SCHOOL OF PUBLIC HEALTH

UNIVERSITY OF GHANA, LEGON

COLLEGE OF HEALTH SCIENCE

PREVALENCE AND DETERMINANTS OF DIARRHEA AND ACUTE RESPIRATORY INFECTION AMONG CHILDREN UNDER FIVE IN WEST AFRICA: EVIDENCE FROM THE DEMOGRAPHIC AND HEALTH SURVEY

BY

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THIS DISSERTATION IS SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF GHANA IN PARTIAL FULFILLMENT FOR THE AWARD OF THE MASTER OF PUBLIC HEALTH DEGREE.

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DECLARATION

I Derrick Owusu Nyantakyi declare that besides references that have been duly acknowledged, this dissertation is the product of my research and to the best of my knowledge has not been submitted for the award of any degree in this institution and other universities elsewhere

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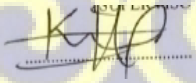

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DEDICATION

This work is dedicated to Mr. Patrick Kwabena Nyantakyi (grandfather) and Nana Prof. Oheneba Woahene Boachie-Adjei for their amazing support.

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ABSTRACT

Introduction: Diarrhoea and Acute Respiratory Infection (ARI) account for 29–30% of all infant mortality worldwide, killing over two million children each year. Diarrhoea and ARI are predicted to kill more children under the age of five than HIV/AIDS, malaria, and measles combined. Children in Africa's sub-regions are 15 times more likely to die from diarrheal disease and ARI than children in high-income countries.

Objectives: The main objective of the study was to examine the prevalence and determinants of diarrhea and ARI among children under 5 years in West Africa.

Methods: The study used data from the most recent nationally representative cross-sectional Demographic and Health Survey (DHS) of thirteen (13) West African countries. Data cleaning, merging, and analysis were done using Stata software version 16. Bivariate and multivariate logistic regression was used to estimate the determinates of diarrhoea and ARI among children under five years in West African sub-region.

Results: The weighted prevalence of diarrhoea and ARI was 13.7% and 15.9%, respectively. The prevalence of comorbid diarrhoea and ARI was 4.4%. The highest burden of diarrhoea and ARI was found in Gambia (19.7%) and Togo (27.9%), respectively. Children under two years old ($p<0.001$), mothers age (<0.003), mothers without formal education ($p<0.001$), poor households ($p<0.001$), and poor nutritional status; wasting ($p=0.005$) and underweight ($p<0.001$) were the independent predictors of diarrhoea. The independent predictors of ARI were children with no childhood vaccinations ($p=0.002$), use of solid fuel in households ($p=0.007$), underweight ($p=0.05$) and diarrhoea ($p<0.001$).

Conclusion: The findings imply the need for holistic public health interventions that target the high risk subgroups in the population to reduce the burden and adverse effects of diarrhoea and ARI in the west African region.

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LIST OF ABBREVIATION

ARI – Acute Respiratory Infection

DHS – Demographic and Health Survey

ORS – Oral Rehydration Salt

SDGs – Sustainable Development Goals

WHO - World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Diarrhea is a condition characterized by an increase in the water content, volume, or frequency of bowel movements. Childhood diarrhea has three main classifications, namely acute watery diarrhea, bloody diarrhea or dysentery, and persistent diarrhea (Corinaldesi, Stanghellini, Barbara, Tomassetti, & de Giorgio, 2012). Diarrhea causes frequent loss of water and electrolytes with subsequent dehydration which can lead to death if there is no fluid replacement (Corinaldesi et al., 2012). Managing diarrhea episodes with Oral Rehydration Salt (ORS) and Zinc supplements has been shown to improve the outcomes of childhood diarrhea, according to the World Health Organization (WHO) (WHO, 2015).

Acute Respiratory Infection (ARI) affects the airways below the epiglottis, on the other side (Boloursaz et al., 2013). Upper respiratory and lower respiratory infections are the two forms of ARI. Pneumonia is the most common lower respiratory infection, as well as the leading infectious cause of death in children under the age of five (Boloursaz et al., 2013; Mirkarimi et al., 2020). Pneumonia can be caused by bacteria, viruses, or fungi. The most common cause of bacterial pneumonia in children is *Streptococcus pneumonia* while *Haemophilus influenza* type is the second most known cause of bacterial pneumonia. Likewise, the most common cause of viral pneumonia is the respiratory syncytial virus (WHO, 2011b). Pneumococcal conjugate vaccine (PCV13) and the pneumococcal polysaccharide vaccine (PPSV23) are wildly used to protect against pneumococcal infections (WHO, 2011b).

In the past, gastrointestinal and respiratory infections were examined independently; however, data suggest that diarrheal disease may increase the risk of respiratory infections in children. (Ashraf, Hamidul Huque, Kenah, Agboatwalla, & Luby, 2013).

Furthermore, children who have diarrhea and respiratory disease at the same time are at a significantly higher risk of mortality than children who only have one of the illnesses. The cocirculation of B and T cells between the mucosal sites of the gut and the respiratory tract is one proposed mechanism for this association(Bingula et al., 2017). Infections, medications, and other processes that change the gut microbiome may alter mucosal immune responses and increase susceptibility to infection in other mucosal sites, including the lungs(Bingula et al., 2017; Newman et al., 2020).

1.2 Burden of Diarrhea and ARI

Since 1990, there has been significant improvement in reducing infant mortality around the world (WHO, 2011a). Globally, under-five mortality has significantly decreased by 59% since 1990, from 93 deaths per 1,000 live births in 1990 to 38 deaths per 1,000 live births in 2019 (WHO, 2011a). In 1990, 1 in 11 children died before reaching the age of 5, compared to 1 in 27 in 2019 (WHO, 2011a). Even though the world as a whole has been making strides in lowering the under-five mortality rate, differences in under-five mortality remain across low- and middle-income countries (WHO, 2019).

One of the main public-health objectives is to reduce childhood mortality. Simultaneous incidence of multiple diseases is one of the leading causes of mortality among children under the age of five in sub-Saharan Africa (WHO, 2019). Diarrhea and Acute Respiratory Infection (ARI) are the leading causes of morbidity and mortality in children in developing countries, according to research (WHO, 2019). Children in developing countries in sub-

Saharan Africa are found to be 15 times more likely than children in developed countries to die before reaching the age of five, with diarrhoeal disease and ARI accounting for the majority of these deaths (WHO, 2019).

Globally, ARI and diarrhea cause more deaths in children under the age of five than HIV/AIDS (4%), malaria (16%), and measles (1%) combined (WHO, 2015). According to a comprehensive study, by 2030, nearly 4.4 million children under the age of five would die from infectious diseases like diarrhea and ARI, with 60% of these deaths occurring in Sub-Saharan Africa (You et al., 2015). According to World Health Organization (WHO), the under-five mortality rate in low-income countries was 73.1 deaths per 1000 live births, nearly 14 times the average rate in high-income countries (WHO, 2011a).

The United Nations (UN), in 2015 adopted the Sustainable Development Goals (SDGs) to reduce child mortality and to promote well-being for all children. This goal is targeted at ending preventable deaths among children under five by 2030 (United Nations, 2020). Similarly, most West African countries have adopted strategies enshrined under their SDGs to reduce preventable deaths among newborns and children under-five. Most of these strategies were targeted at combating the effects of diarrheal diseases and ARI on children under 5 years. Despite these interventions and innovations by a range of stakeholders, under-five mortalities related to diarrhea and ARI remains a major concern in most African Sub-Region (Anand & Roy, 2016).

1.3 Problem Statement

Acute Respiratory Infection (ARI) and diarrhoea together account for 29% to 30% of all child mortality worldwide, killing almost two million children every year (WHO, 2011a). In comparison to HIV/AIDS (4%), malaria (16%), and measles (1%) combined, pneumonia

(14%) and diarrhea (14%) account for more deaths in children under the age of five worldwide (Mulatya & Mutuku, 2020).

Children in Africa's sub-regions are 15 times more likely than children in high-income nations to die from diarrheal illness and ARI (WHO, 2011a). When compared to other age groups, diarrhea is more common among young children aged 6 to 23 months (WHO, 2011a).

Research in Uganda found that 32% and 48% percent of children had experienced diarrhoea and ARI before the age of five, respectively (Bbaale, 2011). Similarly in Kenya, a study discovered that 33.3 % of children under the age of five have diarrhea (Apanga & Kumbeni, 2021b). In addition, Ghana recorded a prevalence of 17 percent for diarrhea and 33.3 percent for ARI (Apanga & Kumbeni, 2021b). Although most of these nations are part of the Global Action Plan for the Prevention and Control of Pneumonia and Diarrhea (GAPPD), which aims to reduce death from pneumonia and diarrhea by 2025, the aforementioned literature indicates the existing burden of diarrhea and ARI in Africa sub-regions.

For policy formulation and campaigning, as well as a general assessment of resource requirements and priority, determining the causes of diarrhea and ARI prevalence is critical. Although there is a wealth of information on the prevalence and determinants of diarrhea and ARI in specific sites or countries, there is no study estimating the prevalence of diarrhea and ARI among children under 5 years in West Africa. Hence, this study aims to investigate the prevalence and determinants of diarrhea and ARI among children under the age of five in West African sub-regions to bridge this gap.

