COLLEGE OF MEDICINE AND HEALTH SCIENCES

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ENVIRONMENTAL HEALTH AND SOCIO-DEMOGRAPHIC RISK FACTORS FOR DIARRHEAL DISEASE AMONG UNDER-FIVE CHILDREN IN RWANDA: SECONDARY DATA ANALYSIS OF THE RWANDA DEMOGRAPHIC AND HEALTH SURVEY 2014-15

A dissertation submitted in partial fulfillment of the requirements for the degree of

MASTER IN PUBLIC HEALTH

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ABSTRACT

Background

Diarrhea is a worldwide public health issue as it is among the first top ten leading causes of global mortality and morbidity. Globally, it accounts for one in nine deaths in children under five years killing 2195 children every day worldwide making diarrhea the second leading cause of death in children under five years. Low and middle income countries of Africa and part of Asia are more affected by diarrheal diseases. However, effective practice of hygiene measures accompanied by provision of water and sanitation can reduce the burden caused by diarrheal diseases. These risk factors vary from one community to another. The present study was to ascertain the prevalence pattern of diarrhea in line of environmental health risk factors contributing to diarrhea disease.

Methods

A cross-sectional study was conducted by the Demographic and Health Survey in 2015 (n= 7,856) in Rwanda. Diarrhea prevalence rate and environmental health risk factors from this survey were analyzed using the STATA version 13.0. For the statistical analysis univariate was performed for all variables, the dependent variable and independent variables. On bivariate analysis, cross tabulations between the dependent variable and risk factors variables were used to interpret the p-value to see if the relationship was statistically significant. Chi-square test was used to assess whether there was statistical significance between the categorical variables associated with the outcome variable. Approval to access the database was thought and secured through online registration.

Results

The study revealed that prevalence of diarrhea in Rwanda is 12.25%. The factors associated with diarrhea among under-five children were found to be child's age (p-value<0.001), mothers' education level (p-value<0.003), place of residence (p-value=0.048), wealth index (p-value=0.001), drinking water source (p-value<0.001), type of sanitation facility (p-value=0.021), frequency of washing water containers (p-value=0.01) and handwashing (p-value=0.043).

Conclusion

Findings from this study have shown that women need to be encouraged to get formal education to help them understand the importance of health promotion and disease prevention.

This requires also supply of improved water and sanitation to households in order to reduce diarrhea prevalence and achieve SDGs targets especially end of poverty for all, ensure health and well-being for all at all ages, ensure available and sustainable management of water and sanitation for all.
Key words: Diarrhea disease, environmental health risk factors, under five years' children

DECLARATION

I Alphonsine MUKAMUNANA, do hereby declare that this proposal entitled "Environmental health risk factors for diarrheal disease among under-five children in Rwanda: secondary data analysis Rwanda Demographic and Health Survey 2014-15" submitted in partial fulfillment of the requirements for masters of public health at the UR/CMHS/School of Public is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided indicating all the sources of information quoted or cited.

DEDICATION

I dedicate this work to almighty God, my husband and children “IMENA Terry Landry and ISHEJA Harry Melvyn”, my sister and my Colleagues at school and relatives for their support and encouragement throughout my studies. I cannot also forget other people like my supervisor who greatly took part in the accomplishment of this work.

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ABBREVIATIONS AND ACRONYMS

AIDS: Acquired Immune Deficiency Syndrome

DALYs: Disability-Adjusted Life Years

ETEC: Entero-Toxigenic Escherichia Coli

HIV: Human Immunodeficiency Virus

IMCI: Integrated Management Childhood Illness

LMICs: Low Middle Income Countries

MDG: Millennium Development Goal

NISR: National Institute of Statistics of Rwanda

ORS: Oral Rehydration Salts

ORT: Oral rehydration therapy

RDHS: Rwanda Demographic and Health Survey

SDGs: Sustainable Development Goals

SSA: Sub-Saharan Africa

UNICEF: United Nations for Children Funds

USAID: United States Agency for International Development

WASH: Water Sanitation and Hygiene

WHO: World Health Organization

LIST OF TABLES

Table 4.1: Socio-demographic characteristics of survey participants 18
Table 4.2: Prevalence of diarrhea in two weeks preceding the survey 20
Table 4.3: Bivariate analysis on diarrhea and demographic characteristics 21
Table 4.4: Bivariate analysis: Diarrhea among under-five year's children and environmental health factors 23
Table 4.5: Multivariate analysis for Diarrhea among under-five year's children and different sociodemographic and environmental health factors 26

LIST OF FIGURES

Figure 2 1: Linkage between environmental factors and diarrhea(25) 8
Figure 2 2: The F-diagram below showing the major transmission of faecal-oral diseases(11) 10
Figure 2 3: Diarrhea conceptual framework 12

TABLE OF CONTENTS

ABSTRACT i

ACKNOWLEDGEMENT v

TABLE OF CONTENTS ix

CHAPTER ONE: INTRODUCTION 1

1.1 Definition of the key terms 1

1.2 Background 1

1.3 Problem statement 3

1.4 Research objectives 4

1.4.1 General objective 4

1.4.2 Specific objectives 4

1.5 Significance of the study 4

CHAPTER TWO: LITERATURE REVIEW 5

2.1 Theoretical literature 5

2.1.1 Burden of diarrhea in under five years worldwide 5

2.1.2 Causes and risk factors associated with diarrhea among under five years 6

2.2 Empirical literature 7

2.2.1 Global effects of under five children diarrhea on economic development 7

2.2.2 Barriers associated with diarrhea prevention in under five children 7

2.2.3 Critical review and research gap identification 7

2.2.4 Common causes of diarrheal diseases 8

2.2.5 Transmission of diarrheal diseases 10

2.2.7 Risk factors for diarrhea diseases 11

CHAPTER THREE: RESEARCH METHODS 15

3.1 Study Design 15

3.2 Study setting 15

3.3 Study population 15

3.3.1 Inclusion and exclusion criteria 15
3.5 Variables 16
3.6 Data collection instruments 17
3.7 Data Analysis Method 17
CHAPTER FOUR: RESULTS 18
4.2 Prevalence of diarrhea in two weeks preceding the survey 20
4.3 Bivariate analysis for diarrhea and household characteristics 20
4.4 Bivariate analysis: Diarrhea among under-five year's children and environmental health factors 23
4.5 Multivariate analysis for Diarrhea among under-five year's children and different sociodemographic and environmental health factors 24
CHAPTER FIVE: DISCUSSION 29
5.1 Prevalence of diarrhea disease among under five year's children 29
5.2 Environmental health factors associated with diarrhea prevalence among under five years children 29
6. CONCLUSION AND RECOMMENDATIONS 33
6.1 Conclusion 33
6.2 Recommendations 34
REFERENCES 35

CHAPTER ONE: INTRODUCTION

1.1 Definition of the key terms

Diarrhea: Is defined as the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual).It is an increase in the frequency of bowel movements, an increase in the looseness of stool or both(1).

Environmental risk factors: Includes; types of water source, distance to water source and access to improved water sources, refuse disposal, livestock in house, availability of toilet facilities, type of latrine and ownership of latrine(2).

Risk factors: Conditions or variables associated with a lower likelihood of positive outcomes and a higher likelihood of negative or socially undesirable outcomes. In this study, risk factors cover environmental factors that are likely to contribute to the occurrence of diarrheic diseases among under five years children(3).

Under five Children mortality: According to United Nations for Children Funds(UNICEF), it is a probability of dying between birth and exactly five years of age expressed per 1,000 live births (4).

Prevalence: Refers to the total number of individuals in a population who have a disease or health condition at a specific period of time, usually expressed as percentage of the population.

1.2 Background

Globally, diarrhea remains a major public health threat and it occurs in all age groups. Approximately 3 billion people globally are infected with helminths (5)**.** It accounts for one in nine deaths in children under five years killing 2195 children every day worldwide making diarrhea the second leading cause of death in children under five years(6). According to the 2015 report of World Health Organization(WHO), there are about 2 billion cases of diarrheal disease worldwide every year, and 1.9 million children younger than five years of age die from diarrhea each year, mostly in developing countries (7).

Though preventable, diarrheal diseases are among the deadliest diseases worldwide, causing substantial morbidity and mortality, especially among children under five years old. Diarrheal diseases accounts for 760,000 deaths each year (8). Over 70% of deaths among children aged 2 years or younger are caused by diarrhea. Almost one third of the causes of severe diarrhea, such as rotavirus and cholera are vaccine preventable. Millennium Development Goal (MDG)

4 was to reduce the mortality rate among under-five children by two thirds between 1990 and 2015. Although significant progress was made, the goal was not achieved in 2015; thus, more

Work needs to be done to achieve this goal. Applications of evidence-based interventions are successful in preventing and treating diarrheal diseases, thereby reducing morbidity and preventing at least 22% of diarrhea-related deaths(9).

