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SANITATION AND DIARRHOEAL DISEASE AMONG CHILDREN UNDER FIVE YEARS IN GHANA

BY

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ACCEPTANCE

Accepted by the Faculty of Social Studies, University of Ghana, Legon in partial fulfillment of the requirements for the degree of MA in Population Studies.

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Date ……..

DECLARATION

I, Solomon Tetteh hereby declare that except for references made to other works which have been duly acknowledged, this is the result of my own research undertaken under supervision, and that it has neither in part nor in whole been presented for another degree elsewhere.

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SOLOMON TETTEH

(STUDENT)

Date …….

DEDICATION

I dedicate this work to my Lord and Saviour Jesus Christ, without whom, this work would not have been possible and also to my mother Madam Mary Lokko for her support and love.

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ABSTRACT

In an ideal situation, over 97 percent of newborn infants can be expected to survive through the first five years of life. Reduction in this survival probability in any society is due to the operation of social, economic, biological, and environmental forces. The aim of this study was to investigate the relationship between sanitation and diarrhoeal diseases among children who are less than five years in Ghana. A sample of 2005 women who had given birth in the last five years preceding the survey was drawn from the women's file of the 2008 Ghana Demographic and Health Survey. In the survey the women were asked whether or not their children suffered from diarrhoeal disease two weeks preceding the survey. Selected socio-economic characteristics of women, environmental factors, and child characteristics were used in the analyses for this study. Due to data limitation, other sanitation variables could not be included in the survey which might have allowed vigorous analyses of the interaction between sanitation and diarrhoeal diseases. Both bivariate and multivariate statistical techniques were employed in the analysis of the data for the study. The analysis shows that wealth of mother, child stool disposal and age of child were the significant predictors of under-five diarrhoeal disease. Most striking is the finding that toilet facility and source of drinking water were not significant predictors of under-five diarrhoeal disease at the multivariate analyses. The study therefore recommends that, education should be intensified on the potential threats of child stool, and the proper way of disposing of it; deliberate focus by government and other institutions should be directed at providing improved sanitation service delivery to rural and urban slum dwellers; and women should be educated on more hygienic way to handle complementary feeding of their children.

CHAPTER 1

1.1 Background to the study

Adequate sanitation, together with good hygiene and safe water, are fundamental to good health and to social and economic development. This is why, in 2008, the Prime Minister of India quoted Mahatma Gandhi who said in 1923, "sanitation is more important than independence." Improvements in one or more of these three components of good health can substantially reduce the rates of morbidity and the severity of various diseases and improve the quality of life of huge numbers of people, particularly children, in developing countries. Although linked, and often mutually supporting, these three components have different public health characteristics, (Mara et al, 2010). This study focuses on sanitation and diarrhoeal disease among children under five years in Ghana.

Diarrhoea is one of the major killer diseases of children less than five years in the world. Globally it is the third largest cause of morbidity and the sixth largest cause of mortality among population of all ages, (Regassa et al, 2008). A ten year review of the global problem of diarrhoeal disease indicates that, there are about 1 billion incidence of diarrhoea and 3 million deaths each year, among children less than five years of age, (Regassa et al, 2008). Diarrhoeal diseases are also, the most important of the faeco-oral diseases globally, which causes about 1.6 to 2.5 million deaths annually. Many of such deaths occur among children less than 5 years living in developing countries, (Mara et al. 2010). With reference to sanitation, more than 280 million children, who are under five years in the world, live in households without access to improved sanitation facilities, and

about 88 percent of diarrhoeal deaths worldwide are attributable to unsafe water, inadequate sanitation and poor hygiene, (Karki et al. 2010). As of 2006, an estimated one in four people in developing countries were not using adequate sanitation facilities, and these people mostly practice open defecation **(**Karki et al 2010).

In the developed world, deaths caused by diarrhoea illness are rare, and the effect of these illnesses is often measured in financial terms. In the United States of America for example, children younger than five years, experience about 25 million episodes of diarrhoea illness, and there are 200 000 hospital admissions every year. This contributes to 4% of all admissions (average cost US$2307) and 2% of outpatient visits at about $50 a time, (The Lancet, 2004). In the developing world however, 24,000 children under the age of five die every day from preventable causes like diarrhoea contracted from unclean water. In 2004, diarrhoeal disease was the third leading cause of death in low-income countries, causing 6.9% of deaths, (WHO 2009). Diarrhoea is more prevalent in the developing world due in large part, to the lack of safe drinking water, sanitation and hygiene, as well as poorer overall health and nutritional status. The unsanitary environments that prevail in developing countries allow diarrhoea-causing pathogens to spread more easily.

In Africa, a child experiences about five episodes of diarrhoea per year, and 800,000 children die each year of diarrhoea related dehydration (UNICEF/WHO, 2009). In Ghana, statistics from the Ministry of Health indicate that diarrhoea accounts for 84,000 deaths annually with 25 percent being children under five years (Boadi and Kuitunen, 2005). Diarrhoea thus poses a major threat to child health and survival in Ghana. Besides

mortality, the long-term effects of diarrhoeal illness on childhood health are extremely serious and these may lead to malnutrition and growth faltering (Brown, 2003). Despite these statistics, systematic reviews suggest that improved sanitation can reduce rates of diarrhoeal diseases by 32%–37%, (Mara et al. 2010).

1.2 Statement of the problem

The number of people in Africa lacking access to improved sanitation is rising, despite repeated promises by the continent's national leaders to tackle the problem. Poor sanitation is causing hundreds of thousands of deaths every year in Africa, where 600 million people – about 70% of the population – do not have a safe toilet facility, according to a report by, a non-governmental organization (WaterAid, 2008). That number is up 210 million from 1990, largely because the continent's population has increased and more people have moved to urban slums, where there has been no corresponding increase in sanitation. (WaterAid 2008)

In Ghana most people have access to safe water, but only 13 percent of the people have access to improved sanitation. About 16 million Ghanaians use unsanitary or shared latrines, 4.8 million have no latrines at all and defecate in the open. The poorest quintile is 22 times more likely to practice open defection than the richest, (Water and sanitation program 2012).

There is a strong relationship between poor sanitation, and the number and severity of diarrhoeal episodes—especially for children under five years. In addition to the lack of

sanitation infrastructure, some cultural beliefs and views encourage people in both rural and urban areas not to use latrines. There are frequent uses of the city's main beaches and open spaces among communities as public toilet. Children, who happen to play around these open spaces, may be infected by diarrhoeal diseases either through direct contact, or through hand to hand transmission by their peers and also through many other routes (Songsore and McGranahan, 1993). In Ghana it is estimated that diarrhoea accounts for 84000 deaths annually with 25 percent being children under five across the country, (Boadi and Kuitunen 2005).

Also poverty is a very good indicator of the prevalence of diarrheal disease in a population. Poverty is associated with poor housing, crowding, dirt floors, lack of access to sufficient clean water or to sanitary disposal of fecal waste, cohabitation with domestic animals that may carry human pathogens, and a lack of refrigerated storage for food—all of which increase the frequency of diarrhoea, (Keusch et. al 2006).

However, when people do not have access to adequate sanitation, money spent on health and education is often wasted, because people may fall ill from preventable diseases such as diarrhoea. The occurrence of diarrhoeal disease among children restricts the potential for growth in the country, since parents may frequently have to interrupt their work; in order to attend to their children who are infected with the diarrhoeal disease. This may amount to loss of productivity and it may cause the nation millions of Cedis each year.

The ability to provide age-appropriate, nutritionally balanced diets or to modify diets when diarrhoea develops so as to mitigate and repair nutrient losses is also lacking in

many households in developing countries like Ghana. Thus, the young suffer from an apparently never-ending sequence of infections, rarely receive appropriate preventive care, and too often encounter the health care system when they are already severely ill, (World Bank, 2006).

