

REGIONAL INSTITUTE FOR POPULATION STUDIES (RIPS)

UNIVERSITY OF GHANA

**WATER, SANITATION AND HYGIENE AND DIARRHOEA INCIDENCE AMONG
CHILDREN UNDER FIVE YEARS IN GHANA**

BY

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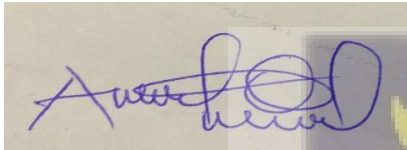
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PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MA
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JANUARY, 2023.

DECLARATION

I hereby declare that, apart from references to previously published works that have been duly cited, this thesis is the result of my own research conducted at the Regional Institute for Population Studies, University of Ghana.



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Date: 12 December 2023



DEDICATION

I dedicate this thesis to the memory of my sister, Anastasia Aboagye, who always believed in my ability to be successful in the academic arena. You are resting in the bosom of our Lord but your belief in me has made this journey possible.



ACKNOWLEDGEMENTS

I would first like to acknowledge God for His mercies and blessings that have brought me this far.

It is by His grace that I live and have pursued this programme.

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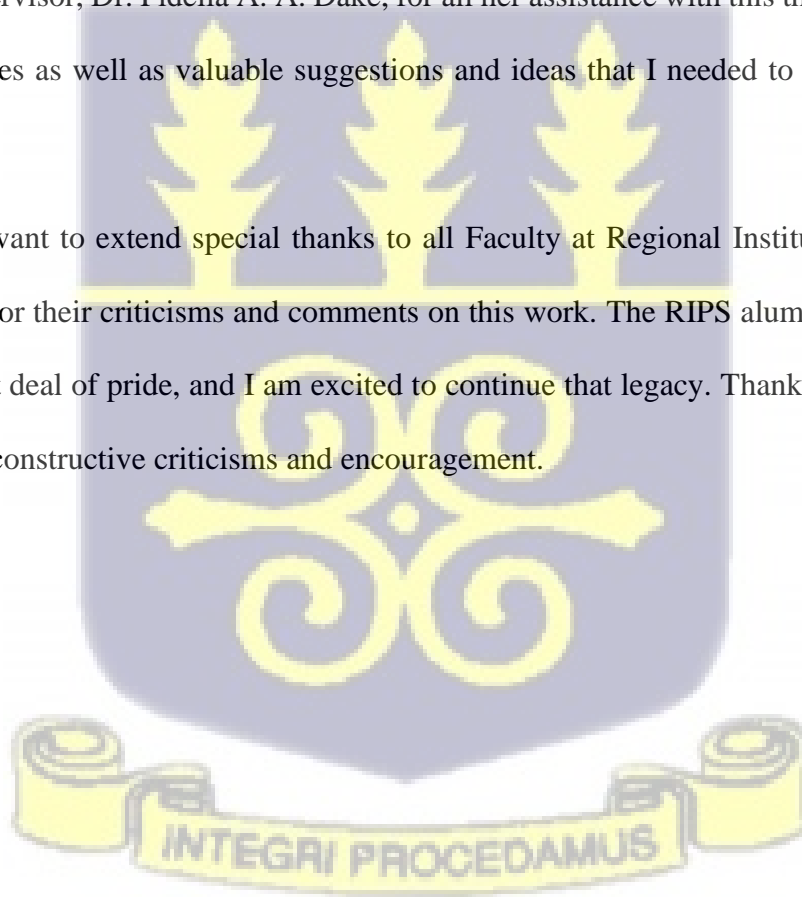


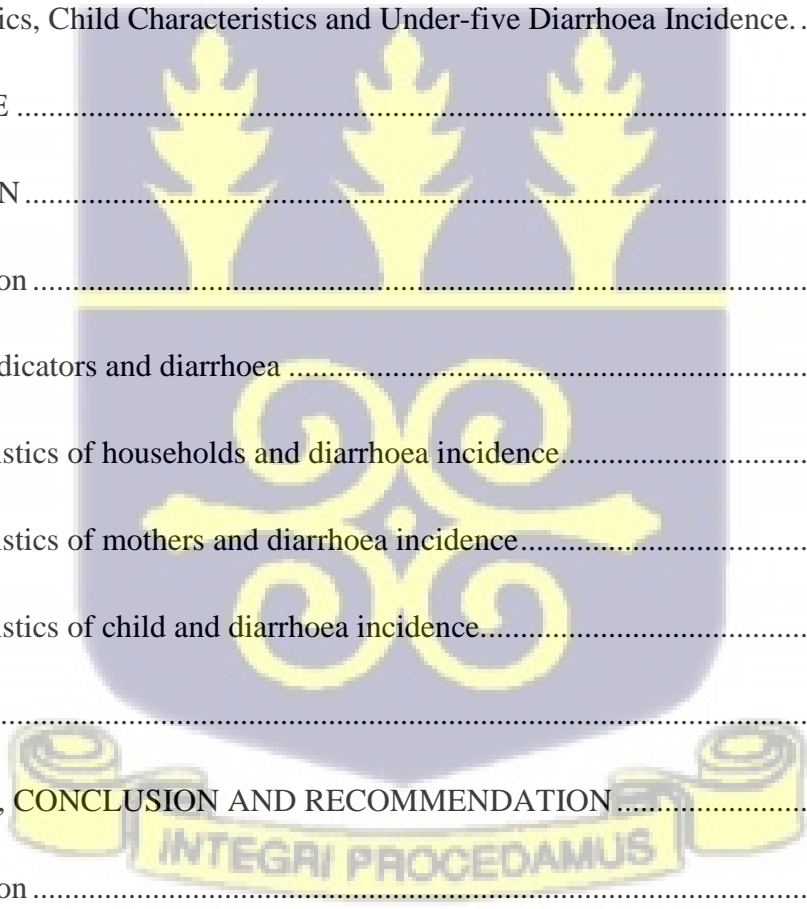
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LIST OF ACRONYMS

DWI	Drinking Water Index
EA	Enumeration Area
GDHS	Ghana Demographic and Health Survey
GSS	Ghana Statistical Services
HI	Hygiene Index
MDGs	Millennium Development Goals
PHC	Population and Housing Census
RC	Reference Category
SSA	Sub-Saharan Africa
SI	Sanitation Index
UNICEF	United Nations Children Fund
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization



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ABSTRACT

Inadequate access to water, sanitation, and hygiene (WASH) are some of the major risk factors associated with diarrhoea incidence among children under five years. The study explored the relationship between household WASH conditions and diarrhoea incidence among children under five years in Ghana using data from the 2014 Ghana Demographic and Health Survey (GDHS). A sample of 5965 children under five years was used in this study. An index was developed to measure households' drinking water, sanitation, and hygiene conditions. The data were analysed at three levels. Univariate analysis was used to provide descriptive statistics on household WASH conditions and describe the socio-demographic characteristics of the study sample. The bivariate level of analysis examined the association between the independent and dependent variables as well as the controlled variables. Multivariate analysis was carried out using binary logistic regression since the dependent variable (child had diarrhoea) was coded as a dichotomous variable with yes and no response options. The findings revealed that 11.8% of the children experienced episodes of diarrhoea two weeks prior to the survey. Also, there was a significant association between sanitation, wealth quintile, sex of child, age of child, mothers' educational level, and diarrhoea incidence among children under five years in Ghana. At the multivariate level, the results indicate that having unimproved sanitation significantly increases the likelihood of a child contracting diarrhoea. The study recommends that stakeholders should continue to encourage and promote the building and usage of improved toilet facilities in households to enhance sanitation at the household level.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

Diarrhoea could be defined as the passage of two or more liquid stools per day, exceeding the typical frequency of bowel movements for an individual (WHO, 2017). However, it is important to note that frequent passage of formed stools, as well as the passage of liquid, "pasty" stools by breastfed infants, is not considered diarrhoea (WHO, 2017). Diarrhoea is a condition that can be caused by a variety of pathogens, including bacteria, viruses, and parasites. In industrialized regions, such as Europe, North America, and other parts of the world, the most common causes of diarrhoea are viral pathogens which exhibit a distinct seasonality, typically peaking during the winter months (Podewils et al., 2004). However, in developing countries with poor hygiene and sanitation, enteric bacteria and parasites are more prevalent, and these pathogens typically reach their peak during the summer months (Podewils et al., 2004). Diarrhoea infections among children under five years of age have decreased globally over the past three decades, but it remains a significant concern in developing countries (Behera & Mishra, 2022).

Diarrhoea is one of the leading causes of infant and child morbidity and mortality worldwide (Humphreys et al., 2010). Diarrhoea is the fifth leading cause of child mortality (Troeger et al., 2018). An estimated 446,000 children lose their lives to diarrhoea each year (Troeger et al., 2018). Diarrhoea continues to be one of the main causes of global deaths and accounts for a higher percentage of disability-adjusted life-years lost (Mebrahtom et al., 2022; Oria et al., 2010). Children under five have the highest death rates from diarrhoea and are more vulnerable to pathogen exposure than other family members because of their weak immune systems. An

estimated 9% of all under-five mortality globally in 2019 was due to diarrhoea this corresponds to more than 1,300 infant deaths every day (UNICEF, 2022b). According to studies, a child's exposure to diarrhoea pathogens is a combination of several factors such as their age, quality and quantity of the water they drink, availability of toilet facilities, their mother's education level, feeding practices, the household's financial situation, the place where they live and the general hygiene conditions in their homes (Hardoy et al., 2013; Kobayashi et al., 2022; Saha et al., 2022; Wolf et al., 2022). In 2018, around four billion persons, or 55 percent of the world's population, lived in urban areas and by 2050, it is anticipated that this percentage will rise to 68 percent (UNICEF, 2018a). Although urbanization is meant to improve living circumstances for the people, substantial development difficulties such as access to WASH services frequently arise in Sub-Saharan Africa (SSA) due to the region's rapid population expansion (UNICEF, 2019; Zerbo et al., 2021). There is evidence in literature that suggest an association between diarrhoea and unimproved water sources, sanitation, and hygiene (Fischer Walker et al., 2013; Hirai et al., 2016). Despite many initiatives, particularly in developing countries, the availability of water, sanitation, and hygiene (WASH) remains a concern.

About half of global population did not have access to improved sanitation in 2020, and one in four individuals lacked access to properly managed drinking water in their homes (WHO/UNICEF, 2021). It is important to note that 44% of the world's population in rural areas had access to improved sanitation facilities, compared to 62% of its urban residents (WHO/UNICEF, 2021). In Sub-Saharan Africa, 418 million people did not have access to basic drinking water services whereas 779 million lacked access to improved sanitation services (about 208 million engaged in open defecation) and 839 million people did not have access to improved hygiene services (UNICEF, 2022a). In Ghana, 11% of households drink water from an unimproved source and 15%

use unimproved toilet facilities while 15% of households practice open defecation (Ghana Statistical Service (GSS), 2018).

Initiatives to enhance household access to WASH have been growing internationally for decades particularly in developing countries. Improved basic hygiene facilities, drinking water supplies, and sanitation facilities are essential for keeping people healthy and ensuring that children live to age five (Irianti & Prasetyoputra, 2021; Prüss-üstün et al., 2019; Wolf et al., 2014). If access to facilities for water, sanitation, and hygiene is quickly improved, the global burden of disease and death rates might be decreased by roughly 9.1% and 6.3%, respectively (Prüss-üstün et al., 2019).

The incidence and spread of diarrhoea illnesses in connection to WASH have been clarified through empirical studies. The F-diagram, also referred to as the faecal-oral transmission model, postulates that the pathogenic bacteria found in people's faeces go into their bodies through touch or ingestion of contaminated meals, liquids, and flies, fingers, etc (Wagner & Lanoix, 1958). This transmission chain can be interrupted by enhancing water availability, water quality, water storage, sanitary infrastructure, and handwashing habits in households. Diarrhoea illnesses among under-five children can be addressed at both primary and secondary preventive levels. The former is concerned with improving sanitation and water quality, whereas the latter is concerned with early treatment (Workie et al., 2018). World health would be significantly improved if universal WASH access were achieved. It is possible to prevent the 829,000 people that die each year from diseases caused by contaminated water, unsatisfactory sanitation, and poor hygiene practices (United Nations, 2022). Additionally, there is potential to significantly reduce child malnutrition and provide assistance to children experiencing physical and cognitive underdevelopment.

1. 2 Statement of the Problem

Water, sanitation, and hygiene access has improved a great deal over the past few decades but despite these improvements, many individuals remain deprived (WHO/UNICEF, 2021). The rising proportion of populations worldwide living in informal settlements as a result of population increase and fast unplanned urbanization has several effects, including public health issues caused by inadequate water, sanitation, and hygiene service supply (Larbi et al., 2021). The case of Ghana and most developing countries is not different. Such conditions continue to pose a challenge to the fight against diarrhoea.