Studies from various literatures have identified risk factors for diarrhea. Diarrheal diseases are related to poverty, household condition, lack of proper sanitation, lack of proper waste disposal, and lack of safe drinking water. Poor access to water, inadequate sanitation and poor hygiene are important determinants of childhood diarrhea in sub-Saharan African countries (10). The types of water point source and of sanitation facility used also impact diarrhea risk , lack of improved sanitation facilities and access to clean water have been shown to increase the risk of diarrheal morbidity. Sharing of sanitation facility with at least one other household can increase the risk of diarrhea. Poor economic status, food insecurity, improper handwashing, and inadequate water storage practices also increase risk for diarrhea. Rainy season increases the incidence of diarrhea. During both the rainy season and the dry season, rotavirus has been postulated as the principal cause of childhood diarrhea (11). Moreover, the ease of access to a water point source plays an important role in diarrhea risk. Where rain water is a major water source and is absent for at least a fortnight during the rainy season, a round-trip water fetching time of greater than 30 minutes has been associated with moderate to severe diarrhea.

Maternal age, education, and working status of mothers are also risk factors for diarrheal disease. Age of mothers in their first pregnancy plays a significant role in infant mortality. First-born children of females less than 27 years of age have been reported to have higher risk of diarrhea and other health problems. In developing countries, increasing the age of mothers at first birth may increase child health and outcomes (12).

Socio-economic conditions influence diarrhea incidence. Mothers' self-efficacy for the prevention of childhood diarrhea increases with socio-economic status. The mother's education level is highly associated with lower incidence of diarrhea. Maternal knowledge of safe source of drinking water can effectively decrease diarrhea. Further, maternal literacy is strongly related to child health. Breastfeeding is an important protective factor for diarrhea. Exclusive breastfeeding, particularly when initiated early, has been shown to be a protective tool in preventing childhood diarrhea mortality. The child's age, sex, weight and nutrition status are significant risk factors for childhood diarrhea. Households with two or more siblings or more than one child less than five years old encounter higher rates of diarrhea.

Improving infant feeding practices by an integrated multi-agency partnership in sub-Saharan countries can improve childhood diarrhea mortality as well as health outcomes(13).

In Rwanda diarrhea is a big concern like in the other part of the world when it is on the third place of the leading cause of deaths in under five children where accounts around 15% of all deaths in this age category compared to the world classification where is on the second leading cause of deaths in under five children(14) . Findings from Demographic and Health Survey 2010 show that the prevalence of diarrhea in that year was 13% and 14% in urban and rural areas respectively whereas only 10% of households have a place for hand washing. Among those households, one in five (21%) has water and soap for hand washing. In the same survey, the high prevalence of diarrhea was in children aged 12-33 and 6-11 months was 25 % and 22% respectively (15).

Therefore, it was worth conducting the study aimed at assessing environmental health risk factors for diarrhea among under-five children in Rwanda using secondary data analysis from RDHS-2014-15. The risk factors were evaluated to determine level of impact on diarrhea morbidity and assess for consistency in impact of the risk factor across the country.

1.3 Problem statement

Worldwide, diarrhea disease in under five children is second leading cause of deaths following pneumonia which make it most dangerous than other known severe diseases like HIV/AIDS, and is most commonly caused by contaminated/unsafe water and food, poor sanitation and hygiene (12). Diarrhea challenges make everyone vulnerable around all countries and more effort and new measures should be established and implemented to decrease its incidence. Unsafe water and hands are two of the primary ways diarrheal disease is spread. Hand-washing with soap, the safe disposal of human and animal waste, and safe drinking water all help to prevent diarrheal disease (13).

In developing countries diarrhea has become most prevalent than in developed world especially is Sub-Saharan Africa (SSA), where there is insufficient safe water, inappropriate disposal of human and animal wastes, intense crowding of rudimentary houses, and poor overall standards of hygiene. As results to such improper condition under five children suffer most due to decreased immunity and become at higher risk of developing diarrhea (14). Reducing its incidence, the common pathways of transmission for diarrhea-causing pathogens, including an improved water Source, sanitation, and hygiene are regarded as the most cost-effective measures for tackling this life-threatening disease worldwide especially in developing countries including Africa (15).

In Rwanda, despite the increased water and sanitation access levels, important associated diseases such as diarrhea remain highly prevalent (16). In Rwanda, the prevalence of diarrhea remains high by comparing Rwanda Demographic Health Survey of 2010 and the one of 2015, the prevalence of diarrhea reduced only from 12% to 10% respectively (17). This study revealed environmental health factors associated with diarrheal diseases in Rwanda.

1.4 Research objectives

1.4.1 General objective

To determine the environmental health risk factors for diarrheal disease prevalence among under 5 year's children in Rwanda.

1.4.2 Specific objectives

1. To determine the diarrhea prevalence among under five years' children in Rwanda.
2. To identify the environmental health and socio-demographic risk factors contributing to diarrhea prevalence among under five years children in Rwanda.

1.5 Significance of the study

For effective prevention of diarrhea diseases, it is necessary to understand risk factors and pathogens. The available literature emphasizes the biological causes and behavioral aspect of but environmental factors in many cases overlooked. This study focuses on environmental risk factors; especially the access to water and sanitation as well as on practices of hygiene as part of the preventive measures that break down the faecal-oral transmission of the diarrheal diseases among children under five years old. The results of this study contribute to the scanty body of knowledge on independent risk factors associated with diarrheic diseases among children under five years in Rwanda.

The study informs the decision makers on the type of water and sanitation that people have access to and inform on methods used to treat drinking water. This can help in developing a community intervention to address environmental risk factors for diarrheal diseases reduction On the other hand the decision makers are aware of the prevalence of diarrheal disease among under five years children. Lastly, the results from the study establish the baseline information that can be used for further researches.

CHAPTER TWO: LITERATURE REVIEW

2.1 Theoretical literature

2.1.1 Burden of diarrhea in under five years worldwide

Globally the burden of diarrhea in under five children estimated the inadequate impact of WASH which is counted around 58% of all diarrhea deaths. This is attributed to a number of factors including the fall in global diarrheal deaths from 2.2 million in 2000 to 1.5 million in 2012 and the use of a far more conservative counterfactual, which retains a significant risk of diarrheal illness.842 000 deaths in LMICs are caused by inadequate WASH, representing 58% of total diarrheal deaths, and 1.5% of the total disease burden (16). Separated out by individual risk factor, 502 000 deaths can be attributed to unsafe and insufficient drinking-water, 280 000 deaths result from inadequate sanitation, and another 297 000 are due to inadequate hand washing. Because some people are exposed to multiple risk factors, the sum of deaths attributable to individual risk factors is different from when the risk factors are considered together. Diarrheal deaths among children under-five have more than halved from 1.5 million in 1990 to 622 000 in 2012. Inadequate WASH accounts for 361 000 of these deaths, or over 1000 child deaths per day (17).

Currently, sub-Saharan Africa and Southeast Asia experience the highest burden of diarrhea-related diseases, with nearly 83% of deaths from diarrhea occurring in just fifteen countries. Despite falling diarrhea- related mortality in most of these countries, some areas are still experiencing a growing number of deaths each year, including Afghanistan, Burkina Faso, Democratic Republic of Congo, Cameroon, Chad and Mali (18).Although diarrhea is a preventable disease, it remains the second leading cause of death following pneumonia among children aged under five years worldwide. It is estimated that in 2010, diarrheal diseases accounted for 60.1 million disability-adjusted life years (DALYs) and for 666 000 deaths among children aged under five years - down from 70.6 million DALYs and 782 000 deaths in 2005 (19).

Approximately 19% of total child deaths globally are attributed to diarrheal disease, which affects about 1.87 million children under the age of five. Diarrhea is largely prevalent in developing countries, such as those in sub-Saharan Africa, where there is a lack of safe water, improper means of human fecal waste disposal, intense crowding of rudimentary houses, and poor overall standards of hygiene. As a result of these poor living conditions, young children under the age of five are at a higher risk of being exposed to pathogens that cause diarrhea, which then contributes to a considerable burden of disease within the population(20).

2.1.2 Causes and risk factors associated with diarrhea among under five years

Diarrhea causes

Diarrheal disease is caused by ingestion of pathogens, principally through faecal-oral pathways. Diarrheal diseases are caused by a variety of pathogens including viruses (for example, rotavirus), bacteria (cholera, Shigella and enterotoxigenic Escherichia coli (ETEC)) and protozoa (Cryptosporidium and Entamoeba histolytica)(21).