Early childhood diarrhoeal disease may cause growth and physical impairment among children. Frequent occurrence of diarrhoea among children may lead to cognitive development defects, and this may also lead to lower human potential and productivity in the future. Above all, diarrhoea mortality among children under five years causes both emotional and psychological pain to the household and the community at large.

1.3 Rationale of the study

Under-5 mortality rate is regarded as a leading indicator of the level of child health and overall development in countries. It is also a millennium development goal indicator, and lack of sanitation contributes to about 10% of the global disease burden, causing mainly diarrhoeal diseases. Government agencies have typically built sanitation infrastructure, and sanitation professionals are now concentrating on helping people to improve their own sanitation and to change their behaviour. This has come about, in efforts to impact not only on health and to reduce diarrhoeal disease, but on social and economic development, particularly in developing countries, (Mara et. al 2010).

Whiles there has been many research on the diarrhoeal disease in Ghana, there has been little effort with most of the studies to rigorously disaggregate the specific effects of

sanitation from the overall effects of wider water, sanitation, and hygiene interrelationship. Thus a study into the relationship between sanitation and diarrhoea among children under five will help to identify and possibly to isolate the most important factors that influence under five diarrhoea levels, so as to design effective programs and policies to tackle them. This is important in the face of limited resources available to the government especially in Ghana and most developing countries.

The diarrhoeal disease is a major public health problem in developing countries like Ghana, (Kosek et al. 2003); studies have shown that prevention of diarrhoea is possible; diarrhoea does not have to be as common as it is now. The research targets children less than five years because; they are more vulnerable to diarrhoea mortality than the other age groups. Above all the millennium development goal four (MDG 4), aims to further reduce child mortality by two thirds, by 2015 from the 1990 level and this makes the research very timely.

1.4 Objectives of the study

The general objective of the study is to investigate the sanitation and diarrhoeal disease nexus.

The specific objectives include:

1. To examine the incidence of diarrhoea among children less than five years in Ghana.
2. To investigate the relationship between some selected socio-economic and demographic factors and under five diarrhoea in Ghana.

3. To examine the relationship between environmental contamination and under five diarrhoea in Ghana.
4. To make recommendations based on the findings on how under five diarrhoea rates could be reduced in Ghana.

1.5 Organization of Work

The study comprises seven chapters and the contents of each chapter are as follows: Chapter one covers the background to the study, statement of the problem, rationale for the study, and research objectives. Chapter two covers the literature review, the conceptual framework; and the hypotheses, whiles Chapter three consists of the methodology for this study.

Chapter four looks at the background characteristics of the respondents. In Chapter five, the study investigates the level and patterns of the selected background characteristics of respondents as provided by the DHS survey on Ghana. Chapter six examines the relationships between selected socio-economic factors and childhood diarrhoeal disease morbidity. Chapter seven, which is the final chapter, is devoted to discussion, policy recommendations, summary and conclusions.

CHAPTER 2

2.1 Literature Review

Many studies have led the way in researching into the environment, sanitation and socio economic determinants of diarrhoeal disease among children under five years, (Kjellstrom et al, 2007; Mara et al, 2010; Girma et al, 2008). Most studies have revealed that, malnutrition, sanitation, water use and supply, and hygiene are very important in the risk profile for childhood diarrhoea. The etiological factors associated with diarrhoeal disease in children include microbial agents which are usually transmitted through food and water contaminated with human feces (Kung'u et al. 2002).

Poor sanitation, lack of access to clean water, and inadequate personal hygiene are responsible for an estimated 90 percent of childhood diarrhoea (WHO 1997). The World Health Organization millennium project which focused on improved water and sanitation for health revealed that, 88% of diarrhoeal disease—the second leading cause of death in children younger than five years after respiratory illnesses—is attributed to unsafe drinking water, inadequate sanitation, and poor hygiene. Diarrhoea morbidity is reduced by around 21% through improved water supply and by around 37% through improved sanitation (www.the lancet.com February 26, 2005).

Chekley et al (2004) also assess the impact of water and sanitation on children's nutritional status in a cohort of Peruvian children. The findings show that nutritional status is related to the quality of water and sanitation interventions and highlights the need to improve sanitation in developing countries. More reliable water sources diminish

the risk of contaminated water, decrease diarrhoeal incidence, and improve linear growth in children.

Jalan and Ravallion (2001) constructed a behavioural model for children, where health status depends on access to piped water, parental spending on private inputs to child health, and a vector of personal and environment characteristics. The authors use Propensity-score matching methods to estimate the causal effects of piped water on child health in a cross-sectional sample. Among the findings are a significantly lower prevalence and duration of the diarrhoeal disease for children living in households with piped water compared to a comparison group of households matched on the basis of their propensity scores.

Whiles many studies included in reviews could not rigorously disaggregate the specific effects of sanitation from the overall effects of wider water, sanitation, and hygiene interventions, a longitudinal cohort study in Salvador, Brazil, found that an increase in sewerage coverage from 26% to 80% of the target population resulted in a 22% reduction of diarrhoea prevalence in children under 3 years of age; in those areas where the baseline diarrhoea prevalence had been highest and safe sanitation coverage lowest, the prevalence rate fell by 43%. Similarly, a recent meta-analysis that explored the impact of the provision of sewerage on diarrhoea prevalence reported a pooled estimate of a 30% reduction in diarrhoea prevalence and up to 60% reduction in areas with especially poor baseline sanitation conditions.

Another longitudinal study in urban Brazil found that the major risk factors for diarrhoea in the first three years of life were low socioeconomic status, poor sanitation conditions, presence of intestinal parasites, and absence of prenatal examination. The study concluded that diarrhoeal disease rates could be substantially decreased by interventions designed to improve the sanitary and general living conditions of households. (Duncan Mara et al. 2010).

Furthermore, reports from different parts of the world showed, lack of excreta disposal facility, the presence of excreta in the yard of a household, lack of latrines and absence of refuse disposal pit were associated with higher diarrhoea morbidity. A study conducted by Boadi and Kuitunen in 2005 on childhood diarrhoea morbidity in the Accra Metropolitan Area, revealed that, the household's access to a toilet facility showed a significant association with diarrhoea morbidity. Lack of access to a toilet facility is associated with high incidence of diarrhoea. The greatest reductions in diarrhoea are associated with flush toilets and pit latrines.

Daniels et al. (1990) also found a reduction of 24 percent diarrhoea incidence associated with latrines in Lesotho. Esrey et al. (1991) found some reductions in diarrhoea disease in 21 out of 30 studies. The greatest reductions were associated with flush toilets, although pit latrines also had positive impacts. Compared with flush toilets and pit latrines, public latrines, bucket latrines and the Kumasi ventilated improved pit latrine (KVIP) show high incidence of diarrhoea. Public latrines are generally unhygienic and unhealthy for children due to the presence of flies and dirty floors. Children who are not accompanied by adults to public latrines may be tempted to pick used tissues on the dirty floors for

cleaning after defecating. Bucket latrines are associated with operational deficiencies, poor hygiene, repugnant smells and flies. The incidence of childhood diarrhoea is high for households who share their toilets with more than five other households. High sharing of toilet creates unsanitary and unkempt conditions which provide enabling environments for vectors and pathogenic organisms associated with diarrhoea infection, and also increases the possibility of transmitting pathogens from one infected household to others. Songsore and McGranahan (1993) also found that sharing toilet with more than five households increased childhood diarrhoea by more than two-fold. Neighborhood outdoor defecation creates potential dangers of infections from fecal pathogens in contaminated grounds. Children who play on grounds contaminated with fecal matter risk contracting diarrhoea. Similar studies in the past found more than two-fold increase in childhood diarrhoeal prevalence due to neighborhood outdoor defecation (Songsore and McGranahan, 1993).