1.4 Research Questions

1. What is the prevalence of diarrhea and ARI among children under 5 years in West Africa?

2. What are the factors associated with diarrhea among children under 5 years in West Africa?
3. What are the factors associated with ARI among children under 5 years in West Africa?

1.5 Objectives

General Objectives

To examine the prevalence and determinants of diarrhea and ARI among children under 5 years in West Africa.

Specific Objectives

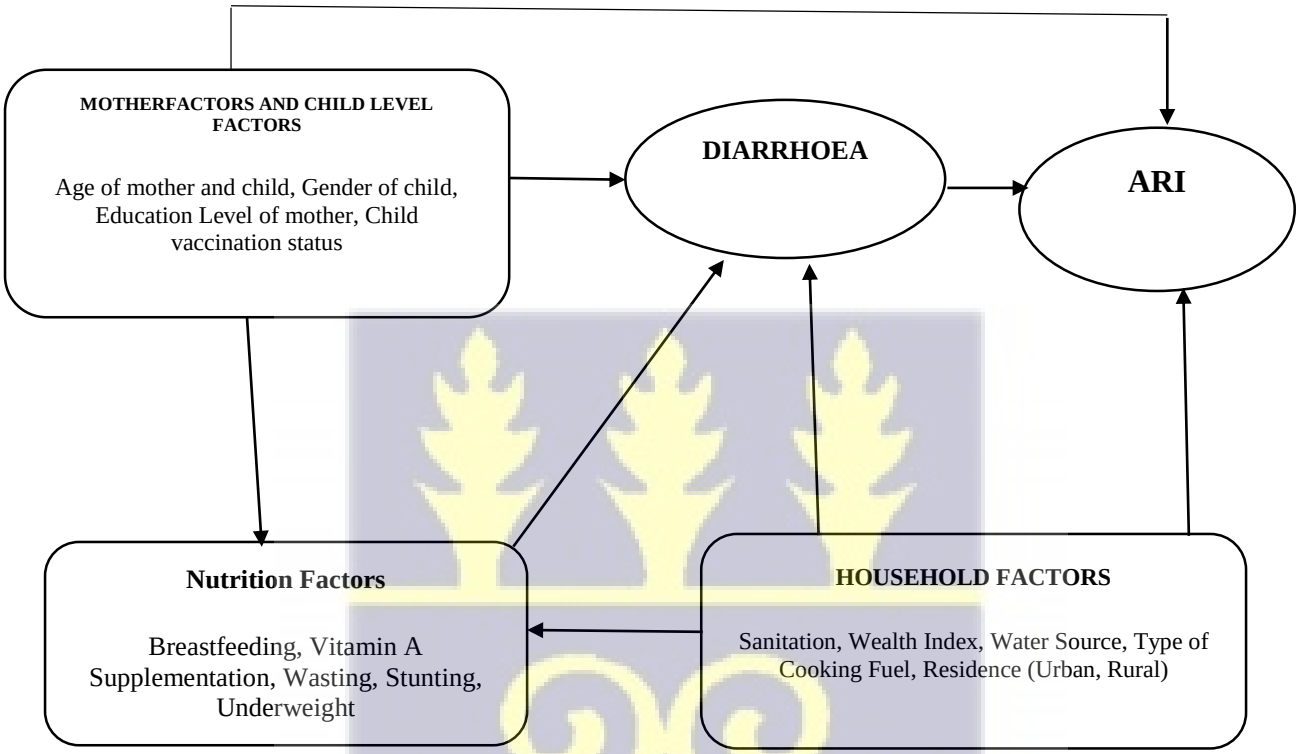
1. To measure the prevalence of diarrhea and ARI among children under 5 years in West Africa sub-regions
2. To determine factors associated with diarrhea among children under 5 years in West Africa.
3. To determine factors associated with ARI among children under 5 years in West.

1.6 Justification

Diarrhoea and ARI in children under the age of five are a global concern to public health and health systems. According to research, diarrhoea and ARI kill more children than HIV/AIDS, malaria, and measles combined. In low-income countries, such as West Africa's sub-regions, the burden of these diseases is significantly greater. In West Africa, however, there is no literature on the prevalence and determinants of diarrhoea and ARI in children under the age of five. The findings of this study will serve as a baseline for health policies and programs in

West Africa aimed at reducing or preventing diarrhoea and ARI in children under the age of five.

1.7 Conceptual Framework of the Determinants of Diarrhoea and Acute Respiratory Infection (ARI)



The conceptual framework demonstrates pathways various factors can interrelate to predispose a child to diarrhoea or acute respiratory infection (ARI). The determinants have been categorized into child level, mother level, and household level. From the framework, diarrhoea tends to predispose a child to acute respiratory infections. This link is possible because diarrhoea can cause a child to be dehydrated and lose essential micronutrients. As a result, the child is left in a compromised immunity state which opens the portal for diverse infections including ARI.

The child level factors such as age, gender, and nutrition status (wasting, stinting, and underweight) can predispose a child to diarrhoea and ARI. Also, household factors such as sanitation, water source, type of cooking fuel, and residence (rural or urban) can have a link to diarrhoea and ARI.

CHAPTER TWO

2.0 LITERATURE REVIEW

Introduction

This chapter presents a detail review of relevant literature on the subject of diarrhoea and acute respiratory infection (ARI) in children under 5 years. The literature was explored on the specific objectives of the study.

2.1 Overview of Diarrhoeal Diseases Among Children Under 5 Years

Diarrhoea is commonly used to describe a gastrointestinal infection caused by the spread of bacterial, viral, and parasitic organisms. The most common causes appear to be enterotoxigenic E. coli, Shigella spices, Salmonella paratyphi, and viral; additionally, other environmental and demographic factors tend to be associated with a higher prevalence of acute diarrhoeal diseases. However, roughly 40% of diarrhoea cases are still caused by idiopathic reasons (Karambu, Matiru, Kiptoo, & Oundo, 2013).

Diarrhoeal illnesses caused by contaminated food or water are a major health concern. According to a study conducted in the US, diarrhoea-related dehydration is a leading cause of death, accounting for around 1.8 million deaths per year (Karambu et al., 2013). More disturbing, most of these deaths happen among children under the age of five who live in low- and middle-income nations. Interventions such as safe drinking water, hand washing, use of sanitation facilities, exclusive breastfeeding of babies, and rotavirus vaccination are used to prevent diarrhea (Bosomprah et al., 2016).

The three clinical criteria used to classify the illness are acute watery diarrhoea, acute bloody diarrhea, and chronic diarrhoea lasting longer than two weeks. Children's diarrhoea is treated

with oral rehydration using a pre-formulated solution or homemade and given fluids. Zinc supplementation is also recommended (Houston, Gibb, & Maitland, 2017). Antibiotics should only be used in specific circumstances, and anti-motility drugs should be avoided.

Despite the availability of equitable and efficient treatment, diarrhoeal illness kills over 1,300 children per day, or around 530 000 children annually (United Nations, 2020). The majority of diarrhoea-related deaths occur in children under the age of five in South Asia and sub-Saharan Africa (Carvajal-Vélez et al., 2016b). Progressively, there has been an appreciable decrease in the high death toll. Between 2000 and 2015, the number of children under the age of five who died from diarrhoea decreased by more than half. The widespread use of a simple solution of oral rehydration salts (ORS) and zinc supplementation when diarrhea arises, as well as basic initiatives to improve drinking water, sanitation, and hygiene (WASH) for diarrhea prevention, have been shown to have a diarrhoea remedy effect (United Nations, 2020).

2.2 Prevalence of Diarrhoea Among Children Under 5 Years

Studies have shown that diarrhoea is a key public health problem in underserved regions such as countries with the middle- and low-income bracket. A study conducted in India revealed that the prevalence of diarrhea is 15.5% among children under five (Paul, 2020). According to the study, diarrhoea contributes enormously to the top five diseases causing mortalities among children under five years (Paul, 2020).

A similar study conducted in Malaysia showed a prevalence of 14.4% (Gurpreet, Tee, Amal, Paramesarvathy, & Karuthan, 2011). This is a little below that of India, however, it is still a major problem as diarrhoea was the leading cause of childhood morbidity in Malaysia. A study carried in Senegal which is West Africa to determine the determinants of diarrhoea among children under 5 years showed that, the prevalence of diarrhoea was 26% (Gurpreet et

al., 2011). This prevalence rate is higher than that of Malaysia and India. This shows the enormity of diarrhoea problem faced by Senegal. According to a study carried out in Burundi, the overall diarrhoea prevalence was 32.6% among children under 5 (Gurpreet et al., 2011). A study in Ghana found that diarrhoea cases among children under the age of five were 9.3% from January to March (Diouf, Tabatabai, Rudolph, & Marx, 2014). During the rainy season, this steadily increased to around 11.3%. This is not surprising because contaminated water bodies wash over other water bodies during the rainy season, contaminating them as well.