Children's cognitive development may be affected by recurring diarrhoea episodes, according to research (Wierzba & Muhib, 2018). Children three years and below in low-income countries get three episodes of diarrhoea on average per year (WHO, 2017). Each episode of diarrhoea deprives these children of essential nutrients for good growth. According to Kipp et al., (2016), though under-5 mortality has declined substantially, Ghana is one of eight African countries that has made little progress in reducing it. The slow pace of decline in under-five mortality is largely attributed to the high diarrhoea morbidities among children under five years of age (Babayara & Addo, 2018). The Ghana Statistical Service reported a 12% under-five diarrhoea prevalence for the 2014 Ghana Demographic and Health Survey (GDHS) (Ghana Statistical Service (GSS), 2015). Diarrhoea is also one of the top ten causes of hospitalization and under-five deaths in Ghana (Apanga & Kumbeni, 2021). Several studies have attributed the prevalence of childhood diarrhoea in Ghana to environmental and behavioral factors (Apanga & Kumbeni, 2021; Boadi & Kuitunen, 2005). These studies have identified a range of factors that contribute to the risk of childhood diarrhoea, including the mother's job and education, the type of toilet facility, the place of residence, wealth quintile, handwashing practices, the presence of human feces in the household

compound, and overcrowding (Bitew et al., 2017; Dessalegn et al., 2011; Sinmegn Mihrete et al., 2014; Workie et al., 2018). Children living in households with poor personal and domestic hygiene, such as inadequate child stool disposal methods, inadequate water supply, and water quality, are at increased risk of developing diarrhoea (Anyorikeya et al., 2016; Tampah-Naah, 2019; Tetteh et al., 2018).

A significant number of investigations into WASH conditions and the prevalence of diarrhoea in Ghana have utilized a cross-sectional study design, with a focus on a particular district within the country (Agyemang et al., 2014; Babayara & Addo, 2018; Osumanu, 2007). This study utilized a nationally representative data and considered various WASH-related factors, including the type of toilet facility, whether it is shared with other households, the time required to access the toilet, the source of drinking water, water treatment practices, and the time required to obtain water, as well as household hand washing practices. The existing body of literature on the relationship between water, sanitation, and hygiene (WASH) conditions and the incidence of diarrhoea among children under five lacks comprehensive investigations utilizing WASH indices in the Ghanaian context. Although individual studies have examined different aspects of WASH and their effect on diarrhoea incidence, there is little in the literature regarding a comprehensive evaluation of WASH conditions through the use of indices. The absence of research employing WASH indices hinders a thorough understanding of the collective influence of multiple factors within the WASH framework on diarrhoea incidence. Therefore, it is necessary for the study to incorporate these key variables into indices in order to provide a more holistic representation of the overall conditions and practices related to water, sanitation, and hygiene and its impact on diarrhoea incidence among children under five. Therefore, the study seeks to examine the relationship between the various WASH components and the risk of diarrhoea among children under the age of five in Ghana.

1. 3 Research questions

The study seeks to answer the following questions;

1. What are the characteristics of the study sample?
2. What are the distribution of WASH indices?
3. What background characteristics of the study sample are associated with the incidence of diarrhoea among children under five years in Ghana?
4. What WASH indices are associated with the incidence of diarrhoea among children under five years in Ghana?
5. What factors predict the occurrence of diarrhoea in children under five years in Ghana?

1. 4 Significance of the study

Families, communities, and the country at large place a high value on a child's survival because children are the foundation of any society's progress. Children contribute to the sustenance of society and the maintenance of human civilization. Due to the crucial role that children play in sustaining society; it is essential to study what generally affects their health and impacts their mortality. The elimination of child mortality in a country is a significant measure of development. To minimize morbidity and mortality from diarrhoea illnesses, global focus should be placed on improving sanitation and hygiene conditions in areas with a high level of vulnerability (Abuzerr et al., 2020; Prüss-ustün et al., 2019).

The precarious WASH conditions in Ghana has substantial health repercussions for children under the age of five, but it also has detrimental effects on the overall health and well-being of the whole

population. According to the findings of the 2014 GDHS, the child mortality rate of 60 per 1000 live births can be decreased when avoidable infections such as diarrhoea are minimized.

Having a thorough understanding of WASH practices in connection to under-five diarrhoea incidence is critical for designing and promoting sanitation and hygiene education and policies that will complement the country's effort in achieving the global standard of 25 deaths per 1,000 live births for children under five years.

The results of this study will shed some light on the relationships between WASH and under-five diarrhoea incidence in Ghana. Finally, as an academic study, the study's findings will add to the current body of literature in relation to WASH and under-five diarrhoea incidence in Ghana.

1.5 Research Objective

1.5.1 General Objective

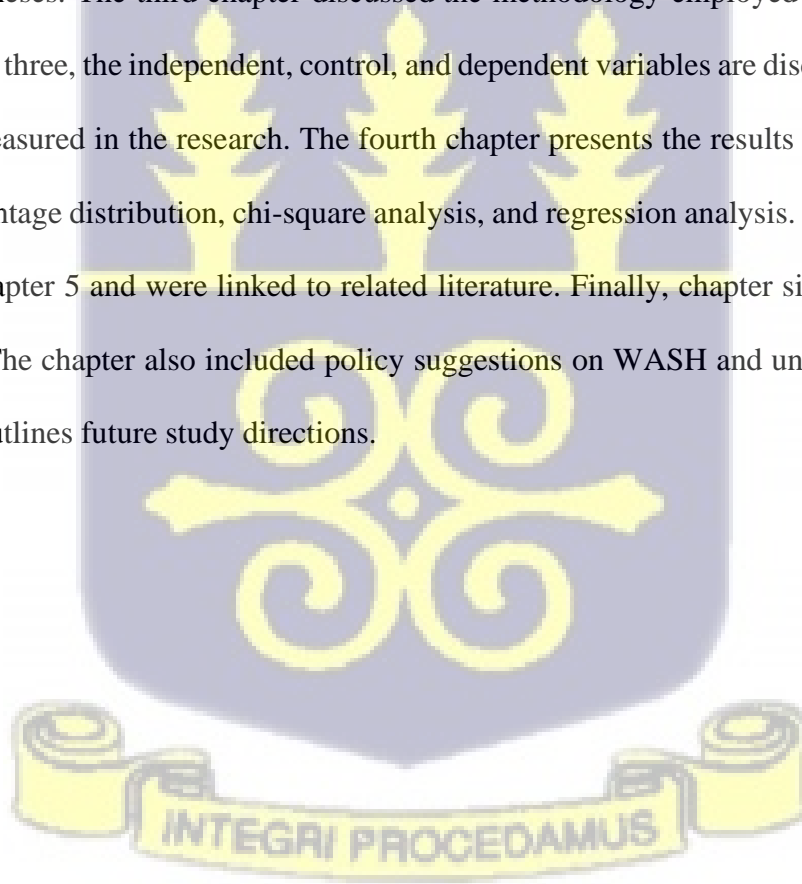
The study's overarching goal was to assess the effect of household water, sanitation, and hygiene conditions on diarrhoea incidence among children under five years in Ghana.

1.5.2 Specific Objectives

1. To explore the background characteristics of the study sample.
2. To explore the distribution of WASH indices.
3. Examine the background characteristics of the study sample associated with the incidence of diarrhoea among children under five years in Ghana.
4. Examine WASH indices associated with the incidence of diarrhoea among children under five years in Ghana.
5. Discuss predictors of diarrhoea incidence among children under five years in Ghana.

1. 6 Organization of the study

The study was divided into six chapters. The first chapter contains the background of the study, the statement of the problem, research questions, the significance of the study, research objectives, and the organization of the study. The second chapter includes a review of related literature on under-five diarrhoea incidence, as well as a theoretical framework, a conceptual framework, and the study hypotheses. The third chapter discussed the methodology employed in conducting the study. In chapter three, the independent, control, and dependent variables are discussed, along with how they are measured in the research. The fourth chapter presents the results of the study using frequency/percentage distribution, chi-square analysis, and regression analysis. The findings were discussed in Chapter 5 and were linked to related literature. Finally, chapter six summarized the main findings. The chapter also included policy suggestions on WASH and under-five diarrhoea incidence and outlines future study directions.



CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter aimed to provide a review of the available literature on the topic of childhood diarrhoea. The overarching goal of this chapter is to synthesize the relevant research on the topic to better understand the factors that affect under-five diarrhoea incidence in Ghana. The literature review examines the theoretical underpinnings of childhood morbidities in relation to diarrhoea. Many studies have attempted to understand the underlying factors that influence under-five diarrhoea incidence. Although, the literature spans wide-ranging factors, this review will concentrate on the individual and household variables that cause under-five diarrhoea among Ghanaian children.

2.2 Etiology and Transmission of diarrhoea

Diarrhoea is characterized by the frequent passage of loose or watery stools. Not all instances of loose stools qualify as diarrhoea, especially in breastfed babies (WHO, 2017). Diarrhoea primarily results from infections within the intestines, caused by various bacterial, viral, and parasitic species. It often spreads through contaminated food, water, or inadequate hygiene practices and can lead to dehydration and nutrient loss (WHO, 2017). Malnourished children or children with weak immune system, are particularly vulnerable to life-threatening diarrhoea (Basile et al., 2021). Diarrhoea can be classified into three clinical types: acute watery diarrhoea, acute bloody diarrhoea (dysentery), and persistent diarrhoea (lasting 14 days or longer) (WHO, 2017). Acute watery diarrhoea can cause severe dehydration and is often linked to pathogens like rotavirus, enterotoxigenic *E. coli*, and *V. cholerae* (causing cholera) (Ciccarelli et al., 2013; Keusch et al.,

2006). Dysentery, or acute bloody diarrhoea, is characterized by blood in the stool and is commonly caused by *Shigella*, *Campylobacter jejuni*, enteroinvasive *E. coli*, or *Salmonella* (Ochoa & Surawicz, 2012). Persistent diarrhoea, which often begins as acute or dysentery, is challenging to eliminate and is associated with malnutrition, both before and after the illness. Cryptosporidiosis-induced diarrhoea can result in significant weight loss (Sponseller et al., 2014).

Diarrhoea is primarily caused by pathogenic microorganisms, including viruses, bacteria, protozoa, and helminths. However, only a few of these microorganisms are responsible for severe cases of childhood diarrhoea (Saeed et al., 2015). Enteric pathogens are the common name for microorganisms that spread via the faecal-oral pathway and infect the gastrointestinal system. They often maintain their stability in food and liquids, and in the context of enteric bacteria, the correct environmental circumstances can allow them to expand outside of the host (Gerba, 2015). Common enteric pathogens include *Salmonella* spp., *Shigella* spp., *Vibrio cholerae*, and rotavirus, among others (Curtis & Cairncross, 2003). They are typically transmitted through faecal-oral transmission, involving the ingestion of faecally contaminated food or drink, person-to-person contact, or direct contact with infected faeces. Childhood diarrhoea and associated mortality are often attributed to a combination of risk factors, including environmental factors like poor access to clean water, sanitation, and hygiene, as well as biological and social variables (Cheng et al., 2012; Mebrahtom et al., 2022).

2. 3 Burden of Diarrhoea Disease

Diarrhoea is a primary cause of under-five morbidity and deaths. Diarrhoea affects persons in low-income societies significantly because of poor state of water, inadequate sanitation, and contamination of food (Larbi et al., 2021; Wolf et al., 2014). Improved access to WASH were one

of the main considerations of the Millennium Development Goals (MDGs). Despite reports from the United Nations and WHO claiming that the MDG for access to water access had been met, there have been considerable complaints that these claims are exaggerated (Hunter et al., 2013). Even if the MDG targets had been fully met, there remain many hundreds of millions of people without access to improved source of drinking water and sanitation. It is obvious that adopting healthy behaviours such as creating sanitation infrastructure, utilizing safely managed water, and decreasing diarrhoea-related mortality in high-income countries has helped to ease the burden of diarrhoea disease (Prüss-ustün et al., 2019). Although different preventive measures have been implemented at the individual and governmental levels, the incidence of diarrhoea mortality has remained steady. In addition to this, those who have been treated also occasionally die and other forms of various public health costs such as slowed immunological response, stunted growth, and impaired cognitive development occur (Behera & Mishra, 2022; Khalil et al., 2016). Diarrhoea has been highlighted as one of the frequent health issues treated in outpatient clinics in Ghana (Osumanu, 2007). An average of 3,249 under-five Ghanaian children dies every year due to diarrhoea (UNICEF, 2018b).

Diarrhoea can have severe economic consequences, particularly for low-income households, in addition to its mortality and morbidity effects. Out-of-pocket expenses for healthcare can cause significant financial strain, leading to a catastrophic impact on households (Khan et al., 2017). This unequal burden on the poorest households highlights the need for interventions to improve access to healthcare and reduce the economic impact of diarrhoea (Hasan et al., 2021; Khan et al., 2017). Diarrhoea has a significant indirect cost, as it often results in women missing work and spending time in hospitals caring for ill children (Aikins et al., 2010). Furthermore, the family's earnings are often used to cover the costs of medication, lodging, and transportation to and from

the hospital (Aikins et al., 2010; Kumi-Kyereme & Amo-Adjei, 2016). The government bears a substantial burden in addressing diarrhoea infections, with an estimated \$33 million spent annually in Ghana on the direct and indirect expenses of diarrhoea illnesses (Aikins et al., 2010).

