UNIVERSITY FOR DEVELOPMENT STUDIES

WATER, SANITATION AND CHILD DIARRHEA OUTCOMES IN NORTHERN REGION

BY

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FEBRUARY, 2017

DECLARATION

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

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ABSTRACT

According to the World Health Organization (2012), each child in Ghana experiences an average of five episodes of diarrhea per year resulting in about 8,000 annual deaths, and 17 percent of children under five were found to have diarrhea two weeks prior to the 2014Ghana Demographic Health Survey. This study examined the relationship between access to water, sanitation and child diarrhea outcomes in Northern Region of which three urban areas (Zogbeli, Kukuo and Tishegu) and three rural areas (Kpanvo, Kotingli, and Bagliga) were purposively selected. Focus Group Discussions were held in each community to collect primary data. The GDHS(2014) data constituted secondary data for the study.Systematic sampling was used in selecting respondents.292 cases were analyzed in the secondary data and 100 mothers for the FGDs . The study revealed that children under age five living in households with an unimproved toilet; open pit, bucket, hanging toilet, pit latrine without a slab, or with no facility are significantly more likely to have episodes of diarrhea than others with an improved toilet facility. Unimproved toilet facilities are routes for infection and germs that affects children. Difference in child diarrhea incidence in Northern Region could not be attributed to sources of water, most households with no access to improved toilet facilities recorded high diarrhea cases. Insanitary child stool disposal was associated with increased diarrhea prevalence in the Region. The study recommends that MMDAs should ensure that before a person is given permit to build a house, the house plan should include a toilet facility.rural areas.

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DEDICATION

I dedicate this thesis to the memory of Mwin Edwin who died of diarrhea at five weeks old in the village of Boo in the Upper West Region in 2011.

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LIST OF ABREVIATIONS/ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
BMI	Body Mass Index
CDC	Centre for Disease Control
DHS	Demographic Health Survey
EA	Electoral Area
GDHS	Ghana Demographic Health Survey
HIV	Human Immune Virus
JMP	UNICEF/WHO Joint Monitoring Programme
LAC	Latin American and Caribbean
NCHS	National Centre for Health Statistics
PSU	Primary Sampling Units
SDGS	Sustainable Development Goals
SSA	Sub-Saharan Africa
STIS	Sexually Transmitted Infections
TB	Tuberculosis
UN	United Nations
UNICEF	United Nations Children's Fund
VIF	Variance Inflation Factor
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Child health has become a key and central indicator of economic development. In addition to it being an economic development indicator, child health is also closely associated with other development indicators such as adult health, educational attainment, productivity, and income of parents and future income prospects of children (Behrman &Rosenzweig, 2004; Persico, Postlewaite, & Silverman 2004; Case, Fertig, &Paxson, 2005).

However, UNICEF (2012) revealed that, diarrhea diseases account for 1 in 9 child deaths worldwide, making diarrhea the second leading cause of death among children under the age of 5. It causes death by depleting body fluids resulting in profound dehydration and can have a detrimental impact on childhood growth and cognitive development. According to the UNICEF, about 88% of diarrhea-associated deaths are attributable to unsafe water, inadequate sanitation, and insufficient hygiene. Most diarrheal germs are spread from the stool of one person to the mouth of another. These germs are usually spread through contaminated water, food, or objects. The World Health Organization (WHO) estimated that globally there are 13,000 million episodes of diarrhea in the developing countries with 3.2 million deaths occurring among children annually (WHO, 2012). In these developing countries, each child on an average suffers from diarrheal diseases for more than three episodes per year (United Nations Children Fund (UNICEF), 2012).

In many developing countries, diarrheal diseases remain a scourge of children. According to the World Health Organization, diarrheal diseases account for the deaths of around 1.8

million people every year (WHO, 2011). In the WHO's Southeast Asia Region and Western Pacific Region, it was responsible for 20.1% and 12%, respectively, of all deaths among children below five years old in 2000. In 2008, it accounted for 13% and 4% of all child deaths in the same regions. This explains why among the eight Millennium Development Goals (MDGs) that were adopted by the 189 members of the United Nations (UN) in 2000, at least four devote critical attention to issues of child health (Todaro& Smith, 2005).According to the World Health Organization (2012), each child in Ghana experiences an average of five episodes of diarrhea per year resulting in about 8,000 annual deaths, and in addition, 17 percent of children under five were found to have diarrhea two weeks prior to the 2003 Ghana Demographic Health Survey. In Ghana, diarrhea has been identified as the second most common health problem treated in outpatient clinics

Nutritional deficiencies, illnesses such asmalaria, diarrhea, and acute respiratory infection, as well as vaccine-preventable diseases are recognized as causes of under-five mortality in most countries in sub-Saharan Africa(Caldwell, 1979; Boerma and Bicego, 1992; Rutstein, 2000; Gyimah, 2002). Children in developing countries are most vulnerable to diarrhea due to the lack of water and sanitation in majority of developing countries (Zwane and Kremer, 2007). It has also long been recognized that socioeconomic factors such as economic growth, poverty, water and sanitation, education and gender are important determinants of health outcomes (Ranis & Stewart, 2005; Deaton, 2001).

Black et al., (2010) also opined that, diarrhea is the biggest killer of children in Africa. According to this study, in almost every day, 2,000 African children die from diarrhea – deaths that are entirely preventable. The study estimated that, nine out of ten cases of diarrhea can be prevented by safe water and sanitation – proven cost-effective interventions. Despite this, today only four in ten Africans have access to a basic toilet. This failure will undermine efforts to fighting prevalence of diarrhea and related ailments thereby the progress on achieving SDG 4 is far from reality.

Although the last three decades have witnessed a 20 percent reduction in the proportion of diseases in children in developing countries, diarrheal diseases continue to be a major threat to child health in developing countries and remains a global challenge around the world. Estimates published by the World Health Organization indicate that diarrheal disease is responsible for approximately eight hundred thousand deaths of children under the age of five per year, causing a higher number of under-age-5 deaths than malaria and HIV combined (WHO, 2007).

Child diarrhea prevalence show substantial and marked differences across the developing regions both in the depth and the number. The region with by far the highest number and prevalence of child diarrhea is South Asia. It is home to half of all diarrhea cases in children under five years old. Sub-Saharan Africa (SSA), where roughly one child out of every nine dies due to diarrhea, has the second highest rate. East Asia and the Near East and North Africa follow in that order. Latin America and the Caribbean (LAC) have the lowest rate and number of cases of child diarrhea (Bhutta ZA 2006; Rudan I, El AS, Bhutta ZA, Black RE, et al 2011).

The picture of diarrhea has not been different in the Ghanaian context as the statistics on child diarrhea are frightening. InGhana, the rate of child diarrhea for all age groups of children less than five years has increased steadily over the past six years.

According to the Ghana Demographic and Health Survey (2008) diarrhea prevalence increased with age and peaks at 12-23 months (33 percent), then decline at older ages in the 2008 survey. Age 12-23 months is when children start to walk and are at increased risk of contamination from the environment. Differences in diarrheaprevalence by gender and by urban-ruralresidence are small. Children in theNorthern and BrongAhafo regions have a higher prevalence of diarrhea thanchildren in the other regions. Prevalence of diarrhea is lowest among children in theVolta region (5 percent) and amongchildren of mothers with secondary or higher education (9 percent). Not surprisingly, diarrhea prevalence is lowest among children who live in households with improved, not shared toilet facilities, and households that are in the highest wealth quintile. Not surprisingly, diarrhea prevalence is highest among children residing in households without improved source of drinking water. Daelmeans and Saadeh, (2003) opined that addressing child diarrhea is a functional prerequisite for achieving internationally agreed goals such as the Sustainable Development Goals. Several efforts have therefore being made globally and locally to reduce the incidence of child diarrhea especially in developing nations. The fourth Sustainable Development Goal (SDG) intends among others to reduce under-five mortality by 2/3rd by the year 2015. This has led to the development of a more integrated and holistic strategies in a manner to ensure maximum benefits to the vulnerable groups the world over. The major interventions in this direction have been the construction of potable water sources and latrines all over the globe and the introduction of the community led total sanitation programme.

Another important instrument that has gained recognition is the role of clean water and sanitation facilities in fighting and preventing diarrhea.Research by Esrey et al. (1991) revealed a 17% reduction in diarrhea induced by improved water supply and a 22% reduction induced by improved sanitation infrastructure. Fewtrell et al. (2005) show a reduction in illness of 25% for water and 32% for sanitation infrastructure.

Substantial evidence exists documenting the relationship between improved water and sanitation and improved health (Montgomery and Elimelech 2007). A recent study by the World Health Organization estimated that environmental risk factors account for 34 percent of the disease burden in children (Prüss-Üstün and Corvalán 2007). Unclean water, lack of sanitary facilities, and improper hand-washing and hygiene practices due to a lack of proper sanitation facilities are key environmental risk factors which are beginning to receive more attention from scholars because they are increasingly shown to influence public health significantly. In addition, unlike many other environmental risk factors, drinking water sources and sanitation facilities are factors that can be changed, given the appropriate technology and funding (Rehfuess et al. 2009).

Recent estimates attribute 1.5 million child deaths each year to unclean water, inadequate hygiene, and a lack of adequate sanitation (UNICEF 2010). Lack of clean water and adequate sanitation is the leading contributor to diarrheal diseases in children (Gamper-Rabindran et al. 2007), which account for 19 percent of total child deaths (Boschi-Pinto et al. 2008). Improving access to piped water and sanitation has been shown to significantly reduce infant mortality rates (Gamper-Rabindran et al. 2007, DaVanzo 1988). Other studies have shown that access to adequate water and sanitation is more highly correlated with decreased child mortality than other socioeconomic indicators, such as access to health care or percentage of households below the poverty line (Shi, 2000).

According to the WHO (2000), providing safe drinking water and access to improved sanitation within the household environment can reduce the risk of mortality and morbidity among children under age five (WHO, 2009). This fact has been demonstrated in some developed countries, where childhood mortality has declined through interventions such as the provision of safe drinking water and adequate sanitary facilities (Rutstein, 2000).

While the fight against global child diarrhea is becoming increasingly complex and challenging, the role of clean water and improved sanitation facilities in tackling child diarrhea has been recognized as crucial. A comprehensive, integrated approach combining provision of clean water and latrine facilities with good personal hygiene and health-focused initiatives can help ensure children reach new heights and celebrate their fifth birthdays and beyond. If we want children to have a healthier future, we give their mothers and the children food helps, but providing them with clean water and toilet facilities will help even more. This therefore calls for concerted efforts among all stakeholders in addressing child diarrhea in Ghana.

1.2 Statement of the problem

The health and well-being of children are of critical importance not only as reflections of the current health status of individuals and the nation as a whole but also as predictors of the health of the next generation.

Even though Ghana has adopted several interventions, strategies, and programmes targeting improving child health and welfare and towards the achievement of the MDG4, much has not been achieved. If there is no immediate action, we can only expect more deaths, more health care spending and further losses in productivity. Child diarrhea still remains a major problem that many countries are still grappling with. According to Black et al, (2010) diarrhea is now the biggest killer of children in Africa. Every day, 2,000 African children die from diarrhea.The incidence of diarrhea among children below five years is also on a rise in Ghana. Data from the Ghana Demographic and Health Survey, (2014) revealed that the prevalence of diarrhea amongchildren below five years was 12 percent, and that one out of every five children suffers from diarrhea.

The Northern Region has very low sanitation facilities . Majority of houses (77%) do not have toilets (GSS, 2014). Only 23.5% of households use safe sanitation facilities (flush toilets, covered pit latrine and VIP/KVIP). 61.5% households in urban and 6.1% in rural.

Mothers and caregivers of children under-5 are more likely to transfer germs when feeding their children due to the insanitary conditions prevailing in the houses.Even though the government of Ghana and several NGOs have introduced some interventions to improve child health, diarrhea among children unbder-5 still remains high.

This thesis contributes to the existing empirical literature in several ways. First, the study would produce econometric estimates of the water, sanitation-child diarrhea relationship for children in Northern region. The study however controlled for geographical heterogeneity by estimating the regression of different sub-samples, for example, rural-urban divide to cater for location heterogeneity.

Again, using the appropriate econometric techniques, we explore the relationship of some further variables that, in theory, could affect child diarrhea prevalence and examine whether or not these measures moderate the apparent relationship for Ghanaian children. Specifically, the study presents evidence on the roles of water and sanitation on child diarrhea prevalence in Northern Region.

This study therefore assessed water, sanitation and diarrhea prevalence of diarrhea among children under-5 in the Northern region

1.3 Objectives of the study

The general objective of the study is to examine the relationship between access to water, sanitation and child diarrhea outcomes in Northern region. The specific objectives are to:

1. Examine the relationship between access to toilet and child diarrhea in Northern region.

2. Estimate the relationship between household water source and child diarrhea in Northern region.

3. Examine the relationship between method of child stool disposal and child diarrhea in Northern region.

1.4 Hypotheses of the study

1. Ho: Access to toilethas no influence on child diarrhea prevalence in Northern region;

2. Ho: There is no relationship between household water source and child diarrhea prevalence in Northern region.

3. Ho: Method of child stool disposal has no effect on diarrhea prevalence among children in Northern region.

1.5 Significance of the Study

From a policy perspective, policy decisions in the absence of consistent evidence is a challenge, hence complementing evidence in policy decision-making is particularly crucial for child health outcomes and welfare. It is therefore envisaged that the results of the study would improve policymakers" understanding the linkages between water, sanitation and child diarrhea in the country and serve as an important tool for any possible intervention aimed at improving child health outcomes in Ghana.

This study will contribute to the existing knowledge of literature by offering significant contributions, both theoretical and empirically, for understanding child diarrhea in Ghana and further provoke future research in the academia. This study is particularly significant in light of the fact that, understanding the determinants of child diarrhea and the getting the appropriate prescriptions for addressing it will be a further in the cap of achieving the seventh and Fourth MDGs.

The influence of water and sanitation on child diarrhea remains a less researched area. In addition, in developing countries, evidence and the contributions of water and sanitation to reduction in child diarrhea have not been well documented. The situation in Ghana is not different.

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1.6Scope of the Study

The study explored the socio-economic and demographic determinants of child diarrhea outcomes in Northern region placing emphasis on water and sanitation. Logistic regression analyses and FGD were employed using the 2014 Ghana Demographic and Health Survey data and primary data from mothers in Tamale Metropolitan Assembly for the purpose of achieving the objective and testing the hypothesis of this study. Geographically, the study covered the Northern Region of Ghana. Contextually, variables such as, child stool disposal, time to water source, source of drinking water, availability of toilet facility, mother's age, household income, rural – urban dynamics and mother's level of education are explored.

1.7 Conceptual framework

FollowingAnnim, Awusabo-Asare and Amo-Adjei (2013), this study adapted the UNICEF (1990) model of child malnutrition to investigate the influence of sanitation and water on child health outcomes—Diarrhea prevalence in Ghana. As illustrated in the adapted model, diarrhea prevalence `among children is the outcome and manifestation of the interplay among basic and underlying factors. The basic factors consist of structural characteristics such as region and urban-rural residence and household characteristics including dependency ratio, wealth index, sources of drinking water, stool disposal and toilet facilities as well as maternal characteristics which also include education, marital status, occupation, maternal health status measured by Body Mass Index and maternal age. These in turn indirectly influence the underlying factors of child-related variables and directly influence the household child diarrhea.

In the modified model, maternal characteristics is emphasized rather thanparental characteristics as in the original model, while a clear separation has been provided for household and maternal characteristics. The argument is that the role of the mother is critical since they are considered primary care givers for children less than five years and that role can also be enhanced by marriage. Availability of good drinking water and toilet facilities in the home are considered indicators of household protective factors for child health outcomes. Therefore the presence or absence and nature of these facilities directly influence child diarrhea prevalence. Again, the interaction among these factors effect on child health outcomes is measured using child diarrhea as presented in Figure 2.

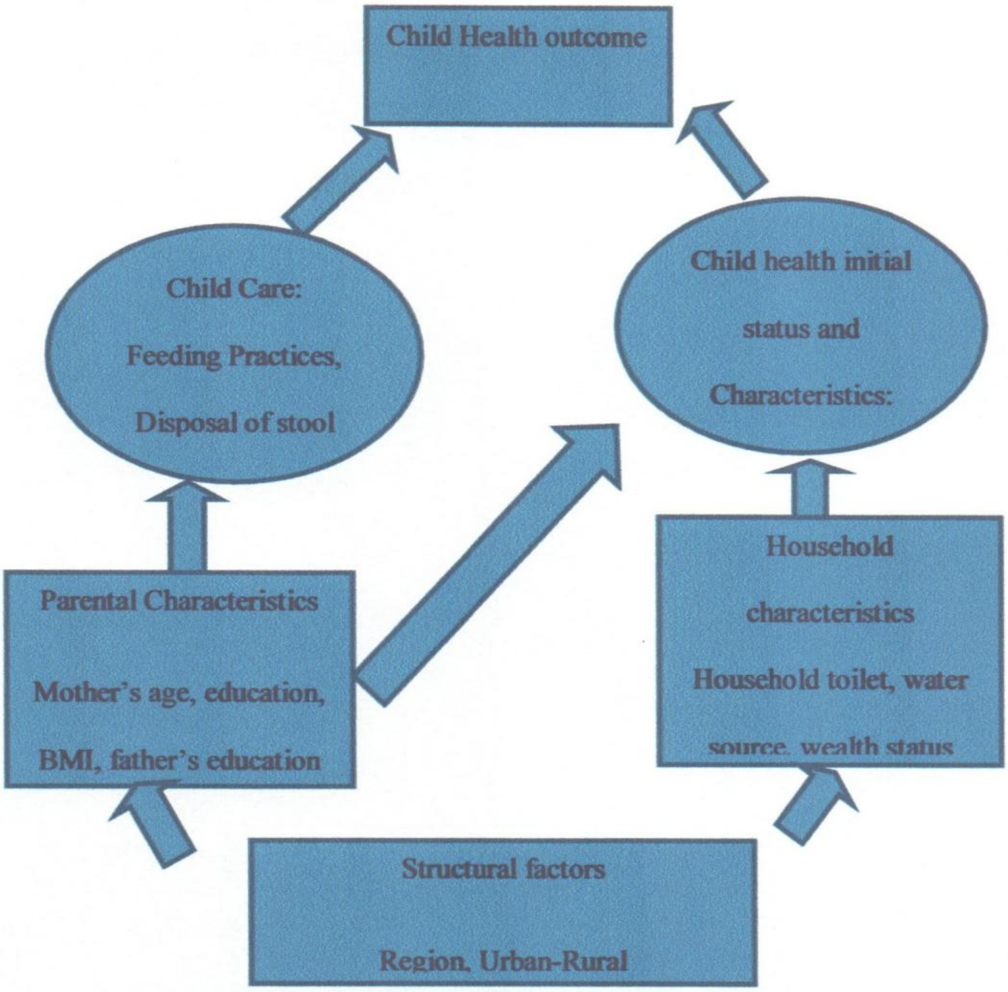


Figure 2: Conceptual framework on Child Diarrhea

Source: Adapted from UNICEF (1990) model of child malnutrition

1.8Organization of the Study

This thesis is organized into five chapters. The rest of the thesis is presented as follows: Chapter Two presents review of relevant literature; both theoretical and empirical that underpins the child diarrhea or health status. Chapter Three presents the methodological framework and techniques employed in conducting the study. Chapter Four examined and discussed the results and main findings with reference to the literature. The final chapter is the summary, conclusions and recommendations of the study.

