sick from diarrhea if contaminated water is consumed, the sick will have to visit the hospital for treatment or management and thus exerting unnecessary

pressure to the health systems. The pressure exerted on the health system will interfere with accessibility of the service as well as service delivery.

5.9 Treatment of water for drinking at household level

The association between the water treatment and outcome variable was significant. This revealed that lack of water treatment at household level is a significant risk factor to diarrheal. This is similar to a study by UNICEF (2023), whereby it was realized that one of the key measures in diarrhea prevention is to perform household water treatment which will improve water quality, thus preventing diarrhea. This reveals that not treating water for drinking at household can be attributed to economical factors or power as well as attitudes, not affording the water treatment chemicals, attitude about the smell/taste of water after treatment, lack of information on the significance and even ignorance. The diarrhea cases out of not treating water for drinking will end up visiting the health facilities for diarrhea treatment and management and thus will put pressure on the functioning of health system.

5.10 Methods of food storage

The study found out an association between the methods of food storage and the response variable. The result indicates that unhygienic food storage such as storing food in uncovered containers were potential sources of diarrheal. In concurrence is the study by PATH (2020),which indicated that proper food storage is an effective intervention in preventing diarrheal diseases. The research findings indicate that there is no discernible impact of engaging in hygiene practices on the prevalence of diarrhea among children. When foods are not covered they are prone to access by flies which will transmit the diarrhea infections. The diarrhea cases will have to visit the health facilities for diarrhea treatment and management and thus put unintended pressure on the system

hindering it from performing its functions and achieving its goals. The system will end up being termed as poor health system.

5.11 Rotavirus vaccination

Rotavirus vaccination status as the main predictor variable had an association which was statistically significant. This is an indication that, full vaccination of children against diarrhea infections was a significant potential protection against diarrheal infection hence a promoter of good health systems. This finding aligns with a study conducted by Asif *et al*. (2022), which revealed inadequate knowledge of women regarding rotavirus vaccination hinders the prevention and management of diarrhea. More so a study by Camille and Miguel (2020) showed that available rotavirus vaccines have demonstrated significant decrease in hospital admissions and mortality. The absence of vaccination against diarrhea can be ascribed to a dearth of awareness regarding the vaccine or insufficient understanding of its benefits, unavailability of the vaccine in stock, limited time to bring children for vaccination, and apprehensions surrounding the safety of the vaccine. The diarrhea cases will have to visit health services and on the process they will put the health system into task of dealing with an extra load and thus exert pressure and affect its performance.

5.12 Study Findings in Relation to the Conceptual Framework

The conceptual framework postulated that there exists a correlation between multiple variables and the performance of health systems in the context of children aged five and below. The study encompasses various variables, namely socio-demographic, socio-economic, and environmental factors. These factors play a crucial role in influencing the outcomes related to growth and development, nutrition, and economics. Additionally, the research also explores preventive measures such as water safety, hygiene practices, sanitation, effective case management, and vaccination strategies. The aforementioned factors have been thoroughly examined and elucidated

in the preceding sections of this study. It is important to acknowledge that there may exist additional factors, not explicitly addressed in the conceptual framework, that could potentially be associated with the occurrence of diarrhea.

5.13 Strengths and Limitations

5.13.1 Strengths of the Study.

The research employed data on diarrhea acquired from the Kenyan Health Information Systems database, a nationally and regionally recognized source of information at the county level. This comprehensive dataset enables the findings to be extrapolated to children under the age of five, enhancing the generalizability of the study. To mitigate bias, the quality of the data was meticulously upheld by employing random sampling strategies. While it is important to note that the data utilized in this study do not pertain to clinical or longitudinal data, the inclusion of cross-sectional surveys proves valuable in evaluating the underlying factors within surveys.

5.13.2 Limitations of the study

The data presented in this study heavily relied upon the caregivers' accounts of the child's health, rather than relying on direct observation or clinical examination. Given the diverse backgrounds of caregivers, it is highly probable that their perceptions of childhood conditions will vary. Consequently, the reports provided by caregivers regarding the health of a child may not exhibit uniformity across different socio-economic cohorts. The presence of these variances has the potential to lead to either an underestimation or an overestimation of child-related data, consequently exerting an impact on the overall findings of the study. The potential presence of recall bias cannot be disregarded, as it is plausible that caregivers may have inadvertently omitted or forgotten details regarding the diarrheal episode during the interview. Nevertheless, the occurrence of diarrhea has frequently been observed and documented in various studies.