2.3 Determinants of Diarrhoea Among Children Under 5 Years

Lack of caregiver awareness of the need for hygiene and sanitation practices for diarrhea prevention were important risk factors for diarrheal disease among children under the age of five, according to a study done in Bolivia, South America (Diouf et al., 2014). A study conducted in Nigeria found that the mother's educational status, employment position, and family income were the factors substantially related to diarrhoea (Ugboko, Nwinyi, Oranusi, & Fagbeminiyi, 2021). The study found that mothers who have less education do not make use of the vital information given to them concerning their children (Ugboko et al., 2021). A study conducted in Ethiopia is congruent with the aforementioned studies as the study revealed that mothers who can't read and write, low monthly family income, poor hand washing practices, and improper refuse disposal were significant predictors of diarrhoea (Wasihun et al., 2018).

Furthermore, a study conducted in Senegal revealed that unemployment of mothers, unimproved methods of waste management, no treatment of stored drinking water, and use of shared toilets were significantly associated with children getting diarrhoea (Thiam et al., 2017). This finding remained significant after controlling for other variables in multivariate logistic regression. In Kenya, a study found that child age, caregiver education, and improper

disposal of household excreta were the most important risk variables related to diarrhoea morbidity in children aged 5 years (Mulatya & Mutuku, 2020).

Furthermore, a study in Ghana discovered that drinking from improved water sources raises the risk of diarrhoea by around 1.3 times and that this link remained stable in both unmatched and matched samples among Ghanaian children under the age of five (Kumi-Kyereme & Amo-Adjei, 2016). Another survey in the same research area indicated that private latrine ownership was low (10%) and household sanitation facilities were mostly unimproved (90%) (Noguchi, Nonaka, Kounnavong, & Kobayashi, 2021). Children living in households with water closets (WCs) in their dwellings had the lowest diarrhoea prevalence rate (11.1 percent), whereas those living in households with WCs outside the dwelling had the highest incidence (13.1%). Children whose moms reported not washing their hands with soap and water after defecation had the highest rate of diarrhoea (36 %) (Noguchi et al., 2021).

2.4 Prevalence of Acute Respiratory Infection

The prevalence of Acute Respiratory Infections (ARI) in Asia and Sub-Saharan Africa has been extensively researched. A survey carried out in 28 sub-Saharan African countries showed that the prevalence of acute lower respiratory infection for all the countries was 25.3% (Seidu et al., 2019a). Countries that emerged with the highest prevalence were; Congo, Gabon, Lesotho, and Tanzania. A survey in Zambia discovered that 8% of people had ARI two weeks before the study. In the same study, it was discovered that the prevalence of ARI has decreased from 13% to 4% between 1996 and 2014 (Mulambya, Nanzaluka, Sinyangwe, & Makasa, 2020). In contrast to this figure, research in Ethiopia found that 27.3 % of children under the age of five have an acute respiratory illness (Dagne, Andualem, Dagnew, & Taddese, 2020).

The prevalence of reported ARI increased from 18.7% in 1993 to 36.5 % in 2014, according to a study conducted in Ghana among coastal people. Within the Middle zone, there was an increase between 1993 (45.2%) and 2014 (47.3%) (Seidu et al., 2019a). Between 1993 and 2014, reported ARI among Savanna inhabitants fell from 36.1 percent to 16.2 percent. In addition, multiple studies in various regions have reported varying diarrhoea prevalence rates. Because of the disparity in environmental and demographic variables, this is unsurprising (Seidu et al., 2019a).

2.5 Determinants of Acute Respiratory Infection Among Children Under 5 Years

According to a study carried out in Pakistan, malnutrition, the use of cow dung as cooking fuel, and maternal literacy were found to be significant predictors of acute respiratory infection among children below five years (Bhutta & Saeed, 2008). In the Middle of Indonesia, children aged below 4 years, mother's occupation poorest wealth index, poor, region of residence were significantly associated with ARI among children under five years (Windi et al., 2021). HIV infection, poor maternal education, exposure to wood, smoke, passive smoking, and contact with someone who has cough were all identified as risk factors in a similar study undertaken in Cameroon to identify the risk factors of ARI among infants (Tazinya et al., 2018). Furthermore, an Ethiopian study found that ARI was substantially related to ARI in children under the age of five. Furthermore, the age mother/caregiver (35 years), occupation as a housewife, medium wealth index, the type of stove used in the house, carrying the child while cooking meals, the absence of windows in the house, and the nutritional state of the child are all risk factors of ARI (Merera, Asena, & Senbeta, n.d.).

According to other studies, the nutrition status of the child was found to be associated with ARI. A study conducted in Zambia showed that underweight children had 1.50 times increased odds of having ARI compared with children who were not. Similarly, to what other

studies have found, children whose mothers had secondary or higher education were less likely to have ARI compared to those with no education (Mulambya et al., 2020). Also, the use of biomass fuels such as charcoal and wood was associated with high odds for ARI compared to electricity or liquid fuel. This is similar to a study conducted in Ethiopia, which found that children under the age of 12 months, mothers aged 16 to 27 and 28 to 33 years, lack of maternal handwashing awareness, rural residence, and a lack of meningitis were all significantly associated with an acute respiratory infection (Merera et al., 2020).

CHAPTER THREE

3.0 METHODOLOGY

Introduction

This chapter presents the methods used in data collection and analysis. The chapter covers areas such as study design, an overview of DHS, sampling frame, extraction of data, methods of data analysis, and ethical considerations.

3.1 Overview of the Demographic Health Survey (DHS)

The Demographic and Health Surveys (DHS) are a prospective cross-country multi-round survey that collects vital information about general health, with a focus on reproductive health, population, and nutrition. The DHS Survey is one of the many surveys that the DHS Program conducts. The Standard DHS Surveys and the Interim DHS Surveys are the two types of DHS Surveys. The regular DHS surveys use large samples and are carried out every five years, whereas the interim DHS surveys use smaller samples and are carried out in between the standard DHS surveys. The DHS surveys are stored in eight (8) main datasets, which are as follows: Household file (HR), Household members or person file (PR),

Women's file (IR), All Births file (BR), Children born in the five years preceding the survey, or kids file (KR), Men's file (MR), Couple's file (CR), and HIV file (AR). For this study, the most recent standard DHS data for 13 West African countries are provided. Children born in the five years preceding the interview, or kids file (KR), were used for this investigation.

3.2 Study Design

Secondary data analysis was conducted on data from Demographic and Health Surveys of 13 West African countries. The surveys, which are conducted at intervals of 5 years in every country, are cross-sectional and provide information on health and population characteristics. The most current survey for various West African countries was used. The counties involved were, Burkina Faso (2010), Benin (2017), Cote D'Ivoire (2011-12), Ghana (2014), Gambia (2019), Guinea (2018), Liberia (2019), Mali (2018), Nigeria (2018), Niger (2017), Serra Leone (2019), Senegal (2010-11) and Togo (2013-14).

3.3 Study Area

The study was conducted in 13 West Africa sub-region namely, Benin, Burkina Faso, Cote d'Ivoire, Gambia, Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. These are all developing countries, where child mortality and morbidity rates are among the highest in the world.

3.4 Study Variables

Diarrhea and ARI were the dependent (outcome) variables. Codes 1 and 0 denoted the outcome variables. Those with the diseases of interest were coded as 1, while those without the diseases of interest were coded as 0. ARI prevalence was calculated by asking mothers with children under the age of five whether their kid had been ill with a cough, short, quick

breaths, and difficulty breathing as a result of a chest condition in the two weeks preceding the demographic health survey. Diarrhea prevalence was determined by asking mothers of children born 5 years before the survey if their children had diarrhea episodes in the two weeks preceding the survey. The child's age in months, gender, location of residence (rural and urban), wealth quintile, caregiver's age, caregiver's education, water source, toilet facility (improved and unimproved), nutritional (wasting, stunting, and underweight), vaccination status (ever and never vaccinated), breastfeeding status (ever and never breastfed), had have had vitamin A 6 months ago (yes, no) were all independent (exposure factors).

3.5 Data Collection Techniques and Instruments

Data were collected using structured questionnaires that were administered by skilled enumerators and were comparable across nations. Only pre-selected households were visited, and the pre-selected households were not allowed to be replaced. In all households, the women's and children's questionnaires were distributed. CSPRO software was used to enter the data. STATA version 16 was used for data cleaning, recoding, merging, and analysis.

3.6 Data Extraction and Analysis

Prior to data analysis, we performed data cleaning and recoding in Stata version 16 (Stata Corporation, College Station, TX, USA). Next, the data were weighted, allowing us to perform univariate analysis by accounting for survey design. Prior to bivariate and multivariate analysis, complex survey mode was activated using the 'svyset' Stata command to enable the adjustment for clusters, stratification, and sample weights. This helps to account for possible analytical errors that are embedded within secondary datasets collected using complex sampling designs[9]. Subsequently, bivariate analyses with Chi-square test were conducted to assess the relationship between the selected independent variables and the two

dependent variables (Diarrhoea and ARI). The strength of the association was estimated using crude and adjusted logistic regression analyses with the “logistic” command. This was performed separately for diarrhoea and ARI.

3.7 Ethical Issues

Ethical approval and use of data were sought from the Demographic Health Survey (DHS) program. The study did not entail field-based methods and relied on secondary data that is available in the public domain. As such, local approval was not required, however, the data was requested and a letter of approval was given which gave legal access to use the DHS data. A letter of approval has been attached (see appendixes).