In addition, most pathogens that cause diarrhoea share a similar mode of transmission – from the stool of one person to the mouth of another. This is known as fecal-oral transmission. There may be differences, however, in the number of organisms needed to cause clinical illness, or in the route the pathogen takes while travelling between individuals (for example, from the stool to food or water, which is then ingested), (UNICEF/WHO, 2009).

Also a policy report in a forum conducted by PLoS Medicine, in a series on water and sanitation, reveals that, of human excreta, faeces are the most dangerous to health. The

report indicated that, one gram of fresh faeces from an infected person can contain around 106 viral pathogens, 106–108 bacterial pathogens, 104 protozoan cysts or oocysts, and 10–104 helminthes eggs. The major faeco-oral disease transmission pathways are demonstrated, which illustrates the importance of particular interventions, notably the safe disposal of faeces, in preventing disease (diarrhoea) transmission, (Mara et al. 2010). The report also revealed that, the diseases associated with poor sanitation are particularly correlated with poverty and infancy, and this alone contributes to about 10% of the global burden of disease. At any given time close to half of the urban populations of Africa, Asia, and Latin America have a disease associated with poor sanitation, hygiene, and water, (WHO 1999).

Diarrhoea is caused by a variety of bacterial, viral, and parasitic enteropathogens. Transmission occurs through the fecal-oral route as a result of direct person-to-person contact (such as hand-to-mouth contact) and exposure to contaminated food, water, and objects. Avoidance of contaminated water and attention to hygienic practices, such as sanitary waste disposal, correct food handling techniques, and washing one's hands, can help prevent illness. In addition, infants may derive some protection from breastfeeding, because breast-milk contains specific rotavirus neutralizing antibodies (Yolken et al., 1978; Huttly et al., 1997).

The availability of safe drinking water is found to significantly affect the incidence of diarrhoea. Low incidence of diarrhoea is associated with private indoor pipe and standpipe but increases with vended water and lack of access to safe water, (Boadi et al. 2005). Shier et al. (1996), also found high incidence of diarrhoea morbidity and mortality

associated with untreated water among young children in northern Ghana. Bacteriological studies in rural Nigeria have shown consistent contamination of traditional water sources with fecal coliforms and *streptococci* (Blum et al., 1987).

The risk of contamination of vended water is high due to poor storage and mishandling. Usually clients are allowed to fetch water from storage tanks or directly from the tap. As different clients handle water from the same storage container or from the same standpipe, the possibility of transmitting pathogenic organisms on the hands of clients, increases with each client. Also, due to the intermittent flow of water in many parts of the city, water vendors have to store water for longer periods in order to meet the demands of their clients. The contamination of water resulting from long periods of storage has been amply demonstrated in the literature (Benneh et al., 1993; Roberts et al., 2001).

The high incidence of diarrhoea associated with vended water confirms earlier studies, which found the contamination of household water from a source outside the home, to pose a greater risk of diarrhoea than any contamination within the household (VanDerslice and Briscoe, 1993). The availability of water makes hand washing easier (Favin et al., 1999). Children whose mothers fail to wash their hands with soap before preparing meals or after defecating are at much higher risk of contracting diarrhoea. Han et al. (1986) showed that hands readily became contaminated after defecation, even with the use of toilet paper. In a study in Thailand, enter-toxigenic *Escherichia coli* (ETEC) were detected in the hands of 6 of 42 mothers selected from homes where children were suffering from ETEC diarrhoea. The type isolated from diarrhoea corresponded to that isolated from hands (Echeverria et al., 1987).

Many studies have shown that because water availability facilitates hand washing and hygiene behaviors, in-house water supplies are associated with reduced rates of childhood diarrhoea (Boot and Cairncross, 1993). Increased water availability and quantity associated with improved hygiene, may reduce fecal contamination of the hands, proper cleaning of utensils, food, and the home environment (Esrey et al., 1985). A 30 percent reduction in diarrhoea was reported in Burma when mothers and children were provided with soap and encouraged to wash their hands before preparing meals and after defecating (Aung and Thein, 1989).

In a study by Kwasi Owusu Boadi and Markku Kuitunen on "Childhood diarrheal morbidity in the Accra Metropolitan Area, Ghana: socio-economic, environmental and behavioral risk determinants," shows that, household socio-economic variables of wealth and education of the mother is seen to bear significant impacts on diarrhoea morbidity. Children living in poor households have higher rates of diarrhoea than their wealthy counterparts, probably due to inadequate access to environmental facilities, unsanitary environments in the home and poor child hygiene. The relationship between the household socio-economic characteristics and childhood diarrhoea has been amply demonstrated in the literature (Martines et al., 1993; Alam, 1995; Ketema and Lulseged, 1997; Timaeus and Lush, 1995).

Timaeus and Lush (1995) found a strong association between the socio-economic status of the household and the incidence of childhood diarrhoea in urban areas of Ghana. Lower levels of maternal education are associated with high incidence of diarrhoea. The

incidence of diarrhoea reduces with basic and secondary or higher levels of maternal education. The findings confirm earlier studies which found lower incidence of childhood diarrhoea among children of educated mothers than among children of mothers with no formal education (Tagoe, 1995). Educated mothers practice good hygiene and better child feeding, all of which increase a child's resistance against infectious diseases. Education enables caregivers to avoid health threats and deal with illness more easily (World Resources Institute, 1998).

Also in a study (Julius N. Fobil et. al, 2011) on "Neighborhood Urban Environmental Quality Conditions are Likely to Drive Malaria and Diarrhoea Mortality in Accra, Ghana," shows that, the lack of evidence of association between the fraction of cluster-level deaths due to diarrhoea and environmental conditions were likely a confirmation that, the urban environmental initiatives for the control of diarrhoeal diseases (CDD) have been effective and the observed diarrhoeal deaths were not related to the environmental conditions. However, it is well known that there is a strong association of diarrhea morbidity and areas with poor hygiene and sanitation. In a study to explore how a citywide sanitation intervention altered the magnitude of the relative and attributable risks of diarrhoea determinants and the pathways by which those factors affected diarrhoea risk, the authors observed that the intervention reduced diarrhoea and also changed attributable and relative risks of diarrhoea determinants by altering the pathways of mediation.

In addition, socioeconomic status was a major distal diarrhea determinant with an attributable risk of 24%. Whereas 90% of risk was mediated by other factors, mostly by poor infrastructure (53%) and lack of sanitation which accounted for 13% of the risk, the remaining 42% mediated by other factors including 18% by lack of sanitation and poor infrastructure. This study observed very weak to very strong associations between neighbourhood urban environmental quality conditions and urban diarrhea mortalities. As expected, although the study could not establish causal relationships, several instances of strong associations were observed among the environmental, socioeconomic, and health variables.

Also, experiences in Sri Lanka and India, have led to the suggestion that for every year of schooling for girls, a 10 percent reduction in infant mortality may be reasonably expected (Amonoo-Lartson, et. al., 1985). Education enhances the opportunities for wage employment and income and increases access to household amenities and facilities including those related to better hygiene and environmental health (Togunde, 1999; Cerrutti, 2000; Ehiri, 1993). Wodemicael (2001) for instance, examines the effect of some environmental and socioeconomic factors that determined childhood diarrhoea in Eritrea using a logistical model. The results show that the risk of diarrhoea peaks at age 6-11 months and then decreases as the child grows older. The low risk of diarrhoea during the age 0-5 months indicates the protective effect of exclusive breastfeeding in the first months of life.