2. 4 Source of Drinking water and diarrhoea incidence

This section of the literature review provides a comprehensive analysis of studies related to drinking water and its impact on diarrhoea risk. Wolf et al., (2022) conducted a meta-analysis in Low and Middle Income Countries and found that providing an improved source of drinking water on premises significantly reduced the risk of diarrhoea, with a 52% reduction compared to unimproved sources. However, they found no additional reduction when comparing piped drinking water on premises to other improved sources. Boadi and Kuitunen, (2005) emphasized the importance of private indoor pipes and standpipes in reducing diarrhoea prevalence, highlighting the role of sanitation conditions in ensuring the safety of vended water. Troeger et al., (2018), using data from 195 countries stressed that drinking from an unimproved source remains a significant risk factor for childhood diarrhoea, attributing 72.1% of diarrhoea-related deaths in children under five to this issue.

Kobayashi et al., (2022) conducted an investigation into the relationship between different water sources and the risk of diarrhoea in Nepal's Kathmandu valley. The study discovered that piped water was the cleanest source, while those relying on jar or tanker water faced a higher risk of contracting diarrhoea. Mebrahtom et al., (2022) identified unsafe water storage and the absence of point-of-use water treatment as significant contributing factors to infant diarrhoea.

Sinmegn Mihrete et al., (2014) emphasized the significance of improved drinking water sources in reducing the risk of diarrhoea, yet a study by Saha et al., (2022) found that children using better water sources had a higher incidence of diarrhoea. This finding necessitates further examination.

Hunter et al., (2013) articulated the significance of improved drinking water sources in decreasing diarrhoea-related morbidities, particularly in impoverished regions. Hunter et al., (2013) also emphasized the marketing of household water treatment, although there is limited evidence of its effectiveness. Moreover, Hunter et al., (2013) noted concerns about the safety of rainwater collection but discovered a lower risk of diarrhoea-related morbidity associated with rainwater and a higher risk with protected groundwater supplies. Providing access to clean drinking water is of utmost importance in reducing the incidence of diarrhoea in children under the age of five, especially in areas where such resources are scarce. The lack of safe and clean water poses significant risks to the health and well-being of children. Therefore, it is imperative that universal access to safe drinking water be ensured in order to effectively prevent diarrhoea and protect the health of young children.

2. 5 Sanitation and diarrhoea incidence

This section of the literature review examines the relationship between sanitation and the prevalence of diarrhoea, a topic that has been extensively explored in scholarly work. Troeger et al., (2018) utilized Bayesian hierarchical modeling to establish that unsafe sanitation is a substantial contributor to under-five diarrhoea mortality, accounting for 56.4%. Troeger et al., (2018) emphasized the potential for reducing morbidity and mortality in this age group by improving household sanitation conditions.

Saha et al., (2022) Saha et al. (2022) conducted research in rural India and found that children using unimproved toilet facilities were more likely to contract diarrhoea, with the likelihood increasing when households shared toilet facilities or inappropriately disposed of children's stool. These findings underscore the significant link between sanitation practices and diarrhoea incidence. Wolf et al., (2022) demonstrated the impact of sanitation initiatives, showing a 24% reduction in diarrhoea risk in low and middle-income countries. Additionally, establishing sewer connections significantly reduced the risk of diarrhoea by 47%, highlighting the importance of sanitation infrastructure.

Larbi et al., (2021) conducted a study in densely populated urban neighborhoods in Accra, Ghana and emphasized the relationship between proper liquid waste disposal (into septic tanks or public sewers) and reduced diarrhoea cases, compared to inappropriate liquid waste disposal. These findings further reinforce the strong association between sanitation and diarrhea incidence. Mebrahtom et al., (2022) found significant risk factors associated with infant diarrhoea death, including households with inadequate sanitation conditions and improper disposal of child faeces. Sinmegn Mihrete et al., (2014) reinforced the importance of proper disposal of children's stool, indicating a 60% decrease in household diarrhoea incidence when this practice was observed.

Masangwi et al., (2010) explored the determinants of under-five diarrhoea in Malawi, noting that households without toilet facilities had a higher probability of reporting diarrhoea in their children. Notably, the study did not find a significant distinction between public toilet use and shared toilet facilities in terms of diarrhoea risk. Boadi and Kuitunen, (2005) conducted research in the Accra Metropolitan Area, revealing that toilet accessibility and availability were inversely correlated with diarrhoea incidence. Boadi and Kuitunen, (2005) also highlighted the impact of neighborhood

open defecation on diarrhoea frequency, particularly in households where open defecation was observed. The study suggested that households with a high prevalence of childhood diarrhoea were more likely to share toilets with numerous other households, linking the practice of toilet sharing to dysentery, which disproportionately affects children in low-income households. These findings contribute significantly to the ongoing debates surrounding the critical role of sanitation in preventing diarrhoea and emphasize the importance of sanitation infrastructure and practices in reducing the global burden of diarrhoea disease.

2. 6 Handwashing and diarrhoea incidence

This section of the literature review examines the impact of handwashing practices on childhood diarrhoea incidence. Hashi et al., (2017) conducted longitudinal research in rural Somali settings and found that using soap to wash hands reduced the risk of diarrhoea by thirty-five percent. Similarly, Abuzerr et al., (2020) conducted a cross-sectional household study in the Gaza Strip and established a strong relationship between handwashing behaviors and diarrhoea incidence. Handwashing before and after specific activities, such as eating, using the toilet, and after cooking, significantly reduced the occurrence of diarrhoea. This highlights the critical role of handwashing in preventing diarrhoea.

Khan et al., (2021) explored the connection between handwashing behavior and communicable diseases among under-five children in urban poor communities in New Delhi. They identified handwashing as a significant determinant of childhood diarrhoea, with particular emphasis on the importance of handwashing after defecation. In contrast, Apanga and Kumbeni, (2021) utilized data from the 2017-2018 Ghana Multiple Indicator Cluster Survey to investigate factors associated with diarrhoea. Surprisingly, they did not find a direct association between having a handwashing

facility at home and diarrhoea incidence. This discrepancy may be attributed to the fact that the mere existence of a handwashing facility does not necessarily reflect actual handwashing behavior. Wolf et al., (2022) supported the findings of several previous studies by demonstrating that promoting handwashing with soap significantly reduced the incidence of diarrhoea by thirty percent. These insights collectively stress the need for both promoting proper handwashing behavior and ensuring consistent utilization of handwashing facilities to combat childhood diarrhoea effectively.

2. 7 Mothers Socio-demographic characteristics and diarrhoea incidence.

This section of the literature review examines the relationship between maternal education, age, birth intervals, and childhood diarrhoea. Abuzerr et al., (2020) and Apanga & Kumbeni, (2021) demonstrate that a mother's educational level has a significant influence on the likelihood of childhood diarrhoea, with higher education correlated with a reduced risk. Education equips mothers with the knowledge and information necessary for effective child health practices, underscoring the crucial role of maternal education in children's well-being.

Mebrahtom et al., (2022) and Demissie et al., (2021) highlight the association between maternal age and childhood diarrhoea, with younger mothers having a higher risk of their children contracting diarrhoea. Birth intervals, as noted by Tampah-Naah, (2019) also emerge as a significant factor, with shorter intervals potentially limiting the time available for each child's care and potentially disrupting feeding routines. These findings collectively emphasize the complex interplay of maternal education, age, and birth intervals in child health, accentuating the importance of considering these factors in an attempt to reduce childhood diarrhoea.

2. 8 Characteristics of under-five children and diarrhoea incidence

This section of the literature review delves into the association between children's characteristics and childhood diarrhoea. Abuzerr et al., (2020) revealed that children aged 4-5 years in Gaza Strip had the highest incidence of diarrhoea, possibly due to their increased exposure to bacteria and viruses. This finding aligns with Sinmegn Mihrete et al., (2014), who emphasized the link between childhood diarrhoea and age, as well as birth order. Children aged 6-11 and 12-23 months were found to be more susceptible, with a notably higher risk for the latter age group (Tampah-Naah, 2019). Children in this age range are typically more mobile and curious. They often explore their environment, touching surfaces, objects, and putting things in their mouths. This behavior increases their exposure to potentially contaminated substances and increases the risk of ingesting harmful pathogens. Getachew et al., (2018) and Siraj et al., (2008) also observed age as a significant predictor of diarrhoea, with younger children being more vulnerable. Also, Lechtenfeld, (2012) explored diarrhoea occurrence in children below age five in urban Yemen and found that boys and girls had an equal risk of infection.

2. 9 Place of residence and diarrhoea incidence

The link between childhood diarrhoea and place of residence is often tied to environmental factors. Rural areas may lack access to clean water and sanitation, increasing diarrhoea risk, while urban areas can face health challenges due to concentrated poverty and living conditions, impacting children's health. Kumi-Kyereme & Amo-Adjei's, (2016) study disclosed that children residing in rural areas of Ghana had a lower likelihood of experiencing diarrhoea compared to their urban counterparts. Additionally, their findings suggested that rural residents reported lower rates of diarrhoea than those in metropolitan areas, although the difference was not statistically significant.

These observations are in line with the concept of the urban health penalty, which posits that cities concentrate impoverished populations, leading to adverse conditions and a disproportionate burden of poor health. Tampah-Naah (2019) further reinforced these findings by emphasizing the significant impact of a child's living environment on morbidity. Conversely, Wolf et al., (2014) found that residence location was significantly associated with diarrhoea occurrence, with a substantial burden of diarrhoea prevalence observed in rural areas. Factors contributing to the higher incidence of diarrhoea in rural settings include the consumption of contaminated food, use of unimproved water sources, improper water handling, lower socioeconomic status, and inadequate sanitation and hygiene practices.

2. 10 Household Wealth and diarrhoea incidence

Household wealth is linked to diarrhoea incidence through its influence on access to improved water, sanitation, and hygiene (WASH) facilities. Apanga & Kumbeni, (2021) and Demissie et al., (2021) reveal that children from wealthier households experience lower odds of contracting diarrhoea, with the risk decreasing as household wealth increases. Notably, children in urban settings generally have lower overall rates of diarrhoea, and even economically disadvantaged urban populations fare better than their rural counterparts (Kumi-Kyereme & Amo-Adjei, 2016). Kumi-Kyereme & Amo-Adjei, (2016) argued that the link between household wealth and diarrhoea outcomes primarily operates through disparities in access to improved WASH facilities, which play a vital role in illness prevention and treatment, as well as child survival. Tareke et al., (2022) further support this association, showing that children from low- and middle-income households face a higher likelihood of diarrhoea infections due to inadequate resources for proper feeding and basic hygiene. This income gradient is particularly evident in Western and Central

Africa, where children from the poorest quintile experience significantly higher diarrhoea morbidity compared to those from the wealthiest quintile (Weber et al., 2021)

2. 11 Theoretical framework

The Mosley and Chen proximate determinants for analysing child survival in developing nations served as the foundation for this study (Mosley & Chen, 1984). The aforementioned framework allows for the measurement of both morbidity and mortality in a single variable. The framework suggests that various social and economic factors impact child mortality. To affect mortality rates, these factors need to operate through more immediate and direct mechanisms, such as access to water, sanitation and hygiene. The proximate determinants were divided by Mosley and Chen into five major categories.

Maternal factors: In their study, Mosley and Chen argue that education, income, and age of the mother affect the health of the child.

Environmental contamination: Mosley and Chen asserted that the environment serves as a pathway for the spread of diseases. This assertion can be validated by directly measuring the routes of disease transmission, which may involve microbial examinations of various samples, including air, food, water, and vectors. Contaminated water sources, often due to pollutants or microbial pathogens, can lead to the ingestion of harmful bacteria, viruses, and parasites. This can result in waterborne diarrhoea diseases, such as cholera or cryptosporidiosis. Also, limited access to safe and clean drinking water sources can force people to use unsafe water for drinking and cooking, increasing the risk of diarrhoea infections. Consequently, diarrhoea infections are more likely to affect children under the age of five whose drinking water comes from unimproved sources.

Children under the age of five who reside in households where human excreta are deposited inappropriately on the premises are at a significant risk of developing diarrhoea.

Personal illness control: It is more likely that mothers who have education send their children to child welfare clinics for rotavirus vaccination, zinc tablet supplementation, severe diarrhoea treatment, and initiate or give oral rehydration solution to their children who are suffering from diarrhea. Once more, mothers and other caregivers who possess education will make sure that bottles used to feed children are thoroughly cleansed and maintained hygienically to stop the spread of diseases like diarrhoea.