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

The results of the analysis of the DHS data used in the study are presented in this chapter. The chapter begins with the distribution of unweighted frequencies for the West African countries included in the study and then moves on to the distribution of various independent variables by country. In addition, this chapter discusses the prevalence of dirrhoea and ARI in West Africa, as well as a split of prevalence across West African countries participating in the study. This chapter also includes a Chi-square illustrating the association between diarrhoea and ARI and independent factors. Finally, the chapter gives the results of the adjusted ordered regression estimates of the determinants of diarrhoea and ARI among West African children under the age of five.

4.2 Unweighted Frequencies of West Africa Countries

In total, 132,587 mothers from various West African countries were interviewed for the study. Nigeria contributed the most participants (23.16%) across the various samples.

Burkina Faso came in second, accounting for 10.34% of the overall sample size. Liberia was the country that contributed the least, accounting for 3.96 percent of the total. Ghana contributed 4.22% (Table 1).

Table 1:Distribution of Unweighted Frequencies of West Africa Countries

Country	**Unweighted Frequency**	**Unweighted Percentage (%)**
Burkina Faso	13716	10.34
Benin	12651	9.54
Cote D' voire	7093	5.35
Ghana	5595	4.22
Gambia	7927	5.98
Guinea	7273	5.49
Liberia	5245	3.96
Mali	9275	7.00
Nigeria	30713	23.16
Niger	11602	8.75
Serra Leone	9063	6.84
Senegal	5899	4.45
Togo	6535	4.93
Total	**132,587**	

4.3 Socio-demographic Characteristics of Study Participants Across West African Countries

The total number of children aged between 0-59 months involved in the study was 75,146. The majority of children were aged 12-35 months accounting for (40.2%). The same age group was predominant in all countries; Burkina Faso (39.8%), Benin (39.1%), Cote D'Ivoire (42.6%), Ghana (41.2%), Gambia (39.9%), Guinea (38.3%), Liberia (37.6%), Mali (40.2%), Nigeria (40.1%), Niger (38.5%), Serra Leone (39.4%), Senegal (42.0%) and Togo (42.1%). About half of children sampled in the study were males (50.6%). Nutritional assessment done on children in the study emerged as follows; 31% of children sampled were stunted, 20.0% were underweight and 8.4% were wasted. Most mothers were in the age categories of 25-34 years accounting for 49.8%. More than half (54%) of mothers who participated in the study had no formal education. For individual countries, Nigeria emerged as the country with the highest number of mothers who have had tertiary education accounting for 8.6%. Next to Nigeria was Ghana, having 4.5% of mothers who have had tertiary education. Furthermore, most mothers (43.3%) were in the poor wealth index. For the type of cooking fuel used at home by mothers in West Africa, solid fuel emerged as the most used cooking fuel accounting for 87.0%. The majority (53.7%) of participants were using unimproved toilet facilities. 70% of participants had access to improved water sources (Table 2).

Table 2:Distribution of Characteristics Across West African Countries

	Countries												
	Burkina Faso (%)	**Benin (%)**	**Cote D'Ivoire (%)**	**Ghana (%)**	**Gambia (%)**	**Guinea (%)**	**Liberia (%)**	**Mali (%)**	**Nigeria (%)**	**Niger (%)**	**Sierra Leone (%)**	**Senegal (%)**	**Togo (%)**	**Total (%)**
Characteristics														
Child Age (Months)														
< 6	11.4	11.5	11.8	12.1	13.2	12.4	12.0	11.8	10.7	13.2	12.5	11.5	9.2	11.4
6-11	10.7	12.4	12.3	10.6	10.4	9.0	13.4	10.2	10.9	10.2	11.7	11.4	11.4	10.9
12-35	39.8	39.1	42.6	41.2	39.9	38.3	37.6	40.2	40.1	38.5	39.4	42.0	42.1	40.2
36-47	19.4	19.0	17.8	18.7	19.9	21.1	19.3	19.5	19.4	20.5	18.7	18.5	19.5	19.3
48-59	18.4	18.1	15.5	17.4	16.6	19.2	17.7	18.3	18.9	17.6	17.7	16.6	17.7	18.1
Sex														
Male	50.5	50.6	48.9	52.0	51.8	51.7	50.0	50.7	50.8	50.4	50.4	48.9	50.1	50.6
Female	49.5	49.4	51.1	48.0	48.2	48.3	50.0	49.3	49.2	49.6	49.6	51.1	49.9	49.4
Mothers Age (Years)														
15-24	28.60	25.30	31.10	20.90	21.40	28.10	34.30	29.20	23.60	27.30	28.70	22.90	21.10	25.20
25-29	26.00	30.90	28.10	25.20	31.20	27.50	25.60	27.70	28.30	27.80	27.60	25.60	28.40	27.80
30-39	36.20	35.60	32.80	43.00	39.00	34.60	31.00	35.40	38.90	36.10	35.40	41.20	40.00	37.80
40+	9.20	8.20	8.00	11.00	8.40	9.80	9.10	7.7	9.20	8.90	8.30	10.30	10.50	9.20
Mothers Education														
No Education	92.3	82.3	81.3	41.4	59.0	84.0	57.2	81.5	49.6	94.3	64.9	80.5	68.9	63.4
Primary/JSH	7.0	15.9	16.5	47.2	29.1	11.8	29.9	17.2	21.1	5.2	28.2	16.0	28.8	19.9
SHS	0.2	0.5	1.1	7.0	7.8	2.0	9.1	0.0	20.6	0.1	4.1	1.0	0.8	11.5
Tertiary	0.6	1.4	1.0	4.5	4.1	2.2	3.9	1.3	8.6	0.4	2.8	2.5	1.6	5.3
Residence														
Urban	17.3	38.9	37.7	45.1	65.7	29.7	53.7	20.7	39.6	13.7	35.3	36.7	36.3	34.9
Rural	82.7	61.1	62.3	54.9	34.3	70.3	46.3	79.3	60.4	86.3	64.7	63.3	63.7	65.1
Wealth Index														
Poor	41.80	41.50	47.00	43.0	43.50	44.90	45.80	41.70	43.50	40.0	45.60	46.10	41.10	43.30
Middle	21.7	20.20	19.40	19.60	20.80	19.70	18.70	21.60	20.60	20.50	20.40	18.20	20.10	20.40
Rich	36.5	38.30	33.60	37.40	35.60	35.40	35.40	36.80	35.60	39.50	34.00	35.70	38.80	36.30
Sanitation														
Improved	24.9	27.7	41.2	64.8	62.6	48.0	43.4	53.6	50.6	17.7	50.0	67.3	34.1	46.3

Unimproved	75.1	72.3	58.8	35.2	37.4	52.0	56.6	46.4	49.4	82.3	50.0	32.7	65.9	53.7
Water Source														
Improved	74.9	65.7	73.9	84.0	89.4	76.1	80.0	67.0	67.6	65.9	60.4	81.6	60.6	70.0
Unimproved	25.1	34.3	26.1	16.0	10.6	23.9	20.0	33.0	32.4	34.1	39.6	18.4	39.4	30.0
Breast Feeding														
Ever Breastfed	98.2	96.1	95.7	98.9	99.0	87.1	98.1	94.1	98.4	98.1	98.1	98.2	98.3	97.6
Never Breastfed	1.8	3.9	4.3	1.1	1.0	12.9	1.9	5.1	1.6	1.9	1.9	1.8	1.7	2.4
Vaccination Status														
Ever Vaccinated	86.7	67.4	84.8	87.7	81.7	58.9	82.2	64.3	67.4	84.0	87.7	82.3	88.2	73.4
Never Vaccinated	13.3	32.6	15.2	12.2	12.3	18.3	17.8	35.7	32.6	16.0	12.3	17.7	11.8	26.6
Vit A in Last 6 Months														
Yes	60.4	48.5	57.6	58.7	49.1	37.2	41.6	61.9	41.4	55.5	62.4	43.4	78.3	48.4
No	39.6	51.5	42.4	41.3	50.9	62.8	58.4	38.1	58.6	44.5	37.6	56.6	21.7	51.6
Type of Cooking Fuel														
Solid Fuel	97.8	97.1	88.8	80.3	98.1	98.5	98.9	99.2	81.0	99.4	99.8	80.6	95.4	87.0
Liquid Fuel	0.0	0.1	0.0	0.0	0.2	0.0	0.1	0.0	9.5	0.0	0.0	0.0	0.0	4.9
Cleaner Fuel	2.2	2.9	11.2	19.7	1.8	1.5	1.0	0.8	9.6	0.6	0.2	19.4	4.6	8.1
Nutritional Status														
Wasting	15.8	5.0	7.8	4.7	5.3	9.1	3.7	8.9	6.9	18.1	5.6	8.0	6.8	8.4
Stunting	34.5	31.6	29.8	17.9	17.0	31.1	28.8	26.7	36.5	43.3	29.1	17.6	26.7	31.7
Underweight	25.7	16.6	14.7	10.8	11.6	16.1	10.3	18.5	21.7	36.2	13.6	14.1	15.7	20.0

4.4 Prevalence of Diarrhoea Among Children Under Five Years in West Africa

The prevalence of diarrhoea across West Africa countries were as follows; Burkina Faso (14.9%), Benin (10.5%), Cote D' Ivoire (18.5%), Ghana (11.9%), Gambia (19.7%), Guinea (14.6%), Liberia (16.3%), Mali (17.2%), Nigeria (12.8%), Niger (14.4%), Serra Leone (7.2%), Senegal (13.7%) and Togo (15.2%) (Figure 1). From the distribution, Gambia was the country with most children who had diarrhoea two weeks before the survey, followed by Cote D'Ivoire. The prevalence of diarrhoea in West Africa was 13.7% (Figure 2).