A study conducted by Boadi et al. 2005, in the Accra Metropolitan Area captured that, the incidence of diarrhoea is high among children who regularly eat street food, but tend to reduce with non-regular consumption of street food. An epidemiological link between vended food and diarrhoea morbidity has been amply demonstrated (Benneh et al., 1993; Mensah, 1997, report submitted to Japan International Cooperation Agency; Henzie and Yackovich, 1988). Esrey and Feachem (1989) estimate a 50—70 percent incidence of childhood diarrhoea involving food contamination. Most often, vendor prepared food are left uncovered in unhygienic environments with flies hovering around in addition to indiscriminate disposal of feces and garbage which increase the risk of food contamination.

Other studies found a 2.6 times increase in childhood diarrhoea in Accra, related to vendor prepared food (Songsore and McGranahan, 1993). Usually food is sold in leaves which are not disinfected and as such there is the possibility that, micro florae on leaves and microbes acquired through poor handling could be transferred to foods (Mensah et al., 2002). Under such conditions the likelihood of a vendor transmitting pathogenic organisms to buyers is high.

Mensah et al. (2002) found a large proportion of vendor prepared food in Accra to be contaminated with unacceptable levels of bacteria. There are health risks associated with the use of fingers to feel foodstuffs and ingredients for texture to ascertain the adequacy of manual grinding since this can contribute to the microbial load of food (Ehiri et al.,

2001). This traditional food preparation method produces an environment that inhibits various diarrhoea pathogens (Mensah et al., 1991).

Failure to wash the hands with soap before preparing meals can increase the risk of food contamination. Vendors who serve with their bare hands can easily transmit diarrhoea pathogens present on their hands to children. Enteropathogens can survive on the hands for about three hours or longer and thereby increase the risk of transmitting diarrhoea pathogens on the hands of vendors to food buyers (Mensah et al., 2002; Mensah, 1997, report submitted to Japan International Cooperation Agency). Food vendors in Accra have been found to carry a variety of bacterial enteropathogens, including *Salmonella typhi* (Mensah et al., 1999).

There is evidence that children in Accra who ate less street foods grew better than those whose diet included a greater percentage of street foods (International Food Research Policy Institute, 2003). Poor household sanitation and hygiene practices also create conducive environments that attract houseflies to the household kitchen. The presence of houseflies in the kitchen increases the risk of food contamination through direct contact with food by walking on the food or through their droppings. *Salmonella typhimurium* and *shigella* can multiply in the gut of houseflies and can be excreted for weeks or even longer (Levine and Levine, 1991).

Also in a study on incidence and risk factors of paediatric rotavirus diarrhoea in northern Ghana (Navrongo Health Research Center 2003) found that, as elsewhere a large proportion (39%) of diarrhoea episodes seen at a health facility were rotavirus-positive. This proportion increased from birth to 1 year of age, leveling off in the second year. The

episodes with more severe Vesikari score were more likely to be rotavirus positive. As found elsewhere (Cunliffe et al. 1998), rotavirus occurred mainly in the dry season, when it was present in most episodes. Peaks of diarrhoea incidence from other causes did occur outside the dry seasons. Previous data from West Africa indicated that G3P (Ramig 2004) was the predominant strain circulating between 1996 and 1999 (Steele 2000).

In Ghana, the incidence of infection with G3P (Ramig 2004) declined throughout the study and G9P (Steele 2000) was the predominant type in 1999 and 2000. This mirrors the global increase of infection with G9P (Steele 2000) strains detected since 1995 (Iturriza-Go´mara et al. 2004a). The detection of multiple infections, confirm the co-circulation of different rotavirus. Diarrhoea incidence is used as a function of distance (in kilometers) from the nearest health center, using the Navrongo Demographic Surveillance System to obtain the population denominator. Also shown is diphtheria, pertussis and tetanus vaccine coverage, using clinic attendees as a denominator. The study demonstrates the great diversity of rotavirus strains circulating in rural Ghana. Although three strains – G2P6, G3P4 and G9P8 – constituted 53% of strains typed, 13 distinct strains were identified on the basis of G–P combination. A further 24% of rotavirus positive specimens were un-typeable or could only be incompletely typed. This is in line with other studies in rural Africa (Cunliffe et al. 1998). Only 41% of strains identified contained G types 1–4 which constitute the RRTV vaccine. This is in marked contrast to the studies in developed countries where more than 95% of strains contains G type 1–4 (Gentsch et al. 1993; Iturriza-Go´mara et al. 2004a). This may have implications for developing an appropriate vaccine strategy to protect against this diversity of strains.

The study concludes that, heterotypic protection is generated following rotavirus infection, but the precise correlate of protection and the scope of heterotypic protection is not fully defined (Jiang et al. 1999) and should be a priority for future research (Cunliffe et al. 2003). The high incidence of rotavirus disease highlights the potential health benefit of an effective rotavirus vaccine. However, the data suggest that it may be difficult to achieve a high coverage in areas where there is a considerable distance from health facilities.

The five-year age distribution of the respondents shows normal trends where the percentage population distribution increases from 15 to age 24 and decrease to age 49 of the women sampled. This is also an indication of the reported youthful nature of the African population (Weeks, 2005). Many researchers familiar with the African situation have attributed this to the in-built momentum of high fertility in sub-Saharan Africa in the past three decades or so even though the fertility rates are now declining, (Nyarko, 1999).

2.2 Conceptual Frame work

A modified version of the Mosley and Chen (1984) framework was used in this study. The framework classifies the determinants of childhood mortality into proximate factors (such as environmental contamination and nutrition deficiency), which contribute in an immediate and direct fashion to children risk of mortality, and ‘‘distal’’ factors (economic status, education, cultural norms, and government policies), which influence exposure to the proximate factors, as cited by Laurel et al. 2006.

The development of a proximate determinants approach to the study of child survival presented here is based on several premises: In an optimal setting, over 97 percent of newborn infants can be expected to survive through the first five years of life. Reduction in this survival probability in any society is due to the operation of social, economic, biological, and environmental forces.

The socioeconomic determinants must operate through more basic proximate determinants that in turn, influence the risk of disease and the outcome of disease processes. The key to the model is the identification of a set of proximate determinants, or intermediate variables, that directly influence the risk of morbidity and mortality. All social and economic determinants must operate through these variables to affect child survival.

The proximate determinants are grouped into five categories: Environmental contamination: air; food/water/fingers; skin/soil/inanimate objects; insect vectors. Environmental contamination refers to the transmission of infectious agents to children (and mothers). The four categories representing the main routes whereby infectious agents are transmitted to the human host include air, food, water, and fingers. These are the principal routes of spread for diarrhoea.

In this study, toilet facility, child stool disposal and source of drinking water are grouped under environmental contamination as proximate determinants that may influence diarrhoea morbidity among children under five years. Distal factors such as mothers'

wealth, education of the mother, place of residence, occupation, religion, age of child, and the sex of child are controlled for, for the exposure to diarrhoeal disease.

The socio-economic determinants in this study were wealth of mother and the place of residence. The place of residence of women plays a part in the incidence of diarrhoeal disease among children under the age five. Rural access to improved drinking water sources remains low, and many people using an improved source must still walk long distances to fetch water, thereby reducing the amount collected. While coverage is higher in urban areas, population growth presents a growing challenge in further increasing improved drinking water coverage. The lack of improved drinking water sources also tends to curtail personal hygiene practices, including hand washing.

The wealth of mother affects a variety of goods, services, and assets at the house- hold level. The availability of a basic minimum food supply of sufficient variety to ensure adequate amounts of all nutrients among children is critical for the incidence of diarrhoea. The sanitary quality of food (clean, fresh, and free from spoilage) is also important in preventing disease transmission. The quantity and quality of water supply are important determinants of exposure to disease. Adequate quantity is essential to permit bathing, washing, and cleaning, and quality (not only at the source but also in the household) for drinking and food preparation.