Moreover, it is important to note that this particular investigation was specifically carried out on a sample of individuals who were under the age of five. Therefore, caution should be exercised when attempting to apply these findings to children who are older than five years. The data utilized in this study were obtained from a cross-sectional study, providing a momentary glimpse of the population at a specific point in time. Consequently, both the predictor variables and the outcome variable were measured concurrently, posing challenges in accounting for seasonal fluctuations of these variables.

5.12.3 Internal Validity

The process of data collection was carried out by proficient research assistants who had undergone prior training specifically for this purpose. The individuals underwent comprehensive training in the utilization of data collection instruments, with the aim of bolstering their dependability and ultimately augmenting the overall quality of the accumulated data. The utilization of the multivariable analysis technique effectively mitigated the influence of confounding factors, thereby bolstering the internal validity of the study. The findings of this study exhibited a high degree of congruity with previous research, thereby enhancing the level of confidence in the validity of the results. Nevertheless, the soundness of the presented findings hinged upon the respondents' capacity to effectively and accurately provide responses pertaining to the subject matter of diarrhea.

5.13.4 External validity

In the context of Kenya, demographic health surveys employ a standardized data collection tool that can be flexibly adapted to various settings. This study has effectively incorporated pertinent

information, allowing for the potential generalization of its findings to Migori county in Kenya, as well as other regional countries experiencing a high prevalence of diarrhea among children under the age of five. However, it is important to acknowledge the diverse backgrounds of the study respondents in order to ensure a comprehensive understanding of the results.

5.14 Public Health Relevance

The persistent prevalence of diarrhea among children below the age of five in Migori County, Kenya, and Sub-Saharan Africa underscores the substantial impact of this preventable and treatable ailment in the area. The Kenyan government, at both the national and county levels, has implemented various initiatives aimed at enhancing latrine coverage, promoting hygiene awareness, and establishing safe water systems. These efforts have been undertaken with the objective of effectively mitigating the occurrence of diarrheal episodes. The water, sanitation, and hygiene Campaign in Kenya holds a significant position within the strategic plans formulated by both county and national governments. In order to ensure effective collaboration, it is imperative for the pertinent stakeholders, along with their corresponding interventions, to synchronize their strategies with the plans set forth by both the local county and national levels of governance.

The discovery of these findings will greatly contribute to the development of evidence-based strategies aimed at reducing the occurrence of diarrhea among children under the age of five. By doing so, we can effectively mitigate the negative impact of this prevalent disease on the health and well-being of young children in Kenya, particularly in rural regions and areas prone to diarrhea outbreaks. It is crucial to address this issue as diarrhea remains a significant cause of morbidity and mortality among children under the age of five in the country. The achievement of this goal can be facilitated through the establishment of additional fundamental sanitation strategies and the enhancement of awareness regarding proper hygiene and sanitation practices. Specifically,

emphasis should be placed on the significance of handwashing, safeguarding water sources, ensuring food quality control, and expanding the coverage of rotavirus vaccination. The present interventions have exhibited notable advancements, thereby necessitating a need for heightened efforts, expanded reach, and long-term viability. The effective prevention and control of diarrhea necessitates meticulous planning, efficient implementation, and diligent monitoring and evaluation of the interventions.

CHAPTER SIX.

CONCLUSION AND RECOMMENDATIONS.

6. 1 Conclusion.

The increase in diarrhea cases has greatly contributed to exerting pressure on health systems performance. Reducing diarrhea conditions is imperative in maintaining or improving health systems performance. With increase in factors contributing to diarrhea infections and effects of

diarrhea, the affected household members will be compelled to seek treatment or management for diarrheal related conditions, thus causing unnecessary pressure on the health systems performance. On the other hand strengthening prevention strategies will reduce diarrhea cases consequently maintain or improving health systems performance.

Various significant factors, effects and prevention strategies were identified to have influence on the outcome variable. The factors that were found to predict the outcome variables were; latrine ownership, presence of flies on latrine and practice of open defecation. Increased risk of outcome variable was observed among households not owning a latrine, households with flies on their latrines and those who practiced open defecation. All these could result to poor health systems. The effects that were found to influence the outcome variable were; stunting growth, cognitive development impairment and dehydration. These effects had a high risk of impacting the outcome variable. All these could result to poor health systems.

The prevention strategies that were established to be associated with the response variable were protection of water sources, drinking water treatment at household level or point of consumption, methods of food storage and rotavirus vaccination. Protecting water sources, treating water for drinking at point of use, covering stored foods and having rotavirus vaccination were observed to be promoting variables of the outcome variable, thus could result to good health systems.