Diarrhea risk factors

Insufficient access to adequate hygiene, sanitation, and clean drinking water are the major risk factors for the heavy burden of diarrheal diseases in developing countries. Intrinsic properties of organisms that promote transmission include a low infectious dose, which enables person-to-person spread usually by the fecal-oral route without a food or water vehicle (eg, norovirus, Shigella, and Cryptosporidium)properties that promote transmission are bioavailability as conferred by a high level and/or prolonged fecal shedding, extended infectivity in the environment, and/or a large environmental or animal reservoir (eg, Cryptosporidium, Giardia, Campylobacter, S typhi), resistance to disinfection (eg, norovirus and Cryptosporidium), and the ability to circumvent immune surveillance (eg, the frequent antigenic changes of norovirus resulting from recombination events). Organisms with higher infectious dose (eg, ETEC, V cholerae, S typhi, NTS) generally require a contaminated food or water vehicle. Exposure to animals or animal products may be important in some settings. The more complex the pathogenesis, the longer the incubation period(11).

In USA the risk factors for diarrheal diseases include childhood underweight, suboptimal breastfeeding, unsafe drinking water and sanitation, vitamin A deficiency, and zinc deficiency(12).In studies conducted here in Rwanda on risk factors associated with diarrhea disease, there found that Children whose mothers/caretakers had never attended school were at higher risk of developing diarrhea, Children who had not vaccinated for Rota virus were about 8 times more likely to develop diarrheal diseases than those vaccinated, Mothers/caretakers who reported presence of feaces around their houses had 2 times more children with diarrheal diseases compared to those reported otherwise; Children living in earthen floor houses had 1.7 times more risk of diarrhea, which comes to be summarized as unsafe water ,bag hygiene and sanitation condition and level of awareness on the disease conditions were all of them the main risk factors to diarrhea disease(13).

2.2 Empirical literature

2.2.1 Global effects of under five children diarrhea on economic development

Diarrhea does not spear anyone, its affect rich and poor both in developed and developing countries even though there is a strong relationship between poverty, an unhygienic environment, and the number and severity of diarrheal episodes especially for children under five. Poverty is associated with poor housing, crowding, dirt floors, lack of access to sufficient clean water or to sanitary disposal of fecal waste, cohabitation with domestic animals that may carry human pathogens, and a lack of refrigerated storage for food all of which increase the frequency of diarrhea(16).The impact is exacerbated by the lack of adequate, available, and affordable medical care. Thus, the young suffer from an apparently never ending sequence of infections, rarely receive appropriate preventive care, and too often encounter the health care system when they are already severely ill. Ironically, the poor spend considerable amounts on inappropriate care and useless drugs purchased from local shops and untrained practitioners. If antibiotics are properly pre- scribed, poverty often limits the purchase of a full course of treatment or leads to cessation of treatment as soon as symptoms improve, even though the infection has not been cured(20). Diarrhea is one of the principal causes of morbidity and mortality among children in the world, unfortunately most of the studies conducted do not specify the financial expenses spent on diarrhea prevention and management as they specify mortality and morbidity rates(21).

2.2.2 Barriers associated with diarrhea prevention in under five children

Some of the barriers were listed to affect negatively the prevention of diarrhea disease in under five year's old children; lack of access to safe drinking-water, poor sanitation, poverty, not exclusively breastfed the child for the first six months, poor personal and food hygiene, lack/inadequate health education about how infections spread (22).

2.2.3 Critical review and research gap identification

Among all reviewed articles the burden of diarrhea among under five years old children is a global concern as it affects all countries from developed to developing world. Its reduction is still a challenging issues as some countries are still under poverty line and some other do not put more effort in fighting its severity even though many of the under five children are still dying from the disease water, sanitation and hygiene have a significant effect on its prevention and reduction even though some countries are still have some gaps in providing

Safe water to the populations, ensure proper sanitation and good hygienic condition. Therefore this study will establish factors which may be associated with the above component in contribution of reducing diarrhea disease among under five children as form the published papers are not clearly listed, and some recommendation will be provided for appropriate implementation(23).

Linkage between environmental factors and diarrhea

Understand and addressing* environmental factors *and addressing the linkage between* environmental factors *and diarrhea is critical to reduction of malnutrition

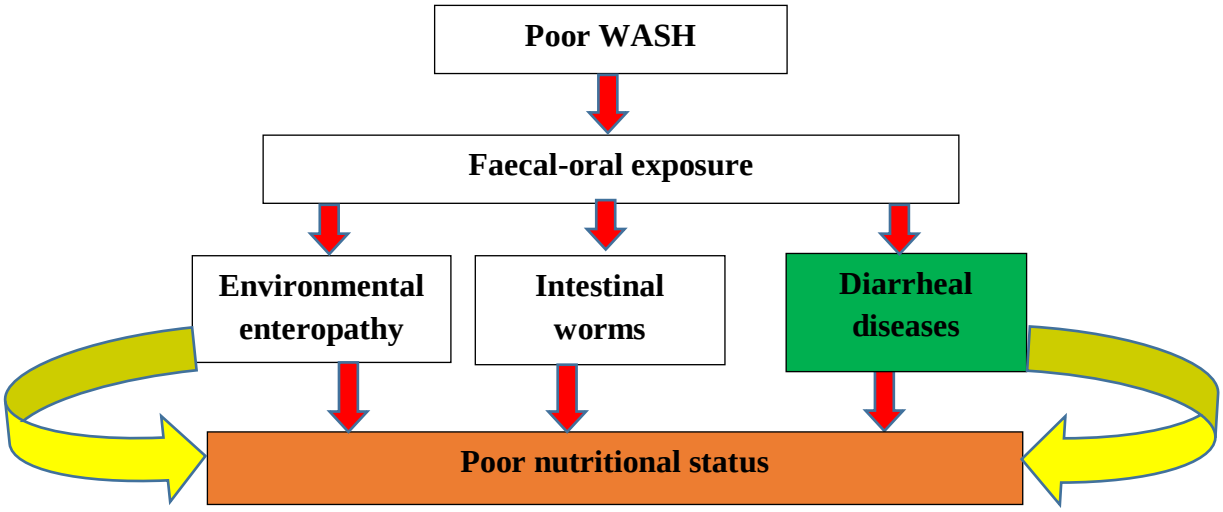

Figure 2 1: Linkage between environmental factors and diarrhea(25)

2.2.4 Common causes of diarrheal diseases

Diarrhea is usually a symptom of an infection in the intestinal tract, which can be caused by a variety of causative agents(26). It can be caused by bacteria, viruses, parasites and others.

Common causes of diarrhea-bacteria

Bacteria which are commonly to cause diarrhea diseases include: Vibrio cholera, Shigella, Escherichia coli, Salmonella, Campylobacter jejuni, Yersinia enterocolitica, Staphylococcus, Vibrio parahemolyticus, and Clostridium difficile. The major serotypes of Shigella which are causing diarrhea are: Dysenteriae type 1 or Shigella shiga, Shigella flexneri, Shigella sonnei and Shigella boydii. And six major types of Escherichia coli which are causing diarrhea are Enterotoxigenic E. coli (ETEC), Enteroinvasive E. coli (EIEC), Enteropathogenic E. coli

(EPEC), Enterohemorrhagic E. coli (E. coli O157:H7), Enteroaggregative E. coli (EAggEC), and Diffuse Adherent E. coli (DAEC)(27).

Common causes of diarrhea- viruses

Common viruses to cause diarrhea include Rotavirus, Adenoviruses, Caliciviruses, Astroviruses, Norwalk agents and Norwalk-like viruses.

Common causes of diarrhea- parasites

Parasites which are commonly causing diarrhea are Entameba histolytica, Giardia lamblia, Cryptosporidium, and Isospora (28).

Other common causes of diarrhea

Diarrheal diseases can also be caused by one or more of the following:

- **Infection:** Diarrhea is a symptom of infections caused by a host of bacterial, viral and parasitic organisms, most of which are spread by faeces-contaminated water. Also this infection can be resulting from poor sanitation and improper hygiene. Rotavirus and Escherichia coli, are two most common etiological agents of moderate to severe diarrhea in low income countries.
- **Food intolerance:** from milk and dairy products, over eating, and consuming too many different foods.
- **Malnutrition:** children who die from diarrhea often suffer from underlying malnutrition, which makes them more vulnerable to diarrhea. Diarrhea is a leading cause of malnutrition in children under 5 years old.
- **Medication:** side effects from conventional medication.
- **From chronic illnesses:** these include Irritable Bowel Syndrome, Inflammatory Bowel Disease including, chronic pancreatitis, celiac disease, colon cancers and certain tumors of the small intestines.
- **Incomplete digestion of food:** eating meal upon meal can result in undigested food remaining in the gastrointestinal tract.
- **Source:** some sources can cause diarrhea like water contaminated with human faeces, for example, from sewage, septic tanks and latrines is of particular concern. Animal faeces also contain microorganisms that can cause diarrhea.
- **Consumption of food sold by street vendors:** this factor can be a significant risk factor of diarrhea. Tourists visiting foreign countries with warm climates and poor sanitation
-

- can acquire diarrhea by eating contaminated foods such as fruits, vegetables, seafood, raw meat, water, and ice cubes.
- **Eating habits**: Eating with the hands; eating raw foods; or drinking uncoiled water, may increase the risk of diarrhea. Food is another major cause of diarrhea when it is prepared or stored in unhygienic conditions. Unsafe domestic water storage and handling is also an important risk factor(29).