Nutrient deficiency: In relation to nutrient shortage, Mosley and Chen assert that a child's survival is influenced by both the mother's diet and nutritional status as well as the child's food and nutritional status, much as they maintained that exposure to environmental factors could lead to the development of disease in an individual. Mosley and Chen held the opinion that the mother's diet and nutrients during pregnancy and breastfeeding have an impact on the quantity, quality, and nutrients of breast milk as well as the weight of the fetus. Mothers who exclusively breastfeed their children will shield them from diarrheal illnesses, especially newborns. Exclusive breastfeeding will almost certainly strengthen the kids' immune systems so they can fight off any pathogens.

The socioeconomic determinants were the second factor the framework considered (independent variables). Mosley and Chen contend that these variables work in conjunction with the proximate determinant to determine the degree of growth faltering. The socioeconomic determinants were grouped into three categories of variables. These were individual, household and community level variables. The individual variables included traditions/norms/attitudes while income and wealth variables were considered household level variables. Community-level variables comprised political economy, ecological context, and health system.

The analytical framework of Mosley and Chen's study was adapted and modified to include four groups of variables: individual, mother, household, and environmental factors. In this study, the sex and age of child was classified as individual factors. The mothers' characteristics included the mothers' level of education, marital status and maternal age. The household factors also included place of residence, household size and wealth quintile of the household. The environmental factors included source drinking water, sanitation (toilet facilities) and hygiene (handwashing) conditions available to households.

Limitations of the Mosley and Chen Framework

The Mosley and Chen theoretical framework, which was developed in 1984, presents a specific perspective on the interrelationships between social, economic, and proximate determinants in the context of child survival in developing countries. However, as our understanding of complex systems has advanced, it has become evident that the causality between these determinants is not unidirectional. The notion that social and economic factors directly impact child survival through a linear pathway is too simplistic, as it fails to account for the complex dynamics at play. A more contemporary view acknowledges that causation is often bidirectional.

While the influence of maternal factors on child survival cannot be denied, the Mosley and Chen framework risks overemphasizing these variables to the detriment of other caregivers and community-level influences. This narrow focus may also perpetuate gender stereotypes by placing an inordinate burden on mothers for child survival. Such oversimplification neglects the dynamic roles played by fathers and other caregivers in shaping a child's health and development.

2. 12 Conceptual framework

The conceptual framework depicted in Figure 1 examines the relationship between Water, Sanitation, and Hygiene (WASH) and the incidence of diarrhoea among children under the age of five. The investigation's primary focus is the dependent variable, "Had Diarrhoea," which is classified into two outcomes: "Yes" and "No." This variable reflects the occurrence or absence of diarrhoea among children under five.

Drinking water as discussed in literature has an influence on diarrhoea incidence among children under-five years. This is due to the possibility of contamination of drinking water from the source. Also, the time it takes to draw water from source might expose the water to diarrhoea causing pathogens. Similarly, whether the water used is been treated or not can significantly influence water quality. Based on this, the researcher posits that creating an index with these variables will give a better understanding of how these variables influence the quality of drinking water and their subsequent effect on diarrhoea incidence among children under five.

Furthermore, varying sanitation situations as established in literature can have an influence on diarrhoea incidence in children. The type of toilet facility, the time it takes to access the facility, and whether the facility is shared with other households can significantly affect a person's exposure to diarrhoea pathogens, and ultimately affect diarrhoea incidence in children. In the absence of proper sanitation facilities, open defecation near water sources or in areas where children play can lead to the contamination of the environment with fecal matter, providing a breeding ground for bacteria and viruses that cause diarrhoea. To assess the impact of these conditions on diarrhoea in children under five, a sanitation index was created.

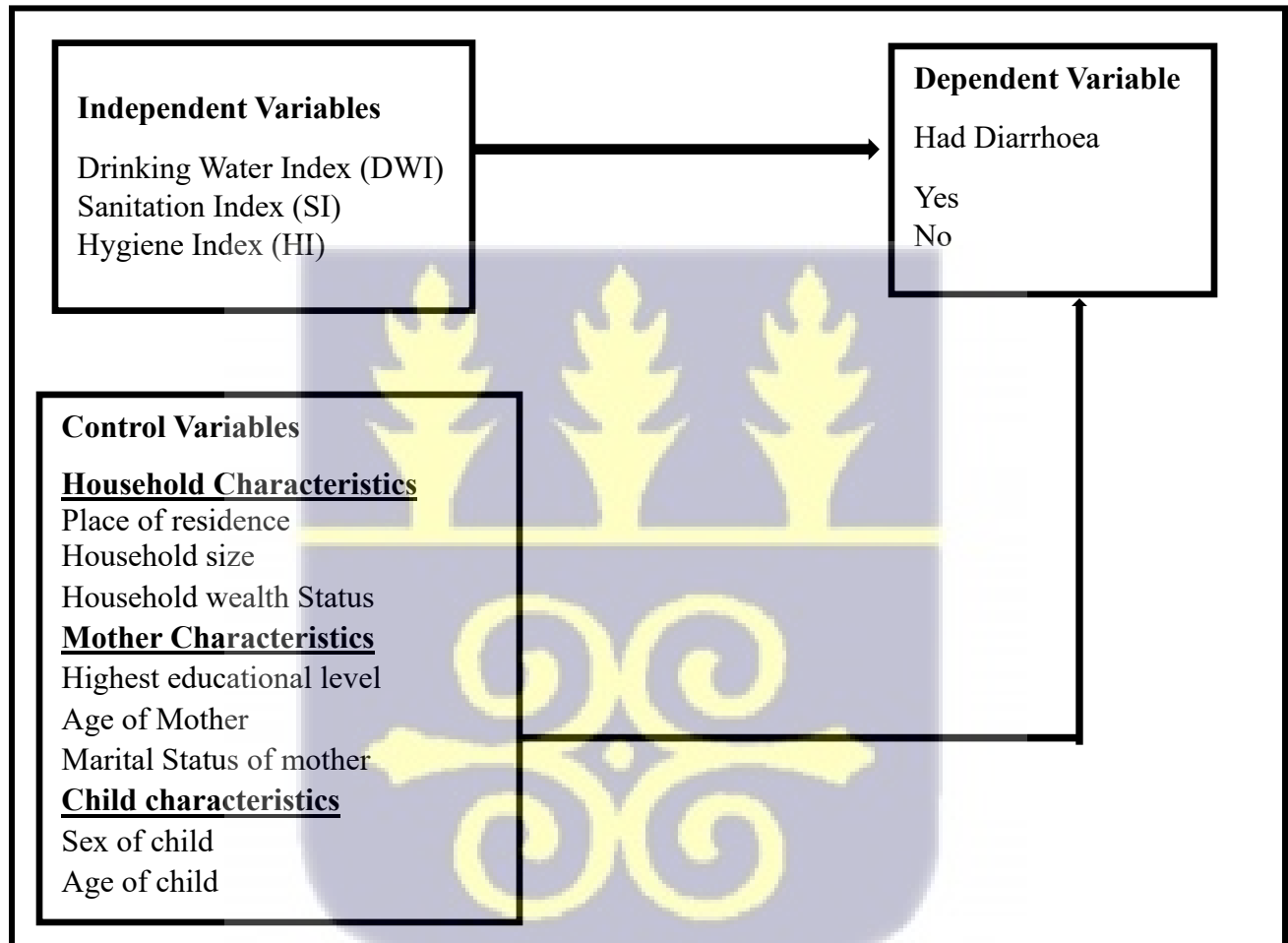
Handwashing practices are also known to greatly affect diarrhoea incidence in children. The presence of a handwashing facility can indicate the potential for handwashing in the household,

but the availability of water and detergents at the facility might indicate an increased potential for handwashing. Poor hygiene practices can facilitate the transmission of pathogens, contributing to the incidence of diarrhoea. To explore the impact of handwashing on diarrhoea incidence among children under five, a hygiene index was created.

Household characteristics, such as place of residence, household size, and wealth status, can have an impact on diarrhoea incidence in children under five years of age. For instance, children from wealthier households may have better access to water, sanitation, and hygiene (WASH) facilities, which can significantly reduce their exposure to diarrhoea-causing pathogens. Similarly, maternal characteristics, such as educational level, age, and marital status, can influence the prevention and exposure to bacteria and viruses that cause diarrhoea. Mothers with higher educational levels may be more knowledgeable and able to implement proper hygiene and sanitation practices. They may also have better access to healthcare information, leading to quicker and more effective responses to diarrhoea symptoms in their children. Conversely, younger, less educated mothers may face challenges in adopting and implementing preventive measures. Furthermore, a child's age and gender can influence their vulnerability to diarrhoea. Younger children, especially those under two years of age, may be more susceptible due to their developing immune systems.

Utilizing the 2014 Ghana Demographic and Health Survey data, the researcher implemented the conceptual framework during the analysis phase to direct the examination and interpretation of the data. The framework served as a tool for organizing and comprehending the data, enabling the researcher to identify pertinent variables and relationships. Through aligning the variables within the dataset with the framework, the researcher could investigate the hypothesized associations and patterns.

Figure 1: Conceptual Framework showing the relationship between independent variables and diarrhoea incidence among children under five.

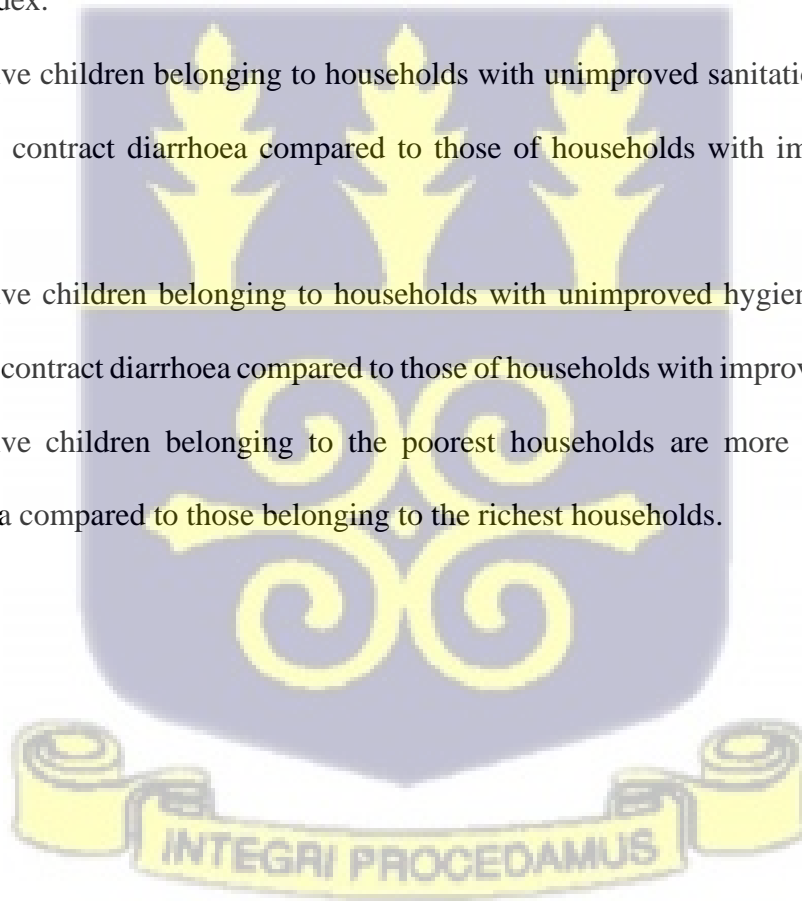


Source: Author's Construct 2022

2. 13 Hypotheses

Considering the reviewed literature and the conceptual framework, the following hypotheses will guide the study.

- i. Under-five children belonging to households with unimproved drinking water index are more likely to contract diarrhoea compared to those of households with improved drinking water index.
- ii. Under-five children belonging to households with unimproved sanitation index are more likely to contract diarrhoea compared to those of households with improved sanitation index.
- iii. Under-five children belonging to households with unimproved hygiene index are more likely to contract diarrhoea compared to those of households with improved hygiene index.
- iv. Under-five children belonging to the poorest households are more likely to contract diarrhoea compared to those belonging to the richest households.



CHAPTER 3

3.0 METHODOLOGY

3.1 Introduction

This chapter presents an overview of the source of data, study design and selection. The chapter also describes the study population, how variables were categorized, data analysis technique as well as analyses and limitations pertaining to this study.