1.9 Definition of terms

Water: For the purpose of this study water refers to the main source of water to households for drinking purposes

Sanitation: This refers to main toilet types used by households, these sanitation types could be improved or unimproved sanitation

Diarrhoea: the condition of having at least three loose or liquid bowel movements each day. It often lasts for a few days and can result in dehydration due to fluid loss

CHAPTER TWO

LITERATUREREVIEW

2.1 Introduction

This chapter is designated to explore the theoretical expositions of water, sanitation and child health outcomes. It opens with the overview of child nutritional status in Ghana. The concept of maternal autonomy was espoused to expand the theoretical underpinning of the understanding of the linkages between maternal autonomy and child health outcomes. The theoretical expositions of demand for health and health care were discussed in detail. The chapter further looked at the empirical evidence of the determinants of child health outcomes with greater emphasis on the dimensions of water and sanitation.

2.1 Overview of Sanitation Situation in Ghana

Kendie (1990, as cited in Kendie 2002:9) defined sanitation to "encompass all those inter-related activities, which in the long run ensure the sustained health of the family". The Water Supply and Sanitation Collaborative Council (WSSCC) working group on sanitation promotion with World Health Organization (as cited in Water Aid 1999 defined sanitation as interventions that minimize the impacts of disease causing organisms through safe and clean environment.

The report recognizes clean environment as an effective barrier capable of breaking the life cycles of disease causing agents. However, it is worth insisting that maintaining a clean and a safe environment is irrelevant, if human excreta and animal waste are disposed of indiscriminately. Furthermore, interventions as tools would not be beneficial in the presence of a multitude of heaps of refuse and waste water that continue to pose health hazards to residents and the absolute lack of hand-washing facilities around public places of convenience. It is also important that all and sundry must make a conscious effort to free the environment from filth. According to Akabzaa and Ayamdoo (2003), "sanitation refers to the safe management of human excreta, including sewers, latrine and the regulation, and hygiene promotion needed to reduce faecal-oral diseases transmission" (Gender and Water Alliance, 2003, as cited in Akabzaa and Ayamdoo, 2006:31). The definitions above give priority to human health hence are useful for the purpose of this study.

A report by Overseas Development Institute (ODI) (2004:3) aptly stated that "sanitation has for long been the poor cousin of water supply". According to a Nigeria Water Supply and Sanitation Forum (2008), even though water and sanitation issues are being discussed dispassionately, water supply seemingly attracts more attention than sanitation because of its direct link with excreta which is regarded as a taboo in some societies.

The installation of a water facility does not guarantee adequate and regular flow of water if spare parts are not available and communities lack skills to carry out regular maintenance. For example, Bacho (2001) pointed out that high cost of borehole parts, materials, chemicals and personnel expenses are factors militating against community ownership of water facilities.

In Ghana, it is estimated that 9 million episodes of diarrhea occurred each year with about 84,000 children dying from diarrhea. This constitutes roughly a quarter of all deaths among under five (Scott et al., 2007). A report from the Ministry of Health in Ghana indicated that a number of water-related diseases such as cholera, diarrhea, skin infection, and intestinal worms were predominant in rural areas. For instance, a lack of adequate safe drinking water and sanitation were the causes of such diseases. Sadly, children and women bear the brunt of such diseases (Fuest, 2005). Although hand washing with soap is effective in eliminating germs, it is difficult to enforce it in rural areas where monitoring is likely to be less effective. Scott et al. (2007) discovered that less than 5% of Ghanaian mothers in Ghana actually washed their hands with soap after critical times or after handling children's stool. The group indicated that hand washing with soap after defecation is a real problem at public toilets where over 50% of the population defecates. In many parts of Ghana, women often spend a greater part of their time, usually 5 hours per day fetching water from unimproved sources, often walking over long distances (10 or even 20 kilometers) particularly during the dry part of the year. The situation is more pronounced in the north of Ghana where there are acute water shortages in the dry season (Fuest, 2005). The use of improved sanitation facilities shows marked variation across the ten regions of Ghana. With the exception of Greater Accra, Western, Eastern and Central Regions, the Northern, Upper West and Upper East Regions are more likely to use unimproved sanitation facilities since only 3% of the population in Northern Ghana use improved sanitation facilities compared with 25% in the Greater Accra Region (WSMP, 2009).

Ghana has over the years faced a number of challenges in ensuring improved water and sanitation for the people of the country. These have resulted in limited access to sanitation by the population, intermittent supply of water, high water losses and low water pressure (National Population Council, 2014).

A report by UNICEF (2014) indicated that Ghana has been ranked second after Sudan in Africa for open defecation, with five million Ghanaians not having access to any toilet facility. The country has also been performing poorly with sanitation coverage of only 15 percent, making the practice of open defecation a key sanitation challenge because people do not have access to key basic facilities.Poor sanitation issues has cost the country $79million a year and also posed the greatest danger to human health, particularly for the most vulnerable, including young children.

According to Zakiya (2015) about 85.1 per cent of people in Ghana do not have access to safe and private toilets as they resort to large household toilet usage.All over the world, it is estimated that more than 2.3 billion people do not have access to a safe and private toilets.Out of this, nearly one billion have no choice but to defecate in the open such as in the bushes, fields or by the road side.

In 2007, the Government of Ghana launched the Ghana National Water Policy which focuses on integrating water resources management with the aim to facilitate improved access to safe water and sanitation in rural and urban areas. To support these efforts, the European Union (EU) using 9th European Development Fund (EDF) resources, has funded a series of projects which were completed between 2008 and 2012. To date, nearly half a million rural Ghanaians have benefited from access to safe water and sanitation facilities including hygiene promotion(GoG, 2014).

According to the Ghana Human Development Report (GHDR) (2008), although there is a significant improvement in access to potable water supply to the rural areas through the drilling of boreholes, it is still inadequate and most people have to rely on ponds and streams for their drinking water. It therefore did not come as a surprise that between 2002 and 2003 Ghana recorded a 44.3% increase in guinea worm infection. Indeed, Ghana now has the highest record of guinea worm in the world, second only to Sudan (GHDR, 2004). The sanitation situation in Ghana seems to be fast deteriorating. A survey undertaken by GWSL (1992, as cited in GHDR, 1998) for all urban areas throughout the entire country has revealed that the sanitation situation has fallen below expectations with coverage of 61 % for sanitation..

According to Kendie (2002), the reason why most people failed to construct latrines is the perception that human excreta can improve soil fertility and therefore crop yields. He further argues that, in some communities in Ghana where access to safe drinking water has seen substantial improvement and health education vigorously pursued and sustained, the sanitation and hygiene situation was found to be disturbing.

Lockwood (2002) has attributed the unsustainable provision of water and sanitation facilities to national agencies' inability to secure enough funding, lack of qualified personnel and lack of defined roles. The problem is further compounded by population growth and the dispersed nature of some settlement patterns. Fuest and Haffner (2005) argue that state machineries operating in the water sector are inefficient as a result of lack of capacity to respond swiftly to population growth and the high demand for potable water supply. UN Water (2010-2015) and UN (2004, as reported in Akabzaa and Ayamdoo, 2006) show that communities benefit very little from capacity building and empowerment. Instead the concentration is on the strengthening of the capacities of water specialists than community members. This is quite unfortunate as communities' capacity building is seen as the main driving force to sustainable water and sanitation projects. The development of the capacities of the indigenous people is essential to manage vital projects and protect the huge investment made on such facilities.

National coverage for improved sanitation increased from 4 percent to 12.4 percent between 1993 and 2008. Among urban populations, improved sanitation coverage increased by approximately 8 percent appreciating from 10 percent in 1993 to 17.8 percent in 2008. For rural populations, improved sanitation coverage increased from 1 percent to 8.2 percent between 1993 and 2008. It is worth noting that there was an appreciable increase of 6 percent in improved sanitation coverage for the rural population between 2003 and 2008 compared to just 3 percent increase in coverage for the urban population during the same period GDHS (1993,2003,2008). The gap between the present national coverage on improved sanitation of 12.4 percent and the 53 percent target by 2015 indicates that there must be approximately five times increase in coverage to be able to achieve the set target.

The use of improved sanitation facilities at the regional level varies considerably as coverage is highest in the Greater Accra, Eastern, Western and Central Regions. Residents of the three regions in the north (Northern, Upper East and Upper West) are less likely than others to use improved facilities as only 3 percent of the population in the Northern region use improved sanitation facilities (not shared) whilst 25 percent in the Greater Accra region use such facilities GDHS (2008).

According to the Ghana Demographic and Health Survey, 2008 the proportion of the population that uses improved drinking water was 83.8 percent and improved sanitation facility was 12.4 percent in 2008. This means that about 3.5 million people living in Ghana did not use improved drinking water and as much as 19.2 milliondid not use improved sanitation facilities in 2008. At the current pace of increase in the use of improved sanitation (toilet facilities), the number of people in Ghana who would not use improved toilet facilities will be 18.7 millionby 2015.

2.2 Child diarrhea prevalence in Ghana

Diarrhea is one major health problem affecting children in Ghana for the past years. The etiological factors associated with diarrhea disease in children include microbial agents which are usually transmitted through food and water contaminated with human feces (Kungu et al., 2002). Studies indicate that factors such as age of the child, quality and quantity of water, availability of toilet facilities, housing conditions, level of maternal education, household economic status, place of residence, feeding practices, and the general level of hygiene in the home affects the exposure to diarrhea pathogens (Teran, 1991; Diame et al., 1990; Timaeus and Lush, 1995). Diarrhea diseases are prevalent among poor households living under conditions of poor personal and domestic hygiene

(McGranahan et al., 1999). Some studies indicate lower diarrhea morbidity and mortality among children from wealthy homes in the developing world (Timaeus and Lush, 1995).

Of the several interventions that may reducediarrhoea morbidity and mortality rates, theimprovement of water supply and excreta disposal facilities has attracted particular interest. These environmental improvements, together with improvements in living standards, played a major role in reducing diarrhoea rates and controlling epidemic typhoid and cholera in Europe and North America between 1860 and 1920 (Hughes et al, 2010). According to Saunders and Warford (2004)the improvement of water supply and excreta disposal in poor communities in developing countries today will have a substantial impact on diarrhea morbidity and mortality rates in those communities. According to VanDerslice et al (2006)reducing the level of environmental contaminationreduces the risk of diarrhoea. Goodsanitation protects infants by creating a series of barriers to keep enteric pathogens out of their environment; excreta disposal facilities isolate human wastes; improved water supplies protect drinking-water from faecalcontamination; and hand washing and personal hygiene reduce the transmission of enteric pathogens in the home.

According to the World Health Organization (1996), each child in Ghana experiences an average of five episodes of diarrhea per year resulting in about 8,000 annual deaths, and in addition, 17 percent of children under five were found to have diarrhea two weeks prior to the 2003 Ghana Demographic Health Survey. In Ghana, diarrhea has been identified as the second most common health problem treated in outpatient clinics. Statistics from the Ministry of Health indicate that diarrhea accounts for 84 000 deaths annually in Ghana, with 25 per cent being children under 5 years (Ghana News Agency, 2003). Diarrhea thus poses a major threat to child health and survival in Ghana. Besides mortality, the long-term effects of diarrhea illness on childhood health are extremely serious and include malnutrition and growth faltering (Brown, 2003).

UNICEF, (2006) also reported that diarrhea takes the lives of over 14,000 Ghanaian children under age five, and is the country's second leading cause of under-five deaths the country's second leading cause of under-five death after malaria. The 2003 Ghana Demographic Health Survey (GDHS) found that 17 percent of children under five had had diarrhea in the two weeks prior to the survey.

In Ghana, the diarrhea prevalence rates for all age groups of children less than five years have increased steadily over the past seven years. According to the GDHS report, 2008, diarrhea prevalence increases with age and peaks at 12-23 months (33 percent), then declines at older ages. In 2008, 37.1 percent of children aged 0-11 months were found to be affected with diarrhea. This shows a steady increase from 26.2% in 2003 to the current figure. For children aged 12- 23 months, 32.6% had diarrhea in 2008 as compared to 24.2% in 2003. The highest diarrhea prevalence rate of 32.5% was recorded by Northern region, while Volta region recorded the lowest rate of .5.1%in 2008.The diarrhea prevalence rate among children 24-59 months age group was 22.1% in 2008 as compared to 17% in 2003.

2.4 The linkages between water, sanitation and child health

Water supply and sanitation, which are components of SDG7 (i.e. ensure environmental sustainability) provide good health and ensure economic benefits. Safe drinking water and basic sanitation are of crucial importance to the preservation of human health. Water-related diseases are the most common cause of illness and death among the poor in the developing countries. Inadequate access to safe water and sanitation services, combined with poor hygiene practices, is the cause of at least one quarter of all child deaths and one fifth of the total childhood disease burden globally (Fewtrell, Prüss-Üstün, Bos, Gore & Bartram, 2007). Water, sanitation and hygiene are also linked to school attendance and performance (particularly among girls), safety and security of women and girls, and the economic and social development of communities and nations.

Machel (1996) cited in UNICEF (2009) examined water and sanitation from three perspectives: as a determinant of conflict, as a key prerequisite for reducing child mortality, and as a gender issue. At the basic level, every community and individual require access to clean water and sanitary waste disposal. Water and sanitation improvements, in association with hygiene behavioural change, can have significant effects on people's health by reducing a variety of disease conditions such as diarrhea, intestinal helminths, guinea worm, and skin diseases. These improvements in health can, in turn, lead to reduced morbidity and mortality and improved nutritional status

Water and sanitation improvements affect health primarily by interrupting or reducing the transmission of disease agents. This occurs through a variety of mechanisms. Of primary importance is the safe disposal of human faeces, thereby reducing the pathogen load in the ambient environment. Increasing the quantity of water allows for better hygiene practices. Raising the quality of drinking water reduces the ingestion of pathogens. With fewer incidences of diseases, children can eat and absorb more food, thereby improving their nutritional status. Also, a healthier adult population is more productive, and improvements in water and sanitation can improve income and the capacity to acquire food. Other benefits associated with better water delivery include time savings for primary caregivers, which can result in the preparation of more or better food for children (Bergeron &Esrey, 1993).

Improvements in sanitation have been shown consistently to result in better health, as measured by fewer diarrheas, reductions in parasitic infections, increased child growth, and lower morbidity and mortality. Modest improvements in sanitation (e.g. pit latrines) may result in better health but major improvements in sanitation (e.g. flush toilets) may lead to even larger health benefits (Anker & Knowles, 1980). These results have been reproduced consistently in a number of settings (e.g. Bateman & Smith, 1991).

2.5 Overview of theoretical expositions of health and demand for health

The most important development in the theory of demand for health and medical care during the 1970"s is beyond doubt the explicit recognition of the fact that medical care is not required for its own sake but for the sake of its effects on health (Muurinen, 1982). The seminal reference of this theory of demand for health is Michael Grossman's 1972 study in which he introduced the concepts of health as a durable capital goods which is inherited but depreciates over time, and investment in health as an activity where medical care is combined with other inputs in order to produce new health so as to partly counteract the gradual natural deterioration of health Grossman (1972). In a sense, therefore, individuals partly determine the length of their life span. His study constructed and estimated a dynamic model of the demand for the commodity good health (Jacobson, 2000).

Even though the Grossman model received high recognition and set the pace as the first to try to give an understanding of demand for health and medical care, it has also received high criticisms from his successors. Notable among them is Muurinen (1982) extension of the Grossman model named the Generalized Grossman. Her main critiques were that his model was unduly unrealistic as a description of the inherently uncertain area of health and utilization behavior in that its main part is based on the assumption of complete certainty. Muurinen sees Grossman justification of the positive education-health correlation to be somewhat unsatisfactory. To her, the inclusion of education as one of the independent variables in Grossman's model is based on the view of education as a productivity factor in household production in general.

For McGuire, Henderson and Mooney (1988), the major shortcomings of the Grossman model are related to its complete neglect of two aspects which may likely affect demand for health: uncertainty and imperfect information. Other important issues raised against the model have to deal with the absence of health insurance.

The model operates in a world without health insurance and assumes that all healthcare costs are covered either from income or personal wealth. This assumption logically arises from another assumption – that of the continuous investment in health under conditions of perfect information, which means that an individual is purchasing healthcare like any other commodity. However, due to the unpredictability of illness and the corresponding healthcare costs, a risk-averse individual demand for healthcare is fundamentally linked to the demand for healthcare insurance, at the very least. The model also simplifies the complexity of an individual's health status into binary states ("sick" or "healthy"); more realistic approximation can be introduced by a continuum of health states (Liljas, 1988).

The model and its" other extensions consider an individual as an isolated health producer, which neglects the fact that most individuals spend their lives with other individuals (i.e. within families), who may influence each other's behaviors. Jacobson (2000) and Bolin, Jacobson and Lindgren (2001) took into account this notion and modeled the family as a health producing unit and spouses as Nash-bargainers.

Though the model yields valuable contributions to explain individuals" health related behaviors and differences in health and health care utilization, it is been based on the individual as producer of health. This implies that both the original model, as well as the extended models, can only be used to analyze adult health, not children's „demand" for health and their health care utilization. It also implies that the influence of other family members on the individual's demand for health and demand for health care cannot be considered. It was based on the premise that Jacobson (2000) derived his demand for medical care by focusing at various levels of the family. For the purpose of this, a careful look at the mathematical derivations of the parents-child model specification of the extended groomsman model by Jacobson (2000) is been looked at.

The extended Grossman model – The parent-child family specification Using a common preference model of family behavior, the instantaneous family (strictly concave) utility function can be written as, (Jacobson, 2000);

$U = U(H_m, H_f, H_c, Z)$

Where time subscripts are omitted in order to simplify the notations: *u* is family utility in period *t*, *Hm*,*Hf*and*Hc*are husband (male), wife (female) and child health respectively, and *Z* is a vector of commodities consumed.