The maternal factors include education, employment status and religion. Education of mother may account for the incidence of diarrhoea among children. Thus, educated

mothers practice good hygiene and better child feeding, and these may increase a child's resistance against diarrhoeal diseases. Education enables caregivers to avoid health threats and deal with illness more easily. Education enhances the opportunities for wage employment and income. This may increase access to household amenities and facilities including those related to better hygiene and environmental health.

The child's characteristics in the study include, the age and sex of the child. Diarrhoea risk varies substantially with age, showing a peak in children aged 7 to 12 months and a dramatic decrease with increasing age thereafter. Age with the strongest risk factor associations found mostly in children aged 13 to 36 months. The lower relative risks observed in children aged 0 to 12 months could be explained either by the protective effect of breast-feeding or by the fact that very young children spend more time indoors and therefore have reduced exposure to contamination near the household. Breastmilk contains the nutrients, antioxidants, hormones and antibodies needed by a child to survive and develop. Exclusive breastfeeding of children protects them from infections and other severe illnesses.

W. Henry Mosley / Lincoln C. Chen: Operation of the five groups of proximate determinants on the health dynamics of a population.

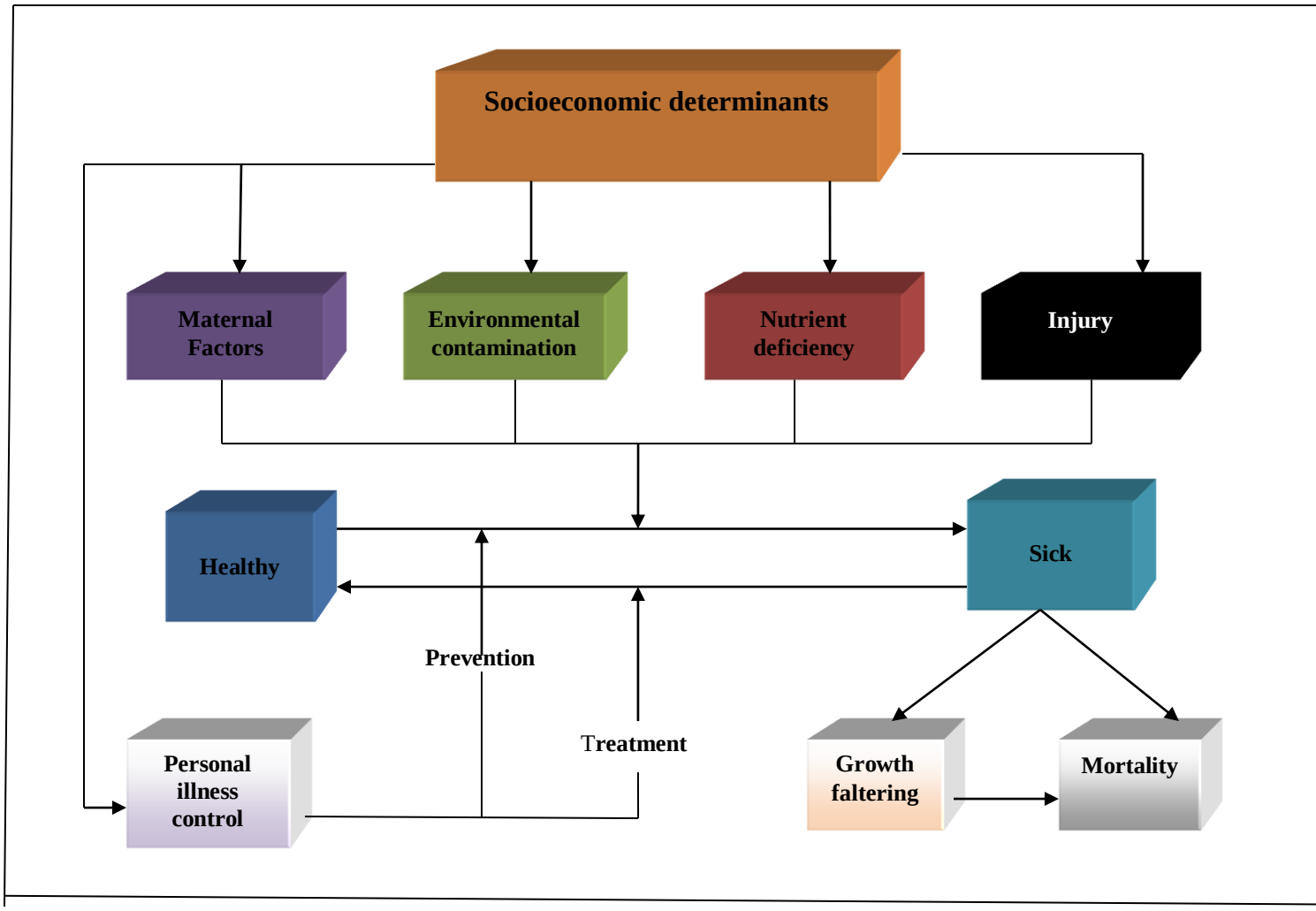
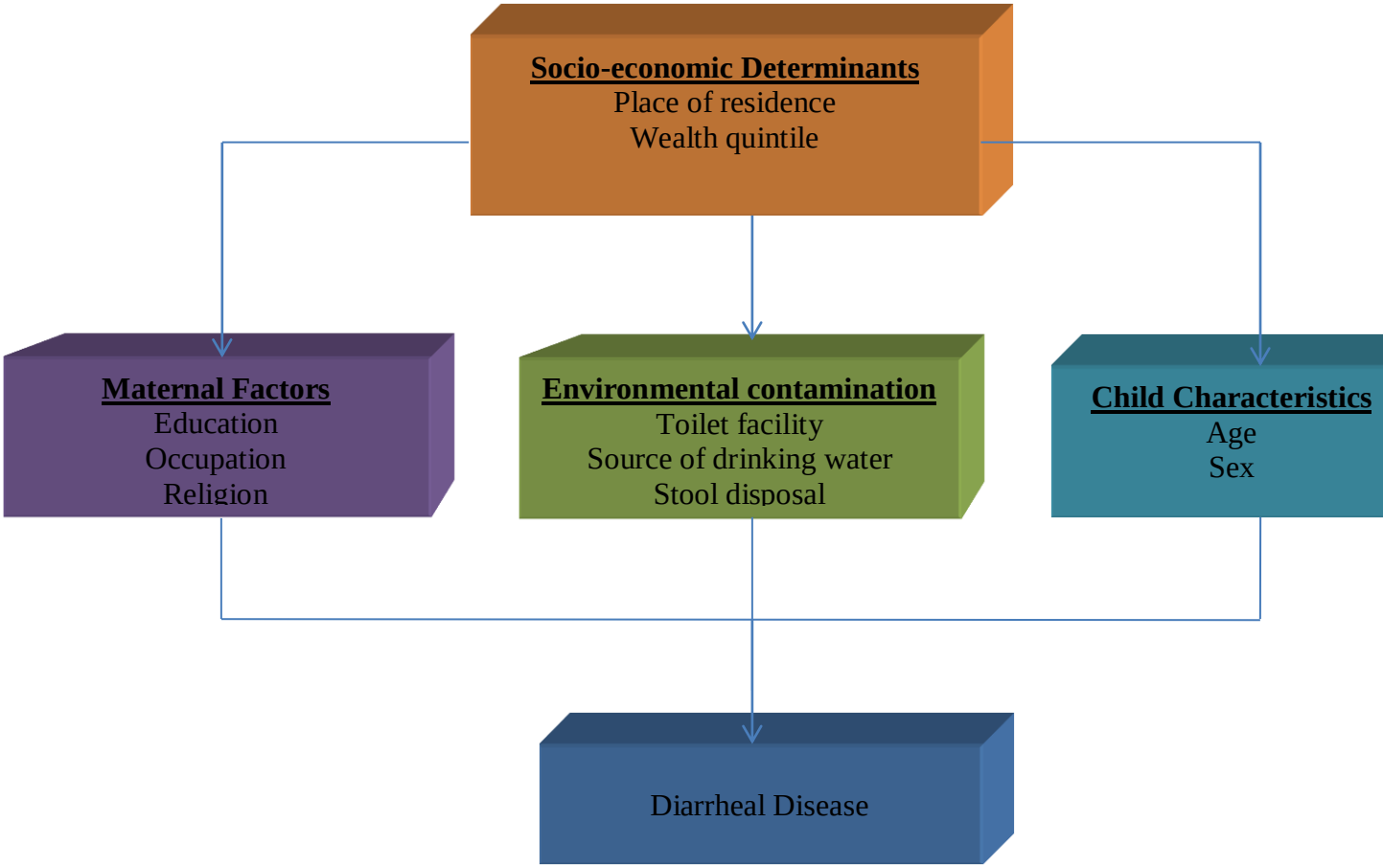