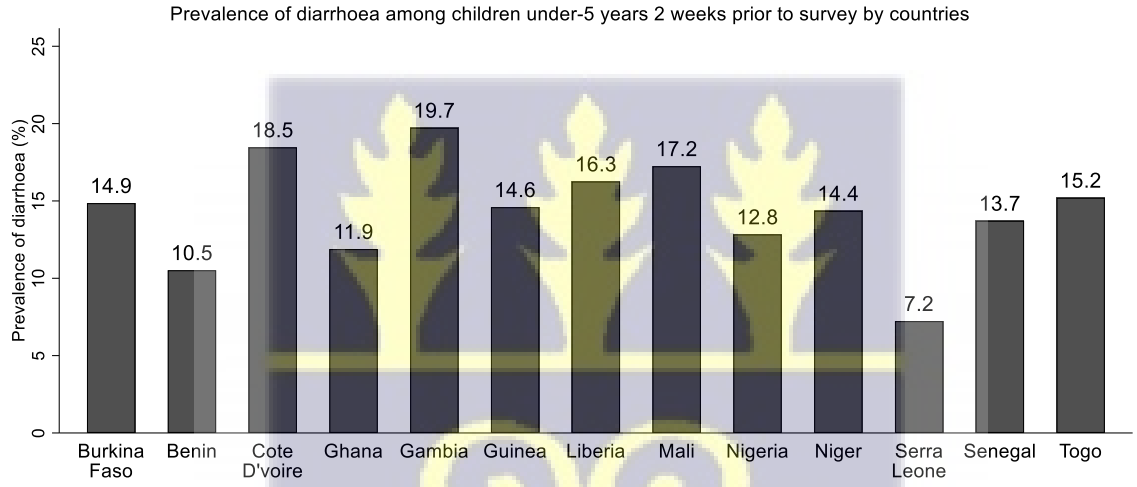


Figure 1: Prevalence of Diarrhoea Among Children Under Five Years by Countries

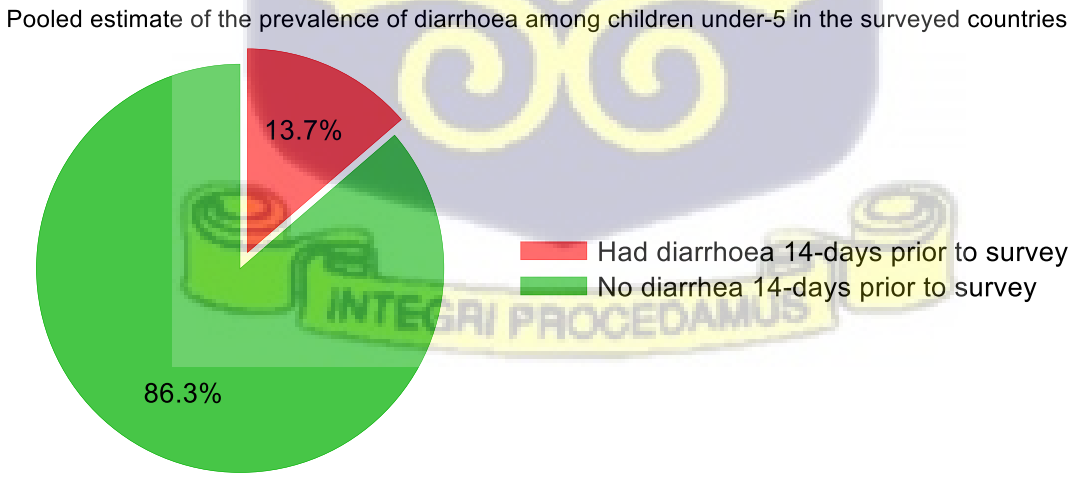


Figure 2: Mean Prevalence of Diarrhoea Among Children Under 5 Years in West Africa

4.5 Prevalence of ARI Among Children Under Five Years in West Africa

The prevalence of ARI across West Africa countries were as follows; Burkina Faso (10.3%), Benin (18.5%), Cote D' Ivoire (22.1%), Ghana (14.0%), Gambia (20.9%), Guinea (13.0%), Liberia (25.3%), Mali (12.6%), Nigeria (15.7%), Niger (14.5%), Serra Leone (14.2%), Senegal (19.8%) and Togo (27.9%) (Figure 3). From the distribution, Togo was the country with most children who had ARI two weeks before the survey, followed by Liberia and Cote D'Ivoire. The overall prevalence of ARI for West Africa was 15.9% (Figure 4). Furthermore, the children who had both ARI and diarrhoea was 4.4% (Figure 5)