2.6Empirical evidence

Numerous studies have examined the relationship between diarrhea incidence and water and sanitation infrastructure in various contexts. Some studies of water infrastructure have focused on the role of water quality in diarrhea incidence, while others have examined the importance of the quantity of water utilized, frequently using the distance between household and water source as a proxy. Studies of sanitation infrastructure have examined both the importance of having any facility, as well as the advantages of particular types of facilities. This literature review provides a summary of key findings on each of these water and sanitation topics.

2.6.1Water Quality

Water quality studies typically examine the impact of improved water sources on diarrhea. Such improved sources include piped water, covered or "protected" wells, and boreholes, which are narrow-diameter, deep wells, usually fitted with a hand pump (Shier et al., 1996). These improved sources normally have lower pathogen counts, reducing child exposure to the diarrhea-causing agents that readily infect traditional water sources (Shier et al., 1996). Esreyet. al., (1991) reviewed 144 studies that measured the impact of water quality on diarrhea incidence (cited in Shier, et al., 2008). Most studies found a statistically significant association between improved water quality and reduced diarrhea incidence (Shier, et al., 2008). However, several studies showed no such association (Shier, et al., 2008).

Since Esrey's 1991 review, a number of additional studies have looked at the association between water quality and diarrhea incidence in the context of specific environments. Many of these studies confirm what scientific understandings of diarrhea causation would suggest – that improving water quality lowers the incidence of diarrhea. For example, Mbonye (2004) used logistic regression methods to analyze diarrhea likelihood for children under age two in the Sembabule district of Uganda and found that drinking water from rivers and streams was associated with a 2.2 times higher likelihood of diarrhea than drinking water from boreholes. In addition, drinking water from stagnant ponds and wells was associated with a 2.8 times higher likelihood of diarrhea than drinking water from boreholes (Mbonye, 2004). A 2003 study in western Kenya likewise found drinking borehole water to be safer than drinking lake water (Brooks et al., 2003). This case control-study of 451 persons with bloody diarrhea found that drinking Lake Victoria water, as opposed to borehole water, was significantly associated with diarrhea (Brooks et al., 2008).

In addition to the benefits of borehole water, a number of studies have found that piped water in the home is safer than other sources, though they did not explicitly compare piped water to borehole water. For example, availability of piped water in the home was associated with lower diarrhea incidence in a 1992 case-control study of children under five from 200 Sri Lankan families (Wijewardene, Fonseka&Wijayasiri, 1992). This same conclusion was reported in a longitudinal multivariate analysis of 2,355 Filipino infants under six months in 1994 (VanDerslice, Popkin& Briscoe, 1994), as well as in a Papua

New Guinean study of urban children under age five in 1991 (Bukenya and Nwokolo, 1991). A 1996 study by the World Bank in Jakarta, Indonesia also found water quality to be associated with diarrheal incidence in children under age six (Alberini, Eskeland, Krupnick&McGranahan). This study tested water quality and found that water contaminated by fecal coliform was associated with a rate of diarrhea two times greater than uncontaminated water (Alberini et al., 1996).

While some studies found unqualified associations between water quality and diarrhea incidence, other studies found that improved water sources only effectively reduced diarrhea under specific circumstances. For example, a 2002 study in rural India found that piped water was associated with decreased prevalence and duration of under-five diarrhea in the upper three wealth quintiles, but not in the lower two (Jalan and Ravallion). The authors theorized that poorer families were unable to complement the "public input" of piped water with other "private inputs" that are necessary for diarrhea prevention, such as sanitation, nutrition, and hygienic water storage. While this study suggested that the effectiveness of improved water quality depended on household wealth, a 1996 study by Steven Esrey at Johns Hopkins University found that the impact of improved water quality depended specifically upon household sanitation infrastructure. This study looked at data from the late 1980s across eight countries on three continents and found that improved water quality was typically associated with improved child health only when improved sanitation was also present. Similarly, a systemic review of quantitative research in 2004 found that interventions to improve water quality at point-of-use tended to have the greatest impact in communities where a high proportion of households had adequate sanitation (Gundry, Wright & Conroy, 2004). A 1995 study of infants in the Philippines likewise found an interaction between water source and neighborhood sanitation (VanDerslice and Briscoe, 1995). In this study, improving water quality had virtually no effect in neighborhoods with very low sanitation, whereas water quality was highly associated with diarrhea incidence in communities with better sanitation (VanDerslice and Briscoe, 1995).

Contrary to expectations, a number of studies found no association between water quality and diarrhea incidence. For example, in a 2002 logistic regression analysis of data from three East African countries, results indicated that households with piped water connections did not have significantly lower diarrhea likelihood than households that lacked piped water (Tumwine et al., 2002). Unlike most other studies, diarrhea likelihood for household members of all ages was included in this analysis of Uganda, Tanzania, and Kenya (Tumwine et al., 2002). A case-control study of children under five in Nicaragua likewise yielded no statistically significant difference in diarrhea prevalence between households utilizing various water sources, including piped, well, and river/stream water (Gorter, Sandiford, Smith &Pauw, 1991). In addition, a 1998 analysis in Pakistan found no significant association between non-piped drinking water and diarrhea in children under five (Arif and Ibrahim, 1998) and a 1992 study in Malaysia found no significant association between water sources with measured fecal contamination and diarrhea in children 4-59 months (Knight et al., 1992). The most unexpected results came from a recent study in the Philippines, which suggested that neighborhoods of Metro Cebu that were fully connected to piped water had significantly higherdiarrhea incidence than those that were not (Bennett, 2007). The author attributed this increase in diarrhea to the significantly poorer sanitation in neighborhoods with piped water, arguing that community attention to sanitation declined when contamination of traditional water sources was no longer a concern.

Several additional studies on water quality deserve special attention, because they utilized data on Ghana, the country of primary interest for this thesis. The results of these studies present a mixed picture on the association between diarrhea and water source in Ghana. Shier et al. examined 1989 and 1991 data from the Upper East region of Ghana, including information on 20,000 children age six months to seven years (1996). Relative to well or stream water, children from households that used piped and borehole water had significantly lower diarrhea prevalence in the hot season (February-April), the season with the greatest contamination of traditional water sources. However, water source was not a statistically significant determinant of diarrhea during the cool season (October-December) or the rainy season (June-August). Another Ghanaian study focused on the rainy season in the Accra metropolitan area (Boadi and Kuitunen, 2005). This study found a significant association between piped water and lower diarrhea incidence among children under the age of six (Boadi and Kuitunen, 2005).

Two studies have used data from the Ghana Demographic and Health Surveys (GDHS) to examine diarrhea incidence. A 2000 study by Clement Ahiadeke used 1993 GDHS data and a 2003 study by Stephen Obeng-Gyimah used 1998 GDHS data. Both surveys drew a nationally representative sample of households. The earlier survey was administered September 1993 through February 1994 and the latter was administered November 1998 through February 1999; thus, both surveys spanned the cool and hot seasons. Gyimah (2003) found that children under age five had a significantly lower likelihood of diarrhea if they came from households with piped water. Controlling for other factors, including type of sanitation, parental education, and urban/rural residence, Gyimah found that, relative to households with piped water, children from households with well water had a .56 higher probability of having had diarrhea in the past two weeks. Likewise, those with stream, dam, or lake water had a .67 higher probability of having had diarrhea in the past two weeks. In addition, the study compared borehole water to piped water and found that the former was associated with a .47 higher probability of diarrhea. Since there are very few studies comparing piped and borehole water, it is noteworthy that this study found a statistically significant difference between the diarrhea likelihood associated with these two sources. The Ahiadeke study combined data from the 1993 Ghana DHS with the 1990 Nigeria DHS and looked at the interaction effect between breast-feeding and water source. Ahiadeke found that breastfed infants age 0-6 months were about 2.5 times more likely to have had diarrhea if breast milk was supplemented with non-piped water, relative to piped water.

2.6.2Source versus Point-of-Use Water Quality

Several explanations have emerged for the lack of consensus among studies of the water-diarrhea link. It is commonly argued that the best strategies against diarrhea vary by location and that the diversity of study findings is a product of the diversity of study sites. In addition, several studies have found that improved water sources did not decrease diarrhea incidence because the quality of water consumed was inferior to the quality of water at the source. In 2004, Wright, Gundry, and Conroy performed a systemic review of 57 quantitative studies that compared water quality at the source to water quality at point-of-use. In about half of the studies reviewed, water quality was significantly lower at point-of-use compared to the source, suggesting that water was contaminated during collection, transport, and/or storage. Similar findings were reported in a 2004 Pakistani study, where fecal contamination levels in household storage containers were found to be high, even when the source water was of good quality (Jensen, Jayasinghe, van der Hoek, Cairncross&Dalsgaard, 2004). As such, where water quality varies between source and point-of-use, studies that use the presence of an improved water source as a proxy for water quality may underestimate its importance.

An additional explanation for the failure of improved water sources to decrease diarrhea incidence in some contexts is that such sources may not always deliver the promised water quality. For example, in explaining the insignificant effect of piped water in their 1998 study in Pakistan, Arif and Ibrahim suggested that damaged pipelines resulted in contamination of water before it even flowed from the tap. Similarly, a 1998 study in Uzbekistan found that over 30 percent of households with piped water lacked detectable levels of chlorine in their drinking water, despite the fact that source water was treated with two-stage chlorination (Semenza, Roberts, Henderson, Bogan& Rubin, et al., 1998). While these findings explain why improved water sources do not always decrease diarrhea incidence, other studies have theorized as to why *poor* quality water is not associated with an increased diarrhea incidence in certain settings. In a 1992 study in Malaysia, 80 percent of water drawn from contaminated sources was found to be clean at point-of-use, and the authors attributed this discrepancy to the frequency of water treatment by boiling in Malaysian households (Knight et al.). Likewise, a 1991 study in Nicaragua suggested water- boiling as a potential explanation for the lack of association between poor quality drinking water and diarrhea incidence in that setting (Gorter, et al., 1991).

2.6.3 Water Quantity

In addition to examination of water quality, a number of studies have looked at the effect of water quantityon diarrhea incidence, directly measuring quantities of water utilized, or using distance from water source or regularity of water availability as a proxy. Increasing the quantity of water available to households can decrease diarrhea incidence by facilitating the use of water for hygienic and sanitation purposes, such as washing hands and utensils and safely disposing of stools (Boadi and Kuitunen, 2005; Shier et al., 1996). A 1996 World Bank study in Jakarta, Indonesia found that persons from households that experienced interruptions in their (piped) water supply were significantly less likely to wash their hands after defecation than persons from households without water supply interruptions (Alberini, Eskeland, Krupnick&McGranahan). Likewise, a 1990 study by

J.V. Pinfold in Thailand tested the bacteriological cleanliness of fingertips in Thai households and found that those with in-house water connections had significantly less contaminated samples than those without in-house connections. Similar results were found in an African setting in 1995 when hygienic stool disposal was found to be linked to ease of water access in Bobo-Dioulasso, Burkina Faso (Curtis et al. 1995).

In 1991, the World Health Organization published a review of 15 studies that specifically examined the link between diarrhea incidence and water quantity, independently of water quality (Esrey, Potash, Roberts &Shiff, 1991). All but one of these studies found that increased water quantity had a negative association with diarrhea incidence. The median reduction in diarrhea incidence was 20 percent in those studies that were deemed most rigorous. Subsequent studies largely confirmed this association. For example, shorter distance from water source was significantly associated with lower diarrhea incidence in studies in Zaire (Tonglet, Isu, Mpese, Dramaix, and Hennart, 1992), Tanzania (Gascon et al., 2000), and Nicaragua (Gorter, Sandiford, Smith, and Pauw, 1991). In addition, quantity of water utilized was measured directly and found to be negatively associated with diarrhea in Uganda, Kenya, Tanzania, and Zaire (Tumwine et al., 2002; Tonglet et al., 1992). In studies that looked at both the impact of increased water quantity and improved water quality, quantity was generally found to be of greater importance than quality (Jensen, Jayasinghe, van der Hoek, Cairncross&Dalsgaard, 2004; Esrey, 1996 as cited in Gundry, Wright & Conroy, 2004; Esrey and Habicht, 1988; Victora, et al., 1988; Feachem, 1986).

2.6.4 Sanitation Infrastructure

Provision of sanitation facilities is an additional infrastructure component that has the potential to reduce the toll of diarrheal disease in developing countries. By separating feces from the human environment, toilets and latrines interrupt the fecal-oral cycle. Flush toilets are typically considered to be the most sanitary form of waste disposal, followed by sealed pit and ventilated improved pit latrines, and finally by open pits, all of which are considered more hygienic than open defecation (unless such defecation is sufficiently distant from human habitation as to pose no risk).

Several studies have looked at the role of sanitation infrastructure in diarrhea prevention in Ghana. In a 2005 study in the Accra metropolitan area, Boadi and Kuitunen found that children in households without sanitation infrastructure had significantly higher diarrhea incidence than those in households with either a flush toilet or a latrine. In addition, the Accra study found that households that shared sanitation facilities with five or more households had significantly higher rates of childhood diarrhea than those with private facilities, presumably because shared facilities tend to be less hygienic. These findings from Accra corroborate results of a multivariate logistic analysis using nationwide data from Ghana (GHDS, 1998), which found that the likelihood of childhood diarrhea was 24 percent higher in households lacking any sanitation facility, relative to those with latrines or toilets (Gyimah, 2003).

A multivariate probit analysis using Ghana's 1993 DHS data sought to distinguish between the diarrhea likelihood associated with different *types* of sanitation infrastructure (Ahiadeke, 2000). This study found that household possession of a flush toilet rather than a pit latrine was associated with significantly lower diarrhea likelihood in infants age 3-6 months (Ahiadeke, 2000). However, this study did not control for household income, potentially biasing the results. In addition, this study found that possession of a pit latrine was associated with lower diarrhea incidence than no toilet facility, though this association was no longer significant once mother's education and age of the child were controlled for. However, it is important to note that the primary concern of this study was the impact of breastfeeding, and that sanitation facilities were added only as a control. Small sample sizes, which limit the variability that can be observed, may have impacted the significance of the latrine variable in some of this study's models.

Studies in other locations have also generally found that sanitation plays a significant role in diarrhea reduction. Several of these studies emphasized the importance of particular types of sanitation facilities. Household ownership of a "sanitary latrine," as opposed to no latrine, was associated with a reduced risk of diarrhea in Egyptian children under age three, where a "sanitary latrine" was defined as one that drains into either a sealed pit or a local sewage system (Abu-Elyazeed et al., 1999). Similarly, availability of a ventilated improved pit latrine was associated with significantly lower cholera risk than traditional pit latrines in a 2005 study in South Africa (Hoque and Worku). Finally, household ownership of a "revised" latrine, including two cubic meters of fecal matter storage and a removable door for regular fecal evacuation, was associated with significantly lower incidence of under-five diarrhea than traditional latrines in a 2004 study in Kabul, Afghanistan (Meddings, Ronald, Marion, Pinera&Oppliger, 2004).

Several additional studies have emphasized the presence or absence of household sanitation, as opposed to the type of sanitation facility. For example, a 2002 study in Uganda, Tanzania, and Kenya found that, while the type of sanitation facility used by a household did not help explain diarrhea incidence, household ownership of a toilet or latrine (of any kind) was significantly protective against diarrhea (Tumwine et al.). Likewise, a 1995 study in the Philippines found that household excreta facilities were associated with a 42 percent reduction in childhood diarrhea relative to households without such facilities (VanDerslice and Briscoe, 1995). Finally, a 2004 study in Uganda found that not owning a sanitation facility was associated with a 40 percent increase in the likelihood that a child would have diarrhea (Mbonye, 2004).

Though presence of sanitation facilities in the household tended to be significant in available literature, some studies failed to produce significant results. For example, a Nicaraguan study found no significant difference in diarrhea incidence between households that owned a latrine and those with no sanitation infrastructure (Gorter, Sandiford, Smith &Pauw, 1991). Likewise, a Brazilian study found no significant difference in diarrhea incidence between households that owned a flush toilet and households with no sanitation facilities (Victora et al., 1988). However, a lack of significant results for sanitation infrastructure does not necessarily mean that sanitation is not associated with diarrhea in these contexts, as some families may not use their sanitation facilities for disposal of children's stools. For example, a 1992 study in Sri Lanka found that, while ownership of a latrine was not a significant determinant of child diarrhea, hygienic disposal of children's stools (for example, in a latrine) was significantly protective against diarrhea, with poor disposal methods associated with a 68 percent increase in childhood diarrhea prevalence (Mertens, Jaffar, Fernando, Cousens&Feachem, 1992). A 1995 study in Burkina Faso also looked specifically at disposal of children's stools, finding a 30 to 50 percent increase in child hospitalizations for diarrhea when children's feces were not disposed of in a latrine (Curtis et al., 1995). These results complement earlier findings in Zaire, where failure to dispose of children's feces in a latrine was associated with an increased risk of childhood diarrhea (Dikassa et al., 1993).

In addition to disposal of children's stools, other factors, such as the privacy of household sanitation facilities, and the sanitation in the greater community, have been examined in some studies. The findings from a case-control study in Kenya paralleled the afore-mentioned Accra study, but found that ownership of a latrine was protective against diarrhea *only* when that latrine was used exclusively by household members (Brooks et al., 2003). Community sanitation was found to be important in a 2007 study in urban

Bangladesh, which found that the proportion of households in the community using "improved latrines" was significantly associated with children's weight-for-height ratios (there was no measure of diarrhea incidence in this study), even though the use of sanitation facilities within a child's household was not significant (Buttenheim, 2007). In this study, "improved latrines" were defined as those that were water-sealed, or otherwise "hygienic." The author of this study suggested that, in this particular context, hygienic sanitation facilities in the home did not confer health advantages where children were exposed to contaminants in the neighborhood environment.

In those studies that looked at the relative importance of sanitation facilities compared to water source, access to latrines was typically found to be a greater protective factor against diarrhea (Arif and Ibrahim, 1998; Feachem, 1986). The relative importance of sanitation facilities is also underscored by the aforementioned studies that found improved water source to reduce diarrhea incidence only when sanitation facilities were also present.

2.6.5 Other Factors

It is important to briefly discuss other factors associated with diarrhea incidence, as these factors were included as controls in this study's regression model. Aside from infrastructure, hygiene – particularly hand-washing – is one of the most important prevention strategies against diarrhea. In their 2005 study in Accra, Boadi and Kuitunen found that mother's hand-washing (with or without soap) after defecation and before meal preparation was significantly associated with decreased diarrhea incidence in children under age six. Similar results have been found in studies from such various contexts as Indonesia (Alberini, Eskeland, Krupnick & McGranahan, 1996), Kenya (Brooks et al., 2003), Uganda (Mbonye, 2004), and in a meta-analysis of six studies from Asia and the Americas (Esrey, Potash, Roberts &Shiff, 1991). However, two studies in Bangladesh and in India suggested that hand-washing was only significantly protective against diarrhea when hand-washing agents such as soap or ash were utilized (Alam, Wojtyniak, Henry &Rahaman, 1989; Sur et al., 2004).