2.2.5 Transmission of diarrheal diseases

The infectious agents associated with diarrheal disease are transmitted chiefly through the faecal-oral route that includes consumption of contaminated food or water, person-to-person contact, or direct contact with fecal matter. With regard to water-borne-diarrhea, transmission patterns occur when in-house water storage facilities or/and water sources are contaminated. Some viruses (such as rotavirus) can be transmitted through air; nosocomial transmission is possible, and Shigella (the bacteria causing dysentery) is mainly transmitted person-to-person(30).

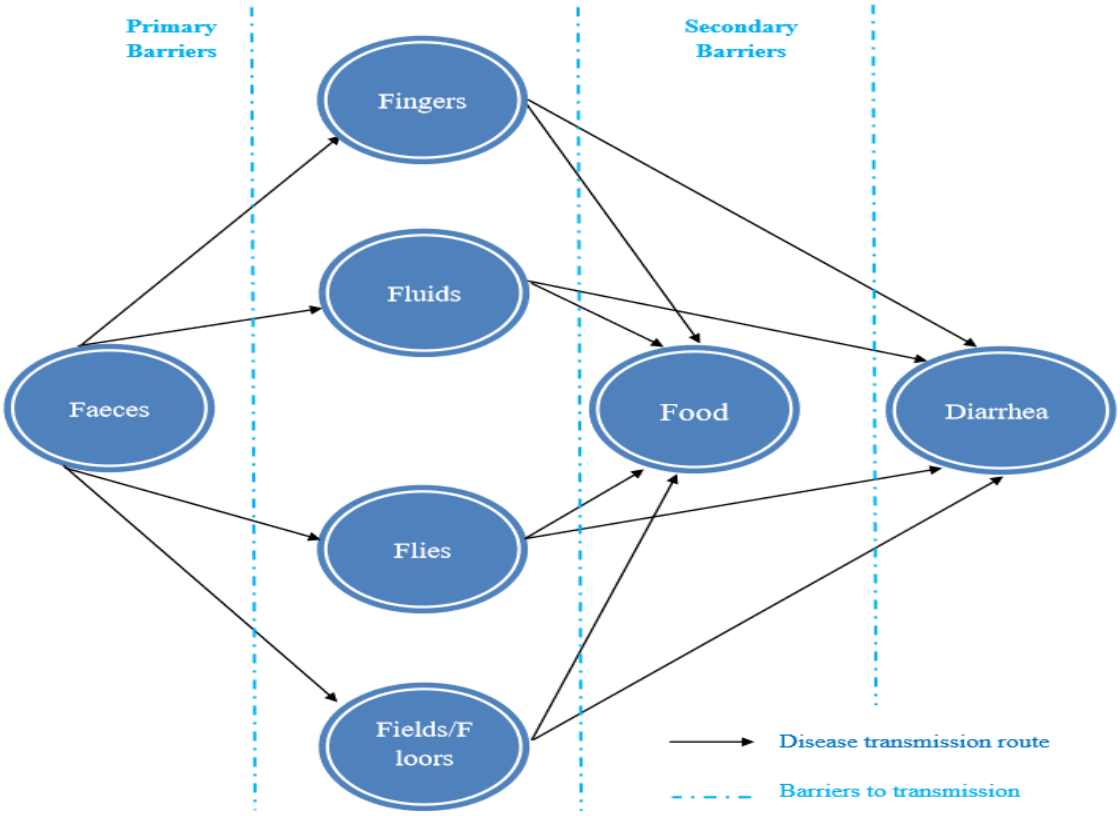

Figure 2 2: The F-diagram below showing the major transmission of faecal-oral diseases(11)

Faeces are the source of diarrheal pathogens, feces carry germs, bacteria, and worms, larvae which are spread in F-diagram since when they are not disposed of safely as the figure shows.

- **Fields:** Eating raw vegetables or half cooked vegetables that are exposed to feces.
- **Flies:** Flies, sitting on the feces, can carry bacteria/germs to food and to our mouths.
- **Fingers:** Not washing hands properly can spread germs and worms.
- **Fluid**: When it rains, feces gets into the water supply.
- **Food:** Vegetables that are exposed to water from feces can carry diseases.

2.2.6 Seasonality and person at risk of diarrheal diseases

Bloody and rotavirus diarrheas are commonly occurring during winter season, and shigellosis is most commonly occurring during dry summer.

People are at risk of diarrheal diseases depends on types of diarrhea and the persons 'years. Cholera: 2 years and above, uncommon in very young infants

- Shigellosis: more common in young children aged below 5 years
- Rotavirus diarrhea: more common in young infants and children aged 1-2 years
- E. coli diarrhea: can occur at any age
- Amebiasis: more common among adults(31).

2.2.7 Risk factors for diarrhea diseases

Factors contributing to diarrheal diseases include: environmental, socioeconomic, behavioral, and demographic factors. According to the study carried out in Ethiopia in 2013, shows that socioeconomic factors may affect, directly and indirectly, environmental, behavioral, nutritional, and demographic risk factors, with the exception of age and sex. Nearly 90% of diarrhea is attributed to unsafe drinking water, inadequate sanitation and poor hygiene. It is widely recognized that exposure to diarrhea pathogens in developing countries is associated with such factors as age of the child, quality and quantity of water, availability of toilet facilities, housing conditions, level of education, household economic status, place of residence, feeding practices, and the general sanitary conditions(32).

Conceptual Framework

This study is guided by the F-diagram of disease transmission commonly known as a fecal oral model of diseases transmission. The movement of pathogens from the faeces of anyone infected to where they ingested by someone else can take a lot of pathways (either direct or indirect transmission of pathogens).

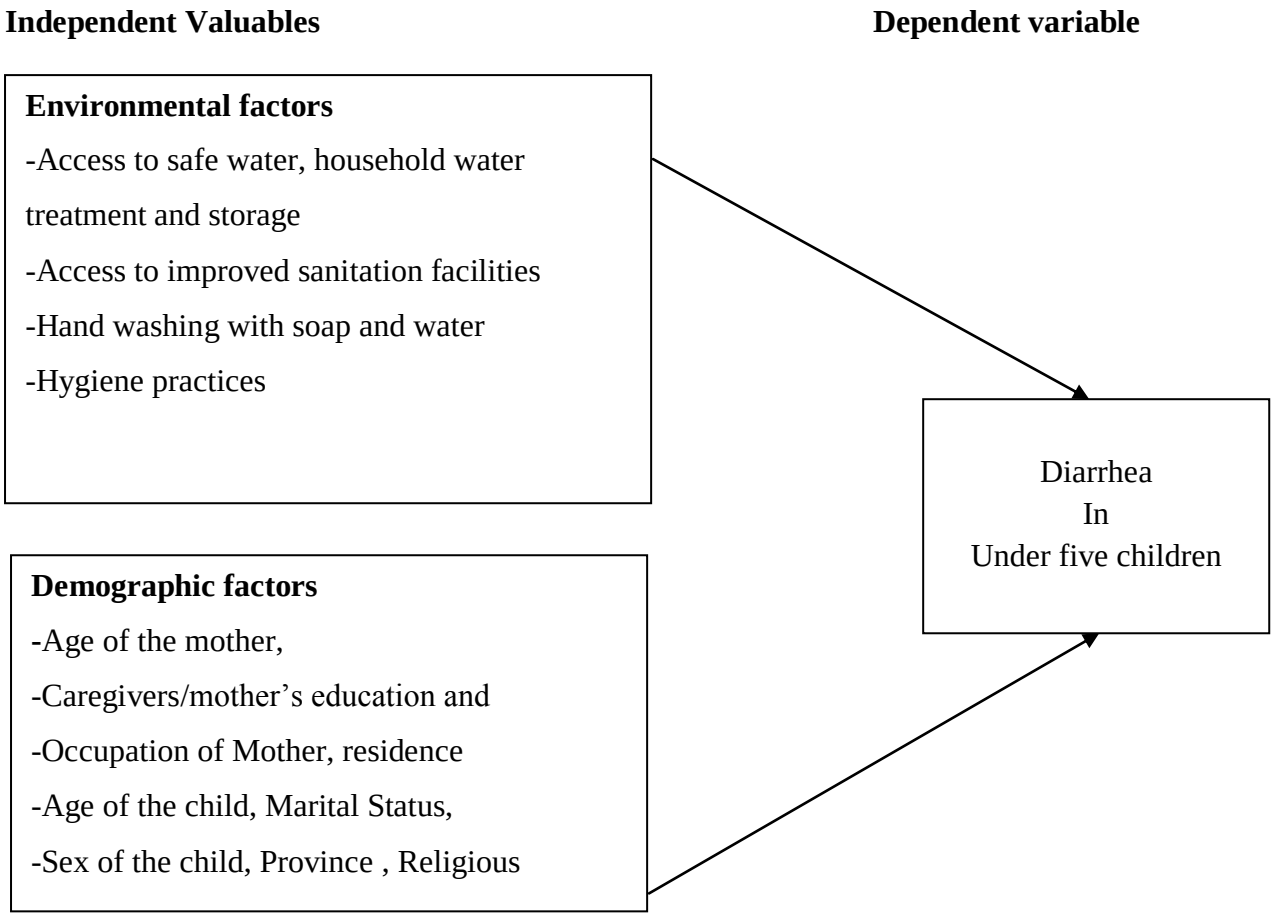

Figure 2 3: **Diarrhea conceptual framework**

Many studies have established that the diarrhea prevalence is higher in younger children. Those demographic factors include:
Parental education: some studies show that children of educated parents are likely to suffer from diarrhea rather than those of non-educated parents.