Figure1: A Modified Version of Mosley and Chen's Framework on the Sanitation and Diarrhoeal Disease among children under five.



2.3 In this study the following Hypothesis were considered**:**

- Children from households with improved toilet facilities are less likely to experience diarrhoeal disease compared to children from households with no toilet facility.
- Children, whose mothers have higher education, are less likely to experience diarrhoeal disease compared to children whose mothers have no education.
- Children from lowest wealth quintile are more likely to experience diarrhoeal disease compared to children from highest wealth quintile

CHAPTER 3

3.1 Data Source and Methodology

The data source for this study is the 2008 Ghana Demographic and Health Survey (2008 GDHS). It is the fifth in a series of national level population and health surveys conducted in Ghana as part of the global Demographic and Health Surveys (DHS) programme. The survey is designed to provide information to monitor the population and health situation in Ghana as follow-on to the 1988, 1993, 1998 and 2003 GDHS surveys. The survey used a two stage sample based on the 2000 Population and Housing Census to produce separate estimates for key indicators for each of the 10 regions in Ghana. The 2008 GDHS household sample of more than 12,000 households was large enough to provide a sampling frame for conducting case specific child mortality surveillance for children less than five years using a Verbal Autopsy Questionnaire. Each household selected for the GDHS was eligible for interview with the Household Questionnaire, and a total of 11,778 households were interviewed. In half of the households selected for the survey, all eligible women age 15- 49 and all eligible men age 15-59 were interviewed with the Women's and Men's Questionnaires, respectively. A total of 4,916 women age 15-49 and 4,568 men age 15-59 from 6,141 households were interviewed. Data collection took place over a three-month period, from early September to late November in 2008.

In the 2008 GDHS, mothers were asked whether any of their children under five years of age had diarrhoea during the two weeks preceding the survey. If a child had diarrhoea, the mother was asked about feeding practices during the diarrhoeal episode and about what actions were taken to treat the diarrhoea.

The survey also provides information on the socio-economic background of respondents such as their educational attainment, place of residence, occupation, marital status, household characteristics and religion, among others as well as demographic characteristics like age of mother and sex of child. These were used in analyzing the sanitation and diarrhoea disease among children under the age of five years. In all, 2790 women were asked whether their children had diarrhoeal disease two weeks preceding the survey, and the last child birth was of interest for this study. The respondents with non-available information were excluded from the sample. This brought down the number of respondents in the study to 2005, and was used for the analyses in the study.

3.2 Measurement of variables

The **independent variables** used for this study were measured as follows:

In the 2008 GDHS, respondents were asked the question; what is the main source of drinking water for members of your household? The following answers were provided for respondents: piped water, piped into dwelling/indoor, piped to yard/plot, public tap/standpipe, tube well or borehole dug well, protected well, unprotected well, water from spring, protected spring, unprotected spring rainwater, tanker truck, cart with small tank, surface water (river/dam/ lake/pond/stream/canal/irrigation channel), bottled water, sachet water, and other. These were grouped into improved and un-improved drinking water sources for the purpose of this study.

Improved drinking water sources will be measured as**:** Household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection. A

respondent who uses any of these water sources is considered to be using improved drinking water source.

Unimproved drinking water sources will be measured as follows**:** unprotected well, unprotected spring**,** rivers or ponds**,** vendor-provided water**,** bottled water**,** tanker truck water. A respondent, who uses any of this water as their water source, is considered to be using an unimproved water source.

Again, in the 2008 GDHS, respondents were asked the question: What kind of toilet facility do members of your household usually use? The following responses were provided for the respondents to choose from: flush or pour flush toilet, flush to piped sewer system, flush to septic tank, flush to pit latrine, flush to somewhere else, flush don't know where, pit latrine, ventilated improved pit latrine, pit latrine with slab, pit latrine without slab/open pit, bucket/pan, composting toilet, no facility/bush/field and other.

Improved toilet facilities will be measured as**:** connection to a public sewer, connection to a septic system, pour-flush latrine**,** simple pit latrine**,** ventilated improved pit latrine. A household which uses any of this facility is considered as using an improved toilet facility.

Non-improved toilet facilities will be measured as: public or shared latrine**,** open pit latrine and bucket latrine. Thus a household which uses any of such a facility is considered as using a non-improved toilet facility.

Furthermore, in the 2008 GDHS, respondents were asked the question: The last time child passed stools, what was done to dispose of the stools? The following responses

were provided: child used toilet or latrine, put/rinsed into toilet or latrine, put/rinsed into drain or ditch, thrown into garbage, buried, left in the open and other.

Safe stool disposal: always use toilet/latrine, put/rinsed into toilet latrine. Thus respondents who use any of these means to dispose of their child stool are considered to be using a safe disposal means.

Unsafe stool disposal: put/rinsed into ditch or drain, thrown into garbage, buried, let in the open space/not dispose of and other. These are considered unsafe stool disposal.

The **dependent variable** (diarrhoeal disease) is used in this study as a categorical variable. It is measured as those whose children suffered from diarrhoea (Yes) and those whose children did not suffer from diarrhoea (No), two weeks prior to the survey. In the 2008 GDHS, mothers were asked whether any of their children under five years of age had diarrhoea during the two weeks preceding the survey. Mothers who answered yes to the question are considered as those whose children suffered from diarrhoea and those who answered no are considered as those whose children did not suffer from diarrhoea.

In the 2008 GDHS, women were asked the question: What is the highest level of school you attended? The following responses were provided: primary, middle/JSS, secondary/SSS, or higher

Education of mother is therefore measured as: No education, primary, middle/JSS, secondary and higher.

Place of residence: the place of residence is measured as, rural and urban.

The wealth quintile, as constructed, used information on household ownership of consumer items, ranging from a television to a bicycle or car, as well as dwelling characteristics, such as source of drinking water, sanitation facilities, and type of flooring material.

Wealth quintile: Poorest, Poorer, Middle, Richer, and Richest.

In the 2008 GDHS, women were asked the question: how old was child at his or her last birthday. These were therefore coded into the following for the purposes of this study.

Age of child is measured as: Age in months <6, 6-11, 12-23, 24-35, 36-47, and 48-59.

Sex of child: the sex of child is measured as male and female.

In the GDHS 2008, women were asked the question: What is your occupation, that is, what kind of work do you mainly do? The responses were categorized into occupation status for the purpose of this study.

Women occupation status: Employed and Unemployed.