In addition to hand-washing, breastfeeding is frequently cited as protective against diarrhea. This protection occurs both through minimization of exposure to potentially contaminated foods and liquids, and through protective agents in the breast milk itself. In an analysis of 1993 data from Ghana, Ahiadeke (2000) found that infants that were either fully breastfed or mixed-fed (fed both breast milk and other foods or liquids) had a lower incidence of diarrhea than non-breastfed infants. Several studies in other locations have found breastfeeding to be protective against diarrhea, including studies in Northeastern Brazil (Victora, Teresa, Olinto, Barros &Nobre, 1996), southern Brazil (Victora et al., 1989), and the Philippines (VanDerslice, Popkin& Briscoe, 1994). In addition, two studies in Ghana and in Malaysia looked at the interaction between breastfeeding and other factors, finding that breastfeeding mitigates the negative effects of poor water quality and poor sanitation on diarrhea incidence (Ahiadeke, 2000;Butz, Habicht&DaVanzo, 1984).

As would be expected, several studies have found that demographic variables also play a role in diarrhea prevalence. For example, children of more educated mothers tend to have lower diarrhea prevalence, irrespective of water and sanitation conditions, presumably due to better understanding of proper hygiene. Ahiadeke's 2000 study in Ghana found that child diarrhea incidence was significantly lower when mothers had a secondary education, compared to mothers with no education. However, primary level education was not significant in this study. Mother's education was a significant determinant of diarrhea in Boadi and Kuitunen's 2005 study in Accra; however, the authors did not report whether primary and/or secondary education was specifically considered in their analysis. Other demographic variables that significantly predicted lower diarrhea incidence among children under five included: higher family income (Boadi and Kuitunen, 2005), older child's age (Arif and Ibrahim, 1998), urban residence (Arifand Ibrahim, 1998), and female sex (VanDerslice and Briscoe, 1995; Arif and Ibrahim, 1998). Finally, diarrhea prevalence has been found to be significantly higher in the rainy season relative to other seasons (Arif and Ibrahim, 1998).

2.7Gaps in the Available Literature

Though a significant body of research exists on the relationship between diarrhea likelihood and infrastructure, there are gaps remaining. The impacts of water and sanitation infrastructure have been shown to vary by location, demanding country-specific analyses wherever diarrhea is a major cause of childhood morbidity and mortality. With an estimated 14,000 diarrhea deaths annually in Ghanaian children under five (UNICEF, 2014), it is important to examine the association between diarrhea likelihood and water and sanitation infrastructure in the Ghanaian context. No such examination has been conducted with nationwide Ghanaian data from the new millennium. The GDHS studies cited earlier in this work used data from 1993 and 1998 and Boadi and Kuitunen's 2003 survey exclusively sampled households in the Accra metropolitan area. This study fills that gap, providing an analysis of nationwide Ghanaian data from 2003.

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.1 Introduction

This chapter presents the description of the study area, the methods employed in the conduct of the study. The chapter contains the research design, theoretical framework, the empirical model and the estimation technique. The chapter also captures the justification and measurement of the variables and a brief description of regression diagnostics, data description and the analysis of the data.

3.2 Profile of the study area

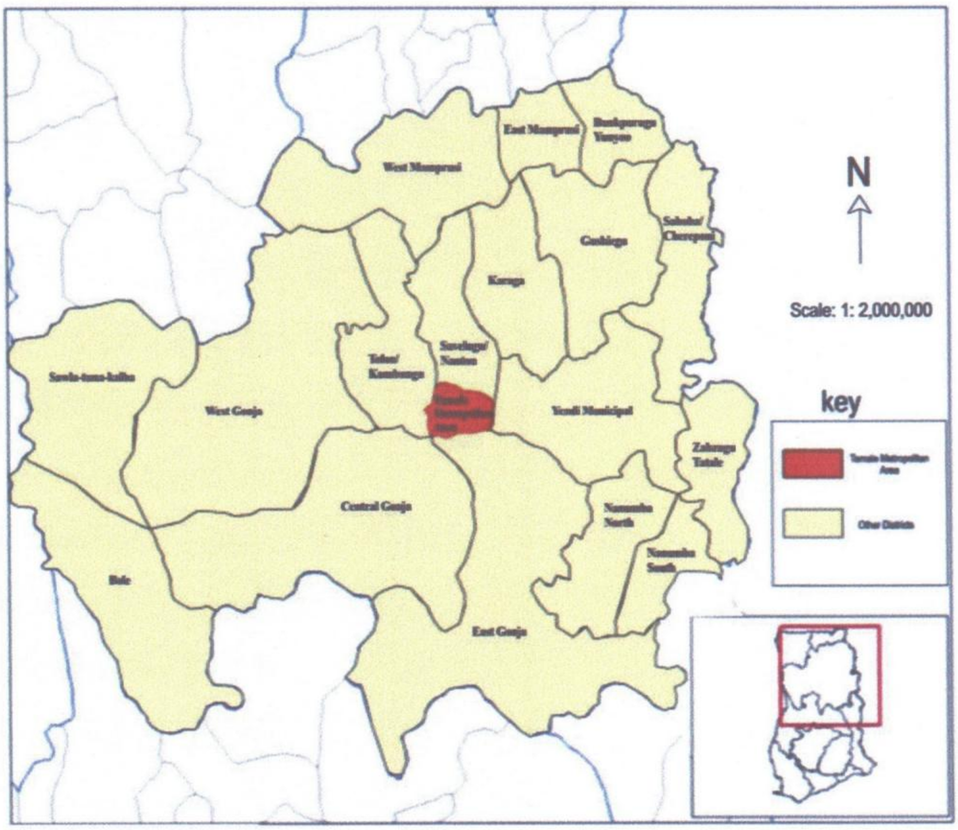
3.2.1 Location and Size

The Tamale Metropolis is one of the 26 districts in the Northern Region. It is located in the central part of the Region and shares boundaries with the Sagnarigu District to the west and north, Mion District to the east, East Gonja to the south and Central Gonja to the south-west. The Metropolis has a total estimated land size of 646.90180sqkm (GSS-2010).Geographically, the Metropolis lies between latitude 9°16′ and 9° 34′ North and longitudes 0° 36′ and 0° 57′West.

Tamale is strategically located in the Northern Region and by this strategic location, the Metropolis has a market potential for local goods from the agricultural and commerce sectors from the other districts in the region. Besides the comparative location of the Metropolis within the region, the area stands to gain from markets within the West African region from countries such as Burkina Faso, Niger, Mali and the northern part of Togo and also en-route through the area to the southern part of Ghana.

There are 115 communities in the Metropolis. Most of the rural communities have a large expanse of land for agricultural activities and serve as the food basket for the Metropolis. However, these communities still lack basic social and economic infrastructure such as good road networks, school blocks, hospitals, markets and recreational centers, thereby hindering socio-economic development, poverty reduction and reducing the general phenomenon of rural-urban migration.

Figure 3.1: Map of the Study Area



Source: GSS, 2015

3.3Research design and methodology

The methodological approach adopted in this study was the triangulation, which involved both quantitative and qualitative methods. This approach allowed the researcher to gain an in-depth understanding of issues related to the study. The quantitative approach is deeply rooted in the positivist philosophy that objective knowledge is possible and can be quantified. Positivism subscribes to the application of natural science methods and practice to study human behavior in social sciences. (Denscombe, 2002; Grix, 2004). The epistemological assumption that follows from positivism is that, human behavior can be captured in numerate and hard data seeking to measure and describe social phenomenon by attribution of numbers (Miller & Brewer, 2004) and this is perfectly in line with the objective of the study.

This study therefore adopts a cross-sectional study aimed at finding association between sanitation, water and child health outcomes. This research design is chosen based on the availability and nature of the data (2014 GDHS), the objectives and hypothesis set and finally, it is chosen because it provides consistent and easy verifiable results. The reasoning behind this study is that, since women are primary child care givers, the environment in which they operate should be conducive enough for child care.

3.3.1 Sampling methods and techniques

Sampling is a process of scientifically selecting cases or respondents for a research (Neuman 1997). The selection of the sample for the study is a combination of probability and non-probability sampling techniques. The reason behind the choice to use both probability and non-probability techniques stems from the guiding philosophical principles surrounding the use of mix methods. As the probability sampling technique would ensure representatives of all the characteristic variables involved in the study, the non-probability sampling techniqueenables the research to target those elements of the study population of particular relevance to the study. The study communities and respondents in the study are drawn accordingly for the study.

The main sampling procedures employed for this study is a combination of systematic (probability) and purposive (non-probability) sampling techniques. Systematic sampling was used to select three rural and three urban areas from the list of 12 urban and 11 rural areas on the sample frame in the Tamale Metropolis. This helped to erase issues of sample selection bias.

Purposive sampling was used to identify mothers who were pregnant with their second child from the two community health promotion systems and services(CHIPS) zones serving majority of the women from Kpanvo, Kotingli and Bagliga. The same approach was used to select second time mothers in Zogbeli, Kukuo and Tishegu who attended antenatal care (ANC) at Tamale Teaching hospital, Tamale west hospital and Tamale central Sub health centre for the focus group discussions. Simple random sampling was used to select 6 mothers from each facility from the list of mothers (mothers having their second child) present at the selected health facilities for ANC for the focus group discussion.

3.4Theoretical model specification of household production of child health

The theoretical model for the analysis of child health production derives fromhousehold production theory, which originated in the work of Becker (1965) and Becker and Lewis (1973), and was adapted by Grossman (1972) to analyze the accumulation and depreciation of health capital. The health production model, in which health capital is conceived as the output of a multivariate production process (Grossman, 1972; Behrman and Deolalikar, 1988; Liebowitz and Friedman, 1979; and Strauss and Thomas, 1994), provides the basis for the empirical modeling. Briefly, in this model it is assumed that the individual inherits an initial stock of health that depreciates over time, but also that the individual may positively influence the stock of health capital via gross investments. Gross investments in health capital can be made via combinations of the individual's own time and market goods such as medical care, diet, housing, exercise and lifestyle. The level of education of the producer also affects how efficiently he or she can produce health and is analogous to the technology of production or stock of knowledge in production theory more generally. Exogenous shocks thus may also affect a consumer's demand for health and the production of gross investments in health.

Jacobson (2000) however extended the Grossman (1972) model to produce a generalized Grossman model by taking the family as the production unit. In this model, every individual in the family is assumed to be both the producer of his or her own health as well as the health of other family members. In this framework, the income of all family members is used in the production of the health capital of each member of the family. Thus, in one of the model, Jacobson (2000) considers a family unit that consists of a father, a mother and a child. In this model, the child is considered a passive participant in the production of its own health since he/she cannot invest directly into his/her own health, therefore the health of the child largely depend on the parents characteristics and resources. The model further assumes that parents get utility from the good health of their child and can use total time available for market and non-market activities. Therefore, parents use inputs of market goods and their own time and resources to produce child health. This model may be regarded as an extension of Grossman's conception of the determinants of individual demands for health as a consumption argument that enters the utility function directly (since sick days produce disutility), and as a derived demand, since sickness/wellness affects the total time available for market and non-market (production) consumption activities.

The basic theoretical framework that guided this study is therefore derived from the theory of utility maximization and household production of health espoused by Becker (1981) and deeply rooted in the generalized Grossman model of demand for health (Muurinen, 1982) and the extended Grossman model of Jacobson (2000) – the parent-child family specification of health demand. Following Jacobson (2000), child health outcome is determined by the health environment resources, a child-specific health input which does not affect parent utility directly, child health endowment or biologicalcharacteristics, parental human capital and household characteristics which include sanitation and water. The health environment composite good consists of goods which affect both utility and child health status directly. In developing countries this could be, for example smoking, while the number of children in the household, household sanitation or the source of water is relevant.

Following these theoretical extensions and like previous empirical studies (Kabubo-Mariara et al. 2008; Jalan and Ravallion, 2003; Khanna, 2008; Gyimah, 2003; Quinn, 2009; Amo-Adjei, 2013) on the relationship between environmental variables and child health outcomesand in the vein of Rosenzweig and Schultz (1983), Rosenzweig and Wolpin (1988), Jacobson (2000), and Annim, Awusabo-Asare, suppose that the utility function for a family at a time can be written as

$$U_t = U(H_{tc}, H_{tp}, X_t, Y_t, L_t, Z_{ut}, \xi_{ut}) \ (1)$$

where $H_{tc} and H_{tp}$ represent the health of a child and parents respectively, X_t is a set of goods that affects child health (e.g., food, toys and housing), X_t represents other commodities consumed by the household, L_t is the leisure time, $Z_{ut},$ and $\xi_{ut}$are exogenous observable and unobservable factors respectively that influenceU_t.

Following the specification of the accumulation of health stock introduced in Grossman (1972), the production of child health is described as

$H_{tc} = H(H_{tc-1}, X_t, L_{ht}, Z_{ht}, \xi_{ht})(2)$

where L_{ht} is the amount of time used in the production of child health,H_{tc-1}represents stock of health proxied by birth weight$Z_{ht}$and ξ_{ht} are respectively exogenous observable and unobservable variables affecting H_{tc}.

The budget constraint of the household is

$I_t = Y_* + w_t T_{wt} = P_{xt} X_t + P_{yt} Y_t$ (3)

whereI_t is a combination of labour and non-labour family income, L_{wt} is the time spent to earn wage income, w_t, $P_{xt}$and P_{yt} are respectively the wage rate, prices of X_t and Y_t.

The household also faces a time constraint in the production of household resources given as

$T = L_{ut} + T_{ht} + T_{wt}$ (4)

where$T$ is the total fixed amount of time available (e.g., 24 hours per day), L_{ut} represents the time for household allocate for leisure, T_{ht} is time household allocate the production of health more especially child care and T_{wt} is time for allocate for work hence w_t is wage rate.

From equation (2), the household utility function can be expressed as an indirect household utility function conditional on the health status of the child given as

$V_t = U(H(H_{tc-1}, X_t, L_{ht}, Z_{ht}, \xi_{ht}), H_{tp}, X_t, Y_t, L_t, Z_{ut}, \xi_{ut})$ (5)

Rewriting simply, we have

$V_t = U(H, C)$ (6)

where H represents child health and C all other commodities that affect household utility. Considering equations (3), (4) and (6), the household utility maximization problem is

Maximize $V_t = U(H, C)$

Subject to the budget and time constraints above, plus the condition of positive initial stock of child health ($H > 0$)

$$\sum_{j=1}^{j} P_{xt}X_t + \sum_{s=j=1}^{s} P_{yt}Y_t + wL_{ut} + wT_{ht} = wT_{wt} + Y_* = I_t \qquad (7)$$

where Y_* is unearned income.

Setting the lagrangian equations gives equation (8) as follows;

$$L = U(H, C) + \lambda[I_t - wL_{ut} + wT_{ht} - \sum_{j=1}^{j} P_{xt}X_t - \sum_{k=0}^{n} P_{yt}Y_t] = 0$$

(8)

Taking the first derivatives of the Lagrangian function with respect to child health and commodities $XandY$ until the initial conditions are met and solving these first order conditions associated with this optimization problem produces the reduced form of the Marshallian demand function for child health given as;

$$H_t = H(H_0, Y, X, L_u, T_u; \xi) \qquad (9)$$

where ξ is the combination of $Z_{ht}, \xi_{ht} Z_{ut}, and \xi_{ut}$ and stands for the non-observable attributes and capture the idiosyncratic errors. As conferred earlier, equation (9) cannot be estimated directly because H_t, the child's quantity and quality of health is not observable. In this however, child diarrhea prevalence is used as a proxy for child since diarrhea prevalence is observable. Equation (9) above also shows that the optimal level of child health is determined by the allocation of parental time between income-generated work, household chores and leisure, the consumption of child-health related goods and other goods and services.

Several modifications of the reduced-form demand and structural functions for child health have emerged in the literature as a result of data constraints and research focus. Thomas, Strauss and Henriques (1992) assert that only a few studies are able to use datasets that meet the required criteria.

3.5Empirical model specification

According to UNICEF (2000), child health status is not determined by food availability alone, but also by access to basic social services and infrastructure such as quality water and access to improved sanitation, quality of home based care for young children, infant feeding patterns, morbidity and other factors. Therefore following UNICEF (2000) framework adapted for this study and Jacobson (2000) theoretical expositions and considering the data available, the empirical model specification for child health measured by child diarrhea can be represented as:

$$ChildH_{ij} = \beta_0 + \beta_1 Water_{ij} + \beta_2 Sanitation_{ij} + \beta_3 Stooldisposal_{ij} + \beta_4 X_{ij} + \xi_{ij}$$

Where $ChildH$ represent the child health outcome measured by prevalence of diarrhea reported in the period of two weeks preceding the survey. I *and* j represent individual child and specific household/family characteristics respectively. Matrix$X$ includes all control variables andξcaptures the idiosyncratic errors. The main focus of this study is to estimate parameters, $\beta_1, \beta_2 and \beta_3$and the expectation is that they should negatively influenced child diarrhea. Hence, it is expected that improved water source, improved toilet facilities, and appropriate child stool disposal should reduce child diarrhea.

3.6Justification of estimation technique

This study employed logistic regression estimation technique as its main estimation technique. A logit model estimation was used as the main estimation technique because the dependent variable (Child health outcome) measured as whether the child had diarrhea two weeks preceding the survey is a binary response variable of "yes or no". The dependent variable was a binary response variable which takes on the value of 1 if a child was reported to have diarrhea and 0 otherwise, hence, a logistic model was used to examine the effects of sanitation and water on the incidence of diarrhea among children under age five. The choice of logit is therefore informed by the nature of the dependent variable and the fact the main interest of the study is to find out the factors associated with child diarrhea. Logistic regression model results are easy to interpret and the method simply to analyse (Vasisht, 2012). The decision to use logit though a probit model can be used is also based on the fact that the choice between logit and probit according to Vasisht (2012) is a matter of personal preference as both estimation techniques produces similar results. Again, logit models produces statistically sound results by allowing for the transformation of dichotomous dependent variable into a continuous variable raging from -∞ to +∞, hence the problem of out of range estimates is avoided. Logit models give parameter estimates which are asymptotically consistent, efficient and normal.

3.7Regression diagnostics and post estimations test

To ensure that estimates from the regression are robust, unbiased and consistent, the data was first observed to deal with influential observations, outliers, missing values and implausible values. The following diagnostics and post estimation tests were also conducted.