High number of siblings: the higher the number of siblings the higher the risk of being affected by diarrhea, in the family where they have many siblings sometimes they are not able to fulfill their needs and this makes those children to be risky of diarrhea.

Age: this is one of the risk factor contributing to diarrhea; especially those under five years are more vulnerable to as it is shown in many studies.

Marital status: the status of person can be the risk factor of diarrhea; especially in rural areas.

Religion: different churches have different beliefs and myths which can be the risk factor of diarrhea.

Social-economic factors

Those factors include:

Parental occupation: occupation can be the risk factor of diarrhea, for example those parents who are overcharged at and left the breast milk to their child.

Average monthly income: family income can another risk factor of diarrhea where there is no money poverty is there which leads to poor hygiene and sanitation which also make family members to be at risk of diarrhea

Poor housing: housing condition is a risk factor of diarrhea; for example, location of house near the toilets and stagnant water.

Crowded conditions: the transmission of diarrhea in case of crowding conditions is very easy.

Environmental factors

There are many environmental risk factors like,

Types of water source, distance to water source and access to improved water sources, and Water quantity and daily water consumption: one of the most common causes of infectious diarrhea is a lack of clean water. Often, improper fecal disposal leads to contamination of groundwater. This can lead to widespread infection among a population, especially in the absence of water filtration or purification. Water touches every part of our lives, from drinking to food preparation to bathing to cleaning. Because of this, access to safe, clean water is critical in diarrheal prevention and unsafe water is a key factor to cause diarrhea disease.

Refuse disposal: ways of waste disposal can be a risk factor of diarrhea; for example, poor wastes disposal can be source of flies and according to F-diagram open defecation is a leading cause of infectious diarrhea leading to death.

Livestock in house: those people who have livestock in their house can be a risk factor to cause diarrhea especially those who live with them.

Type of latrine and availability of toilet facilities: those are risk factors where unclean or poor latrine and lack of toilet facilities are more likely to cause diarrhea.

Ownership of latrine: toilet sharing is a risk factor of diarrhea(33)(34).

Behavioral factors

Behavior is a major determinant of diarrhea occurrence; those factors include:

Lack of hand-washing: handwashing properly obviously plays a key role in reducing diarrhea morbidity from 42 to 48 % but in case it is missed and not done properly it becomes a mode of diarrhea transmission as hands are major ways of diseases transmission.

Lack of child immunizations: unimmunized child is riskier to diarrhea than the immunized one.

Methods of water storage: poor water storage is risk factor to cause diarrhea, the way in which water is stored can be a breeding site of microorganisms causing diarrhea when people use and drink it while it is not well treated.

Methods of water drawing: water drawing method can a risk factor of diarrhea depending on where it is drawn and how is it drawn

Feeding practices and time of introducing supplementary feeding: the way a child feed and even time of getting supplementary food is very risky to him or her depending on how it is done. (30).

Seasonal distribution

Patterns of seasonal to childhood diarrhea have been noted in many tropical locations where there are two definite seasonal peaks such as the summer one which is associated with bacterial infections and the winter one which is related to viruses. In some studies, diarrhea prevalence was found to be high in the rainy season than in the dry one. During the dry season when the rainwater and borehole water are less available, disinfecting drinking water from available surface sources may significantly reduce illness(35).

CHAPTER THREE: RESEARCH METHODS

3.1 Study Design

The current study uses secondary data analysis from Rwanda Demographic and Health Survey (DHS, 2014-15) which was a population-based cross-sectional study. In this study, prevalence of Diarrhea among children under five years of age in Rwanda and associated factors are simultaneously measured. Cross-sectional analytical study design was used to identify associated factors with this health condition. It follows quantitative research approach as numerical information was collected.

3.2 Study setting

The study was conducted in Rwanda as Rwanda Demographic and Health survey in the whole country. Rwanda is landlocked country with about 12 million population composed by 48% of men and 52% of female distributed in five provinces and 30 districts.

3.3 Study population

This research considers children aged between 0 to 59 months from households assessed in DHS2014- 2015

3.3.1 Inclusion and exclusion criteria

1. Inclusion criteria

- Being a male or female aged between 0 to 59 months and belonging to the households that participated in DHS 2014- 2015.
- All men or women of 15-59 years old either permanent residents or visitors before the night of survey.

2. Exclusion criteria

- Household heads having children of above five years.

3.4 Sample size

The sample size was all children under five years old living in selected households. A total of 7324 children under five years old constituted a sample size of the study.

3.5 Variables

The dependent variable: Diarrheal was defined as binary variable with an outcome of ever had recently diarrhea or not. RDHS2014-15 collects this data by asking to parents if the child experienced diarrhea for the last 2 weeks preceding the survey.

The independent variables: Were the socio-demographic characteristics of clients which are:

- ***age of mother:*** is the instance of a woman being of an older **age** at a stage
- ***gender:*** is the range of characteristics pertaining to, and differentiating between, masculinity and femininity.
- ***profession of mother:*** as a label, refers to women who are **mothers** and who work outside the home for income in addition to the work they perform at home in raising their children.
- ***marital status of the mother:*** The legal status of a child at birth refers to the marital status of its mother. "Legitimate" children are those whose parents are married
- ***wealth index of household:*** is a composite measure of a household's cumulative living standard.
- ***education level of the mother and the father:*** is the highest **level** of schooling attained of **mothers** and fathers who are living with their children.
- ***birth interval***: Is the time elapsed between a full-term pregnancy and the termination or completion of the next pregnancy.
- ***number of children under five in the household****:* is defined as the percentage of **children aged** 0–59 months.

Environmental Health Factors include:

- ***source of drinking water:*** This mean both the origin of the water and also the place where people get their water (spring, piped supply to household tap, water point, well, etc.).
- ***distance between the household and source of drinking water:*** This mean that the source of water is less than 500 meter away from its place of use and that it is possible to reliably obtain at least 20 liters per member of a household per day.
- ***type of toilet used:*** Toilets come in various shapes and forms around the world, including for flush toilets used by sitting or squatting, and dry toilets like pit latrines;
- ***disposal of children's stool:*** is considered to be disposed of safely when the child uses the toilet/latrine; the faeces is put/rinsed in the toilet/latrine or buried.

3.6 Data collection instruments

Data have already been collected by data collectors from National Institute of Statistics of Rwanda (NISR) and data used to this study were extracted from dataset with permission from Demographic and Health Survey 2014- 15, **Data** were then downloaded in SPSS and analysed.

3.7 Data Analysis Method

Data were analyzed using Stata version 13, tables were used to present the results obtained from the study. The secondary data from RDHS 2014-15 for this targeted population were gathered and analyzed to answer the study research question.

For the statistical analysis, univariate analysis was performed with descriptive statistics for all variables, the dependent variable and independent variables. For bivariate analysis, cross tabulations between the dependent variable and risk factor variables were plotted to detect the relationship. Chi-square test was used to assess whether there was statistical significance between the categorical variables and the outcome variable. The significant level α was set at 0.05 and the corresponding p-values were reported. Binary logistic regression on multivariate analysis was used to identify which variables were predictors of the outcome variable.

3.8 **Ethical considerations**

The study used RDHS, 2014-15 database. Approval to access the database was obtained through online registration. As requested the database was confidentially treated and no efforts were made to trackback individual participants.

CHAPTER FOUR: RESULTS

1. Socio-demographic characteristics of survey participants

The results showed that majority of the participants 72.06% reported that they have primary education. For wealth index, those who reported to be the poorest households were 23.91% and the poorer households were 21.10%. For age of mothers, results showed that majority 29.49% of mothers participated in the survey aged between 25 and 29 years. Concerning, the type of place of residence, results showed that the higher number of participants 78.52% were in the rural. According to the age of children in months, a high proportion of participants 57.84% was aged between 24-59 months. For the sex of the children, results showed that male sex was 50.41% nearly equal to female sex 49.59%.The majority of study respondents were married 54.01%.Regarding respondent's occupation; a high proportion of respondents 49.19% were agriculturalist. For religion, the majority of study respondents 48.78% were Protestants. Concerning husband's education level a high proportion 65.51% of husbands had attained primary school (Table 4.1).