3.2 Source of data

Data for this study was primarily derived from the Ghana Demographic and Health Survey (GDHS) that was carried out in 2014. It is the sixth in a line of demographic and health surveys that were carried out in Ghana in 1988, 1993, 1998, 2003, 2008 and 2014. The 2014 GDHS is a comprehensive national survey that was conducted among 12,810 households in 427 clusters as a representative probability sample. One of the main goals of the 2014 GDHS, as with previous surveys, was to provide data on child morbidity and mortality. The survey included all women aged 15 to 49 years who are usual members of the chosen households and visitors who stayed in the households the night before the survey. The 2014 GDHS sample was designed to generate estimates of demographic and health parameters, such as fertility and death rates, for the entire nation, for urban and rural areas, and also for the ten regions of Ghana before the introduction of new regions. All under-five children who were alive during the time of the interview were included in the data set, as well as children who passed away but would have turned five at the time of the interview. Households participating in the survey were questioned regarding whether a child under the age of five had experienced a fever or diarrhoea two weeks before the survey. In addition, in-depth data was gathered on mothers' demographic and socioeconomic status (educational level,

age, marital status). Data was also gathered on water, sanitation, and hygiene conditions in households. This data will provide information that is used to determine the effect of household WASH conditions on under-five diarrhoea incidence.

3. 2 Sample Design and Selection

The Ghana Statistical Services used the 2010 population and housing census as the sampling frame for the 2014 Ghana Demographic and Health Survey (GDHS). Enumeration areas (EAs) created during the 2010 Population and Housing Census were fully accounted for in the census frame. The sample for the 2014 GDHS involved two stages of stratification and selection. Each region was divided into urban and rural areas, resulting in a total of twenty sampling strata. Within each stratum, EAs were selected through a process of implicit stratification and proportionate allotment. Prior to selecting respondents based on administrative units and utilizing probability proportional to size sampling, 427 EAs were chosen in the first stage based on their size in the 2010 PHC. Within these selected EAs, household lists were created to serve as the sampling frame for household selection in the second stage. In some cases, large EAs were divided into segments, with one segment chosen for the survey. The 2014 GDHS clusters consisted of either entire EAs or segments of EAs. The second selection round involved choosing 30 households per cluster through systematic selection from the household listings. Interviewers conducted surveys with only the selected households.

3. 4 Study Population

The study focused on children under the age of five, and the sample included 5,695 children living in households at the time of the survey.

3. 5 Categorization of variables

3.5. 1 Dependent variable: Incidence of Diarrhoea

Diarrhoea in children below five years was the dependent variable for this study. Mothers were interviewed to find out if their children below five years had experienced diarrhoea two weeks before the survey was conducted. Mothers with children had experienced diarrhoea answered "Yes," whereas mothers whose children did not have an episode of diarrhoea answered "No". The responses were coded as 1 for "Yes", 2 for "No" and 3 for "don't know". In this study, diarrhoea incidence was considered as a dichotomous variable and recoded as 1 = Yes and 0 = No. "Don't know" responses were dropped. The response "don't know" was so insignificant that it did not affect the outcome regardless of how it was handled since there was less than one percent cases of "don't know".

3.5. 2 Independent Variables

The study computed three indexes which served as the main independent variables. The independent variables covered three areas or fields; drinking water index (DWI), sanitation index (SI) and hygiene index (HI). The use of indices is essential for this study, as it facilitates a detailed analysis that goes beyond the evaluation of individual variables. By consolidating measures for each aspect of WASH, indices offer a comprehensive perspective that takes into account the relationship between various factors. This approach not only simplifies the complexity associated with multiple variables, but also enables identification of potential correlations between WASH conditions and the incidence of diarrhoea among children under five.

3.5.2. 1 Drinking Water Index

The drinking water index was computed using four measures: (1) the source of drinking water for household members, (2) how long it takes to get drinking water and come back, (3) household water treatment and (4) type of water treatment. For the first dimension, households were asked about where they derive drinking water and they provided the following responses: piped into dwelling, piped into yard/plot, public tap/standpipe, borehole, protected well, unprotected well, protected spring, river, rainwater, tanker truck, cart with a small tank, bottled water, sachet water and other. For this research, the different drinking water sources were recoded as “1” and “0”, with “1” indicating an improved source of drinking water and “0” representing an unimproved source of drinking water. The improved sources include piped-into dwellings/homes, piped to yard or plot, public taps, boreholes, protected well, protected springs and rainwater. One may argue the classification of rainwater, but rainwater was classified as an improved source of drinking water by the WHO/UNICEF Joint Monitoring Programme in 2018. The unimproved source includes unprotected well, unprotected springs, and river. Bottled water, sachet, tanker truck, and cart with small tank water were classified as unimproved by WHO/UNICEF in 2005 because they argued that the source of the water was unknown and again the treatment could not be guaranteed. However, a recent review of the source of water by the WHO/UNICEF has categorized these sources as improved (WHO/UNICEF, 2018). Therefore, bottled water, sachet water, tanker truck, and cart with small tank of water were classified as improved sources of drinking water in this study. “Other” source was recoded as an unimproved source because it is argued that respondents or mothers couldn't tell where their water came from.

The argument is not only about the source of drinking water but how long it takes to go get water and come back. Thus, for the second measure of the drinking water index, households were also

asked the number of minutes it takes to go get water and come back. The responses were recoded into one “1” basic water service and zero “0” as not basic water service. According to the WHO/UNICEF joint monitoring programme, basic water services imply fetching water from an improved source which does not take more than thirty (30) minutes to go on a round trip to get water including queuing. Therefore, responses ranging from zero (0) to 30 minutes were categorized as having access to basic water services and otherwise as not having access to basic water services.

Water from improved sources do not automatically translate into safe water for drinking as some improved sources of drinking water are contaminated by other external factors. Thus, for the third measure of the drinking water index, household water treatment was assessed to find out if anything was done to the water to make it safe for drinking. The responses were coded as “1” Yes and “2” No. The response “No” was recoded as “0” to ensure consistency in creating the index. However, not all methods of water treatment were an improved way of treating water. As such, households’ method of water treatment was re-categorized into safe treatment and unsafe treatment. Thus, all who treated their water but not with an improved method were put in the same category as households that did not treat their water at all. Households that treated their drinking water were asked what they do to usually make the water safe. The responses accompanying this question were boil, add bleach/chlorine/alum, strain through a cloth/use water filter, solar disinfection, let it stand and settle, camphor/naphthalene, purification tablet and other. Safe water treatment was coded as “1” and unsafe water treatment was coded as “0”. Safe water treatment included boiling, adding bleach/chlorine/alum, straining through a cloth/using a water filter, and solar disinfection while unsafe water treatment included letting it stand and settle, camphor/naphthalene, purification tablet and other specifics.

The drinking water index was calculated as a simple sum of the variables. The maximum possible score of the drinking water index was three (3). Therefore, a score of 3 represented an improved drinking water condition and a score of 0 to 2 represented an unimproved drinking water condition.

3.5.2. 2 Sanitation Index

The sanitation index was computed using three measures: (1) the type of toilet facility for household members, (2) whether members of the household share toilet facility with other household members, (3) how long it takes to get to toilet facility and come back. For the first dimension, households were asked the type of toilet facility they use and the following responses were provided: flush to a piped sewer system, flush to a septic tank, flush to pit latrine, flush to somewhere else, flush don't know where, ventilated improved pit latrine, pit latrine with slab, pit latrine without slab/ open pit, bucket toilet, hanging toilet/hanging latrine, no facility/bush/field and other. For this study, the different type of toilet facilities were grouped as “1” and “0”, with “1” representing an improved type of toilet facility and “0” signifying an unimproved type of toilet facility. The improved type of toilet facilities were flush to a piped sewer system, flush to a septic tank, flush to pit latrine, flush to somewhere else, flush don't know where, ventilated improved pit latrine, and pit latrine with a slab. The unimproved include pit latrines without slab/ open pits, bucket toilets, hanging toilets/hanging latrines, no facility/bush/field, and others.

When sanitation facility is shared with other households it is classified as unimproved (WHO & UNICEF, 2010). Thus, for the second measure of sanitation index household were asked whether members of the household shared the toilet facility with other household members. The responses were “Yes, other households only”, “Yes, public” and “No”. The response “No” was recoded

from 3 to “1” and identified as improved whereas the response “Yes, other households only”, and “Yes, public” were recoded from “2” and “3” to “0” and identified as unimproved.

For the third dimension of sanitation index, how long it takes an individual to go to the location of the toilet facility and come back was used. Therefore, responses ranging from zero (0) to 30 minutes were categorized as improved and otherwise as unimproved. The sanitation index was calculated as a simple sum of the variables. The maximum possible score of the sanitation index was three (3). Therefore, a score of 3 represented an improved sanitation condition and a score of 0 to 2 represented an unimproved sanitation condition.

3.5.2. 3 Hygiene Index.

The hygiene index was computed using three measures: (1) whether a household had a handwashing facility, (2) whether the presence of water was observed at the handwashing place, (3) whether soap or detergent was observed at the handwashing place. For the first dimension of hygiene index, whether a household handwashing facility was observed was used and the response to this question were “observed”, “not observed, not in dwelling/yard/plot”, “not observed, no permission to see” and “not observed, other reason”. The various responses were grouped into observed and not observed. The response observed was coded as “1” and all other responses recoded as not observed as “0”.

For the second measure of the hygiene index, whether the presence of water at the handwashing place was observed was used. The response to the question was either water is available, or water is not available. They were coded 1 and 2 respectively. However, water is not available was recoded to “0” to make it consistent with the computation of the index.

For the third measure of hygiene index, observing the presence of soap or detergent at the handwashing facility was also used. The responses were “soap or detergent”, “Ash, sand, mud” and “none”. Soap or detergent was coded as “1” whereas “Ash, sand, mud” and “none” were recoded as “0”. The hygiene index was calculated as a simple sum of the variables. The maximum possible score for the hygiene index was three (3). Thus, a score of 3 represented an improved handwashing practice and a score of 0 to 2 represented an unimproved handwashing practice.

3.5.3 Control Variables

In addition to our primary focus on household water, sanitation, and hygiene conditions and their impact on childhood diarrhoea incidence, the study recognized the significance of other variables that have been indicated in prior studies as potential factors affecting diarrhoea incidence. To ensure a thorough analysis, the researcher included these 'other variables' as control factors in the study. These control variables include place of residence (categorized as rural or urban), household size, household wealth quintile, mothers' educational level, maternal age, maternal marital status, child age, and child gender. While not the primary focus of our investigation, these control variables were considered due to their potential influence on childhood diarrhoea incidence. The inclusion of these controls enables us to measure the relationship between household WASH conditions and under-five diarrhoea prevalence in Ghana while accounting for the influence of these additional factors

Table 3.1: Measurement of study variables

Dependent Variable	Had Diarrhoea	Yes No
Independent Variables	Drinking Water Index	Unimproved, Improved
	Sanitation Index	Unimproved, Improved
	Hygiene index	Unimproved, Improved
Control Variables	Place of residence	Urban, Rural
	Household size	1-3 HH members, 4-6 HH members, 7-9 HH members, 10 or more HH members
	Wealth index	Poorest, Poorer, Middle, Richer, Richest
	Mothers' Level of education	No education, Primary, Middle/JSS/JHS, Secondary/SHS, Higher
	Current marital status	Never married, Married, formerly married
	Age 5-year groups	15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49
	Sex of child	Male, Female
	Age of child (months)	0-11, 12-23, 24-35, 36-47, 48-59

3. 6 Data Analysis Techniques

Data analysis was performed at three levels: univariate, bivariate, and multivariate levels.

Univariate analysis was performed to explore the background characteristics of the study sample

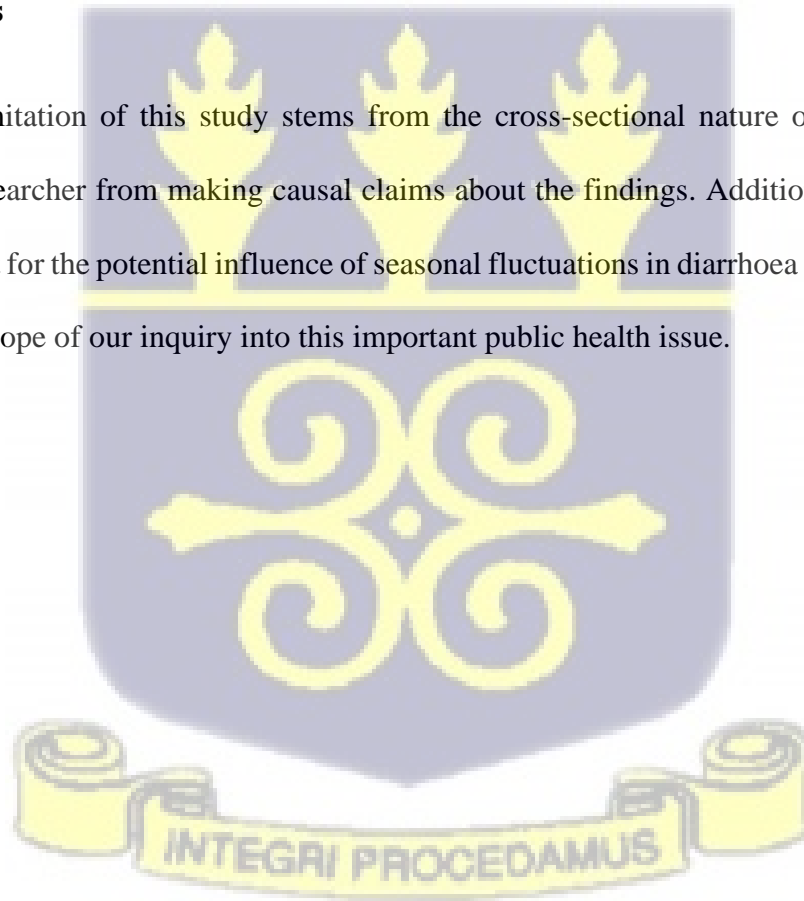
and the distribution of WASH indices. Descriptive statistics such as frequencies and percentage distributions were utilized in this regard. Univariate analysis was suitable in informing the objective because it allowed the researcher to gain a comprehensive understanding of the study sample and the distribution of WASH (Water, Sanitation, and Hygiene) indices. To examine the background characteristics and WASH indices that are associated with the incidence of diarrhoea among children under five years in Ghana, chi square cross tabulation was utilized to achieve this objective at the bivariate level. Chi square cross tabulation is suitable for achieving this objective because it focuses on exploring the relationships between two variables. In this case, it helps to understand the associations between background characteristics (e.g., age, gender, socio-economic status), WASH indices and the incidence of diarrhoea among children under five years in Ghana. Associations were tested at the 5% (0.05) level of significance. An alpha value less than 0.05 indicated that there was an association between the independent variables and under-five diarrhoea incidence, but an α -value that is above or equal to 0.05 indicated that there was no association.