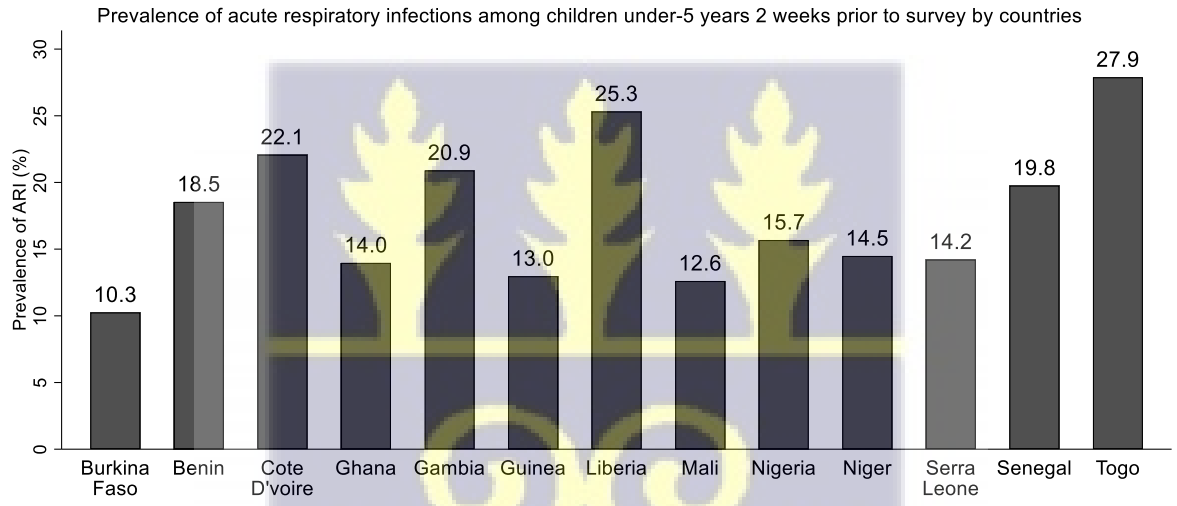


Figure 3: Prevalence of ARI Among Children Under Five Years by Countries

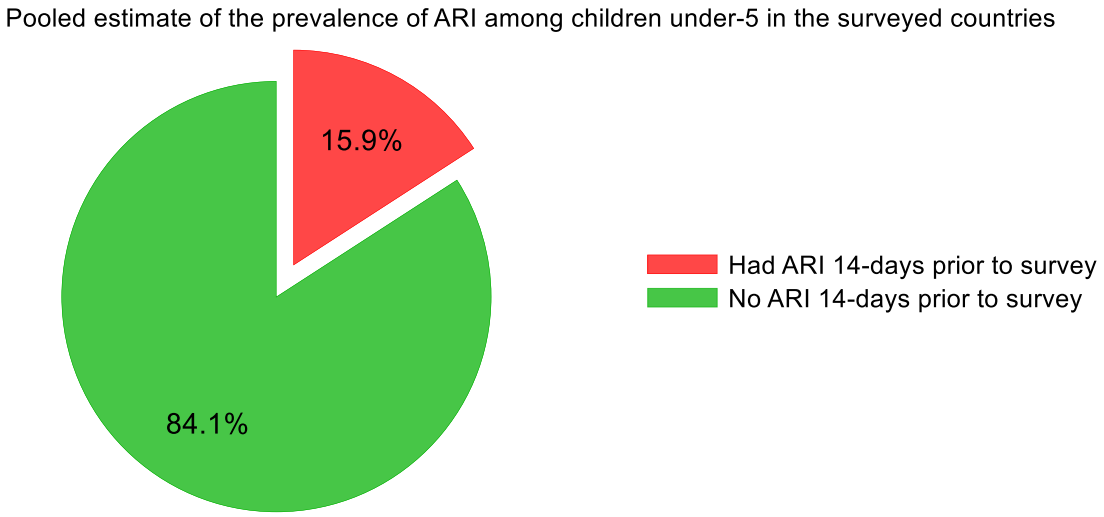


Figure 4: Mean Prevalence of ARI Among Children Under 5 Years in West Africa

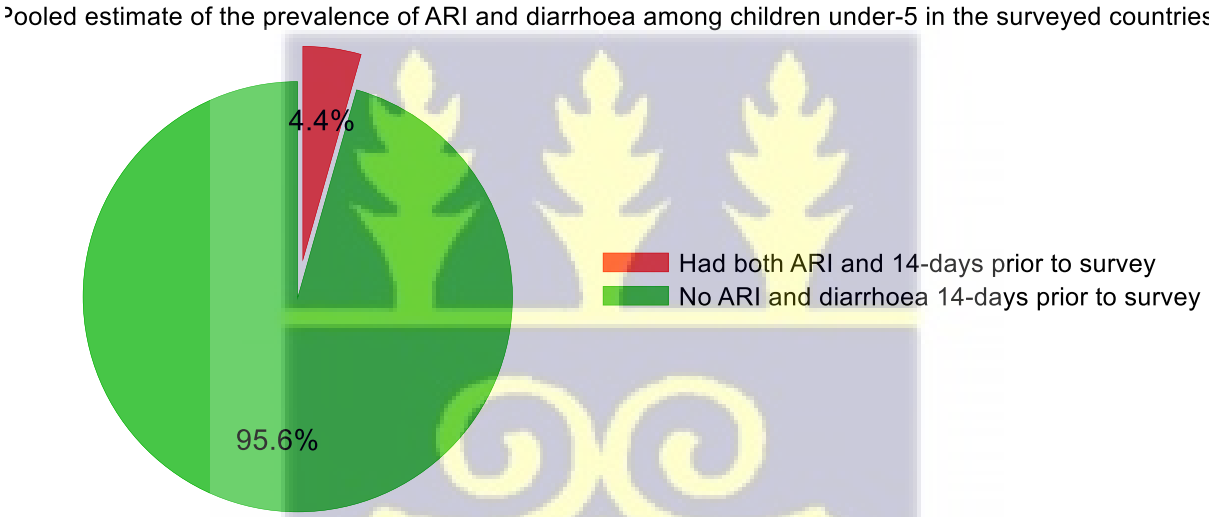


Figure 5: Mean Prevalence of both ARI and Diarrhoea Among Children Under 5 Years in West Africa

4.6 Chi-Square Association Between Diarrhoea and Independent Variables

From the chi square statistics, all independent variables under study but gender ($\chi 2 = 4.83$, p=0.120) were found to be associated with diarrhoea. Residence ($\chi 2 = 285.98$, p=<0.001), Child's Age ($\chi 2 = 1688.27$, p=<0.001), Mother's age ($\chi 2 = 390.43$, p=<0.001), Mother's education level ($\chi 2 = 869.96$, p=<0.001), Wealth Index ($\chi 2 = 698.12$, p=<0.001), Sanitation ($\chi 2 = 132.86$, p=<0.001), Water source ($\chi 2 = 133.03$, p=<0.001), Cooking Fuel ($\chi 2 = 662.20$, p=<0.001), Nutritional Status; Wasting ($\chi 2 = 262.05$, p=<0.001), Stunting ($\chi 2 = 221.78$, p=<0.001), and Underweight ($\chi 2 = 489.71$, p=<0.001) (Table 3).

From the chi square statistics, Child's gender ($\chi 2 = 0.132$, p=0.795), Wealth index ($\chi 2 = 23.28$, p=0.22), Water source ($\chi 2 = 0.5480$, p=0.7481), Type of cooking fuel ($\chi 2 = 34.21$, p=0.07), and being underweight ($\chi 2 = 1.676$, p=0.395) were found not to be associated with ARI. On the other hand, Residence ($\chi 2 = 36.17$, p=0.01), Mother's age ($\chi 2 = 64.46$, p=<0.001), Mother's education level ($\chi 2 = 415.93$, p=<0.001), Sanitation ($\chi 2 = 66.43$, p=<0.001), Nutritional Status; Wasting ($\chi 2 = 10.14$, p=0.02), and Stunting ($\chi 2 = 14.13$, p=0.01) were found to be associated with ARI (Table 4).

Table 3: Chi-Square Association Between Diarrhoea and ARI and Independent Variables

Characteristics	Diarrhea among children under-5 years				Acute respiratory infection among children under-5 years			
	No diarrhoea	Diarrhoea	Chi-Square	P-value	No ARI	ARI	Chi-Square	P-value
	%	%			%	%		
Overall								
Country			470.12	<0.001			1016.41	<0.001
Burkina Faso	85.1	14.9			89.7	10.3		
Benin	89.5	10.5			81.5	18.5		
Cote D'lvoire	81.5	18.5			77.9	22.1		
Ghana	88.1	11.9			86.0	14.0		
Gambia	80.3	19.7			79.1	20.9		
Guinea	85.4	14.6			87.0	13.0		
Liberia	83.7	16.3			74.7	25.3		
Mali	82.8	17.2			87.4	12.6		
Nigeria	87.2	12.8			84.3	15.7		
Niger	85.6	14.4			85.5	14.5		
Serra Leone	92.8	7.2			85.8	14.2		
Senegal	86.3	13.7			80.2	19.8		
Togo	84.8	15.2			72.1	27.9		
Residence			285.98	<0.001			36.17	0.01
Urban	88.5	11.5			83.3	16.7		
Rural	85.1	14.9			84.6	15.4		
Child's Age (Months)			1688.27	<0.001			478.26	<0.001
< 6	90.3	9.7			85.5	14.5		
6-11	79.3	20.7			78.7	21.3		
12-35	81.7	18.3			81.3	18.7		
36-47	93.2	9.8			84.6	15.4		
48-59	93.0	7.0			88	12		
Sex			4.83	0.120			0.132	0.795
Male	86.1	13.9			84.2	15.8		
Female	86.5	13.5			84.1	15.9		
Mothers Age (Years)			390.43	<0.001			64.46	<0.001
15-19	80.7	19.3			82.5	17.5		
20-24	84.1	15.9			83.5	16.5		
25-29	86.5	13.5			83.7	16.3		
30-34	87.9	12.1			85.0	15.0		
35-39	87.5	12.5			84.1	15.9		

40-44	87.5	12.5			85.7	14.3		
45-49	88.2	11.8			85.6	14.4		
Mothers Education			869.96	<0.001			415.93	<0.001
No Education	84.7	15.3			85.9	14.1		
Incomplete Primary	83.9	16.1			80.1	19.9		
Complete Primary	86.6	13.4			83.2	16.8		
Incomplete Secondary	87.0	13.0			81.8	18.2		
Complete Secondary	91.6	8.4			82.3	17.7		
Tertiary	93.3	6.7			83.3	16.7		
Wealth Index			698.12	<0.001			23.28	0.22
Poorest	83.1	16.9			84.4	15.6		
Poorer	84.5	15.5			84.2	15.8		
Middle	86.9	13.1			84.5	15.5		
Richer	87.7	12.3			84.1	15.9		
Richest	90.4	9.6			83.1	16.9		
Sanitation			132.86	<0.001			66.43	<0.001
Improved	87.5	12.5			83.2	16.8		
Unimproved	85.3	14.7			84.9	15.1		
Water Source			133.03	<0.001			0.5480	0.7481
Improved	87.0	13.0			84.2	15.8		
Unimproved	84.6	15.4			84	16		
Breast Feeding			0.825	0.5392			16.04	0.008
Ever Breastfed	86.3	13.7			84.1	15.9		
Never Breastfed	86.9	13.1			86.7	13.3		
Vaccination Status			7.604	0.09			68.19	<0.001
Ever Vaccinated	84.4	15.6			84.1	15.9		
Never Vaccinated	85.6	14.4			87.6	12.4		
Vit A in Last 6 Months			3.865	0.292			228.49	<0.001
Yes	86.1	13.9			82.6	17.4		
No	86.5	13.5			85.6	14.4		
Type of Cooking Fuel			662.20	<0.001			34.21	0.07
Liquid Fuel	85.4	14.6			84.3	15.7		
Solid Fuel	94.6	5.4			84.3	15.7		
Cleaner Fuel	91.1	8.9			82.1	17.9		
Nutritional Status								
Wasting			262.05	<0.001			10.14	0.02
Yes	76.1	20.9			81.8	18.2		
No	86.7	13.3			83.5	16.5		

Stunting			221.78	<0.001			14.13	0.01
Yes	83.2	16.8			84.1	15.9		
No	87.3	12.7			82.9	17.1		
Underweight			489.71	<0.001			1.676	0.395
Yes	80.2	19.8			82.9	17.1		
No	87.4	12.6			83.4	16.6		

4.7 Determinants of Diarrhoea Among Children Under Five Years in West Africa

In a univariate analysis (Table 5), Rural residence (cOR 1.34, 95% CI 1.06-1.70), Child's age (cOR 1.42, 95% CI 1.19-1.69 for below 6 months, cOR 3.46, 95% CI 2.94-4.07 for 6 to 11 months, cOR 2.98, 95% CI 2.66-3.33 for 12 to 35 months and cOR 1.43, 95% CI 1.26-1.62 for 36 to 47 months); Mother' s age (cOR 0.78, 95% CI 0.73-0.83 for 15 to 24 years, cOR 0.70, 95% CI 0.64-0.76 for 25-29 years, and cOR 0.70, 95% CI 0.64-0.7 for 40 years and above); Mother's Education (cOR 2.50, 95% CI 1.93-3.23 for No Education, cOR 2.07, 95% CI 1.70-2.52 for Primary/JHS, and cOR 1.25, 95% CI 1.02, 1.53 for SHS) ; Wealth Index (cOR 1.56, 95% CI 1.25-1.94 for poor wealth index, and cOR 1.21, 95% CI 1.04-1.41) for middle wealth index); Sanitation (cOR 1.20, 95% CI 1.04-1.39 for Unimproved Toilet Facility); Water Source (cOR 1.21, 95% CI 1.07-1.37); and Nutrition Status (cOR 1.71, 95% CI 1.51-1.95, for Wasting, cOR 1.39, 95% CI 1.26-1.53 for Stunting, and cOR 1.71, 95% CI 1.56-1.86 for Underweight); were predictors of having diarrhoea. All these variables remained predictors of diarrhoea in a multivariate analysis except Sanitation (aOR 0.89 95% CI 0.79-1.00 for Unimproved Toilet Facility), Water Source (aOR 1.01, 95% CI 0.91-1.12 for Unimproved Water Source), and Nutritional Status (aOR 1.08, 95% CI 0.99-1.19 for Stunting).