Table 4.1: Socio-demographic characteristics of survey participants

Characteristics	Frequency	Percentage
Level of mother's education (n=7324)		
No education	504	13.94
Primary	2605	72.06
Secondary and above	506	14
Wealth index category (n=7324)		
Poorest	1751	23.91
Poorer	1545	21.1
Middle	1399	19.1
Richer	1256	17.15
Richest	1373	18.75
Age of mother(n=7324)		
15-19	139	1.9
20-24	1222	16.68
25-29	2160	29.49
30-34	1963	26.8
35-39	1145	15.63
40-44	557	7.61

45-49	138	1.88
Place of residence (n=7324)		
Urban	1,573	21.48
Rural	5,751	78.52
Age of children in months (n=7324)		
	353	9.76
Less than six months		
6_23	1,171	32.39
24-59	2,091	57.84
Sex (n=7324)		
Male	3,692	50.41
Female	3,632	49.59
Current marital status		
0. never in union	618	8.44
1. married	3956	54.01
2. living with partner	2112	28.84
3. widowed	144	1.97
4. Divorced/Separated	494	6.76
Respondent's occupation (grouped)		
0. not working	11	0.15
1. professional/technical/managerial	478	6.53
2. clerical	1263	17.24
3. sales	901	12.30
4. agricultural	3603	49.19
6. household and domestic	369	5.04
8. skilled manual	576	7.86
9. unskilled manual	124	1.69
Religion		
1. catholic	2627	35.89
2. protestant	3570	48.78
3. adventist	875	11.96
4. muslim	159	2.17
5. jehovah witness	49	0.67

7. no religion	39	0.53
96. other	0	0
Husband/partner's education level		
0. no education	571	7.80
1. primary	4798	65.51
2. secondary	1899	25.93
3. higher	56	0.76
Number of children 5 and under in household (de jure)		
0	0	0.00
1	911	12.44
2	1399	19.10
3	3201	43.71
4	1603	21.89
5	139	1.90
7	71	0.97
Total	7324	100

4.2 **Prevalence of diarrhea in two weeks preceding the survey**

The study reported diarrheal diseases by 12.1% mothers of under five years children under five years old is 12.1% (Table 4.2).

Table 4.2: Prevalence of diarrhea in two weeks preceding the survey

Characteristics	Frequency	Percentage
Had diarrhea in the past two weeks		
Yes	897	12.1
No	6,426	87.99

4.3 Bivariate analysis for diarrhea and household characteristics

As summarized in table 4.3, results show that education level of participants was significant with diarrhea ($p<0.003$); wealth index of children was significantly related to diarrhea ($p<0.001$), and types of place of residence were significantly related to with diarrheal disease ($p<0.048$), age of the child ($p<0.001$), current marital status ($p<0.001$), respondent's occupation ($p<0.001$),. In addition, husband/partner's education level was also found

significantly related to diarrhea disease (p<0.001) in dealing with children under five years old (Table 4.3).

Table 4.3: Bivariate analysis on diarrhea and demographic characteristics

Variables	Had Diarrhea	No Diarrhea	Total	p-value
Level of mother's educational				<0.001
No education	165(14.7%)	961(85.3%)	1126(100%)	
Primary	724(13.2%)	4756(86.8%)	5480(100%)	
Secondary and above	82(10.2%)	719(89.8%)	801(100%)	
Wealth index category				<0.001
Poorest	276(15.2%)	1545(84.8%)	1821(100%)	
Poor	227(14.4%)	1352(85.6%)	1580(100%)	
Middle	162(11.4%)	1259(88.6%)	1421(100%)	
Richer	132(10.2%)	1161(89.8%)	1292(100%)	
Richest	117(8.1%)	1327(91.9%)	1444(100%)	
Age of mother				0.125
<18 years	67(13.5%)	431(86.5%)	499(100%)	
19-34 years	451(11.4%)	3509(88.6%)	3960(100%)	
>35 years	291(9.4%)	2807(90.6%)	3099(100%)	
Place of residence				0.01
Urban	171(10.3%)	1491(89.7%)	1663(100%)	
Rural	743(12.6%)	5152(87.4%)	5895(100%)	
Age of children in months				
Less than six months	44(5.9%)	697(94.1%)	741(100%)	<0.001
6_23	554(21.5%)	2023(78.5%)	2577(100%)	
24-59	360(8.5%)	3880(91.5%)	4240(100%)	
Sex				0.165
Male	482(12.6%)	3342(87.4%)	3824(100%)	
Female	434(11.6%)	3300(88.4%)	3734(100%)	
Current marital status				
Never in union	92(14.9%)	526(85.1%)	618(100%)	<0.001
Married	436(11%)	3520(89%)	3956(100%)	
Living with partner	269(12.7%)	1843(87.3%)	2112(100%)	
Widowed	18(12.6%)	125(87.4%)	143(100%)	

Divorced	34(19.2%)	143(80.80%)	177(100%)	
5. no longer living together/separated	48(15.2%)	268(84.80%)	316(100%)	
Respondent's occupation (grouped)				
Not working	46(9.5%)	440(90.5%)	486(100%)	<0.001
Professional/technical/managerial	13(5.4%)	226(94.6%)	239(100%)	
Clerical	1(5.9%)	16(94%)	17(100%)	
Sales	88(12.6%)	612(87.4%)	700(100%)	
Agricultural - self employed	559(12.4%)	3943(87.6%)	4502(100%)	
Household and domestic	8(10.5%)	68(89.5%)	76(100%)	
Skilled manual	12(7%)	160(93%)	172(100%)	
Unskilled manual	16(15.4%)	88(84.6%)	104(100%)	
Religion				
Catholic	322(12.3%)	2304(87.7%)	2626(100%)	0.676
Protestant	443(12.4%)	3126(87.6%)	3569(100%)	
Adventist	96(11%)	779(89%)	875(100%)	
Muslim	21(13.2%)	138(86.8%)	159(100%)	
Jehovah witness	8(17%)	39(83%)	47(100%)	
No religion	7(17.9%)	32(82.1%)	39(100%)	
Other	0(0%)	2(100%)	2(100%)	
Husband/partner's education level				
No education	153(13.6%)	969(86.4%)	1122(100%)	<0.001
Primary	583(12.4%)	4109(87.6%)	4692(100%)	
Secondary	49(8.2%)	550(91.8%)	599(100%)	
Higher	13(5%)	248(95%)	261(100%)	
Number of children 5 and under in household (de jure)				
0	9(20.9%)	34(79.1%)	43(100%)	0.458
1	394(12%)	2895(88%)	3289(100%)	
2	391(12.5%)	2737(87.5%)	3128(100%)	
3	97(12.2%)	696(87.8%)	793(100%)	
4	6(11.3%)	47(88.7%)	53(100%)	
5	0(0%)	9(100%)	9(100%)	
7	0(0%)	7(100%)	7(100%)	

4.4 Bivariate analysis: Diarrhea among under-five year's children and environmental health factors

The results showed that types of toilet facility; toilet facilities shared with other households and non-improved facility were significantly related to diarrhea (p< 0.001), household using unimproved sources as drinking water sources found also significant (p< 0.001) with diarrhea disease. In addition, time used to obtain drinking water (p=0.028), frequency of washing water containers (p=0.01) and handwashing (p=0.043) were significant to diarrhea. Furthermore, stool disposal is significantly associated with diarrhea (p<0.003) in dealing with children under five years old (Table 4.4).

Table 4.4: Bivariate analysis: Diarrhea among under-five year's children and environmental health factors

Explanatory variables	Had diarrhea	No Diarrhea	p-value
Types of toilet facility(n=7075)			<0.001
Improved, not shared facility	897(12.3%)	6419(87.7%)	
Shared facility	211(13.6%)	1344(86.4%)	
Drinking water sources(n=7322)			<0.001
Improved source	608(11.7%)	4602(88.3%)	
Unimproved source	238(12.4%)	1681(87.6%)	
Treatment of drinking water			0.927
Boiling	254(9.5%)	2417(90.5%)	
Filtration	37(14%)	228(86%)	
Use of Chlorine	55(12.9%)	373(87.1%)	
Solar disinfection	2(12.2%)	11(87.8%)	
No treatment	1087(17.3%)	5195(82.7%)	
Time to obtain drinking water (round trip)			0.028
Less than 30 minutes	397(13.4%	2574 (86.6%	
30 minutes or above	500(11.5%)	3847(88.5%)	
Frequency of washing containers			
Seven times	11(15.9%)	58(89.4%)	0.01
Less than seven times	115(16.7%)	547(83.3%)	
More than seven times	7(9.9%)	64(90.1%)	
Handwashing			0.043
Place for handwashing	76(9.10%)	756(90.9%)	

Presence of soap and water	27(6.5%)	391(93.5%)	
Presence of water and cleansing agent other than soap only	6(12.5%)	44(87.5%)	
Presence of water only	492(11.9%)	3642(88.1%)	
Disposal of children's stools			0.003
Child used toilet or latrine	81(8.7%)	853(91.3%)	
Put/rinsed into toilet or latrine	668(12.8%)	4554(87.2%)	
Buried	20(22.2%)	70(77.8%)	
Put/rinsed into drain or ditch	59(10%)	530(90%)	
Thrown into garbage	17(9.9%)	154(90.1%)	
Left in the open	46(16.4%)	234(83.6%)	

4.5 Multivariate analysis for Diarrhea among under-five year's children and different sociodemographic and environmental health factors

Significant variables considered in the bivariate analysis were considered in the full and the reduced models.