A binary logistic regression model was employed at the multivariate level to evaluate the predictors of diarrhoea incidence among children under five years of age in Ghana. This technique is appropriate for achieving objective three of the study, as it involves the simultaneous examination of multiple variables to determine their collective impact on the occurrence of diarrhoea among children under five years of age in Ghana. The binary logistic regression model was used because the dependent variable is dichotomous, with values of "0" and "1". Two set of models were specified, model 1 examined the relationship between WASH indices and under-five diarrhoea incidence, and model 2 assessed the relationship between WASH indices, household characteristics, mother characteristics, Child characteristics and under-five diarrhoea incidence. Odds ratios were employed in both models to explain the relationship between indicator variables

and the outcome variable, a p-value showed the degree of significance (p-value 0.05), and the confidence interval illustrated the range of values the odds ratio lay within. In the analysis, the reference category was denoted as RC. An odds ratio of 1 indicates the lack of an association, an odds ratio that was less than 1 indicated a lower probability, and an odds ratio that was greater than 1 indicated increased risk of having diarrhoea.

3.7 Limitations

One notable limitation of this study stems from the cross-sectional nature of the data, which prevents the researcher from making causal claims about the findings. Additionally, the analysis does not account for the potential influence of seasonal fluctuations in diarrhoea incidence, thereby restricting the scope of our inquiry into this important public health issue.



CHAPTER FOUR

4.0 FINDINGS OF THE STUDY

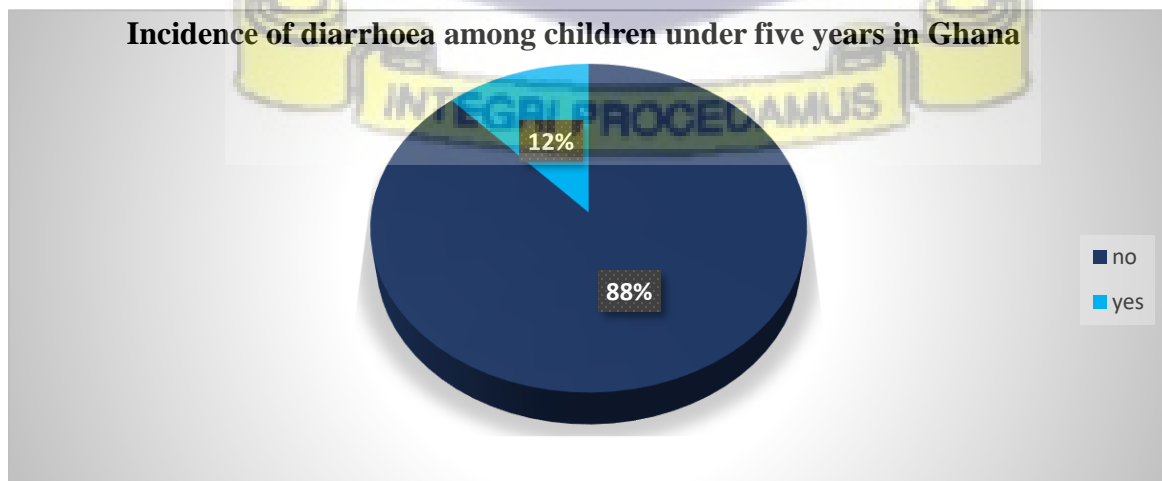
4.1 Introduction

This chapter primarily presents the findings obtained from the study. It details the background characteristics of the study participants, as well as the distribution of Water, Sanitation and Hygiene (WASH) indices. Furthermore, it outlines the association between the independent variables and the outcome variable, and concludes by highlighting the variables that may influence the risk of diarrhoea infections among children under five years in Ghana.

4.2 Diarrhoea incidence

The results presented in Figure 4.1 show that a large percentage of children in the study, about eighty-eight percent (88.2%) did not have diarrhoea two weeks preceding the survey. Also, approximately one out of ten (11.8%) children had diarrhoea two weeks preceding the survey.

Figure 2: Pie Chart showing Percentage distribution of diarrhoea incidence among children under five years



Source: Computed from 2014 GDHS

4.3 Household WASH Indicators

Table 4.1 displays the distribution of household WASH indicators. The results show that nearly all the children (97.6%) belonged to households that had an unimproved drinking water index. About 9 in 10 of the children (88.5%) belonged to households with unimproved sanitation whilst approximately 8 in 10 of the children (82.1%) belonged to households that had an unimproved hygiene index.

Table 4.1: Frequency/Percentage distribution of household WASH indicators

	Frequency (N)	Percentage (%)
Drinking Water Index		
Unimproved	5557	97.6
Improved	138	2.4
Sanitation Index		
Unimproved	5041	88.5
Good	654	11.5
Hygiene Index		
Unimproved	4674	82.1
Improved	1021	17.9
Total	5695	100.0

Source: Computed from 2014 GDHS

4. 4 Background characteristics of the study sample.

4.4. 1 Household Characteristics

Table 4.2 revealed that slightly more than half of the children in the study lived in the urban areas (55.0%). A little more than half (54.2%) were from households with four to six members with a few coming from households with ten or more members. It was observed that most of the children belonged to the poorest and the poorer households (22.2% and 21%) respectively. There was only a small variation between the richer and the richest. The proportion of children belonging to richest and richer wealth quintiles did not differ significantly (18.4% and 18.9%) respectively.

Table 4.2: Frequency/Percentage distribution of place of residence, household size, wealth quintile.

	Frequency (N)	Percentage (%)
Place of residence		
Urban	2563	45.0
Rural	3132	55.0
Household size		
1-3 HH members	1048	18.4
4-6 HH members	3088	54.2
7-9 HH members	1165	20.5
10 or more HH members	393	6.9
Wealth quintile		
Poorest	1263	22.2
Poorer	1196	21.0

Middle	1114	19.6
Richer	1074	18.9
Richest	1048	18.4
Total	5695	100.0

Source: Computed from 2014 GDHS

4.4. 2 Mother Characteristics

From table 4.3 below, it was observed that the highest proportion of under-five children belonged to mothers who had completed Middle/JSS/JHS level of education. It was also observed from Table 4.3 that few of the children belonged to mothers who had completed tertiary education.

Table 4.3: Frequency/Percentage distribution of mothers' educational level, mothers' age, and current marital status of mothers

	Frequency (N)	Percentage (%)
Mothers Educational Level		
No education	1561	27.4
Primary	1141	20.0
Middle/JSS/JHS	2208	38.8
Secondary	531	9.3
Higher	254	4.5
Mothers' age		
15-19	204	3.6
20-24	971	17.0

25-29	1421	25.0
30-34	1418	24.9
35-39	1052	18.5
40-44	488	8.6
45-49	141	2.5

Current marital status

Never Married	437	7.7
Married	4879	85.7
Formerly Married	379	6.7
Total	5695	100.0

Source: Computed from 2014 GDHS

Approximately half of the under-five children belonged to mothers between the ages of twenty-five and thirty-four years while 2.5 percent of under-five children belonged to mothers who were between the ages of 45 and 49 (Table 4.3). Also, approximately nine out of ten under-five children belonged to mothers who were married and about 7.7 percent belonging to mothers who have never been married.

4.4. 3 Child Characteristics

As gleaned from table 4.4, a little over half of the under-five children were male. It was also observed that the age of child was inversely proportional to the number of under-five children. The percentage distribution of the age of under-five children showed that the children were about evenly distributed among the various age groups.

Table 4.4: Frequency/Percentage distribution of sex of child and age of child

	Frequency (N)	Percentage (%)
Sex of child		
Male	2970	52.2
Female	2725	47.8
Total	5695	100.0
Age of child (months)		
0-11	1163	21.4
12-23	1113	20.5
24-35	1090	20.1
36-47	1060	19.5
48-59	1004	18.5
Total	5430	100.0

Source: Computed from 2014 GDHS

4.5 Test of Association between independent variables and diarrhoea incidence

4.5.1 Association between WASH indicators and diarrhoea incidence

The analysis of diarrhoea incidence in relation to various indices yielded significant insights in Table 4.5. There is no statistically significant association between drinking water index and diarrhoea incidence among children under five years, as evidenced by a p-value of 0.8170. Conversely, the Sanitation Index exhibits a highly significant association, wherein children belonging to households with improved sanitation facilities experience a significantly lower rate

of diarrhoea (p-value = 0.0000). Children belonging to households with unimproved sanitation recorded nearly twice the proportion of diarrhoea as compared to children belonging to households with improved sanitation conditions. However, there was no statistically significant association observed between the Hygiene Index and diarrhoea incidence (p-value = 0.7802).

Table 4.5: Cross-tabulations showing the relationship between drinking water index, sanitation index, hygiene index and diarrhoea incidence.

	Incidence of Diarrhoea (%)		Number	P-value
	No	Yes		
Drinking Water Index				0.8170
Unimproved	88.2	11.8	5226	
Improved	89.1	10.9	124	
Sanitation Index				0.0000
Unimproved	87.5	12.6	4733	
Improved	94.3	5.7	617	
Hygiene index				0.7802
Unimproved	88.2	11.8	4395	
Improved	88.7	11.3	955	
Total			5350	

Source: Computed from 2014 GDHS.

4.5. 2 Association between household characteristics and diarrhoea incidence.

Table 4.6 revealed that there was no significant association between place of residence and under-five diarrhoea incidence although 12.81% of children from rural areas had diarrhoea as compared

to 10.46% of children from urban areas who had diarrhoea. Household size was also not significantly associated with diarrhoea incidence. However, it was observed that households with ten or more members recorded the highest proportion of under-five diarrhoea incidence while households with members between one and three recorded the lowest proportion of under-five diarrhoea incidence. It was also observed that the wealth quintile of the household children live in was significantly associated with diarrhoea incidence. Children from poorer households recorded the highest proportion of under-five diarrhoea incidence while those from households in the richest quintile recorded the lowest.

Table 4.6: Cross-tabulations showing the relationship between of place of residence, household size, wealth quintile and diarrhoea incidence.

	Incidence of Diarrhoea (%)			P-value
	No	Yes	Number	
Place of residence				0.0725
Urban	89.5	10.5	2395	
Rural	87.2	12.8	2954	
Household size				0.3643
1-3 HH members	95.3	4.7	957	
4-6 HH members	88.0	12.0	2922	
7-9 HH members	89.2	10.8	1101	
10 or more HH members	86.5	13.5	370	
Wealth quintile				0.0007
Poorest	86.0	14.1	1187	

Poorer	85.6	14.4	1127
Middle	87.5	12.5	1053
Richer	89.9	10.1	1005
Richest	93.2	6.8	978
Total (N)			5350

Source: Computed from 2014 GDHS.

4.5. 3 Association between mother characteristics and diarrhoea incidence.

Table 4.7 revealed a significant association between mothers' educational level and incidence of diarrhoea. Children of mothers with no education recorded the highest proportion of diarrhoea incidence (11.4%) while children of mothers who have completed tertiary education recorded the lowest diarrhoea incidence (4.8%). The age of mothers was not significantly association with under-five diarrhoea incidence. However, children belonging to young mothers (15-19 years) recorded the highest proportion of diarrhoea while children of older mothers (30-34 and 40-44 years) recorded the lowest proportion. Also, there was no statistically significant association between marital status of mothers and under-five diarrhoea incidence.