3.7.1 Checking homoscedasticity of residuals

One basic assumption of regression analysis is the assumption homoscedasticity of the residuals; this condition needs to be fulfilled in order to produce consistent and unbiased results. Therefore following Stock and Watson (2003), as a rule-of-thumb, estimation of every model requires an assumption of heteroskedasticity and by default STATA assumes homoscedastic standard errors, so the model was adjusted to account for heteroskedasticity by using heteroskedasticity-robust standard errors to deal with the problem of heteroskedasticity (Ronchetti, 1985). By adding robust to the estimated equation therefore addressed the problem of hetereoskedasticity.

3.7.2 Model specification error test

A logistic regression model is built on the assumption that the outcome variable is a linear combination of the independent variables. This involves two aspects, as when dealing with the logistic regression equation. First, consider the link function of the outcome variable on the left hand side of the equation. The assumption here is that the logit function (in logistic regression) is the correct function to use. Secondly, on the right hand side of the equation, the assumption is that all the relevant variables are included, and that the model has not included any variables that should not be in the model, and the logit function is a linear combination of the predictors.

It could therefore happen that the logit function as the link function is not the correct choice or the relationship between the logit of outcome variable and the independent variables is not linear. In either case, we have a specification error. The missecification of the link function is usually not too severe compared with using other alternative link function choices such as probit (based on the normal distribution). In practice, we are more concerned with whether our model has all the relevant predictors and if the linear combination of them is sufficient.

There are a number of methods to detect specification errors. The Linktest performs a model specification test for single-equation models. **Linktest** can be used to detect a specification error, and it is issued after the **logit** or **logistic** models. The idea behind **linktest** is that if the model is properly specified, one should not be able to find any additional predictors that are statistically significant except by chance. After the regression command (in this case, **logit** or **logistic**), **linktest** uses the linear predicted value (**_hat**) and linear predicted value squared (**_hatsq**) as the predictors to rebuild the model. The variable **_hat** should be a statistically significant predictor, since it is the predicted value from the model.

This will be the case unless the model is completely mis-specified. On the other hand, if our model is properly specified, variable **_hatsq** shouldn't have much predictive power except by chance. Therefore, if **_hatsq** is significant, then the **linktest** is significant. This usually means that either we have omitted relevant variable(s) or our link function is not correctly specified (Chen *et al.,* 2003).

3.7.3Goodness-of-fit of the model

There are several ways of testing the goodness-of-fit of the model. The model fit implies whether the model specified fits the distribution and nature of the data available. One way to check model fit is by the use of log likelihood chi-square. The log likelihood chi-square is an omnibus test to see if the model as a whole is statistically significant. It is 2 times the difference between the log likelihood of the current model and the log likelihood of the intercept-only model. A pseudo R-square is in slightly different flavor, but captures more or less the same thing in that it is the proportion of change in terms of likelihood.

Another commonly used test of model fit is the Pearson or Hosmer and Lemeshow's goodness-of-fit test. The idea behind the Hosmer and Lemeshow's goodness-of-fit test is that the predicted frequency and observed frequency should match closely, and that the more closely they match, the better the fit. The Hosmer-Lemeshow goodness-of-fit statistic is computed as the Pearson chi-square from the contingency table of observed frequencies and expected frequencies. Similar to a test of association of a two-way table, a good fit as measured by Hosmer and Lemeshow's test will yield a large p-value to indicate that the model fits the data.

3.7.4Multicollinearity

Multicollinearity (or collinearity for short) occurs when two or more independent variables in the model are approximately determined by a linear combination of other independent variables in the model. The degree of multicollinearity can vary and can have different effects on the model. When perfect collinearity occurs, that is, when one independent variable is a perfect linear combination of the others, it is impossible to obtain a unique estimate of regression coefficients with all the independent variables in the model.

Moderate multi-collinearity is fairly common since any correlation among the independent variables is an indication of collinearity. When severe multi-collinearity occurs, the standard errors for the coefficients tend to be very large (inflated), and sometimes the estimated logistic regression coefficients can be highly unreliable.

The primary concern is that as the degree of multicollinearity increases, the regression model estimates of the coefficients become unstable and the standard errors for the coefficients can get wildly inflated (Stock & Watson, 2003). Apart from constructing and observing correlation matrix, the Variance Inflation Factor (VIF) test after the regression was also used to check for multicollinearity. As a rule of thumb, a variable whose VIF values are greater than 10 may merit further investigation. Tolerance, defined as 1/VIF, was also used to check on the degree of collinearity. A tolerance value that is lower than 0.1 is comparable to a VIF of 10. It means that the variable could be considered as a linear combination of other independent variables (Stock & Watson, 2003).

What STATA does in this case is to drop a variable that is a perfect linear combination of the others, leaving only the variables that are not exactly linear combinations of others in the model to assure unique estimate of regression coefficients. We cannot assume that the variable that STATA drops from the model is the "correct" variable to omit from the model; rather, we need to rely on theory to determine which variable should be omitted.

3.8Justification and measurement of the variables

The variables used in this study are conceptually and operationally defined in the following section. The choice of variables was primarily informed by evidence provided in the literature and ably supported by availability of data and guided by the research hypotheses. The health status of a child is assumed to be influenced by socio-economic and demographic characteristics.Following UNICEF (2000), child health outcome is determined by the health environment resources, parental human capital, a child-specific health input which does not affect parent utility directly and a child health endowment or biological characteristics. Therefore consistent with the UNICEF framework which espoused that child nutritional status is not determined by food availability alone, but also by access to basic social services, quality of home based care for young children, infant feeding patterns, morbidity and other factors, this study uses the following variables for the purpose of achieving the objectives.

3.8.1 Dependent variable: Child diarrhea prevalence

Reported prevalence of diarrhea in children under age five during the two weeks preceding the survey was used as the outcome variable. The variable is a dummy which takes on the value of 1, if a child had diarrhea and 0, otherwise. The two-week period reduces possible recall bias that may arise. However, the measure was self-reported; hence, it still has the likelihood to contain some bias though to the minimal extent (Baker & van der Gaag, 1993; Wagstaff, 2002). The concern regarding this measure of overall health is that it is subjectiveand that it may be biased by correlation with some other unobservable variables.For example, there is the possibility that maternal reporting of child's healthmight be affected by the mother's own health state. Some previous studies(e.g., Dadds et al., 1995; Case et al., 2002) have examined this proposition,but found no empirical evidence to support this claim.

3.8.2 Water

One of the main explanatory variables in this study is water measured by source for drinking water and time taken to fetch water.Numerous studies have examined the relationship between diarrhea incidence and water. Some studies of water infrastructure have focused on the role of water quality in diarrhea incidence, while others have examined the importance of the quantity of water utilized, frequently using the distance between household and water source as a proxy.Improved water sources normally have lower pathogen counts, reducing child exposure to the diarrhea-causing agents that readily infect traditional water sources (Shier et al., 1996).

Evidence from previous studies has given uneven results with regard the relationship between water and child diarrhea. Most studies found a statistically significant association between improved water quality and reduced diarrhea incidence (Gyimah, 2003; Mbonye, 2004; Brooks, 2008). However, some studies also showed no such association (Tumwine et al., 2002; Shier, et al., 2008). To this effect several explanations have also emerged for the lack of consensus among studies of the water-diarrhea linkage. It is commonly argued that the best strategies against diarrhea vary by location and that the diversity of study findings is a product of the diversity of study sites. In addition, several studies have found that improved water sources did not decrease diarrhea incidence because the quality of water consumed was inferior to the quality of water at the source.

In this study therefore, water was measured as follows;

Source of drinking water:

(1) Piped water (improved water source)- *piped into dwelling; piped into yard/plot; public tap or standpipe*

(2) Other improved sources - *protected dug well; protected spring; bottled water; rainwater; tube well/borehole*

(3) Unimproved sources - *Unprotected dug well, unprotected spring; cart with small tank/drum; tanker truck; surface water*

Time to water source: Regrouped from actual values in minutes to

(1) On premises

(2) Less than 15 minutes

(3) 15-29 minutes

(4) 30 minutes and above

3.8.3 Sanitation

Sanitation is next variable of interest per the hypotheses of the study. Since the study hypothesis are based on the environment and child health outcomes, it is imperative to espouse the relation between sanitation and child diarrhea prevalence. According to Quinn (2008) provision of sanitation facilities has the potential to reduce the toll of diarrheal disease in developing countries.

3.8.4 Mother's educational status

As would be expected, several studies have found that the educational status of a mother also plays a role in diarrhea prevalence. For example, children of more educated mothers tend to have lower diarrhea prevalence, irrespective of water and sanitation conditions, presumably due to better understanding of proper hygiene. Ahiadeke's 2000 study in Ghana found that child diarrhea incidence was significantly lower when mothers had a secondary education, compared to mothers with no education. A study in India indicated that, even when controlling for 12 possible confounding variables, greater maternal education is strongly correlated with improved child health (Mishra &Retherford, 2000). The path ways through which mothers" education affect child health outcomes include chances of better employment, greater knowledge of the importance of good personal hygiene, and increased maternal status (Mishra &Retherford, 2000).

In addition, educated mothers are reported to be more likely to take advantage of health services (Simon *et al.,* 2002). As the level of mother's education increases, the prevalence of child diarrhea decreases (Chen & Li, 2009). In the literature, some studies used years of schooling, others also used the highest educational level of the mother. This study employed the highest educational level of the mother for the purpose of the analysis.

3.8.5 Household economic status

The economic status of a household is also an important determinant of child health status (UNICEF, 1990). Income is a central variable in models of the determinants of child health and nutrition outcomes. More resources available to a household translate into higher expenditures on safe water and health, implying a negative relationship for the income variable on child diarrhea is expected. However, it is extremely difficult to measure income accurately in developing countries for a number of reasons.

Many people in the informal sector do not know their income or only know it in broad ranges, earnings vary daily, weekly, or seasonally, and an earner may have several sources of income at one time. Wealth is more easily measured (with only a single respondent needed in most cases) and requires far fewer questions than either consumption expenditures or income. The wealth index is calculated using data on a household's ownership of selected assets, such as televisions and bicycles, materials used for housing, types of water access and sanitation facilities, and other characteristics that are related to wealth status. The wealth index places individual households on a continuous scale of relative wealth. DHS categorizes all interviewed households into five wealth quintiles to compare the influence of wealth on various health and child diarrhea indicators. The wealth index allows for the isolation of problems particular to the poor, such as unequal access to health care, as well as those which pertain to the wealthy. The wealth index is particularly essential for this research, as the DHS data lacks detailed information about earnings and income. The wealth index enables the model to identify the extent to which household economic status affects child health outcomes. Hence, another important control variable in the model is the wealth index.The association between socioeconomic status and health status has been highly studied (Thomas, 1997; Razzaque, 2011). Comparative studies on child diarrhea (Boadi&Kuitunen, 2005), showed that the higher the level of economic status of the household, the lower the diarrhea incidence among children under five included.

3.8.6 Child characteristics

The child characteristics included in this study are the sex of the child, the age of the child and size of child at birth. Sex of the child is captured by a dummy variable equal to 0 for female child and 1 for male child. If there are gender biases in the care of children, it is expected that there would be a lower incidence of diarrhea in male children than female children if male children are favoured and the converse is true. There is evidence elsewhere that female children tend to be less prone to diarrhea than male children. For example, (Van Derslice&Briscoe, 1995; Arif& Ibrahim, 1998) revealed that female children were less prone to diarrhea than male children. Other studies have proved otherwise, one study indicated that male children are biologically at greater risk of contracting child diseases, though the reason for this is unknown (Wamani, 2007). There is therefore an interesting trend in the association between child sex and child health status because there is mix evidence to the variable.A cumulative indicator of health (height-for-age) in children is positively associated with age (Anderson, 1995 as cited in Aschalew, 2000). Local and regional studies in Ghana have also shown an increase in child diarrhea with increase in age of the child (Arif and Ibrahim, 1998).

3.8.7 Place of residence (Urbanization)

Rural children tend to be at greater risk of diarrhea when compared to urban children (Kritz&Makinwa-Adebage, 1999; Mazur & Sanders, 1988; Rajaram*et al*, 2007). Where a family lives can contribute to child diarrhea prevalence due to the fact that rural areas may not have as much access to improved water and sanitation facilities as those in urban areas (Arif and Ibrahim, 1998). Rural dwellers may also lack access to health facilities, and educational resources (Rajaram*et al*, 2007).

3.8.8 Mother's Age

One other determinant of child diarrhea prevalence is the age of the child's mother, several studies have supported this claim. A study conducted in Ghana showed negative relationship between mother's age and child diarrhea prevalence suggesting that children of older mothers were less likely to have had diarrhea (Quinn, 2009). This finding is in keeping with the only previous Ghanaian study to use the variable (Gyimah, 2003). It therefore appears that mother's maturity and/or parenting experience may play a role in diarrhea likelihood.

3.9Source, type and description of data

The analysis in this study is based secondary on data from the 2014 Ghana Demographic and Health Survey and primary data from Focus group Discussions (FGDs). The 2014 GDHS is the seventh round of the worldwide Demographic and Health Survey undertaken in Ghana since 1988. The survey was implemented by the Ghana Statistical Service in collaboration with the Ministry of Health/Ghana Health Service management team and other stakeholders in various sectors of government, researchers, civil society organizations, and international organizations.

The 2014 GDHS survey is designed to allow reliable estimation of key demographic and health indicators such as fertility, contraceptive prevalence, family planning, women empowerment, knowledge and behaviour related to HIV/AIDS, nutritional status, child diarrhea, infant and child mortality, anaemia etc. The population covered in the 2014 GDHS is defined as the universe of all women age 15-49 in Ghana in a sample of 6,180 selected households (half of 12,360).

The 2000 Population Census was used as the sampling frame for the 2014 GDHS, and the stratification process for the 2014 GDHS sample used the census administrative subdivisions. The primary sampling unit (PSU) for the 2014 GDHS was the cluster, which is defined on the basis of EAs from the 2000 census frame, with one (or more) EAs per cluster. Except for the Upper East and Upper West regions, the number of clusters assigned to each region was usually allocated proportionally, according to the total population. For the Upper East and Upper West regions, the proportion of EAs allocated for the 2014 GDHS sample was twice the proportion used in the 2000 census proportional population distribution.

The 2014 GDHS targeted 12,360 households for the verbal autopsy questionnaire. The 412 selected households for the country as a whole were divided into 182 clusters in urban areas and 230 clusters in rural areas. The household sample for the 2014 GDHS is not self-weighted because the distribution of the 412 EAs by region and the household sample distribution for the country as a whole were not allocated according to the population distribution in the 2000 census. Individual level information such as age, sex, education etc. was collected along with information on the household's socio-economic status.

The socioeconomic status of households in the dataset include data on the wealth indices calculated from assets, ownership of national health insurance, level of education, residential status, source of water, type of toilet facilities, construction material used for the floor, outer walls of the house and ownership of various durable goods.

The 2014 GDHS sample was selected using a stratified, two-stage cluster design. The number of clusters in each region was calculated by dividing the total allocated number of households by the sample takes of 15 (that is, the number of households per EA). In each region EAs were stratified by urban first and then by rural, and clusters were selected systematically with probability proportional to size. In each selected cluster a household listing operation was carried out June-July 2014 and households were selected to achieve a fixed sample take per cluster. However, because the 2014 GDHS sample was not proportional to its population by urban-rural residence area or region, a final weighting adjustment procedure was required to provide estimates for each domain.

The household response rate for all households, including the Verbal Autopsy survey component, is 98.9 percent, ranging from 97 percent in the Greater Accra region to 99.7 in the Central region. For women, a total of 6,141 households were selected, of which almost 5,829 were successfully interviewed, with a household response rate of 98.5 percent. A total of 5,096 women were identified as eligible for the individual interview, with an individual women's response rate of 96.5 percent, and an overall response rate, the product of the household and individual response rates was 95.1 percent for the entire country. By region, the response rates for women range from 90.2 percent in the Northern region to 98.5 percent in the Central region.

The Women's Questionnaire was used to collect information from all women age 15-49 in half of selected households. Detailed information on women, their male partners if they had and their children under five years old were gathered. These women were asked questions about themselves and their children on the following topics: education, residential history, media exposure, reproductive history, mobility, perception on domestic violence, knowledge and use of family planning methods, fertility preferences, child diarrhea prevalence, antenatal and delivery care, breastfeeding and infant and young child feeding practices, vaccinations and childhood illnesses, marriage and sexual activity, woman's work and husband's background characteristics, childhood mortality, awareness and behavior about AIDS and other sexually transmitted infections (STIs), awareness of TB and other health issues, and domestic violence.

3.9.1 Justification for the use of this data

In view of the non-availability of a composite data set in Ghana that captures information on (i) prices on non-health goods and services, leisure and health goods and services, (ii) both wage and non-wage income, and (iii) the characteristics of the child, parent, household and community, our empirical analyses is based on the scope of data in the GDHS. Nationally representative child anthropometric studies in Ghana have either relied on the Ghana Living Standard Survey (GLSS) data set (Lavy*et al.,* 1996) or the GDHS (Annim, 2012).

This study opted for GDHS for the following two reasons. First, the main explanatory variable (water and sanitation) can be identified only with GDHS. Second, in view of the shift in the measurement of child health indicators from the National Centre for Health Statistics (NCHS)/Centre for Disease Control (CDC)/World Health Organisation (WHO) reference to the new growth standards developed by WHO in 2006, the 2014 GDHS report provides a platform for validating the height-for-age z-scores generated in this paper. For consistency the current measure of child health indicators were recalculate using the WHO 2006 new growth standards.

The primary data was also collected using qualitative means to ensure that in-depth answers could be given.

3.10Method of analysis and unit of analysis

Statistical analysis was carried out using Stata/SE version 12.0. Using the GDHS data, women and children anthropometric data sets were merged and organized according to strata and primary sampling unit. Matching variables between women and children's data sets reduced the sample size and by further accounting for inaccurate and implausible weight, or age values for children who were measured, the sample reduced. A final removal of missing variables for each of the independent variables gave a final sample size of 292 cases. The unit of the analysis for this study was the individual.

The primary data from the FGDs was analyzed using thematic and content analyses. The themes of the discussions were presented and supported with some extracts from the interviews.