Concerning education, children whose mothers were not educated found to be 2.94 times more likely to develop diarrhea (OR=2.94; CI=2.392-3.617;p<.001) than whose mothers were secondary and above educated.

In relation to wealth index, the children from poorest household category were 2 times more to two times (OR=2.03; CI=1.618-2.562;p<.001) to develop diarrhea than those from households of richest category. The poorer households were 1.91 times more risk to develop diarrhea (OR=1.91; CI=1.510-2.424;p<.001) compared to richest household, and the middle were 1.45 times more likely to develop diarrhea (OR=1.45; CI=1.135-1.874; p.003) compared to richest households.

Furthermore, this research revealed that children from rural areas were 1.47 times more likely to have diarrhea (OR=1.47; CI=0.121-1.764; p.003) than children from urban areas.

The researcher found that some factors are significantly associated with diarrhea. According to the age of children, results showed that a children who were aged between 6 and 23 months were 2.61 times more likely to diarrhea (OR=2.61; CI= 2.161-3.823; p<0.001) compared to those with age ranged between 24-59 months.

According to types of toilet facilities, results showed that the risk of developing diarrhea increased among children who used shared facility were 1.82 times more (OR=1.82;

CI=1.240-2.693; p<.0021) to develop diarrhea than those who had improved not shared facility.

Children from the households using unimproved source as drinking water sources were found positively associated with diarrhea 3.26 times more likely to have diarrhea than those from the households use unimproved water sources (OR=3.26; CI=2.438-3.921; <0.001).

Frequency of washing containers; children whose families wash water containers less than seven times per week were 2.28 times more likely to have diarrhea (OR=2.28; CI=1.164-2.861; p<.001) than those whose families wash water containers more than seven times per week.

Disposal of children's stools in the open environment and thrown into garbage showed a statistical significance association with diarrhea. Those children whose households use open environment, thrown into garbage and rinsed into drain or ditch were 2.76 times, 1.64 times and 1.37 likely to have diarrhea (OR=2.76; CI=1.184-2.953; p<.001) , (OR=1.64; CI=1.281-3.527; p<.001) and (OR=1.37; CI=2.881-7.716; p<.0014) respectively than those who dispose children's stools in the toilet or latrine. Furthermore, respondent's occupation indicated a statistical significance with diarrhea where respondents whose occupation was clerical were 1.87 times more to have diarrhea than professional/technical (OR=1.87 CI=1.28-2.71; p; <0.01).

Time to obtain drinking water (round trip);respondents who use 30 minutes or above to obtain drinking water were 1.5 times more to develop diarrhea than those who use less than 30 minutes (OR=1.5 CI=1.540–5.449 p; <0.001).

Concerning handwashing, respondents that had no water, no soap, no other cleansing at their respective households were 2.38 times more to have diarrhea than households than had place for handwashing (OR=2.38 CI=0.615–3.442;p <0.001).

Table 4.5: Multivariate analysis for Diarrhea among under-five year's children and different sociodemographic and environmental health factors

	Full model			Reduced model		
Variables	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Level of mother's educational						
Secondary and above	1			1		
Primary	1.93	[2.150–3.420]	0.160	1.46	[1.174-2.421]	<0.001
No education	3.65	[1.330–7.103]	0.045	2.94	[2.392-3.617]	<0.001
Wealth index category						
Richest	1			1		
Richer	1.33	[0.309–2.980]	0.17	0.70	[0.294-2.801]	0.079
Middle	1.86	[0.371–2.943]	0.59	1.45	[1.135-1.874]	0.003
Poorer	2	[1.191–6.406]	<0.001	1.91	[1.510-2.424]	<0.001
Poorest	1.94	[0.339–7.211]	<0.001	2.03	[1.618-2.562]	<0.001
Place of residence						
Urban	1			1		
Rural	2.93	(0.663–3.597)	0.003	1.47	[0.121-1.764]	<0.001
Age of children in months						
24-59	1			1		
6_23	1.23	[1.114–5.693]	0.029	2.61	[2.161-3.823]	<0.001
Less than six months	0.22	[1.715–3.461]	1.147	1.23	[1.412-2.619]	<0.029
Husband/partner's education level						
No education	1			1		
Primary	3.11	[2.28-4.24]	0.04	1.72	[1.16-2.54]	0.07
Secondary	2.2	[1.69-2.87]	0.27	1.47	[1.04-2.08]	0.11
Higher	0.19	[0.07-0.51]	1.43	0.38	[0.14-1.03]	0.14

Respondent's occupation						
Professional/technical	1			1		
Not working	2.26	[1.71-2.99]	1.02	1.40	[0.96-2.05]	0.08
Clerical	3.21	[2.47-4.19]	<0.01	1.87	[1.28-2.71]	<0.01
Sales	1.6	[1.21-2.10]	<0.01	1.04	[0.72-1.51]	0.83
Agricultural	0.5	[0.06-4.41]	0.53	0.40	[0.05-3.06]	0.375
Household and domestic	1.64	[1.19-2.26]	<0.01	1.01	[0.70-1.44]	0.972
Skilled manual	2.33	[1.64-3.31]	<0.01	1.19	[0.81-1.75]	0.371
Unskilled manual	1.2	[0.87-1.63]	0.24	1.30	[0.94-1.80]	0.118
Current marital status						
Never in union	1			1		
Married	1.89	[3.32-5.20]	0.72	0.24	[2.11-5.66]	0.10
Living with partner	1.51	[1.31-1.73]	0.42	0.59	[1.27-1.52]	0.23
Widowed with partner	0.69	[0.27-1.79]	0.047	0.31	[0.11-1.43]	0.09
Divorced/Separated	1.22	[0.98-1.53]	0.09	1.20	[087-1.36]	0.07
Types of toilet facility						
Improved, not shared facility	1			1		
Shared facility	1.43	[2.193–5.308]	0.048	1.82	[1.240-2.693]	0.021
Non-improved facility	3.06	[1.901–3.130]	<0.001	2.35	[2.709-3.442]	<0.001
Drinking water sources						
Improved source	1			1		
Unimproved source	7.38	[2.391-4.207]	<0.001	3.26	[2.438; 3.921]	<0.001
Frequency of washing containers						
More than seven times	1			1		
Seven times	0.33	[0.714-2.109]	0.168	0.96	[0.539-1.207]	0.214
Less than seven times	4.96	[2.117-5.093]	<0.001	2.28	[1.164-2.861]	<0.001

Disposal of children's stools						
Child used toilet or latrine	1			1		
Put/rinsed into toilet or latrine	0.99	[1.459-5.174]	0.910	0.72	[0.791-1.803]	0.397
Buried	0.52	[0.701-1.449]	0.161	0.91	[0.893-1.484]	0.073
Put/rinsed into drain or ditch	2.84	[1.200-9.817]	0.057	1.37	[2.881-7.716]	0.014
Thrown into garbage	3.05	[1.926-5.587]	<0.001	1.64	[1.281-3.527]	<0.001
Left in the open	5.4	[3.001-7.051]	<0.001	2.76	[1.184-2.953]	<0.001
Time to obtain drinking water (round trip)						
Less than 30 minutes	1			1		
30 minutes or above	2.04	[1.931-8.703]	<0.001	1.5	[1.540–5.449]	<0.001
Handwashing						
Place for handwashing	1			1		
Presence of soap and water	0.69	[0.837-6.173]	0.610	0.35	[0.016-4.641]	0.193
Presence of water and cleansing agent other than soap only	1.27	[1.061-3.484]	0.851	1.11	[0.370-1.844]	0.458
Presence of water only	0.51	[0.874-7.229]	0.093	0.4	[0.190-5.301]	0.074
Presence of cleansing agent other than soap only	0.93	[0.628-4.181]	0.517	0.65	[0.530–1.609]	0.291
No water, no soap, no other cleansing	5.71	[1.309-12.163]	<0.001	2.38	[0.615–3.442]	<0.001

CHAPTER FIVE: DISCUSSION

5.1 Prevalence of diarrhea disease among under five year's children

The study reveals that prevalence of diarrhea in Rwanda is 12.25% with a slight difference compared to the one reported by the 2014-15, Rwanda Demographic and Health Survey.