6.2 Recommendations.

The study results have proved to have critical policy implications for public health intervention with a focus on the factors, effects and prevention strategies that may have a significant impact on reducing diarrheal infections, consequently promoting health systems performance. As a long-term solution, the county should develop a strategic sanitation and hygiene policy which will be a

pathway to minimizing the mortality and morbidity from diarrhea infections. As a result the health systems will not be overburden with events relating to diarrheal.

The county should intensify health educational programs that should concentrate on household based factors influencing diarrhea occurrences. The county should identify the effects relating to diarrhea conditions and effectively address them in specificity. The county to develop prevention and control mechanisms of dealing with diarrhea infections at community level. These should include ensuring quality water supply at household level, hygiene and sanitation promotion and social marketing approaches.

Multisectoral approach should be utilized in providing safe water systems, hygiene and sanitation requirements at community and household levels. These should have relevant sectors such as public health, water, environment and natural resources, social services and development partners among others. The community health strategy should be strengthened through; recruitment of community health promoters and more community health assistants and further equipping them with skills and knowledge on diarrhea prevention and control approaches.

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Appendix i **: Work plan**

TASK	***2017***		***2018***				***2019***				***2020***	
	Q3	***Q4***	***Q1***	***Q2***	***Q3***	***Q4***	***Q1***	***Q2***	***Q3***	***Q4***	***Q1***	***Q2***
Selection of Research topic												
Approval of research topic												
Concept writing												

Concept approval												
Proposal writing												
Literature Review												
Proposal Defence												
Correction of proposal												
Recruitment and training of research assistants												
Pretesting of tools (Piloting)												
Tools review												
Data collection												
Data analysis and interpretation												
Report writing												
Submission of first draft for review by supervisor												
Professional language control and editing												
Dissemination of research findings and publications												

Appendix ii: Informed consent:

Influence of diarrhea conditions on healthcare systems among children under five years in Migori County.

Jaramogi Oginga Odinga University of Science and Technology
School of Health Sciences

Greetings, My name is ……...…..I am a resident of Migori County and in this exercise I am a research assistant. During the past there have been reported cases of diarrhea in this area. We are conducting a study to get household information on the influence of diarrhea conditions onhealthcare systems among children under five years in Migori County, Kenya. The information that you and other participants will provide will enable the concerned authority to design and implement interventions to reduce diarrhea cases in the area.

We have selected your household randomly to participate in the study. If you agree to participate it will take less than one hour. Your participation is voluntary and there is neither a penalty for refusing to participate nor potential risks for participating in this study. The information you will provide will be treated with utmost confidentiality and your name will not appear anywhere in the study report. Furthermore your responses cannot be tracked back to you because they will be combined as a block with the responses of others to establish common trends.

Do you have any question about the study? Would you like to participate? (If yes, ask the participant to sign or put their thumb print below)

Signature (respondent)…….....…...…Or thumb print if unable to sign…….……...

(If respondent has refused to participate, thank him or her for their time and leave the household.)

Thank you for accepting to participate in this study.

Appendix iii: Household questionnaire

QUESTIONNAIRE NUMBER: | | | |

Date _____**Time**_____

Name of respondent (Optional)_____

Name of research assistant_____

Instructions:

Tick/put X on the response box for each question where applicable.

Part I: FACTORS INFLUENCING DIARHEA

A. Socio-demographic factors.

1. Which is the sex of the child?

☐ Male

☐ Female

2. What is the age of the child in months?

☐ 0-11 months

☐ 12-23 months

☐ 24-35 months

☐ 36- 47 months

☐ 48-59 months

3. (a)What is your age in years?

☐ <19 years

☐ 19-29 years

☐ 29-39 years

☐ 40 - 49 years

☐ >49 years

(b) State sex of the caretaker

☐ Male

☐ Female

4. What is your current marital status?

- ☐ Married
- ☐ Single
- ☐ Others (specify).....

5. What is your relationship with the child?

- ☐ Mother
- ☐ Father
- ☐ Caregiver
- ☐ Others (specify).....

6. What is your highest level of education completed?

- ☐ No formal education
- ☐ Primary education
- ☐ Secondary education
- ☐ Tertiary institution education
- ☐ Others (specify).....

7. What is your religion?

- ☐ Christian
- ☐ Muslim
- ☐ Others (specify).....

8. Which is your area of residence?

- ☐ Urban
- ☐ Rural

9. Which is your main occupation?

☐ House wife/husband.

☐ Privately employed.