4.8 Determinants of ARI Among Children Under Five Years in West Africa

In a Bivariate analysis (Table 6), Child's age (cOR 1.24, 95% CI 1.19-1.69 for below 6 months, cOR 1.99, 95% CI 2.94-4.07 for 6 to 11 months, cOR 1.68, 95% CI 2.66-3.33 for 12 to 35 months and cOR 1.34, 95% CI 1.26-1.62 for 36 to 47 months); Mother's Age (cOR 0.90, 95% CI 0.83-0.90 for 30-39 years and cOR 0.83, 95% CI 0.75-0.91 for 40 years and above); child never vaccinated (cOR 1.75, 95% CI 0.61-0.93) and Type of Cooking Fuel (cOR 1.87, 95% CI 1.68-2.09 for Solid cooking fuel) were predictors of ARI. After adjusting

for other variables in a multivariate analysis, the age of the child, never vaccinated and the kind of cooking fuel (Solid Fuel) remained predictors of ARI. Nutritional status (underweight) was also found to be a determinant of ARI.

Table 4: Multivariate Logistic Regression Estimates of the Determinants of Diarrhoea and Acute Respiratory Infection

Characteristics	Diarrhoea among children under-5 years				Acute respiratory infection among children under-5 years			
	Unadjusted model		Adjusted model		Unadjusted model		Adjusted model	
Residence	cOR [CI]	P-value	aOR [CI]	P-value	cOR [CI]	P-value	aOR [CI]	P-value
Urban	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Rural	1.34 [1.06, 1.70]	**0.014**	0.92 [0.77, 1.10]	0.364	0.90 [0.72, 1.14]	0.425	0.90 [0.71, 1.15	0.436
Child's Age (Months)								
< 6	1.42 [1.19, 1.69]	**<0.001**	1.44 [1.21, 1.72]	**<0.001**	1.24 [1.10, 1.40]	<0.001	1.26 [1.10, 1.44]	**<0.001**
6-11	3.46 [2.94, 4.07]	**<0.001**	3.38 [2.87, 3.98]	**<0.001**	1.99 [1.79, 2.21]	<0.001	1.87 [1.68, 2.09]	**<0.001**
12-35	2.98 [2.66, 3.33]	**<0.001**	2.87 [2.57, 3.22]	**<0.001**	1.68 [1.56, 1.82]	<0.001	1.64 [1.52, 1.78]	**<0.001**
36-47	1.43 [1.26, 1.62]	**<0.001**	1.39 [1.22, 1.57]	**<0.001**	1.34 [1.22, 1.47]	<0.001	1.33 [1.21, 1.46]	**<0.001**
48-59	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Sex								
Male	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Female	0.96 [0.92, 1.00]	0.075	0.99 [0.94, 1.04]	0.931	1.00 [0 .96, 1.05]	0.806	1.01 [0.95, 1.07]	0.679
Mothers Age (Years)								
15-24	1.00 [reference]		1.00 [reference]		1 [reference]			
25-29	0.78 [0.73, 0.83]	**<0.001**	0.92 [0.84, 1.00]	0.078	0.97 [0.90, 1.04]	0.479	1.07 [0.90, 1.27]	0.391
30-39	0.70 [0.64, 0.76]	<0.001	0.84 [0.77, 0.91]	<0.001	0.90 [0.83, 0.97]	0.010	1.05 [0.89, 1.23]	0.538
40+	0.70 [0.64, 0.77]	<0.001	0.83 [0.74, 0.94]	0.003	0.83 [0.75, 0.91]	<0.001	0.95 [0.76, 1.18]	0.672
Mothers Education								
No Education	2.50 [1.93, 3.23]	**<0.001**	2.15 [1.65, 2.80]	**<0.001**	0.87 [0.69, 1.10]	0.258	0.79 [0.53, 1.19]	0.271
Primary/JHS	2.07 [1.70, 2.52]	**<0.001**	1.88 [1.49, 2.38]	**<0.001**	1.07 [0.89, 1.28]	0.458	1.01 [0.70, 1.46]	0.923
SHS	1.25 [1.02, 1.53]	**0.028**	1.08 [0.80, 1.46]	**0.596**	1.07 [0.94, 1.22]	0.280	1.03 [0.76, 1.41]	0.820
Tertiary	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	

Wealth Index								
Poor	1.56 [1.25, 1.94]	**<0.001**	1.36 [1.16, 1.60]	**<0.001**	0.95 [0.77, 1.17]	0.636	0.98 [0.74, 1.32]	0.940
Middle	1.21 [1.04, 1.41]	**0.011**	1.13 [0.99, 1.29]	**0.054**	0.93 [0.81, 1.07]	0.363	0.96 [0.76, 1.21]	0.747
Rich	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Sanitation								
Improved	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Unimproved	1.20 [1.04, 1.39]	**0.012**	0.89 [0.79, 1.00]	0.068	0.88 [0.77, 1.00]	0.06	0.93 [0.81, 1.06]	0.287
Water Source								
Improved	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Unimproved	1.21 [1.07, 1.37]	**0.002**	1.01 [0.91, 1.12]	0.737	1.01 [0.87, 1.17]	0.871	1.07 [0.96, 1.19]	0.173
Breast Feeding								
Ever Breastfed	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Never Breastfed	0.95 [0.77, 1.17]	0.646	1.05 [0.70, 1.59]	0.790	0.81 [0.66, 0.98]	0.039	1.05 [0.72, 1.54]	0.773
Vaccination Status								
Ever Vaccinated	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Never Vaccinated	0.912 [0.76, 1.08]	0.287	0.83 [0.68, 1.99]	0.067	1.75 [0.61, 0.93]	0.008	1.68 [0.53, 0.87]	**0.002**
Vit A in Last 6 Months								
Yes	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
No	0.96 [0.83, 1.13]	0.689	0.96 [0.81, 1.15]	0.733	0.79 [0.68, 0.94]	0.006	0.98 [0.83, 1.16]	0.877
Type of Cooking Fuel								
Solid Fuel					1.87 [1.68, 2.09]	<0.001	1.36 [1.06, 1.49]	**0.007**
Liquid Fuel					0.85 [0.62, 1.16]	0.325	0.85 [0.58, 1.23]	0.391
Cleaner Fuel	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Nutritional Status								
Wasting								
Yes	1.71 [1.51, 1.95]	**<0.001**	1.19 [1.05, 1.35]	**0.005**	1.11 [0.99, 1.25]	0.057	1.03 [0.92, 1.16]	0.505
No	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Stunting								
Yes	1.39 [1.26, 1.53]	**<0.001**	1.08 [0.99, 1.19]	0.07	0.92 [0.82, 1.03]		0.91 [0.82,	0.131

							1.02]	
No	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Underweight								
							1.10 [1.01,	
Yes	1.712 [1.56, 1.86]	**<0.001**	1.36 [1.26, 1.47]	**<0.001**	1.03 [0.92, 1.15]	0.584	1.23]	**0.05**
No	1.00 [reference]		1.00 [reference]		1.00 [reference]		1.00 [reference]	
Diarrhoea								
No					1.00 [reference]		1.00 [reference]	
							2.92 [2.60,	
Yes					**3.16 [2.85, 3.46]**	**<0.001**	**3.29]**	**<0.001**

cOR: crude odds ratio. aOR: adjusted odds ratio. CI: confidence interval.

4.9 Summary of Results

This section presents the key findings from the data analysis. This is about the main objectives of the study.