This prevalence is lower compared to the similar survey done in Uganda reported a high prevalence (22.5%) of diarrhea among under five (21). Another survey also done in Burundi reported that the prevalence of diarrhea disease in children under five was 32.6%(9).Furthermore, DHS report of Tanzania reported another high prevalence 32.7% of diarrhea(11).This diarrhea prevalence of Tanzania is almost similar to the one of Burundi and all of them they greater than the one of Rwanda reported by the current study through secondary data analysis of DHS 2014-15 dataset.

The occurrence of diarrheal diseases among under five years of age was significantly related to children aged between 6-24 months, household characteristics including practices related to types of toilets facilities, toilets facilities shared with others household, stool disposal, source of drinking water, wealth index of household, education level of household heads/caregivers.

Prevalence of diarrhea showed no statistically significant difference between male and female children 12.8% and 11.7% respectively. This means that sex was not influential in the prevalence of diarrhea among under-five children in Rwanda.

5.2 Environmental health factors associated with diarrhea prevalence among under five years children

Mother's educational level was found to have a strong association with diarrhea. Mothers can understand better the importance of child health if they are exposed to health promotion messages, or if they are of higher education as this was evidenced by the findings of this study which showed that children of mothers with no education were 2.94 times more likely to have diarrhea compared to those whose mothers had secondary and above education (OR=2.94; CI=2.392-3.617;p<.001). A similar result was observed from a study done in India to assess knowledge and attitude at household level. The result showed that those who had knowledge on prevention of diarrhea had lesser cases compared to those who had less or no knowledge at all(15).

Another study that showed similar results was the one done in East Africa countries as a significant number of women did not have adequate knowledge on occurrence and prevention of diarrhea(29). A study that was conducted by Gebru T et al 2018 also supports the results of this study. The results indicated that low level of maternal education was found to have a strong association with childhood diarrhea after adjusting for other variables(32). Another study in the India, however, suggested that the protective effect of mother's education on childhood diarrhea varies according to the environment where the family lives, as this is more likely in more economically and socially advantaged communities but has no effect in the more disadvantaged communities(35).

Moreover, wealth index also was found associated with diarrhea; the poorest household category was two times risk to develop diarrhea (OR=2.03; CI=1.618-2.562;p<.001) compared to richest families. The poorer households were 1.91 times more risk to develop diarrhea (OR=1.91; CI=1.510-2.424;p<.001) compared to richest household, and the middle were 1.45 times more likely to develop diarrhea (OR=1.45; CI=1.135-1.874; p.003) compared to richest households. The children under five years from poor family are at high risk of developing diarrhea compared to those from the richest family because the richest family had sufficient basic needs to build their body and promote health.

The study also demonstrated a strong association between residence and diarrhea prevalence. Children who were in the rural areas had 1.75 increased odds of having diarrhea compared to those in the urban areas, even after controlling for other variables. The question that may arise from this is whether the women in the rural areas have enough access to the health promotion messages on the importance of under-five child vaccinations, or whether most of them live far from the health centers. These results are in line with a study by Tambe et al (2015) in Suba-Saharan which observed that those who lived in rural areas were associated with high incidence of diarrhea(26).

Globally, about 1.1 billion people have no access to improved water sources and 2.4 billion do not have basic sanitation(28).Among the environmental factors this study found that the type of water point source was significantly associated with diarrhea (OR=3.26, CI=2.438-3.921; p 0.001). The children who came from households that had unimproved water sources had 3.26 more odds of having diarrhea compared to those that had improved water sources. This is in line with a study that was conducted by Sanyaolu et al 2018 on global trends of diarrhea diseases in children which found that the households that had lack of improved water sources also had a higher percentage of children with diarrhea. Sanyaolu also found that those in rural areas had higher prevalence of diarrhea compared to those in the urban because water sources and sanitation in the rural were worse than in the urban areas of Indonesia (22).

The type of toilet was significantly associated with the prevalence of diarrhea among the underfive children. It means that the use of improved toilet facilities decreased the risk of having diarrhea compared with those who used unimproved toilet facilities. This showed that households who used improved toilet facilities lowered prevalence of diarrhea among children under five years old while the households who used unimproved toilet facilities increased the risk of having diarrhea.

The study conducted in India reported that children's stool were managed unsafely at 79%. The researcher stated that unsafe disposed stool increase the risk of developing diarrhea among children under five years old. The sanitation facilities are poorly managed. Excreta-related diseases, where sanitation was poorly managed contributed to contamination of food, water, and caused diarrhea diseases especially to young children(15). According to Path, et al., the children from developing countries were frequently exposed to excreta contaminated food, water, human hands, and soils. This can result to diarrhea infection in young children. Contrary, appropriate sanitation practices among mothers reduced diarrhea morbidity to almost 37% (15). The sanitation programmes focused on safe disposal of children's stool in Rwanda need to be improved.

This study finding contrast the study that was done in Misisi compound in Lusaka, Zambia showed that toilet facility was not significantly associated with the prevalence of diarrhea among the underfive children at multivariate analysis. However, univariate and bi-variate analyses showed significant association between toilet ownership and diarrhea (p-<0.001), while multivariate analysis showed no significance (p-0.251) (4).

The current study revealed the association between handwashing practices and diarrhea. The study findings found that hand washing with no water, no soap, no other cleansing was positively associated with diarrhea. The researcher did not explore the reason behind. Similar study conducted in Nigeria showed that the risk of diarrhoea was higher among children of the mothers who did not wash their hand with soap before preparing food (13).

Study limitations

Being a secondary data analysis, it was noted that additional variables were needed to enrich the analysis of the factors associated with the diarrhea disease among under five year's children.

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study has identified although there are prevention and treatment guideline protocols, there is still a problem in the prevalence of diarrhea in Rwanda among the under-five children. In addition to that, some important determinants of diarrhea among children under the age of five were revealed as detailed below including; environmental factors as well as demographic factors. A higher risk was observed among the children aged between 6-23 months. The factors associated with diarrhea among under-five children were found to be child's age, mothers' education level, water source, type of sanitation facility, wealth index, and residence, respondent's occupation, time to obtain drinking water and handwashing.

Child's age; results showed that a children who were aged between 6 and 23 months were 2.61 times more likely to diarrhea (OR=2.61; CI= 2.161-3.823; p<0.001) compared to those with age ranged between 24-59 months. Mothers' education level; children whose mothers were not educated found to be 2.94 times more likely to develop diarrhea (OR=2.94; CI=2.392-3.617;p<.001) than whose mothers were secondary and above educated. In addition water source was found positively associated with diarrhea where children from the households using unimproved source as drinking water sources were found positively associated with diarrhea 3.26 times more likely to have diarrhea than those from the households use unimproved water sources (OR=3.26; CI=2.438-3.921; <0.001). In relation to type of sanitation facility; results showed that the risk of developing diarrhea increased among children who used shared facility were 1.82 times more (OR=1.82; CI=1.240-2.693; p<.0021) to develop diarrhea than those who had improved not shared facility. For wealth index; the children from poorest household category were 2 times more to two times (OR=2.03; CI=1.618-2.562;p<.001) to develop diarrhea than those from households of richest category. Furthermore residence; this research revealed that children from rural areas were 1.47 times more likely to have diarrhea (OR=1.47; CI=0.121-1.764; p.003) than children from urban areas. Respondent's occupation; respondent's occupation indicated a statistical significance with diarrhea where respondents whose occupation was clerical were 1.87 times more to have diarrhea than professional/technical (OR=1.87 CI=1.28-2.71; p; <0.01). Time to obtain drinking water; respondents who use 30 minutes or above to obtain drinking water were 1.5 times more to develop diarrhea than those who use less than 30 minutes (OR=1.5 CI=1.540–5.449 p; <0.001). For handwashing; respondents that had no water, no soap, no other cleansing at their respective households were 2.38 times more to

have diarrhea than households than had place for handwashing (OR=2.38 CI=0.615–3.442;p <0.001).

6.2 Recommendations

To Ministry of Health (MoH):

- Policy makers should ensure that health promotion messages reach all masses especially those in the rural areas, by increasing frequency of health promotion messages through community health workers by doing house to house visits. It was shown in the study that most of the children affected by the disease were those in the rural areas

To Ministry of Infrastructure:

- Encourage household members to use improved water source and treated by chlorine boiling water and safe storage of treated water.
- Supply of safe water sources to vulnerable households should be ensured in order to decrease the prevalence of diarrheal disease among children under five years old.
- Encourage mother's/care givers to use improved sanitation facilities for the safety of their children.

Researchers and NISR (RDHS):

- To increase number of environmental health factors indicators to be assessed in Demographic and Health Survey.
- Similar studies on factors associated with diarrhea among under-five children should be conducted in future in order to facilitate continuity and effective implementation of child health intervention programs for policy formulation and the general assessment of resource requirements and intervention prioritization.
- Further studies should be undertaken to explore other possible factors associated with Diarrhea disease a part from environmental health risk factors.
- During survey, the researchers did not explore the impacts of diarrheal diseases among children under five years. This needed to be studied in future research in order to update data on determinants of diarrhea disease

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