3.3 Limitation of Data

The main limitation of using the 2008 GDHS, data to estimate diarrhoea morbidity is the cross sectional nature of data collection. The information obtained from the survey is of diarrhoea prevalence in the two weeks previous to the survey, which does not account for seasonality. This is so because, the prevalence of diarrhoea varies seasonally, the results of the 2008 GDHS—which pertain to the fieldwork period from September to late November—should be interpreted with caution.

Also the data do not provide information on other key sanitation variables, such as frequency of garbage collection, household liquid waste disposal, and many other key variables which may be necessary for assessing the impact of sanitation on childhood diarrhoea among children under the age of five years. The data provide information on only toilet facility as the major sanitation variable (for international comparative studies) and this is seen as a limitation to the study.

3.4 Method of Analysis

In this study, three major analyses were conducted, thus **univariate, bivariate and multivariate** analyses. The data is collected and entered through SPSS. The first analysis was the univariate analysis, with an odds ratio with a confidence interval at 95%, was conducted to find statistical significances. Descriptive statistics was applied to demographic characteristics, sanitation coverage, and water sources. A frequency distribution of the individual cases is presented in the number of cases in the sample that fall into each category of values of the variable.

Secondly a bivariate analysis was conducted, for the purpose of determining the empirical relationship between variables and also to test for simple hypotheses of association and checking to what extent it becomes easier to know and predict a value for the dependent variable if we know a case's value of the independent variable. The bivariate analysis considers the relationship that exists between the variables.

Finally a multivariate analysis -where multiple relations between multiple variables are examined simultaneously, was also employed. A logistic regression model was employed

to evaluate association between factors and variables, to measure the sanitation risk factors and under five years childhood morbidity in the last two weeks prior to the survey.

CHAPTER 4

Background Characteristics of Respondents

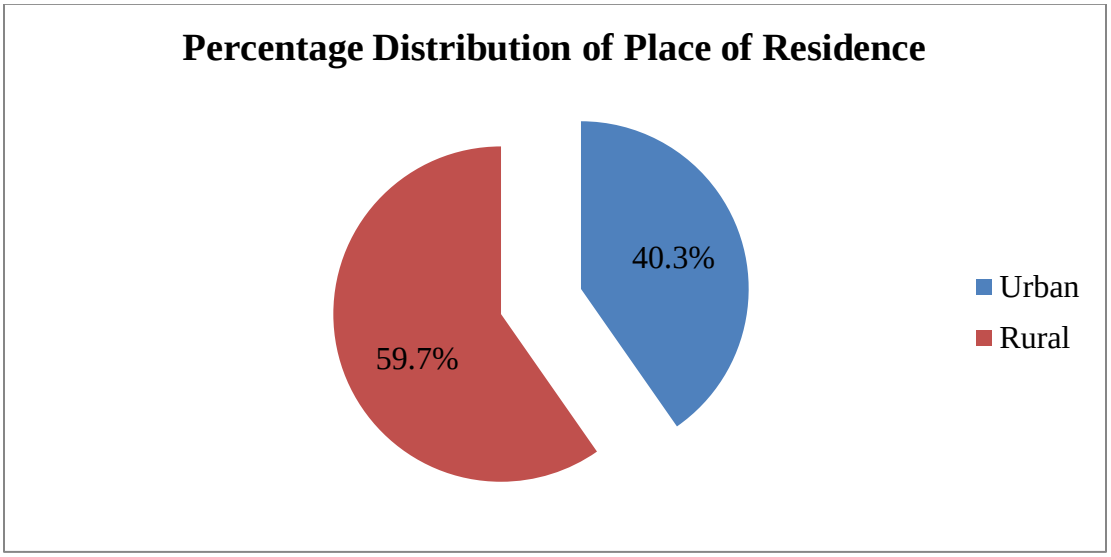
4.0 Introduction

This chapter will examine the background characteristics of the respondents in the study. The incidence of diarrhoeal disease among children under five years may be influenced by certain peculiar characteristics of women. Thus knowledge of the respondents' characteristics will enhance one's understanding of the subject under discussion, highlight areas of concern during planning and implementation of programs that could enhance the reduction of childhood diarrhoeal disease.

4.1.1 Place of residence

The GDHS 2008, provided data on the rural and urban distribution of the respondents in the survey, which is presented in Figure 4.1. The Figure indicates that 40.3% of the respondents live in urban areas, whiles 59.7% live in the rural areas.

Figure 4.1 Percentage Distribution of Place of Residence

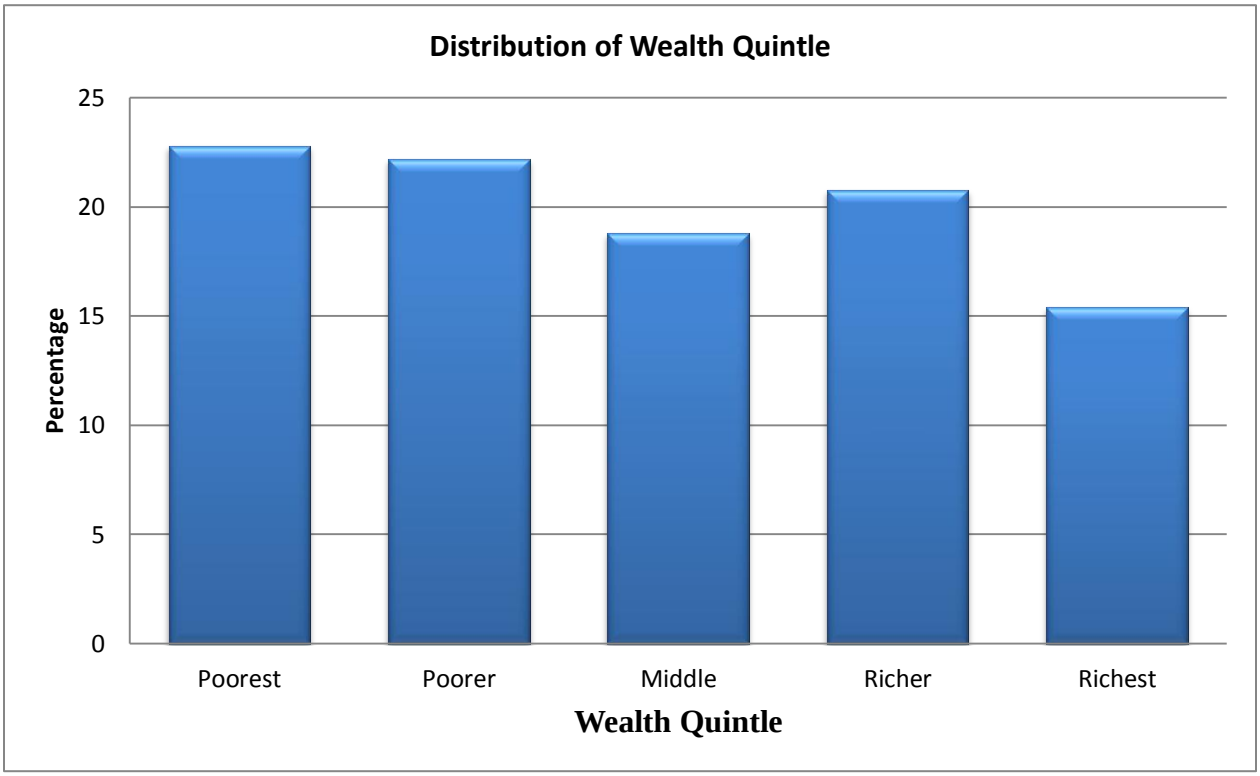


Source computed from 2008 GDHS

4.1.2 Wealth quintiles

The Figure 4.2 shows the percentage distribution of respondents by wealth quintiles index. The Figure illustrates that, 22.8% and 22.2% of women fall in the poorest and poorer category respectively, 18.8% falls in the middle wealth category and 20.8% and 15.4% fall in the richer and richest category respectively.