1. The prevalence of diarrhoea among children under five in West Africa was 13.7%.
2. The top five West African countries with the highest burden of diarrhoea were Gambia (19.7%), Cote D'Ivoire (18.5%), Mali (17.2%), Liberia (16.3%), and Togo (15.2%)
3. The prevalence of Acute Respiratory Infection (ARI) among children in West Africa was 15.9%.
4. About 4.4% of children under 5 years had both diarrhoea and acute respiratory infection (ARI)
5. The top five Africa countries with the highest burden of ARI among children under five were Togo (27.9%), Liberia (25.3%), Cote D'Ivoire (22.1), Gambia, (20.29%), and Senegal (19.8%).
6. Children aged 47 months and below had higher odds of having diarrhoea and ARI. This was statistically significant after adjusting for all variables.
7. Children whose mothers had No Education to Primary had an increased risk of developing diarrhoea as compared to those who have completed tertiary.
8. Children from homes of middle to poorer wealth index had an increased odd of getting diarrhoea.
9. Nutritional Status of children such as Wasting and underweight was found to be associated with diarrhoea and ARI
10. Children who have never been vaccinated had, higher odds of getting ARI

11. Children from households where solid fuel was the main source of cooking fuel had a higher risk of developing ARI
12. Finally, children who had diarrhoea had an increased risk of getting ARI

CHAPTER 5

5.0 DISCUSSION

In this study, the researcher looked at the prevalence and determinants of diarrhoea and Acute Respiratory Infections (ARI) in children under the age of five in West Africa.

5.1 Prevalence of Diarrhoea and Acute Respiratory Infection in West Africa

The study found that the prevalence of diarrhoea among children under 5 years in West Africa was 13.7%. The prevalence of diarrhoea in the current study was below the overall prevalence estimated in a study conducted in sub-Saharan Africa, which reported the prevalence of diarrhoea to be 15.3% (Mulatya & Mutuku, 2020). Contrarily, the current prevalence is above that of other countries such as India; 5%, Vietnam; 11%, and Mesoamerica; 13%. Furthermore, the prevalence of ARI in this study was 15.9%. This was below the prevalence rate reported by a study conducted in Australia (19.9%) and Sub-Saharan Africa (25.3%) (Chen & Kirk, 2014; Seidu et al., 2019b). Variations in prevalence could be attributable to differences in the environment and infrastructure, such as improved water sources, the presence of improved toilet facilities, and improved waste disposal methods(Mara, Lane, Scott, & Trouba, 2010). Finally, the study showed that about 4.4% of children had both diarrhoea and ARI two weeks prior to the survey. This prevalence is twice the prevalence of having both diarrhoea and ARI reported by a study conducted in East Africa (Mulatya & Mutuku, 2020)

5.2 Determinants of Diarrhoea and Acute Respiratory Infection in West Africa

Children aged 47 months and younger had a significantly higher risk of diarrhoea and ARI than older children. According to research, children in this age group have lower disease

immunity. This is most likely the case for this finding in this research. Although the risk factors of ARI and diarrhoea are complex and cannot be attributed solely to the child's age, it appears that it is a significant contributor. This finding is consistent with previous studies that reported a higher likelihood of ARI and diarrhoea among children aged 36 months and below (Gao, Dang, Yan, & Wang, 2012; Gao, Liu, & Yan, 2014).

Furthermore, roughly half of the mothers in the survey had no formal education. This finding is not surprising because a UNESCO assessment indicated that Africa has the greatest rates of school exclusion, particularly among women (UNESCO, 2017). Furthermore, it has been demonstrated that the increased economic burden in Africa sub-regions translates into families' incapacity to provide formal education to their children. Additionally, cultural factors may explain the high prevalence of uneducated women. Until recently, most women in Africa's sub-regions were expected to work in the "kitchen." That is, women were supposed to stay at home and handle all domestic responsibilities. Same cultural practices in Africa pushed for early marriages, depriving women of formal education (Efevbera, Bhabha, Farmer, & Fink, 2019; Shabaya & Konadu-Agyemang, 2004).

The level of education of mothers was linked to a higher incidence of diarrhoea in their children. Diarrhoea was twice as common in children whose mothers had no formal education or have had education up to the primary level. This is not strange considering that education enables women to be well informed about how to find and utilize appropriate child health information (Kumi-Kyereme & Amo-Adjei, 2016; Tampah-Naah, 2019). The study also found that children in the poor wealth index had higher odds of diarrhoea as compared to children in the rich wealth index. Generally, children in poor households may face a level of social and health inequalities which can predispose them to preventable health conditions.

The finding conforms with previous studies conducted in Kenya and Ethiopia (Hassen et al., 2020; Mulatya & Mutuku, 2020).

Also, the study showed that children who were malnourished (wasting and underweight) were likely to suffer from diarrhoea and ARI. This relationship is plausible because literature has shown that diarrhoea is malnutrition among children generally denies them of essential micronutrients needed to combat childhood-related diseases such as diarrhoea. According to literature, malnutrition causes diarrheal infections to occur more frequently and for longer periods, with about a 38% increase in frequency and a 73% increase in length accounting for a doubling of the diarrhoea burden in malnourished children (Colombara et al., 2016). This finding is congruent with other studies (Adedokun & Yaya, 2020; Ashraf et al., 2013; Carvajal-Vélez et al., 2016a; Newman et al., 2020).

The study also found that the use of solid fuel for cooking in households was associated with a higher odd of predisposing children to ARI. This finding is congruent with other studies that revealed the solid fuel produces a lot of smoke which caused household air pollution (HAP) and renders children higher odds of respiratory infection (Nandasena, Wickremasinghe, & Sathiakumar, 2013; Ranathunga et al., 2019). According to that research, HAP caused by the use of solid fuel predisposes the entire home to elevated CO and PM2.5 levels, which can lead to respiratory diseases in the residents. When it comes to the detrimental effects of HAP, children are one of the most vulnerable groups. Air pollution primarily affects the respiratory system, resulting in a variety of acute and chronic symptoms. Respiratory side effects might range from minor symptoms and changes to life-threatening illnesses and even death.

Interestingly, the study discovered a link between diarrhoea and ARI. Children under 5 years in West Africa who had diarrhoea were more likely to have ARI than those who had no

diarrhoea. Other studies have extensively discussed this finding. Diarrhoea dehydrates children and deprives them of important micronutrients that aid in immune strengthening. As a result, their immunity is impaired, predisposing them to infections such as ARI. This finding is consistent with earlier research on the impact of diarrhoea on children under the age of five (Apanga & Kumbeni, 2021a; Colombara et al., 2016; G. D. Demissie, Yeshaw, Aleminew, & Akalu, 2021). Again, on immunity and ARI, the study showed that children who have never had vaccination were at a higher odd of getting Ari as compared to children who were vaccinated before the survey. This finding is congruent with other studies in Asia and Africa that revealed an association between vaccination status and ARI (B. W. Demissie, Amele, Yitayew, & Yalew, 2021; Fathmawati, Rauf, & Indraswari, 2021). In those studies, the association was plausible because vaccines help children to build immunity against infections. For example, in the case of pneumococcal vaccine and respiratory infections.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

The study's conclusions and recommendations are presented in this chapter. It starts with the conclusion of the study and then moves on to spell out recommendations based on the study findings. Also, the study's limitations and recommendations for future research are explored.

Conclusions of the Study

The study sought to investigate the prevalence and determinant of diarrhoea and ARI in children under five years across different 13 countries in the West African sub-region. The overall prevalence of diarrhoea and ARI was 13.7% and 15.9%, respectively. The comorbid burden of the two conditions was 4.4%. Children under two years old, mothers under 30 years old, mothers without a formal education, poor households, and poor nutritional status (wasted and underweight) were the independent predictors of diarrhoea. The independent predictors of ARI were children with no childhood vaccinations, use of solid fuel in households, underweight and diarrhoea. The findings imply the need for holistic public health interventions that target the high risk subgroups in the population to reduce the burden and adverse effects of diarrhoea and ARI in the west African region.

Recommendations

1. Policymakers, including public health professionals, must ensure that holistic health policies are formulated to address all these multi-level independent factors to ensure

the effectiveness of policies aimed at addressing the problem of Diarrhoea and ARI in children under five years in West Africa

2. The findings of the study highlighted the need to address the educational and wealth inequalities in the West Africa Sub-regions. Mothers with higher education and from households with a rich wealth index reduce the odds of Diarrhoea in children under five years in West Africa. Therefore, to lower the risk of diarrhoea in children under the age of five, measures addressing educational and income disparities must be strengthened.
3. It is advised that households adopt cleaner cooking fuels such as LPG or electricity. It is strongly recommended that children be kept outside the cooking zone in households where financial restrictions prevent the adoption of cleaner cooking fuels. This will cut down on the amount of smoke inhaled during cooking.
4. Vaccination campaigns should be intensified across West Africa. West African countries' health services should dispatch enough nurses to various communities to help vaccinate children.
5. During the period of diarrhoea, health professionals should be extra cautious and take steps to improve children's immunity. This will help to reduce the occurrence of infections like ARI, which thrive in the presence of weakened immunity.

Limitations

1. There may have been slight recall bias and misclassification of diseases since cases were self-reported by the mothers and not subject to clinical diagnosis.

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APPENDICES

Letter of Clearance from DHS

ICF

Mar 30, 2021

Derrick Owusu Nyantakyi
University of Ghana
Ghana
Phone: +233547505328
Email: owusuwesley@gmail.com
Request Date: 03/30/2021

Dear Derrick Owusu Nyantakyi:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Prevalence and Determinants of Diarrhea and Acute Respiratory Infections in West Africa: Evidence from the Demographic and Health":

Benin, Burkina Faso, Cote d'Ivoire, Gambia, Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo.

For restricted surveys, you must also request special permission from the Implementing Agencies. If approved, the restricted datasets will be provided to you by FTP.

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

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