3.11 Conclusion

This chapter delved into methods employed in this thesis. It succinctly described the source of the data, the measurement and definition of variables, how the findings were estimated. It also critically looked at the post estimation techniques that will improve the findings.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1Introduction

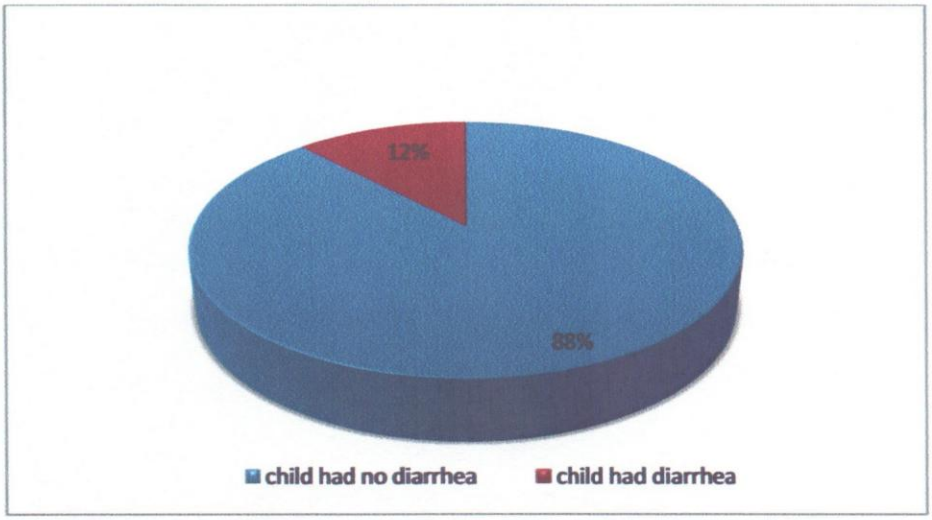
The main objective of this study is to examine the relationship between household sanitation practices and child diarrhea in Northern Ghana. To this effect, this chapter presents the results of the study.

4.2 Incidence of child diarrhea in Ghana

Incidence of diarrhea in children under five years of age in the two-week period prior to the 2014 Ghana Demographic and health Survey is the outcome of interest in this analysis. This variable acts as a proxy for Child health outcomes on which household environmental factors influence greatly. As was briefly outlined in the introduction, unsafe drinking water and poor toilet facilities increases the risk of diarrheal diseases, and young children are the most susceptible to these adverse effects.Incidence of diarrhea is relevant in itself since it is high in Ghana and the fact that it is the most commonly used outcome variable in water supply, sanitation, and hygiene intervention analyses. Figure 4.1 displays the number of children and the percentage of the sample which had diarrhea within the two weeks prior to the survey. As presented, 12% percent of children had diarrhea two weeks prior to the survey. This should be considered as high and unacceptable and worrying since diarrhea is one major causes of child and infant mortality in developing countries.

This is slightly lower than child diarrhea incidence found in studies conducted using Ghana's 1998 DHS (Gyimah, 2003) and in the 2003GDHS (Amy, 2009) and also in a study of the Accra metropolitan area (Boadi and Kuitunen, 2005).However, the true diarrhea incidence is likely to be underreported in DHS surveys since all of these surveys used a recall period of 14 days. Past research has found that diarrhea incidence is underestimated when researchers use a recall period longer than 48 hours (Gundry, Wright & Conroy, 2004).

Figure 4.1: Child diarrhea incidence in Ghana



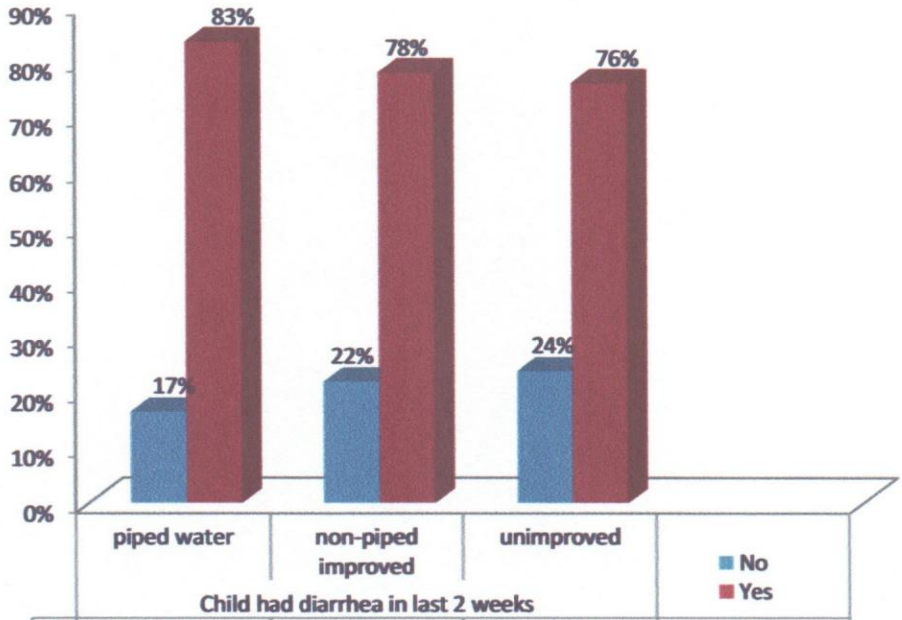
Source: Computed from GDHS, 2014

4.2.1Incidence of child diarrhea in Northern Region

The study revealed that 12% of Ghanaian children suffered from child diarrhea two weeks prior to the 2014 GDHS survey, a figure that is lower than the 17% of children under five who suffered from child diarrhea in the Northern region of Ghana (GDHS, 2014). This clearly depicts an increase of 5% in diarrhea cases among children below five years than the national average.

Figure 4.2 shows the percentage of children in homes with improved source of drinking water, who contracted diarrhea as against those in households with no access to improved drinking water. It showed that diarrhea incidence is high in homes with unimproved source of drinking water.

Figure4.2: Incidence of diarrhea in Northern Region



	piped water	non-piped improved	unimproved
No	17%	22%	24%
Yes	83%	78%	76%

Pearson chi-square (1) = 4.4237 Probability = 0.035 N=292

Source: Computed from GDHS, 2014

The study through the FGDs reveals that access to improved water sources influences the health of children including incidence of diarrhea. One respondent argued that;

> *"... I stay in a village where there is no improved water sources so we often relay on hand dug wells, rivers, dams and other unimproved sources of water. When my children drink it they have a lot of health related problems including stomach pains and diarrhea..."*

This could be attributed to the fact that rural area dwellers may not practice appropriate sanitation practices and also lack access to improved water source as indicated by Kritz&Makinwa-Adebage, 1999). It could also be attributed to the fact that children of families in rural areas have earthen floors, use unprotected well water, do not have toilet facilities and therefore practice open defecation as well as being over crowded in their dwelling place, which make them prone to diarrhea infection. This is corroborates with Al-Sekait, 1988, who found that households that are exposed to the factors mentioned are more prone to diarrhea infections compared to their counterpart who are not exposed to such factors. .The chi-square and the probability indicates that the difference is significant meaning that diarrhea is predominant in rural areas in Ghana.

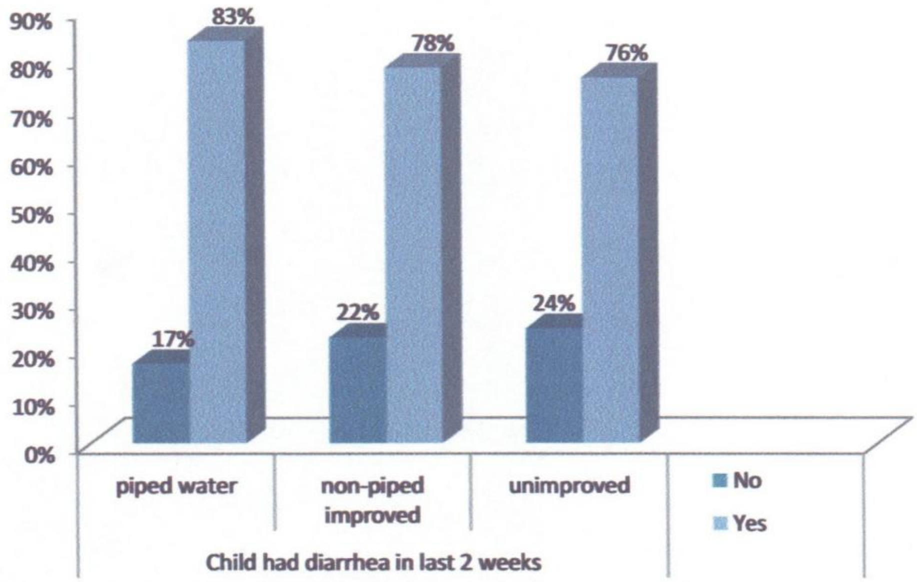
4.3Household environment and incidence of child diarrhea in Northern Region

The physiological characteristics of households' environment in which children live place them at risk of diarrhea. Therefore, this study examined the patterns of household environmental health hazards in Northern Region. The source of drinking water has a profound implication for child health outcomes. Improved sources of drinking water are less likely to be contaminated, while other sources, such as surface water and open wells, are more likely to carry disease-causing agents.

Figure 4.3 show that diarrhea incidence was higher among children who lived in households where the primary source of drinking water was non-piped improved water and unimproved drinking water according to the WHO criteria. To this 22.1% of children from households that drink non-piped water were reported to have had diarrhea in the 14 days prior to the survey, compared to 16.6% of children from households drinking piped water.Again, 24% of children from households that drink unimproved drinking water had diarrhea prior to the survey. This means children households that rely on open well/surface water, have higher risks of diarrhea than those with piped water/borehole or covered well (Rutstein, 2000).

The chi-square value with the corresponding probability value of 0.002 confirms that there is statistically significant relationship between household source of water and child diarrheal incidence in Ghana.

Figure 4.3: Relationship between water source and child diarrhea in Northern Region



Pearson Chi-square = 7.93: Pr= 0.002: N= 292

Source: Computed from GDHS, 2014

The study through the FGDs also revealed that there is significant relationship between water sources and incidence of child diarrhea in the Northern region. One respondent argued that;

> *"... we the rural dwellers have no option than to rely on dams, hand dug wells and other unimproved water sources for drinking, cooking and other domestic purposes. Anytime our kids drink the water they have a lot of health related problems including stomach pains and diarrhea..."*

This finding is consistent with other studies using 1993 and 1998, 2003 DHS data from Ghana (Ahiadeke, 2000; Gyimah, 2003; Quinn, 2009). It is also largely consistent with studies conducted in Ghana using other data sources (Boadi and Kuitunen, 2005) and a number of studies from other countries (Wijewardene, Fonseka&Wijayasiri, 1992; VanDerslice, Popkin& Briscoe, 1994; Fayehun, 2010).

4.3.1Relationship between time to drinking water source and child diarrhea in Northern Region

Although the source of water may be improved and made hygienic, timely access to thewater is also very important in determining and influencing diarrhea cases among children. If the source of the water is more than 15 minutes away from the household, there may not be sufficient water from that source, and hence unsafe water might be consumed at times.

Table 4.1 demonstrates that diarrhea incidence showed discernible pattern by minutes required to fetch water. Of all children living in households that have their drinking water source in their premises, 13.9% of them had diarrhea. Child diarrhea incidence was about 21.1% and 22.8% when fetching drinking water required about 15 minutes or less and more 15 minutes respectively. Diarrhea incidence was about average at 16.8 percent when fetching water required five or fewer minutes, or greater than 20 minutes, and oscillated up and down for times in between. The association between time to drinking water source and child diarrheal incidence was statistically significant and hence could be a predictor of child diarrhea in Northern Region (see Table 4.1).

Table 4.1: Relationship between time to drinking water source and child diarrhea incidence

Time to drinking water source	Child had no diarrhea		Child had diarrhea		Total
	F	%	F	%	
On premises	30	86.1	9	13.9	39
15 minutes or less	107	78.9	49	21.1	156
More than 15 minutes	67	77.2	30	22.8	97

Total	204	79.3	88	20.7	292

Pearson Chi-square = 12.51:Pr = 0.002

Source: Computed from GDHS, 2014

The Focus Group Discussions (FGDs) held in the Northern region revealed that urban residents have improved access to portable water than rural residents. The study found that the sources of water for urban residents are household connected pipes, public stand pipes and protected dug wells. The sources of water for rural residents are rivers, unprotected dug wells, unprotected springs and dams.

The study found that both urban and rural residents have access to sachet water but the purchasing power of rural residents for sachet water was low. The following are some extracts from the discussions;

> *..."the main source of drinking water for us in this community is the river. We go there to fetch water for cooking and drinking but during the dry season it dries up so we have to fetch water from the dam and treat it before drinking it"...(Rural resident)*

Some of the rural residents also reported that the unprotected nature of the dug wells expose them to other animals such as frogs. This is a reported by one of the residents;

> *...."there are dug wells in this community which are unprotected. We fetch water from them during rainy season but in the dry season they dry up. Sometimes frogs fall and other animals fall into this dug wells because they are unprotected."...(rural resident)*

Majority of the urban residents reported that they have access to water because their households are connected to the urban water system. These are some of their statements;

> *..."we have access to water because our house has pipes that flow with water. Even though the pipes do not flow all the time it is better*

because we reserve water in big containers and use it when the pipes are locked"...(urban resident)

Another respondent asserted that:

....."we always have pipe borne water because our house is connected to the pipes. We also have protected dug well and reservoir for water storage" ... (urban resident)

These findings are consistent with the evidence of several studies which have found greater accessibility of water to be significantly associated with lower child diarrhea incidence (Gascon et al., 2000; Tonglet, Isu, Mpese, Dramaix, and Hennart, 1992; Gorter, Sandiford, Smith, and Pauw, 1991).The importance of water accessibility is that households with a closer source may use more water for hygienic and sanitation purposes, such as washing hands and utensils, and disposing of children's stools (Boadi and Kuitunen, 2005; Shier et al., 1996). Again, one may also argue some households may spend more time searching for good and quality water sources and hence much time to get to water source may influence positively on diarrhea incidence. However, since these households spend more time in getting to their destinations, the likelihood that the water will get contaminated on their way home is great.

4.3.2 Association between households' access to toilet facilities and child diarrhea

An examination of sanitary facilities within the household reveals that the use of flush toilet or improved facilities is very low in Northern region as only 53.7% of households in Ghana had access to improved facilities. Also as presented in Table 4.2, children who lived in households that lacked improved sanitation facilities had a higher diarrhea incidence than those from households that had sanitation facilities. The diarrhea incidence was 31.1% for those without sanitation facilities, compared to only 10.6% for those with sanitation facilities. Table 4.2 shows the association between households' access to toilet facilities and child diarrhea in Ghana.

Table 4.2: The association between households' access to toilet facilities and child diarrhea incidence in Ghana

Toilet Facility	Child had no diarrhea		Child had diarrhea		Total
	F	%	F	%	
Unimproved	92	76.9	48	31.11	130
Improved	128	81.38	24	10.62	162
Total	220	79.3	72	20.7	292

Pearson Chi-square = 7.92:Pr = 0.005:

Source: Computed from GDHS, 2014

The study through the FDGs held, assessed the accessibility of toilet facilities to urban and rural residents. The results showed that even though there is access,toilet facilities are inadequate to both group of residents (urban and rural).The level of access among rural residents is very low and in most cases totally absent as one rural respondent claimed that;

> *..."there is no toilet facility in this community. We all go to the bush to free ourselves. When it rains the whole community stinks because of the faeces around the whole community"....(rural resident).*

Another respondent claimed that:

> *...."there is only one KVIP in this community that was constructed by the District Assembly. It is a very old facility and none is taking care of it. The KVIP is not cleaned so people shit around it and inside the corridors of it. Most of us no longer use it we go to toilet in the bushes and the farms around the community"....(rural residents)*

The study found that some urban dwellers have access to toilet facilities whilst others do not have full access to toilet facilities. Some of the urban residents have full access to toilet facilities with each individual household having its own toilet facility. These are some of the extracts from the FGDs;

> *..."we have water closets in this house so we don't have any problem with access to toilet facilities."* .... *(Urban resident).*

Another respondent said that:

> *...."each household in our house has its own toilet facility. They are all kept neat and disinfected all the time"* .... *(Urban resident)*

The FGDs al so revealed that some of the houses for urban residents do not have toilet facilities. These are some of their statements;

> *..."I live in a compound house and there is no single toilet facility in the house. There are about 10 households in the house but we don't have any toilet facility. We go out to queue and use the nearby KVIP" (urban resident)*

Another resident insisted that:

> *..."there is no toilet facility in our house. Most of the houses around our area do not have toilet facilities so we all go toilet in the nearby bushes"...(urban resident)*

Another respondent said that:

> *...."there is only one toilet facility in our house for a total of 8 households living in that house. it is therefore difficult to use that toilet facility"...(urban resident)*

This finding is consistent with extant literature on the association between sanitation facilities and low diarrhea incidence in Ghana (Ahiadeke, 2000; Gyimah, 2003; Boadi and Kuitunen, 2005; Quinn, 2009) and other countries (Mbonye, 2004; Tumwine et al., 2002).

4.3.3Relationship between child stool disposal and child diarrheal incidence in Ghana

Notwithstanding, the lack of availability of proper sanitary facilities which can be a public health concern and canhave adverse implications on child health in many developing countries, the proper disposal of child stool is also crucial. A large proportion of households in Northern region do not dispose their children's stool properly. This study has revealed as indicated in Table 4.3 that, 23.6% of children living in households that do not dispose children stool properly (put/rinsed into drain or ditch, throw into garbage, buried, left in the open/not disposed of) had reported cases of diarrhea. 16.1% of child diarrhea cases were also reported in households that practiced proper child disposal methods (always use toilet/latrine, put/rinsed in toilet/latrine). This indicates that, diarrhea was high for households that do not dispose their children stool properly.Table 4.3 shows the relationship between child stool disposal and child diarrhea incidence in Ghana.