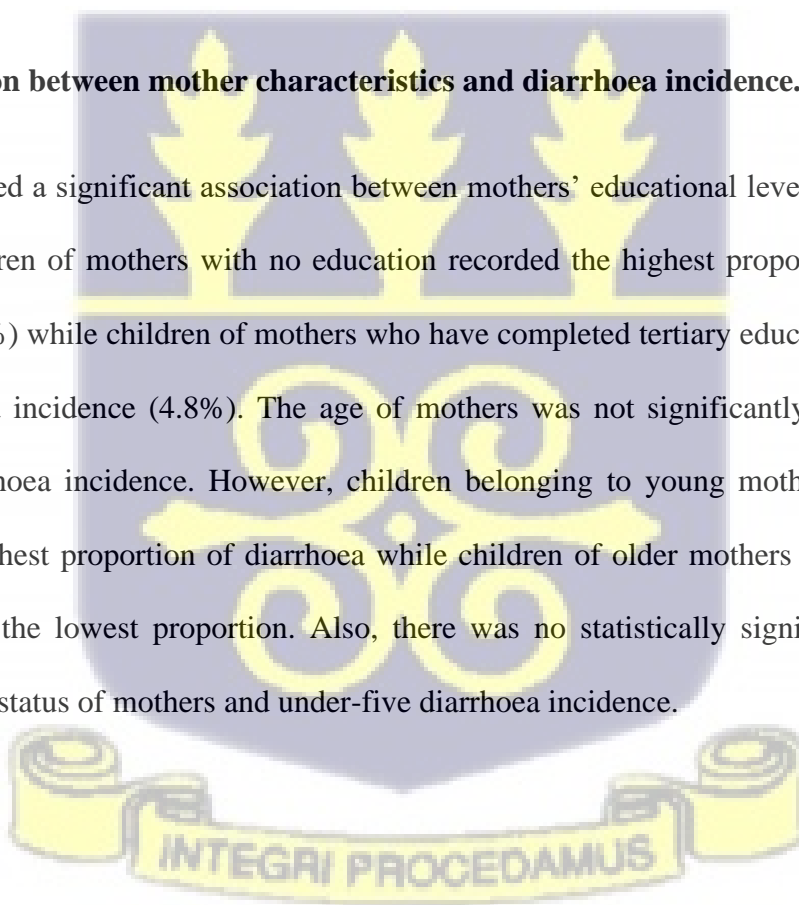


Table 4.7: Cross-tabulations showing the relationship between mothers' educational level, age of mothers, marital status of mothers and diarrhoea incidence.

	Incidence of diarrhoea (%)		Number	P-value
	No	Yes		

Mothers educational level			0.0109
No education	85.6	14.4	1458
Primary	88.6	11.4	1070
Middle/JSS/JHS	88.5	11.5	2090
Secondary/SHS	90.6	9.4	497
Higher	95.2	4.8	235
Age 5-year groups			0.2532
15-19	81.4	18.6	198
20-24	87.7	12.4	920
25-29	88.3	11.7	1349
30-34	89.3	10.7	1319
35-39	88.4	11.6	976
40-44	89.3	10.7	457
45-49	86.4	13.6	131
Current marital status			0.0593
Never Married	83.5	16.6	404
Married	88.7	11.3	4593
Formerly Married	87.8	12.2	353
Total (N)			5350

4.5. 4 Association between child characteristics and diarrhoea incidence

From table 4.8, the sex of a child was found to be significantly associated with under-five diarrhoea incidence two weeks before the survey. The results further showed that a higher proportion of male

children (13.14%) had episodes of diarrhoea two weeks preceding the survey compared to female children (10.26%). From table 4.8, the age of child was significantly associated with diarrhoea incidence. Children between the ages 12 and 23 months recorded the highest proportion of under-five diarrhoea incidence while children between the ages of 36-47 months recorded the lowest proportion of diarrhoea incidence.

Table 4.8: Cross-tabulations showing the relationship sex of child, age of child and diarrhoea incidence.

	Incidence of Diarrhoea (%)			P-value
	No	Yes	Number	
Sex of child				0.0095
Male	86.9	13.1	2781	
Female	89.7	10.3	2569	
Age of child (months)				0.0000
0-11	89.7	10.3	1147	
12-23	83.2	16.8	1097	
24-35	83.9	16.2	1074	
36-47	92.7	7.3	1044	
48-59	92.2	7.8	988	
Total (N)			5350	

Source: Computed from 2014 GDHS.

4. 6 Relationship between Independent Variables and Dependent Variables

4.6. 1 Model 1: Relationship between WASH indicators and incidence of diarrhoea among children under.

Model 1 focuses solely on WASH indices and under-five diarrhoea incidence. From Table 4.9, sanitation index was found to be a significant predictor of under-five diarrhoea incidence in Ghana. Children belonging to households with an improved sanitation index were 59% less likely to have had diarrhoea in the two weeks preceding the survey compared to children belonging to households with an unimproved sanitation index. Drinking water index and hygiene index were not significant predictors of diarrhoea incidence among children below age five.

Table 4.9: A Binary Logistic Regression Model Showing the Relationship between WASH Indices, Household Characteristics, Mothers’ Characteristics, Child Characteristics and Under-five Diarrhoea Incidence.

Indicator Variables	Incidence of Diarrhoea (Model 1)			Incidence of Diarrhoea (Model 2)		
	Odds Ratio	95% Confidence Interval	P-value	Odds Ratio	95% Confidence Interval	P-value
Drinking Water Index						
Unimproved (RC)	1.00			1.00		
Improved	0.89	(0.43,1.84)	0.7470	1.35	(0.78, 2.34)	0.2890
Sanitation Index						
Unimproved (RC)	1.00			1.00		
Improved	0.41	(0.27,0.63)	0.0000	0.57	(0.39, 0.84)	0.0020

Hygiene Index						
Unimproved (RC)	1.00			1.00		
Improved	1.09	(0.77,1.54)	0.6380	1.08	(0.84, 1.40)	0.5380
Place of Residence						
Urban				1.00		
Rural				0.77	(0.62, 0.96)	0.0210
Household Size						
1-3 HH members				1.00		
4-6 HH members				1.16	(0.91, 1.48)	0.2350
7-9 HH members				0.90	(0.67, 1.22)	0.4980
10 or more HH members				1.25	(0.86, 1.79)	0.2380
Wealth Quintile						
Poorest				1.00		
Poorer				1.07	(0.85, 1.35)	0.5530
Middle				1.03	(0.79, 1.35)	0.8340
Richer				0.70	(0.50, 0.99)	0.0410
Richest				0.54	(0.35, 0.84)	0.0060
Mothers Educational Level						
No Education				1.00		
Primary				0.82	(0.65, 1.04)	0.0960
Middle/JSS/JHS				0.84	(0.67, 1.06)	0.1460
Secondary				0.72	(0.48, 1.07)	0.1050

Higher	0.56	(0.29, 1.07)	0.0770
Age of Mother			
15-19	1.00		
20-24	0.70	(0.45, 1.07)	0.0980
25-29	0.76	(0.49, 1.16)	0.2040
30-34	0.83	(0.54, 1.28)	0.4030
35-39	0.84	(0.53, 1.31)	0.4370
40-44	0.79	(0.48, 1.29)	0.3420
45-49	0.80	(0.42, 1.52)	0.4960
Marital Status of Mother			
Never Married	1.00		
Married	0.70	(0.50, 0.98)	0.0390
Formerly Married	0.87	(0.55, 1.36)	0.5310
Sex of Child			
Male	1.00		
Female	0.71	(0.60, 0.84)	0.0000
Age of Child (Months)			
0-11	1.00		
12-23	1.68	(1.32, 2.14)	0.0000
24-35	1.59	(1.25, 2.02)	0.0000
36-47	0.67	(0.50, 0.90)	0.0080
48-59	0.56	(0.41, 0.76)	0.0000
_cons	0.14	(0.13,0.16)	0.0000
	0.35	(0.20, 0.60)	0.0000

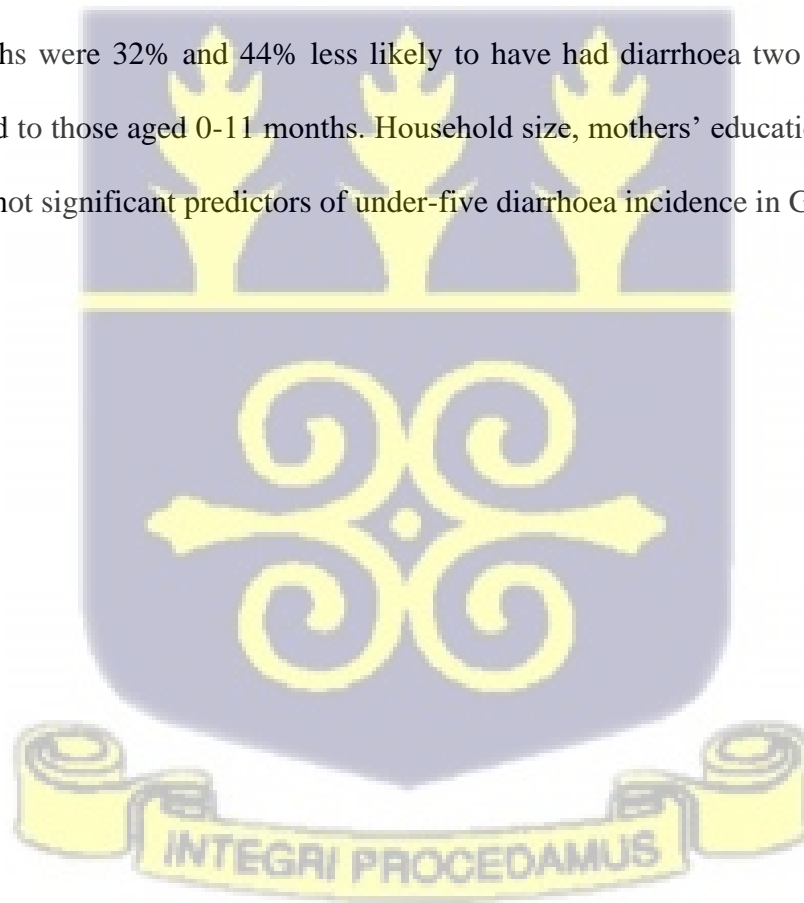
Source: Computed from 2014 GDHS.

4.6. 2 Model 2: Relationship between WASH Indices, Household Characteristics, Mothers' Characteristics, Child Characteristics and Under-five Diarrhoea Incidence.

Model 2 examined the relationship between WASH indices, household characteristics, mother characteristics, child characteristics and incidence of under-five diarrhoea. Using poor sanitation score as a reference category, there was a significant association between household sanitation conditions and under-five diarrhoea incidence. Considering household characteristics, mothers' characteristic and child's characteristics, children belonging to households with an improved sanitation index were 43% less likely to have had diarrhoea in the two weeks preceding the survey compared to their counterparts in households that had unimproved sanitation index. Drinking water index and hygiene index were not significant predictors of under-five diarrhoea incidence.

Among the control variables, place of residence was a significant predictor of under-five diarrhoea incidence. Children belonging to households in rural areas were 0.23 times less likely to have had diarrhoea compared to those in urban residence. As gleaned from table 4.9, household wealth status was a significant predictor of diarrhoea incidence. Children belonging to the richer households were 30% less likely to have had an episode of diarrhoea two weeks preceding the survey compared to children belonging to the poorest households. Also, children of the richest households were 0.46 times less likely to have had an episode of diarrhoea compared to children belonging to the poorest households. Children belonging to the poorer and middle households were not significantly different from those of the poorest households with regards to the likelihood of having diarrhoea. From table 4.9, it was also observed that marital status of mother was a significant predictor of diarrhoea incidence and children of married mothers were 30% less likely to be

infected with diarrhoea. With respect to sex of child, females were 29 % less likely to have had an episode of diarrhoea two weeks prior to the survey compared to males. There was a significant relationship between the age of child and under-five diarrhoea incidence. Children aged 12-23 months were 1.68 times as likely to have had an episode of diarrhoea compared to children aged 0-11 months. Also, children aged 24-35 months were 60% more likely to have had diarrhoea two weeks prior to the survey compared to children aged 0-11 months. Children aged 36-47 months and 48-59 months were 32% and 44% less likely to have had diarrhoea two weeks before the survey compared to those aged 0-11 months. Household size, mothers' educational level and age of mother were not significant predictors of under-five diarrhoea incidence in Ghana.



CHAPTER FIVE

5.0 DISCUSSION

5.1 Introduction

This chapter is devoted to examining the outcomes of the research. The implications of the findings were explored, and the study's results were utilized to compare with and contrast other investigations in order to either corroborate or contradict prior research. The factors that influence the incidence of diarrhoea in children below the age of five and the factors that did not predict its occurrence are discussed. Additionally, this chapter examines potential explanations for the lack of association between certain factors and diarrhoea incidence among children under five. The results are analyzed in light of existing studies.