☐ Government employed.

☐ NGO employed.

☐ Others (specify).....

B. Environmental factors.

10. Do you own a functional Pit latrine? (Observe)

☐ Yes

☐ No

Note: If No to Question 10, move to Question 15.

11. If Yes to **Question10**, what is the type of ownership?

☐ Private

☐ Shared

12. If Yes to **Question10**, which is the type of latrine owned? (Verify)

☐ Traditional pit latrine.

☐ VIP latrine.

☐ Pour flush

☐ Others

13.If Yes to **Question10,** are there flies in or around the latrine?

☐

Yes

No

14. If Yes to **Question 10**, are there feces around or on the floor of latrine (observe)

Yes

No

15.If NO to **Question10**, what is alternative do you use for defecation?

Use the neighbour's latrine

Use bushes near the house

Use cat system

Others (specify).....

16. Are there feces around the house/within the compound? (Observe)

Yes

No

17. Is the hand washing facility available at the household?

Yes

No

18. Which is the common method do you use for refuse disposal at the household level?

Compost/Refuse pit

Open field

Burning

Burying

☐ Others (specify).....

Water systems.

19. Which is the main source of drinking water for this household?

☐ Rain catchment

☐ Piped system

☐ Spring

☐ Shallow well

☐ Borehole

☐ River

☐ Lake

☐ Others (specify).....

20. Is the main source of water protected?

☐ Yes

☐ No

21. How long do you normally take to obtain water from the main source?

☐ <30 Minutes

☐ >30 Minutes

22. What is the approximate distance to the main water source?

☐ < 0.5 KM

☐ 0.5-1.0 KM

☐ >1.0 KM

23. What is the status of water supply from the source throughout the year?

☐ Intermitted

☐ Continuous

D. Economic factors.

24. What is the main source of income for this household?

☐ Earned income (Wages and salaries)

☐ Self-employed

☐ Farming.

☐ Others (specify) _____

25. What is the range of household head monthly income (Kenya Shillings?)

☐ < 10,000

☐ 10,000 –19,000

☐ 20,000 – 29,000

☐ 30,000 – 39,000

☐ 40,000 – 49,000

☐ >50,000

26. Based on the variables below what is the wealth index for the household?

**Does the household own the following items?*

1. Yes
0. No

	Asset	**Score**
1	Radio	
2	TV	
3	Refrigerator	
4	Car	
5	Mobile phone	
6	Motorbike	
7	Livestock	
8	Bicycle	

9	Sewing machine	

☐ Poorer

☐ Poor

☐ Middle

☐ Rich

☐ Richer

Part II: EFFECTS OF DIARRHEA

27. The following statements are descriptive of effects of diarrhea conditions as determined by opinions, attitudes and practice. The statements are based on a scale of 1-5 {1(Strongly Disagree), 2(Disagree), 3(Neutral), 4(Agree), 5(Strongly Agree)}.Please indicate by ticking or putting an "X" in the table below. Do what extent do you agree or disagree on the following statements on effects caused by diarrhea infections?

Q.	STATEMENT	SD	D	N	A	SA
1	Increased diarrhea conditions significantly causes stunted growth					
2	Increased diarrhea conditions significantly reduces cognitive development					
3	Increased diarrhea conditions significantly causes severe wasting					
4	Increased diarrhea conditions significantly causes dehydration					
5	Increased diarrhea conditions significantly causes financial losses					
6	Increased diarrhea conditions significantly cause productivity losses					

Part III. PREVENTION STRATEGIES.

a) Improving sanitation and hygiene.

28. What type of container do you use to collect/fetch water from the main source?

☐ Covered container

☐ Uncovered container

29. Do you use a separate container for storing drinking water?

☐ Yes

☐ No

30.If Yes to **No.** 29above, what type of container do you use for storing drinking water?(verify)

☐ Container with a wide mouth, a tap and a lid

☐ Container with a wide mouth, a tap and no lid

☐ Container with a wide mouth, a lid and no tap

☐ Container with a wide mouth, no lid and no tap

☐ Container with narrow neck, a tap and lid

☐ Container with narrow neck, a tap and no lid

☐ Others (specify)

31. Do you treat water for drinking at the Point Of Use (POU)? (HH level).

☐ Yes

☐ No

32. If yes to **No**. 31, which methods of water treatment at Point Of Use do you practice? (Tick all applicable)

S/No	Method	Tick all applicable
1	Boiling	
2	Filtration	
3	SODIS (Solar Disinfection)	
4	Use of chemicals (water guard, aqua tab, PUR etc)	
5	Sedimentation	
6	Others (specify)	

33. Do you use a separate container for drawing drinking water?

☐ Yes

☐ No

34. How do you dispose of infant feces? (method of disposal of infant feces)

- ☐ Collecting and taking to pit latrine
- ☐ Burying
- ☐ Giving to pets (dogs etc)
- ☐ Leaving it to dry and washed a way
- ☐ Others (Specify).....