Table 4.3: Relationship between child stool disposal and child diarrhea incidence in Ghana

Child stool disposal	Child had no diarrhea		Child had diarrhea		Total
	F	%	F	%	
Improper disposal	100	76.4	40	23.6	140
Proper disposal	12	83.9	40	16.1	52
Total	112	79.3	82	20.7	292

Pearson chi-square = 16.8031: Pr = 0.000:

Source Computed from GDHS, 2014

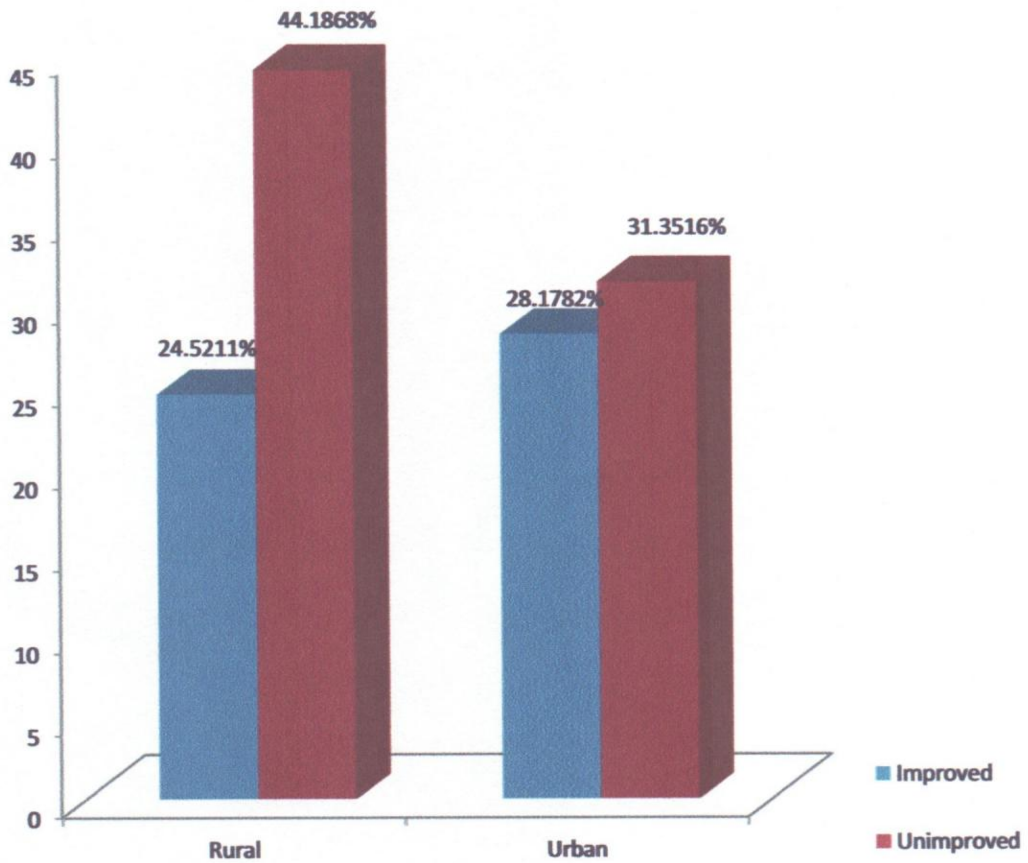
Several studies in Sub-Saharan countries on childhood mortality have found that improper disposal of excreta was significantly related to high incidence of childhood morbidity. There is increased prevalence of diarrhea and cholera in such households, which could contribute to childhood mortality (Ayeni&Oduntan, 1980; Tankins, 1981; Trussell&Hammerslough, 1983; Obungu, Kizito, &Bicego, 1984; Jinadu*et al*, 1991;

Rutsein, 2000). Waddington, Snilstveit, White &Fewtrell (2009) shows that faeces is a major transmission route through which the pathogens that cause diarrhea can enter into the human body.

4.3.4 Child stool disposal across area of residence

As seen in figure 4.4, 44.19 percent of household in the rural areas practice inappropriate sanitation practice in terms of indiscriminate disposal of child faeces. Thirty one percent of households in the urban area also practice indiscriminate disposal of child faeces. In terms of appropriate disposal of child faeces, urban dwellers perform better than rural dwellers.

Figure 4.4: Child stool disposal across area of residence in Northern Region



Pearson chi-square =12.8031: Pr = 0.000: N=292

Source: Field survey, June, 2014

The study through the FGDs held in the Northern region assessed the disposal of the stools of children in both urban and rural communities. The discussions revealed that about 70% of both rural and urban mothers do not properly dispose the stools of their children. These are some of the extracts from the discussions;

> *..."I always add the diapers of my child into the household dustbin together with other household waste. They are then disposed off into the Zoomlion container placed around this area"...(urban resident)*

Some of the urban dwellers properly dispose off the stools of their children. One respondent claim that:

> *..."my younger child who is two years old always shit into the chamber pot and it is then emptied into the water closet of the household. I don't keep it for even five minutes. I dispose it off immediately after the child has finished shitting"...(urban resident)*

Another respondent insisted that:

> *..."I always dig a hole around our house to burry all the used diapers of my baby. Because we are living in a new site there is some undeveloped land around our house so that is where I dig and burry all the used diapers of the child"...(urban dweller)*

The study found that rural dwellers do not properly dispose the stools of their children. These are some extracts from the interviews to support this assertion.

> *...."I don't have money to buy baby diapers so my child always shit on the ground after which we cover it with sand"...(rural resident)*

One other respondent claimed that:

> *...."I allow my child to shit into a polythene bag after which we dump it into the nearby bush around the house"....(rural resident)*

Another respondent argued that:

> *...."the children shit around the house and we sweep it away the next morning when we are cleaning the environment" ...(rural dweller)*

This confirms the findings that rural children tend to be at greater risk of diarrhoea when compared to urban children (Kritz&Makinwa-Adebage, 1999; Mazur & Sanders, 1988; Rajaram et al., 2007).

4.3.5 Relationship between child's age in months and child diarrhea incidence in Northern Region

An examination ofthe relationship between child's age and diarrhea prevalence within the household revealed that child diarrhea prevalence decreased at a decreasing rate with increase in the age of the child. Also as presented in Table 4.4, the diarrhea prevalence was 21.19 percent for children aged 0-11 months and then peaked at 33.27 percent for children aged 12-23 months. The incidence of diarrhea among children then declined to 22.49 percent for children aged 24-35 months, and 12.27 percent for children aged 36-47 months till it attained a minimum value of 10.78 percent for children aged 48-59 months. The results clearly showed that, the incidence of diarrhea was highest for children aged 12-23, and then decreased at a decreasing rate with increase in age until it reached a minimum of 10.78 percent. This finding is consistent exiting literature on the association between sanitation facilities and low diarrhea incidence in Ghana (Ahiadeke, 2000; Gyimah, 2003;

Boadi and Kuitunen, 2005; Quinn, 2009) and other countries (VanDerslice and Briscoe, 1995; Mbonye, 2004; Tumwine et al., 2002).

Table 4.4: Relationship between child's age in months and child diarrhea incidence in Northern Region

Child's age	Child diarrhea					
	Column %			Row %		
	No	Yes	Total	No	Yes	Total
0-11 months	24.7	21.19	23.97	81.7	18.3	100
12-23 months	17.52	33.27	20.78	66.85	33.15	100
24-35 months	17.42	22.49	18.47	74.79	25.21	100
36-47 months	18.58	12.27	17.28	85.3	14.7	100
48-59 months	21.79	10.78	19.51	88.56	11.44	100
Total	100	100	100	79.3	20.7	100

Pearson Chi-Square=95.4407: Pr=0.000:

Source: Computed from GDHS, 2014

4.3.6 Relationship between wealth of household and child diarrhea incidence in Northern Region

The household wealth index, categorized into high and low, is another variable examined in this study. It has been established in demographic studies that the wealth index is a good indicator of the influence of social class on the health of mother and child. The higher the wealth index, the greater is the likelihood of a good household health environment. Therefore, children from lower social classes may be more likely to be subject to ill health due to household environmental health hazards. This study also revealed that, 76.57 of the children in low wealth households had diarrhea two weeks prior to the study, compared to children from the high wealth households who only recorded 23.43 diarrhea cases. Table 4.5 indicates the relationship betweenwealth of households and child diarrhea incidence in the Northern Region.

Table 4.5: Relationship between wealth of household and child diarrhea incidence in Northern region

Wealth Quintile	Child diarrhea					
	Column %			Row %		
	No	Yes	Total	No	Yes	Total
Low	53.71	76.57	55.75	76.4	23.6	100
High	46.29	23.43	44.25	82.96	17.04	100
Total	100	100	100	69.3	30.7	100

Pearson Chi-Square=85.4407: Pr=0.000

Source: Computed from GDHS, 2014

The FGDs held confirms these findings as a rural resident put it;

"... due to poverty, I cannot provide nutritious diets for my kids, we only manage with less costly and less preferred food which usually affects the growth of my children since they frequently run diarrhea"

One urban respondent argued that;

"... I have always worked had towards providing clean environment and nutritious diets for my children which has influenced their health status since my children don't usually fall sick and have never run diarrhea. This I belief is due to the quality of environment and food they eat..."

The study therefore suggest that, wealth quintile influences child diarrhea prevalence indicating that the higher the wealth quintile, the lower the diarrhea prevalence. This result conforms to results of studies and conclusions of Arif& Ibrahim (1998) and Quinn (2009).

4.3.6Relationship between mother's educational level and child diarrhea incidence in Northern Region

Theory suggests that higher maternal education could mitigate the effect of absent sanitation facilities (Ahiadeke, 2000), and therefore help to reduce the incidence of diarrhea among children but this study does not suggest any such effect. The variable mother's educational level was only included in this study as a control variable. As can be seen in table 4.6, there was 32.1 percent reported cases of diarrhea among children of women who had no education and 32.2 percent reported cases of diarrhea among children from households where mother's had higher education. The result clearly showed no significant difference in the reported incidence of child diarrhea between mothers with no education and mothers with secondary or higher education. Though Gyimah (2003) and Ahiadeke (2000) both found higher level of mother's education to significantly lower diarrhea likelihood in Ghanaian children, neither of these studies controlled for wealth, which limits the interpretability of their findings. The results on the other hand, corroborate a study by (Quinn, 2009) which also found no statistical significance between mother's educational level and child diarrhea prevalence.

Table 4.6: Relationship between mother's educational level and child diarrhea incidence in Northern region

Mother's Education	Child diarrhea					
	Column %			Row %		
	No	Yes	Total	No	Yes	Total
No Education	34.1	32.1	23.97	81.7	18.3	100
Primary Education	31.7	35.7	20.78	66.85	33.15	100
Secondary or higher	34.2	32.2	18.47	74.79	25.21	100

Education						
Total	100	100	100	65.3	34.7	100

Person chi-square=85.4407: Pr=0.000:

Source: Computed from GDHS, 2014

4.4Multivariate Analysis

Table 4.7 presents the logistic results for the determinants of child diarrhea incidence in Ghana. Odd ratios are presented in the table. From the Table it can be observed that three explanatory variables are not statistically significant even though they all have the expected signs. These variables are sex of the child, source of drinking water and time taken to get to the source of the drinking water.

Many studies did not use the sex of a child as a control variable to explain the likelihood diarrhea among children but this study did. However, studies have shown under-five female children are biologically stronger than their male counterparts (Garret and Ruel, 1999). This study however, did not find any evidence to support or otherwise that male/female children are more susceptible to diarrhea in Northern region.

The variable time taken tofetch drinking water was insignificant but the odd was expectedly negative. Holding all other variables at their means, diarrhea likelihood increased as time required to fetch water increased. The insignificant negative coefficient on this variable lends credence to the theory that households that spent more time drawing water were accessing higher quality water (for example, traveling a greater distance to get to a cleaner source). Past studies of child diarrhea in Ghana have not controlled for time required to fetch water and numerous studies have found greater water accessibility to be associated with lowerdiarrhea likelihood (Gascon et al., 2000; Tonglet, Isu, Mpese, Dramaix, and Hennart, 1992).

There are several explanations as to why source of water was not a significant predictor of diarrhea in this study. First, Ghana's 2008 DHS data covered only the rainy and cool seasons. Though several Ghanaian studies have found significant results during these seasons (Ahiadeke, 2000; Boadi and Kuitunen, 2005; Gyimah, 2003), Shier, et al. (1996) found non-piped water to be significantly associated with diarrhea only during the hot season, when unprotected sources are typically most polluted. Second, the piped water variable was only a proxy for water quality, as the GDHS did not perform any water quality tests. For example, an association between non-piped water and diarrhea would not be expected if households boiled or otherwise treated their water (Knight et al., 1992; Gorter, Sandiford, Smith &Pauw, 1991) or if piped water was contaminated either by damaged pipelines (Arif and Ibrahim, 1998) or during water transport and storage (Jensen, Jayasinghe, van der Hoek, Cairncross&Dalsgaard, 2004; Wright, Gundry, and Conroy, 2004). Contrary to the results of this study, Gyimah (2003) found a statistically significant effect of piped water using 1998 GDHS data, which also lacked information on actual water quality. This difference in results may be explained by the lack of any control for wealth in Gyimah's study. Alternatively, it is possible that piped water has become a less important predictor of diarrhea over time, due to decay in Ghanaian pipe infrastructure, or improvement in household water treatment practices.

Six controlled explanatory variables were found to be significant predictors of child diarrhea in the Northern region. These variables are the age of the child, the age of the mother of the child, wealth status of household in which the child lives, stool disposal, toilet facility, mother's age and mother's educational level.

The relationship between age of child and child diarrhea incidence is curvilinear with the coefficient of the age of a child being negative and that of age squared being positive and statistically significant at 5 percent level. This indicates a U-shaped relationship in which the likelihood of diarrhea in under-five children increases with age; but that is only up to some critical age beyond which a child's diarrhea likelihood reduces as the child grows older. Therefore, child's age in months and the square of the child's age in months were both highly statistically significant at one percent significance level. Child's age had a positive association with diarrhea likelihood, but the likelihood of diarrhea increased with age at a decreasing rate holding all other factor equal. This finding corroborates with the results of Ahiadeke (2000) and Quinn (2008) study in Ghana, which also found diarrhea likelihood to increase with child's age at a decreasing rate.

The variable mother's age had negative and statistically significant relationship with child diarrhea as expected, suggesting that children of older mothers were less likely to have had diarrhea. All else equal, per a unit increase in the age of the mother will reduce the likelihood of child's diarrhea incidence by 1.85 times. This suggests that mother's maturity and/or parenting experience may play critical role ameliorating child health outcomes in general and in reducing child diarrhea likelihood to be specific.This finding is in keeping with the only previous Ghanaian study to use the variable Gyimah (2003) and Quinn (2008).

The sign on household wealth index was negative, suggesting that wealth may have an inverse association with diarrhea likelihood. Holding other variables at their means, the likelihood of child diarrhea will reduce by 1.0076 times if there is a per unit increase in household wealth. These results were statistically significant at 5 percent significance level. Surprisingly, previous studies of diarrhea in Ghana have either not controlled for household wealth (Shier et al., 1996; Gyimah, 2003; Ahiadeke, 2000), or have looked at wealth without controlling for sanitation facilities and water source (Boadi and Kuitunen, 2005). Wealth has been found to be significantly associated with diarrhea in other countries, such as Pakistan (Arif and Ibrahim, 1998).

The results show that urbanization has a negative effect on child diarrhea incidence with the coefficients being statistically significant at the 10 percent level. This study also found that, all else equal, children in urban areas are less susceptible to diarrhea relative to their counterparts in rural areas. Thus, living in the urban has a significant effect in avoiding child diarrhea compared to living in rural areas. As compared to children in rural areas, children in urban areas are 0.7457 time less likely to have diarrhea. This urban bias in diarrhea incidence may reflect the differential access to health facilities and health information relative to the rural areas. The positive effects of urbanization may also reflect the relatively better income opportunities for households and education of parents compared with the rural areas. This is so because children in urban areas may have access to infrastructure and other social services that will promote child health support than child in rural areas. This finding corroborates the evidence of Garrett and Ruel (1999) and Quinn (2008).

4.5Hypothesis testing

The main trust of this study was to test three hypotheses. These hypotheses relate issues of sanitation and child diarrhea in Ghana. This study has hypothesized that, Access to toilet facility, household water drinking source and households' method child stool disposal has no effect on diarrhea prevalence among children in Northern region .The study employed the Z statistic and the probability values of the odd ratios to test the hypothesis about the parameters to determine the statistical significance of the predictors. The study uses a 10% significance level as the decision criterion to determine the statistical significance.

Consideration is first given to household access to toilet facility and child diarrhea incidence. The hypothesis is as follows;

Ho: Access to toilet has no influence on child diarrhea prevalence in Northern Region

This hypothesis is tested on grounds that if a child lives in household that has access to improved toilet facility; the likelihood of diarrhea affecting that child will reduce. From this study, with a Z-statistic of -2.19 and a corresponding p-value of 0.029 there is enough evidence to conclude that the effect of household access to toilet facility on under five children diarrhea prevalence is statistically different from zero in Ghana. The study has therefore revealed that children who live in households with improved toilet are 0.985 times less likely to have diarrhea compared with children that live in households with unimproved toilet facilities. This means that children under age five that live in households with an unimproved toilet, such as open pit, bucket, hanging toilet, pit latrine without a slab, or with no facility are significantly more likely to have episodes of diarrhea than others with an improved toilet facility. An unimproved toilet facility is a route for infection and germs that could affect young children. This study does provide some evidence that improved toilets are more protective against diarrhea than unimproved toilets in the Ghanaian context. This finding corroborates with the evidence provided by Quinn (2008) and Fayehun (2010).

The next hypothesis the study tested was;

Ho: There is no relationship between household drinking water source and child diarrhea prevalence in Northern Region.

This hypothesis was also formulated to test the effect of the source of drinking on child diarrhea in Northern region since the pathogens that cause diarrhea are mostly found in feces and water. The study has revealed that improved water variable (relative to unimproved water) was not significant at conventional confidence levels. Thus, the difference in diarrhea incidence by water source was found to be insignificant once other factors were controlled for. From this evidence, the study fails to reject the null hypothesis and maintain that difference in child diarrhea incidence in Northern region cannot be attributed to the source of drinking water of the household in which children live. Although there seems to be adecrease in childhood diarrhea if the household drinking water is from an improved source, the expected high effect of source of drinking water on childhood diarrhea is likely to be distorted by other factors, such as fetching practices, storage, and treatment of the drinking water which are not accounted for in the data. Unlike the results of this study, (Gyimah, 2003) found a statistically significant effect of piped water using 1998 GDHS data. A number of authors has espoused that an association between unimproved water and diarrhea would not be expected if households boiled or otherwise treated their water (Knight et al., 1992; Gorter, Sandiford, Smith &Pauw, 1991) or if piped water was contaminated either by damaged pipelines (Arif and Ibrahim, 1998) or during water transport and storage (Jensen, Jayasinghe, van der Hoek, Cairncross&Dalsgaard, 2004; Wright, Gundry, and Conroy, 2004). This therefore may explain why there is no significant relationship between source of drinking water and child diarrhea in Northern region.

The third hypothesis that was tested is;

Ho: Method of child stool disposal has no effect on diarrhea prevalence among children in Northern Region.

This study has also found that, the way a child's feces (stool) is disposed is significantly associated child diarrhea in Northern region. With a z-statistic of 2.85 and a corresponding probability value of 0.004, there is enough evidence to reject the null hypothesis and conclude that the way and manner in which children feces are dispose is significantly related to child diarrhea in Northern region. This means children under age fivewholive in households that have insanitary disposal of child feces such as feces put/rinsed into drain or ditch; thrown into garbage; rinsed away; left in the openare significantly more likely to have episodes of diarrhea than others in households that have sanitary disposal such child used toilet/latrine; feces put/rinsed into toilet or latrine; used disposable diapers; used washable diapers. This results is consistent with Quinn, 2008; Ayeni and Oduntan, 1980; Tankins, 1981; Trussell and Hammerslough, 1983; Obungu, Kizito, and Bicego, 1984; Jinadu*et al*, 1991; Rutsein, 2000 that also found evidence to support that there is mostly increase in the prevalence of child diarrhea and cholera in households that do not dispose child feces properly. Table 4.7 indicates the determinants of child diarrhea prevalence in the Northern Region.