5.2 WASH indicators and diarrhoea

The finding that drinking water is not a significant factor in predicting under-five diarrhea incidence in Ghana highlights the complex nature of health determinants in the country. This indicates that an exclusive focus on improving water access or quality may not necessarily result in a decrease in childhood diarrhoea cases. In order to effectively mitigate the incidence of diarrhoea among children under the age of five, policies and interventions should not only concentrate on the provision of drinking water, but also encompass critical factors such as sanitation infrastructure, hygiene education, and access to healthcare, as emphasized in various studies (Cairncross et al., 2010; Fewtrell et al., 2005). The hypothesis that under-five children belonging to households with unimproved sources of drinking water are more likely to contract diarrhoea compared to those of households with improved sources of drinking water was not accepted. Therefore, the odds of having diarrhoea were not significantly different among children

from households with improved drinking water index and those belonging to households with unimproved drinking water index. The results of drinking water index corroborates the finding of Jeyakumar et al., (2021). However, the result is inconsistent with the findings of other studies that reported a higher risk of diarrhoea infection among children belonging to households with unimproved drinking water (Mebrahtom et al., 2022; Sinmegn Mihrete et al., 2014; Troeger et al., 2018). Also, the result is inconsistent with the findings of Saha et al., (2022) which reported that children belonging to households with improved drinking water were more likely to be infected with diarrhoea compared to children in households with unimproved drinking water. The discrepancies in the findings of this research compared to other studies regarding the relationship between drinking water and childhood diarrhoea can be attributed to a combination of factors. First, variations in study populations and contexts, as well as regional differences in water access can influence outcomes. Second, differences in research methodologies, including data collection methods and the criteria used for classifying "improved" or "unimproved" drinking water, can lead to varying results.

The lack of proper sanitation facilities, such as toilets or access to sanitation systems, can result in the practice of open defecation. This can lead to the contamination of the environment and water sources, which in turn can promote the spread of pathogens that cause diarrhoea. The finding that household sanitation significantly predicts under-five children's diarrhoea incidence, with higher odds of diarrhoea in households with unimproved sanitation, emphasizes the critical importance of sanitation in child health. This finding aligns with established literature such as (Saha et al., 2022; Troeger et al., 2018; Wolf et al., 2022), highlighting the role of sanitation in preventing childhood diarrhoea. To effectively reduce the burden of diarrhoea among young children, it is imperative to prioritize interventions that upgrade sanitation facilities in households with

unimproved conditions. This holistic approach resonates with the principles of the Water, Sanitation, and Hygiene (WASH) strategy advocated by organizations like UNICEF, where improved sanitation is a key component in ensuring child well-being. The finding corroborates the hypothesis and extant literature that under-five children belonging to households with unimproved sanitation conditions are more likely to contract diarrhoea compared to those of households with improved sanitation conditions.

Inadequate education and awareness concerning appropriate hygiene practices, such as the thorough washing of hands with soap, can contribute to elevated rates of microbial transmission, as contaminated hands can readily transfer pathogens to food, water, and surfaces that young children frequently encounter. However, the likelihood of a child contracting diarrhoea was not significantly different among children of households with improved hygiene and those belonging to households with unimproved hygiene. The absence of an association between the hygiene index and diarrhoea incidence in the study could be attributed to several factors. Notably, a significant number of children in the study resided in households lacking proper handwashing facilities, and their mothers may not have been practicing adequate hand hygiene before preparing food or feeding. This is a crucial point as insufficient hand hygiene is a recognized risk factor for diarrheal diseases due to the potential transmission of harmful pathogens in several studies (Abuzerr et al., 2020; Hashi et al., 2017; Khan et al., 2021). The third hypothesis of the study was not accepted since there was not enough evidence to buttress the assertion that under-five children belonging to households with unimproved hygiene conditions are more likely to contract diarrhoea compared to those of households with improved hygiene conditions. This highlights the importance of considering context-specific determinants and tailoring public health interventions to address the specific challenges and risk factors related to childhood diarrhoea in Ghana. This emphasizes the

need for a comprehensive approach that addresses other key factors such as sanitation infrastructure and healthcare access, which might have a more substantial impact on preventing childhood diarrhoea within this context.

5. 3 Characteristics of households and diarrhoea incidence

The finding that children in rural areas had a lower likelihood of experiencing diarrhoea compared to those in urban settings underscores the distinct health challenges faced by urban populations, including factors like overcrowding and limited sanitation infrastructure. This observation aligns with existing research emphasizing the vulnerability of urban children to various health issues, as discussed in the work by Apanga & Kumbeni, (2021) and Kumi-Kyereme & Amo-Adjei, (2016). However, Tampah-Naah, (2019) revealed contrasting findings which showed that children living in rural settings were more likely to be infected with diarrhoea than their counterparts in the urban settlements.

Additionally, the study did not find any significant association between household size and under-five diarrhoea incidence. This finding is inconsistent with the findings of (Larbi et al., 2021), which indicated that households' size was significantly associated with diarrhoea incidence. Similarly, this result of the study is inconsistent with Woldu et al., (2016), which indicated that a larger household size increases the risk of under-five diarrhoea infection. A probable explanation for the absence of an association between household size and diarrhoea incidence might be that there was no significant variation in household sanitation conditions among the different categories of household size. The absence of a significant association between household size and under-five diarrhoea incidence suggests that this relationship is not universal and may vary based on local conditions and context.

The research further revealed a significant relationship between a child's household wealth quintile and the likelihood of experiencing diarrhoea, emphasizing the significant impact of socioeconomic factors on disease incidence. Children from the poorest and poorer households faced an elevated risk of diarrhoea, while the risk substantially decreased as household wealth improved. One plausible explanation for this outcome is the disparities observed in the sanitation conditions among these households. This result aligns with the study's fourth hypothesis and corroborates existing literature, which consistently indicates that children from economically disadvantaged households face a higher risk of diarrhoea compared to those from wealthier households. These findings emphasize the urgent need for targeted interventions to address economic inequalities and improve sanitation conditions, particularly among the most economically vulnerable populations, to effectively combat childhood diarrhoea and enhance public health outcomes (Kumi-Kyereme & Amo-Adjei, 2016; Tareke et al., 2022; Weber et al., 2021). Similarly, the finding is consistent with Demissie et al., (2021) which indicated that the likelihood of acquiring diarrhoea decreases as household wealth increases.

5. 4 Characteristics of mothers and diarrhoea incidence

The results of this study suggest that maternal education may not play a significant role in predicting the incidence of diarrhoea among children under the age of five. Therefore, it can be inferred that, in this particular context, maternal education may not be a crucial factor in determining the occurrence of childhood diarrhoea. As a result, interventions and policies aimed at reducing the prevalence of diarrhoea among children under five should target a wider range of determinants in order to effectively tackle the problem. This finding is inconsistent with other studies that have reported that under-five diarrhoea incidence reduces as mothers level of education increased (Alebel et al., 2018; Demissie et al., 2021; Sinmegn Mihrete et al., 2014). One plausible

explanation for this discrepancy could be attributed to the observed lack of significant variation in household Water, Sanitation, and Hygiene (WASH) conditions across different maternal education levels. However, it is crucial to acknowledge that various unexamined factors, both within and beyond the scope of this study, might also contribute to this outcome.

There was no significant association between the age of mothers and the incidence of diarrhoea in children under the age of five. This particular finding seems to challenge the outcomes of other research studies, prompting us to explore the potential reasons behind this variation. One plausible reason for the observed discrepancy may lie in how mothers' ages were classified in those different studies. It is possible that the age groupings used in this study differed from those in prior research, leading to distinct conclusions. Furthermore, another likely explanation for the observed result is that variations in maternal age may not have translated into significant differences in WASH practices within households. Nonetheless, it is important to note that Mebrahtom et al., (2022) reported that children born to mothers under the age of 20 were at an increased risk of diarrhoea diseases, suggesting that maternal age can indeed play a role in certain contexts. Similarly, Demissie et al., (2021) drawing from data across thirty-four Demographic and Health Surveys (DHS) in sub-Saharan Africa, established a significant association between maternal age and the incidence of diarrhoea among children under the age of five.

The study revealed association between the marital status of mothers and the incidence of diarrhoea in children under the age of five in Ghana. Specifically, it revealed that children of married mothers were less likely to contract diarrhoea when compared to those of never-married mothers. This finding aligns with the conclusions drawn by Claudine et al., (2021), whose research in Rwanda also emphasized the significant impact of a mother's marital status on under-five diarrhoea incidence. A plausible explanation for this observed association could be rooted in the level of

support that married mothers may receive from their partners. It is conceivable that having a spouse may enable married mothers to take better care of their children and, in doing so, limit the extent to which their children interact with an environment that may expose them to diarrhoea-causing pathogens. In this context, married mothers may be more inclined to implement effective household management and prevention techniques for addressing childhood diarrhea, as noted by Momoh et al., (2022).

5. 5 Characteristics of child and diarrhoea incidence.

The study also brought to light an intriguing finding, shedding light on the influence of a child's gender on the incidence of diarrhea among those under the age of five. Notably, male children were more likely to contract diarrhoea when compared to their female counterparts. This outcome resonates with the findings of previous research studies, including those by Saha et al., (2022 and Sarker et al., (2016), which similarly pointed to a higher susceptibility of male children to diarrhoea. A plausible rationale for this observed gender-based difference could be associated with the distinct ways in which male and female children tend to interact with their immediate environments. As highlighted by Vlassoff, (2007) , it is often the case that male children are more active and engage more frequently with their surroundings, potentially increasing their exposure to pathogens that can trigger diarrhoea.

Additionally, the age of child significantly predicted under-five diarrhoea incidence. This result corroborates other studies elsewhere (Abuzerr et al., 2020; Getachew et al., 2018; Sinmegn Mihrete et al., 2014; Siraj et al., 2008; Tampah-Naah, 2019). The results of this study showed that children who were aged 12-23 and 24-35 months had higher odds of having diarrhoea than those who were less than 12 months. This was anticipated since children less than 12 months old are

mainly undergoing breastfeeding. Thus, children aged 12-23 and 24-35 months are susceptible to eating more complementary foods that may expose them to diarrhoea-causing pathogens. This finding of the study is consistent with Sinmegn Mihrete et al., 2014 and Tampah-Naah, 2019 which indicated that children aged 12-23 and 24-35 months are new to complementary foods, and this increase their risk of diarrhoea infection. Possible explanations for this observed result include the children in this study have comparable eating habits to those in the previous studies.



CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 Introduction

This chapter aims to deliver a conclusion on the research by summarizing the work conducted, outlining the objectives of the study, evaluating the methods utilized, presenting the results, and offering policy recommendations.

6.2 Summary

This study aimed to identify the factors associated with the occurrence of diarrhoea in children under the age of five in Ghana using data from the 2014 Ghana Demographic and Health Survey (GDHS). The analysis focused on various indicators related to Water, Sanitation, and Hygiene (WASH), household characteristics, maternal factors, and child characteristics. The study found that the two-week prevalence of under-five diarrhoea in Ghana was 11.8%. To investigate the relationships between these factors and diarrhoea incidence, statistical tests were conducted, including chi-square tests and a binary logistic regression model. The results revealed that sanitation index, household wealth quintile, maternal educational level, child's gender, and age were significant factors associated with under-five diarrhoea. Although the study initially hypothesized that improved drinking water, sanitation, and hygiene conditions would reduce the likelihood of diarrhoea, the results showed that the risk of under-five diarrhoea is influenced by sanitation conditions, household factors, maternal characteristics, and child-related aspects. Specifically, children residing in households with improved sanitation were less likely to contract diarrhoea, whereas the hypotheses related to drinking water and hygiene conditions were not supported, as these variables did not significantly predict under-five diarrhoea incidence.

6. 3 Conclusion

Improved sanitation is a crucial factor in reducing the incidence of diarrhoea among children under the age of five in Ghana. The relationship between unimproved sanitation and the elevated risk of under-five diarrhoea is a notable concern. Additionally, place of residence, household wealth quintile, maternal marital status, child's gender, and age further contribute to the heightened risk of under-five diarrhoea within the Ghanaian context. Addressing the issue of unimproved sanitation comprehensively is vital in mitigating its impact on the elevated risk of under-five diarrhoea in Ghana.

6. 4 Recommendation

The study's findings carry significant policy and health intervention implications. Firstly, there's an urgent need to improve household sanitation conditions by promoting better hygiene practices and enhancing sanitation facilities. Additionally, addressing wealth disparities to ensure economically disadvantaged households have access to improved sanitation and healthcare services is crucial. It's recommended that poverty-reduction programs such as Livelihood Empowerment Against Poverty (LEAP) be strengthened to uplift living standards in Ghana. Maternal education programs should focus on raising awareness about hygiene and childcare practices. Given the association between a child's age and diarrhoea incidence, it's advisable to educate mothers on safe complementary food practices, particularly for children aged one and above. Furthermore, intensifying maternal education on best care practices, including avoiding inappropriate defecation on the floor to shield children from diarrhoea pathogens, is recommended.

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