34. What type of hand washing do you practice?

- ☐ Water in a container without soap
- ☐ Water in a container with soap
- ☐ Running water without soap
- ☐ Running water with soap
- ☐ Others (specify).....

35. How do you store food for the child? (method s of food storage)

- 1 Covered container
- 2 Uncovered container
- 3 Refrigerator
- 4 Others (specify) .....

36. Do you re-heat the stored food before feeding the child?

- 1 Yes
- 2 No

Case management

37. Which common approach of diarrhea management do you apply?

	Diarrhea management approach	**Yes**
	Continuous feeding	

	Increased fluids.	
	Oral Rehydration Solution	

Vaccination.

38. Has the child received Rotavirus vaccination? (Confirm doses at 2, 4, 6 months)

1	Yes
2	No

Health systems performance.

39. In a scale of 1 to 3 points, how can you rate the following structures and processes during your visit to the health facility for treatment of your child during diarrheal infection? Whereby (1= Not so good, 2 = So-so and 3 = Good).Tick as appropriate.

S/No.	**Sub-discipline (accessibility, efficiency and quality)**	**Score**		
	Item	**1**	**2**	**3**
1	Access to care without any hindrances			
2	Facilities for service delivery within the health facility			
3	Human resources adequacy and availability			
4	Health insurance services offered at the facility			
5	Management or treatment of the diarrheal infection			
6	Treatment plan provision to the patient			
7	Patient centered services provision			
8	Timeliness of services offered to the patient			
9	Equipments available for treatment and diagnosis			

Appendix v : Focus group discussion guide

DIARHEA CONDITIONS AMONG CHILDREN UNDER FIVE YEARS ON HEALTH SYSTEMS PERFORMANCE IN MIGORI COUNTY- KENYA

DATE: _____ LOCATION: _____

Name of Focus Group: _____

Stanley Nyamato Aranda is a student at Jaramogi Onginga Odinga University of Science and Technology, School of Health Sciences pursuing Doctor of Philosophy in Public Health.

The aim of the Focus Group Discussion is to get the insight on the diarrhea conditions and health systems performance among the children under five years in Migori County. The findings from this study will be shared with caregivers, health workers, policy makers and other stakeholders to facilitate designing, implementing, strengthening and evaluation of Health intervention that will focus on reducing the morbidity and mortality associated with diarrhea. Your participation in this discussion is voluntary and any responses given to the questions will be treated with confidentiality. You are free to raise any concern or clarification as pertains to this discussion at any point of discussion.

Discussion Questions.

1. What are the factors causing diarrhea in the county?
2. What are the effects of diarrhea conditions in regards to health care systems?
3. How is the management of diarrhea cases in this area?
4. What are roles of the community in prevention and control of diarrhea in the county?
5. What are some of the challenges encountered during diarrhea events?
6. How is the household water treatment done in this county?
7. How is the waste management done at the household level?
8. Do you have any issues on diarrhea you want to share?

Thank you for your participation.

Appendix iv : KEY INFORMANT INTERVIEW GUIDE.

Diarrhea conditions among children under five years on health systems performance in Migori county- Kenya.

Stanley Nyamato Aranda is a student at Jaramogi Onginga Odinga University of Science and Technology, School of Health Sciences pursuing Doctor of Philosophy in Public Health.

The aim of this INTERVIEW is to get the insight on the diarrhea conditions and health systems in Migori County. Your participation in this discussion is voluntary and any responses given to the questions will be treated with confidentiality. You are free to raise any concern or clarification as pertains to this interview at any point of discussion.

GUIDING QUESTIONS.

1. what is your role as regards to diarrhea prevention in the county.
2. What is the general situation of diarrhea in the county?
3. What is your view as regards to burden of diarrhea conditions in regards to health care systems?
4. Are there diarrheal management challenges encountered in the county?
5. What are roles of the community in prevention and control of diarrhea in the county?
6. What are some of the challenges encountered during diarrhea events?
7. How is the household water treatment done in this county?
8. what is the vaccination status in this county?
9. Do you have any experience or lesson on diarrhea you want to share?

Thank you for your participation.