Table 4.7: Determinants of child diarrhea prevalence in Northern Region

Diarrhea incidence	Odd Ratio	Std. Err	Z	P>z
Child's Sex				
Female child	0.9788	0.0972	-0.22	0.829
Child's Age	1.0813	0.0127	6.67	0.000
Child age squared	0.9983	0.0002	-7.45	0.000
Mother's Age	0.7585	0.4593	-1.85	0.082
Mothers' Education				
Primary	0.8160	0.1099	-1.51	0.021
Secondary	0.8401	0.1134	-1.29	0.017
Higher	0.4754	0.2366	-1.49	0.015
Source of Drinking water				
Improved water source	0.9847	0.1313	-0.12	0.908
Stool disposal				
Insanitary stool disposal	0.7388	0.0783	2.85	0.004
Time to water source				
15 minutes and less	-1.1489	0.2164	-0.74	0.461
Above 15 minutes	1.1307	0.2293	-0.61	0.545
Toilet Facility				
Improved toilet facility	0.985	0.0068	-2.91	0.028
Household Wealth index	1.0076	0.0097	-2.38	0.018
Residence				
Households in Urban areas	0.7457	0.1155	-2.11	0.048
Constant	0.3425	0.1560	-2.35	0.019
Observation	292			
Prob> chi-square =	0.000			
Pseudo R-square =	0.0527			

Source: Computed from GDHS, 2014

4.6Robustness check and post-estimation results

A number of robustness checks were employed to ensure consistency in the logistic regression estimates of child diarrhea prevalence in Ghana. Consistent with regression diagnostics, correlation matrix of the explanatory was first examined. It shows that the regressors are not strongly correlated hence the variables were included in the model. The correlation matrix is presented in Appendix A.Also following Stock and Watson (2003); Wooldridge (2006), the robust command was added to the estimated equation to address the problem of heteroskedasticity. With a p-value of 0.33, the Hosmer and Lemeshow's goodness-of-fit test indicates that the model fits the data well. For model specification test, the linktest was also conducted and the results indicated that the model was correctly specified (the probability value from the Linktest = 0.881, this means failure to reject that the model is correctly specified). The value of Pearson Chi-square test shows the overall goodness of fit of the model at less than 1% probability level.

4.7Conclusion

This study set out to examine the relationship between water, sanitation and child health outcomes in Northern region using data from Ghana's Demographic and Health Survey (2014). Binary logistic regression was the main estimation technique used to examine the relationship between water, sanitation and child health outcomes. The main variable of interest, access to improved toilet facilities, child stool disposal and time to fetch water were significant across many models

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1Introduction

This chapter summarized the key findings of the study and as well as drew conclusions based on the findings of the study. The results of the study gave way for the research to enumerate policy implications of the findings.

5.2 Summary

This study set out to examine the relationship between water, sanitation and child diarrheaoutcomes in Northern region using data from the seventh round of Ghana's Demographic and Health Survey (2014) and focus group discussions. The study adapted a qualitative and quantitative approach. The main reasoning behind this study is that if a child lives in a household that has access to improved toilet facilities and water the likelihood of diarrhea affecting that child will reduce. The study explored the theoretical perspectives of the Grossman demand for health, Generalized Grossman demand for health and the extended Grossman models for health models for its empirical model specifications. It also adapted valuable insight from the UNICEF 1999 model of child nutrition and survival.

Binary logistic regression was the main estimation technique used to examine the relationship between water, sanitation and child health outcomes. As mentioned earlier the dependent variables were, household wealth status, maternal age and education level, time to water source, child stool disposal , water source and urbanization as the covariate.

Different models were estimated and these covariates were marginally consistent across the different child health functions. What was emphatically evident was that, child's age and mother's age were significant across all models. On the main variable of interest, access to improved toilet facilities, child stool disposal and time to fetch water were significant across many models. The study conducted regression diagnostics and post estimation test and in both categories the models passed.

5.3 Conclusion

5.3.1 Policy Context

The U.N. MDGS represent the world's premier poverty reduction strategy, agreed upon by all of the world's nations and leading development institutions. Halving the proportion of people without sustainable access to safe drinking water and basic sanitation by the year 2015 is among the global commitments outlined in these goals. This target requires increasing the proportion of the world's population with safe drinking water from 77 percent in 1990 to 89 percent, and increasing the proportion with basic sanitation from 49 percent to 75 percent (WHO/UNICEF Joint Monitoring Program, 2014). While the U.N. includes this target within MDG 7: Ensure Environmental Sustainability, it would be more appropriate within MDG 4: Reduce Under-Five Mortality by two thirds. Diarrhea is the second leading cause of death in children under age five worldwide, representing nearly one fifth of such deaths, and improving water and sanitation is an important weapon against this disease (United Nations Children's Fund [UNICEF], 2012).

The World Health Organization (2008) estimates that 1.1 billion people globally do not have access to safe water sources and 2.4 billion people do not have adequate sanitation infrastructure. In order to meet the MDG goal of increasing water coverage to 89 percent and sanitation coverage to 75 percent, the World Bank (2014) estimates that global spending on water and sanitation needs to double from $15 billion to $30 billion per year. While better coverage is being achieved for both water and sanitation in Sub-Saharan Africa, the region is not on track to reach SDG 7, and is not improving coverage as rapidly as other regions. For example, at current rates of progress, water coverage in Sub-Saharan Africa is expected to improve from 49 percent in 1990 to 68 percent in 2015, seven percentage points below the region-specific target of 75 percent. In contrast, in South Asia, water coverage is projected to improve from 71 percent in 1990 to 98 percent in 2015, greatly surpassing the regional target of 86 percent. Sub-Saharan Africa's progress on sanitation is particularly slow, with 32 percent coverage in 1990, and a projected coverage of 40 percent in 2015, 26 percentage points below the regional target of 66 percent. Due to population growth, the absolute number of persons without access to sanitation is expected to *increase* in Sub-Saharan Africa by 91 million between 2005 and 2015. As with water coverage, the progress in percent with sanitation access in Sub-Saharan Africa compares unfavorably to South Asia. South Asia started well behind Sub-Saharan Africa with 20 percent sanitation coverage in 1990, and is projected to achieve 55 percent coverage by 2015. This is still somewhat short of the regional target of 60 percent, but demonstrates that progress on sanitation is possible at levels far greater than what has been achieved in Sub-Saharan Africa. Globally, sanitation coverage is projected to fall short of the MDG goal of 75 percent coverage, with a projected global coverage of 68 percent by 2015. In contrast, global water coverage is expected to reach 90 percent, surpassing the MDG goal of 89 percent (WHO/UNICEF Joint Monitoring Program, 2014).

It is unsurprising that progress toward sanitation coverage has lagged behind water coverage. Donors typically house both water and sanitation within a single program, and sanitation is often treated as an afterthought, or neglected entirely. For example, the U.N.'s Decade for Action (2005-2015) on water and sanitation is titled *Water for Life*, and the

World Bank's topics web page lists water and sanitation under the simple heading *Water*. This neglect of sanitation is not simply semantic. According to the WHO/Unicef Joint Monitoring Program, global investment in sanitation is only one eighth of the investment in water (Medact, 2008).

The international community is beginning to recognize the imbalance between sanitation needs and sanitation investments. The U.N. General Assembly declared 2008 the International Year of Sanitation, following a recommendation by the U.N. Secretary Advisory Board on Water and Sanitation. In explaining the need to emphasize sanitation, U.N. Secretary General Ban Ki-Moon stated, "Access to sanitation is one of the most overlooked, and underserved human needs" (United Nations Millennium Campaign, 2009). In addition, Global Health Watch 2, a Global Health Report by a coalition of non-governmental organizations, attempted to change the dialogue in 2008, referring to a crisis in *Sanitation and Water* (Medact, 2008). Though it may seem unremarkable to simply invert the order of these words, sanitation has traditionally followed water as predictably as jelly has followed peanut butter. This shift in top billing is an attempt to reverse the historic neglect of sanitation and usher in an era of equality between water and sanitation in both focus and funding. As such, while sanitation has yet to gain the attention that it warrants, there has historically been no more opportune moment to champion an increase in sanitation funding.

5.3.2 Major Findings

The study was conducted to examine the relationship between access to water, sanitation and child health outcomes. The main findings of the study conducted are discussed below.

In the study, the researcher set out to examine the relationship between access to toilet and child diarrhea. The findings from the research revealed that children who lived in households with improved toilet were 0.985 times less likely to have diarrhea compared to children who lived in households with unimproved toilet facilities. This means that children under age five that live in households with an unimproved toilet, such as open pit, bucket, hanging toilet, pit latrine without a slab, or with no facility are significantly more likely to have episodes of diarrhea than others with an improved toilet facility. An unimproved toilet facility is a route for infection and germs that could affect young children. This study does provide some evidence that improved toilets are more protective against diarrhea than unimproved toilets in the Ghanaian context

From the data analysis, it was also revealed that, difference in child diarrhea incidence in Ghana could not be attributed to the source of drinking water of the household in which children lived .Although there seem to be a decrease in childhood diarrhea if the household drinking water is from an improved source, the expected high effect of source of drinking water on childhood diarrhea is likely to be distorted by other factors, such as fetching practices, storage, and treatment of the drinking water which are not accounted for in the data

In addition, from the GDHS data it came out that children under age five who lived in households that had insanitary disposal of child feces such as feces put/rinsed into drain or ditch; thrown into garbage; rinsed away; left in the open were significantly more likely to have episodes of diarrhea than others in households that had sanitary disposal such child used toilet/latrine; feces put/rinsed into toilet or latrine; used disposable diapers; used washable diapers

5.4 Recommendations

5.4.1 Recommendations for Donor Agencies

1. In order to ensure a sustained commitment to sanitation, donors should reframe the way in which the issue of sanitation is presented to the public. Though it would be a waste of resources to officially rename agencies and programs *Sanitation and Water*, donors should

think about the way these complementary issues are presented on their websites and in promotional materials. For example, simply changing the World Bank topics page to include a heading for Water and Sanitation, as opposed to just Water, would relay the message that sanitation is an important topic worthy of attention and funding. Likewise, while the phrase *Water for Life* may be a catchy heading for the U.N.'s Decade for Action on water and sanitation, the title should be reworked to reflect the initiative's inclusion of sanitation. Without such a change in the way that the issue of sanitation is presented, we risk a one-time infusion of funding, followed by a return to water-focused business as usual.

2. While increasing resources for sanitation, donors must be sure to sustain the current level of funding for equitable access to safe water. The projected achievement of the Sustainable Development Goals(SDGs) especially goal 6, targets 1 and 2 about equitable access to safe, affordable water for all by 2030 is predicated on current spending commitments. If the projected achievement invokes complacency and a failure to fulfill those commitments, the goal will not be achieved. In addition to sustaining global water investments, donors should increase water investment in Africa, where the SDG 6 for water and sanitation is not on track to be met. Though studies have produced divergent results as to the role of water infrastructure in diarrhea incidence, provision of water has many other objectives, including time-saving for girls and women, whose water-fetching responsibilities may prevent them from going to school and engaging in income-earning activities. As such, achieving 89 percent water coverage continues to be an important goal. In addition, the absence of statistically significant results in some studies may indicate a need to increase expenditure on maintenance of water infrastructure, as infrastructure decay limits the efficacy of improved water sources in diarrhea prevention.

3. As a final recommendation to donors, a few additions to the USAID-funded DHS survey would help researchers to better understand the issue of diarrhea in developing countries. First, it is unclear why the Ghana DHS data set did not include any information on mother's hand-washing behavior, a variable that is supposedly included in the survey. As hygiene is an important determinant of diarrhea, inclusion of such information would be valuable. Second, the survey asks only how much time is required to draw *drinking* water. As diarrhea incidence in a number of contexts is associated with availability of water for *hygienic* purposes, it would be useful to also ask how much time is required to fetch water for these purposes. Some households may access most of their water close by, but travel to a distant source for their drinking water, because that source is believed to be cleaner. Third, the survey does not ask about household water treatment practices. Household water treatment is an important protective factor against diarrhea, and such information might clarify why non-piped water is not associated with higher diarrhea likelihood in Ghana.

5.4.2 Recommendations for the Government of Ghana

1. It is recommended that the Government of Ghana create Rural Sanitation and Urban Sanitation programs as complements to the existing Rural Water and Urban Water programs. Funding from the recent World Bank loan should be allocated to these programs. The percentage of the loan allocated to these programs is left to the discretion of the Ghanaian government, which is in a better position to evaluate the competing needs in Ghana. However, the government is urged to seriously consider the results of this study, which suggest that provision of sanitation would reduce diarrhea, the second leading killer of children in Ghana. In addition, the Government of Ghana should note that investment in sanitation is considered to be a highly cost-effective intervention by health economists.

2. While there are a number of strategies that the Government of Ghana could employ in implementing sanitation programs, evidence suggests that community-led initiatives are particularly effective. For example, the Asian Development Bank, which has succeeded in catalyzing a dramatic increase in sanitation coverage in Asia, points to community participation as a key element of success in its paper "Best Practices in Water Supply and Sanitation" (2007). Ghana is fortunate to already have a government agency tasked with community participation in development – the Department of Community Development. This Department could coordinate with the proposed Rural and Urban Sanitation programs to facilitate latrine construction at the community level. Community responsibilities may include identification of a local skilled mason for certification in latrine construction, and coordination of digging of pits (an unskilled task) by households themselves. Local participation ensures that community members are invested in the project, and also minimizes costs. As hygiene is an important determinant of diarrhea, health education should complement the provision of sanitation infrastructure in Ghana. This task should likewise be coordinated by the Department of Community Development. Health educators should be elected at the community level and participate in health training-of-trainers, offered jointly by the Department of Community Development and the Ghana Health Service. Trained educators would then return to their community to facilitate trainings themselves. Given the results of this study, health educators should convey to mothers that diarrhea risk peaks at age two in Ghana. As breastfeeding has been shown to decrease incidence of diarrhea and other illnesses in children two and under, instruction on recommended breastfeeding practices should be a component of the health education program. The health education strategy might also include

community mentorship programs between older and younger mothers, as this study suggests that children of older mothers are at significantly lower risk for diarrhea.

3. As a final recommendation, the Rural and Urban Water programs in Northern region should conduct water quality testing from a sample of piped water sources throughout the country. The lack of statistically significant results for the piped water variable in this study may indicate that piped water is of low quality in Ghana, failing to protect against diarrhea. Should the water quality prove low, the Ghanaian government must assess and address the cause of the low quality, either by repairing damaged pipelines, or by improving water treatment processes. In addition, community members should be advised as to the level of water quality, and educated in household water treatment methods. The department of Community Development could coordinate the dissemination of this message at the community level.

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APPENDICES

APPENDIX A

Table 1: Correlation matrix

	Piped	Timetofet~	Sanitat~	Ageinm~	Wealth	Noed	Second~	Stool dis	Momsage
piped	1.00								
Timetofet~	-0.20	1.00							
Sanitat~	0.27	-0.12	1.00						
Ageinm~	0.01	-0.01	0.02	1.00					
Wealth	0.66	-0.23	0.50	0.02	1.00				
Noed	-0.28	0.09	-0.50	0.00	-0.45	1.00			
Second~	0.30	-0.12	0.38	-0.01	0.44	-0.65	1.00		
Momsage	-0.02	-0.00	-0.07	0.20	-0.05	0.16	-0.10	1.00	
Stool dis	-0.03	-0.12	0.38	-0.01	0.44	-0.23	0.50	0.02	1.00
Obs=2,599									

Source: Computed from GDHS, 2008

APPENDIX B

Table 2: Linktest

Logistic regression Number of obs = 2599

LR chi2(2) = 123.37

Prob> chi2 = 0.881

Log likelihood = -1459.6939 Pseudo R2 = 0.0405

diarrhea	Coef.	Std.Err.	z	P>|z|	[95% Conf. Interval]	
_hat	2.048219	.4289051	4.78	0.000	1.207581	2.888858
_hatsq	.3054118	.1198969	2.55	0.011	.0704182	.5404053
_cons	.8119366	.3593101	2.26	0.024	.1077018	1.516171

APPENDIX C

Questions for Group Discussion

My name is Eric Yandanbon. I am conducting a household survey for a research i am doing on the topic, Water, Sanitation and Child Health Outcomes in Ghana. This is in partial fulfillment for the award for Masters Degree in development studies. So, I kindly request you to provide me with your answers. The information you give will be used only for academic purpose. I would like to emphasize that any information you give will be processed anonymously and no personalized data will be handed over to local authorities or other authorities. I guarantee that your privacy will be protected.

1. What are the basic problems in the community?

2. Do you think these problems are negative impact on the community members' economic welfare?

3. What is the main source of drinking-water for members of this area?

4. How long does it take to go there, get water, and comeback?

5. What is your opinion about the water quality [main source of drinking water]?

6. Do you treat your water in any way to make it safer to drink?

7. What do you usually do to the water to make it safer to drink?

9. What is the main source of drinking-water for members of this area?

Do members of this community have household toilets?

10. Do you think the current water and sanitation facilities situations are satisfactory to the community members?

11. What initiatives does the community take to increase the availability of safe drinking water and sanitation?

12. What are the priority infrastructures in the community?

13. What is your opinion in the relationship of infrastructure and economic development?

14 Do you have children who are under five?

15. How do you dispose the child's stool?

16. How many of them fell ill in the last 3 months?

17. What were the symptoms?

18. In your opinion what barriers do you have not to have potable water and basic sanitation?

APPENDIX D

Interview Questions for CHWs in the Community

1. Background: age, sex, education, etc.

2. Major activities of community health worker

3. What are the basic problems in this community?

4. Are the diseases are related to unsafe drinking water and poor sanitation?

5. What role do you play to minimize the exposition of the community members to water borne diseases?

6. Do you think unsafe drinking water and sanitation have negative impact on the economic welfare of the community members? If 'yes' in what way?

7. Do you believe that the training you have had allows you to address most problems you encounter at community level?

8. Do you contribute to creating awareness about using safe water?

9. Do you advise and train community members to take care in preventive actions?

10. What are the perceived health problems owing to reliance on unsafe water?

11. Which types of diseases are the most prevalent – water-borne, water washed or water related?

12. What are the perceived health problems because of poor water and sanitation?

13. What types of households are most susceptible to water-related diseases?

14. Do you think there is a linkage between poor accessibility of water and sanitation and the economic welfare of the community?