Figure 4.2 Percentage Distribution of Wealth Quintile Index

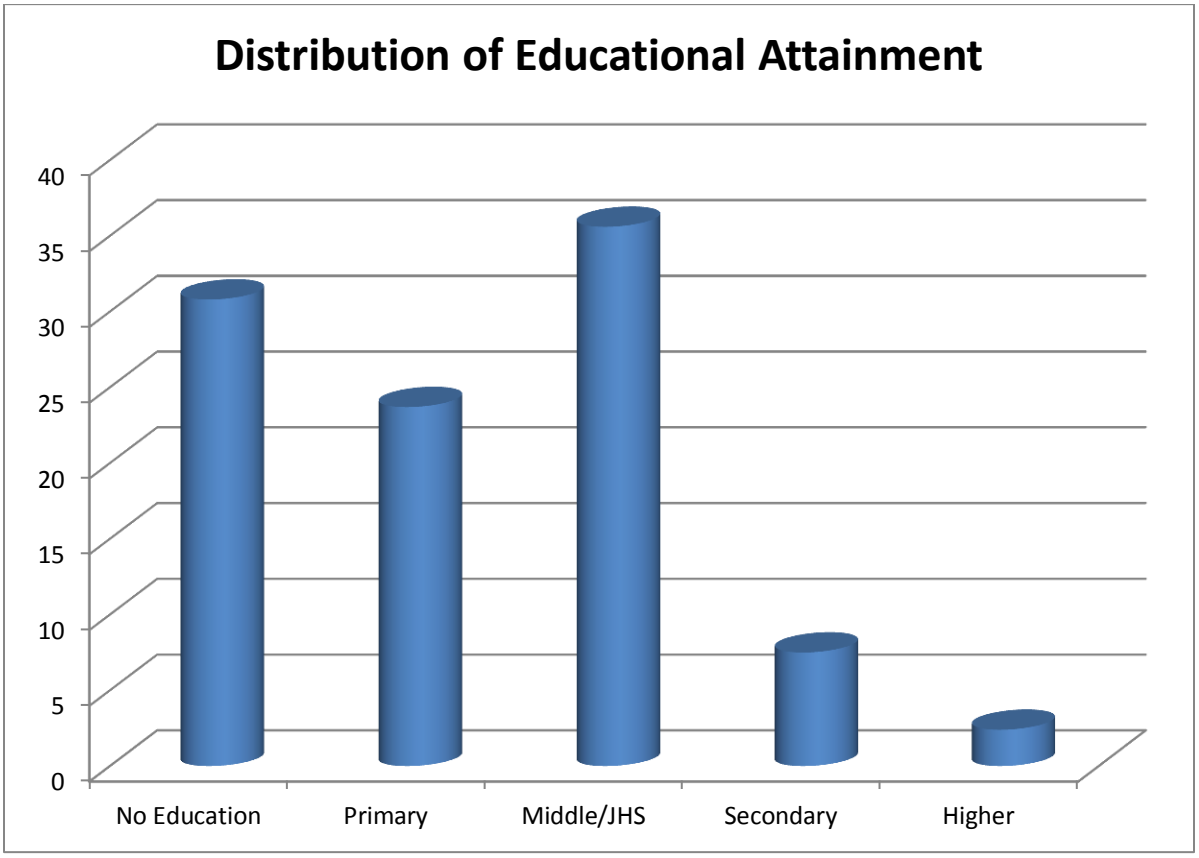


Source computed from 2008 GDHS

4.1.3 Mother's Education

The Figure 4.3 shows the distribution of women by highest level of schooling attended or completed. Thirty percent of women have no education, 23.7 percent have primary education, 35.6 have middle/junior high education, 7.5% have secondary education, and 2.4 percent have attained higher education.

Figure 4.3 Percentage Distribution of Educational Attainment

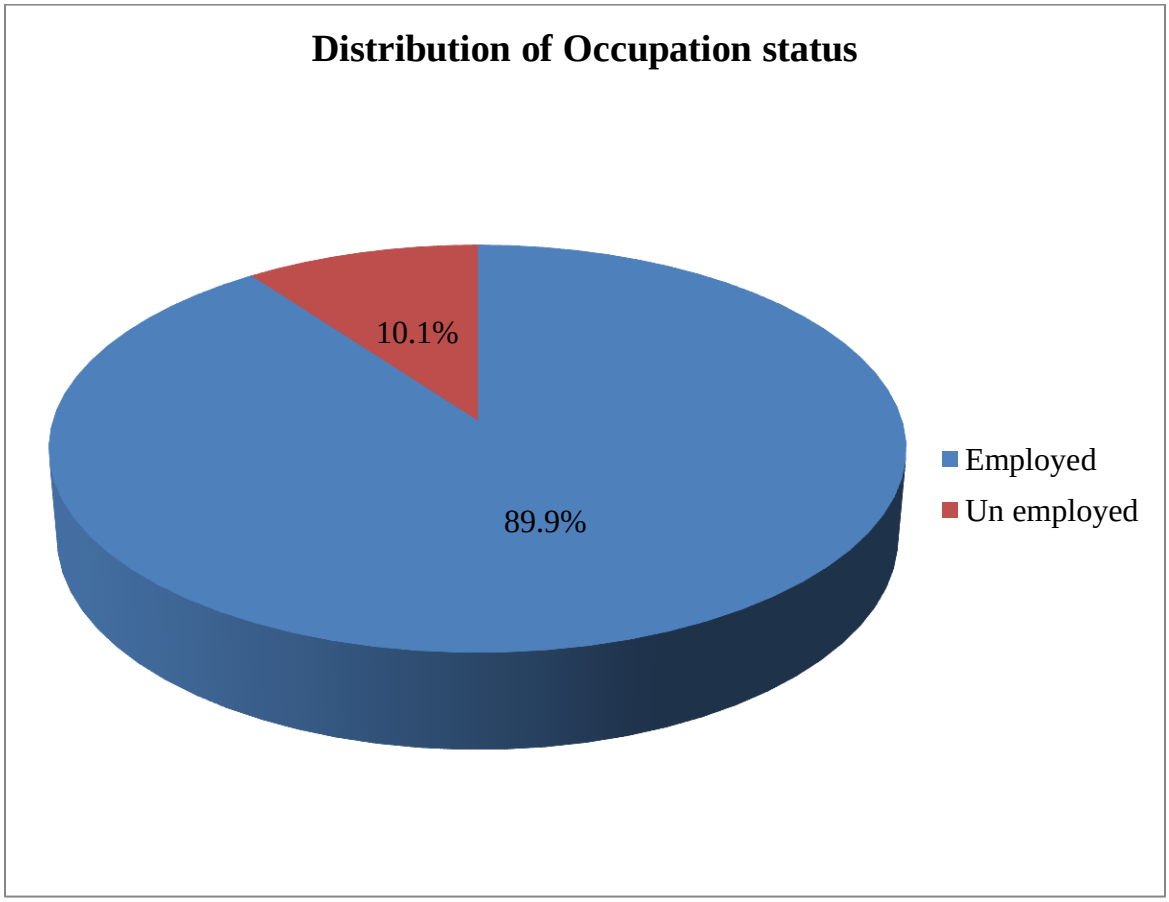


Source computed from 2008 GDHS

4.1.4 Occupational status

The Figure 4.4 indicates that, 10.1% of women respondents fall in the "Unemployed" category. The table also indicates that, a high percentage of 89.9% of women respondents are in some kind of employment.

Figure 4.4 Percentage Distribution of Occupation status

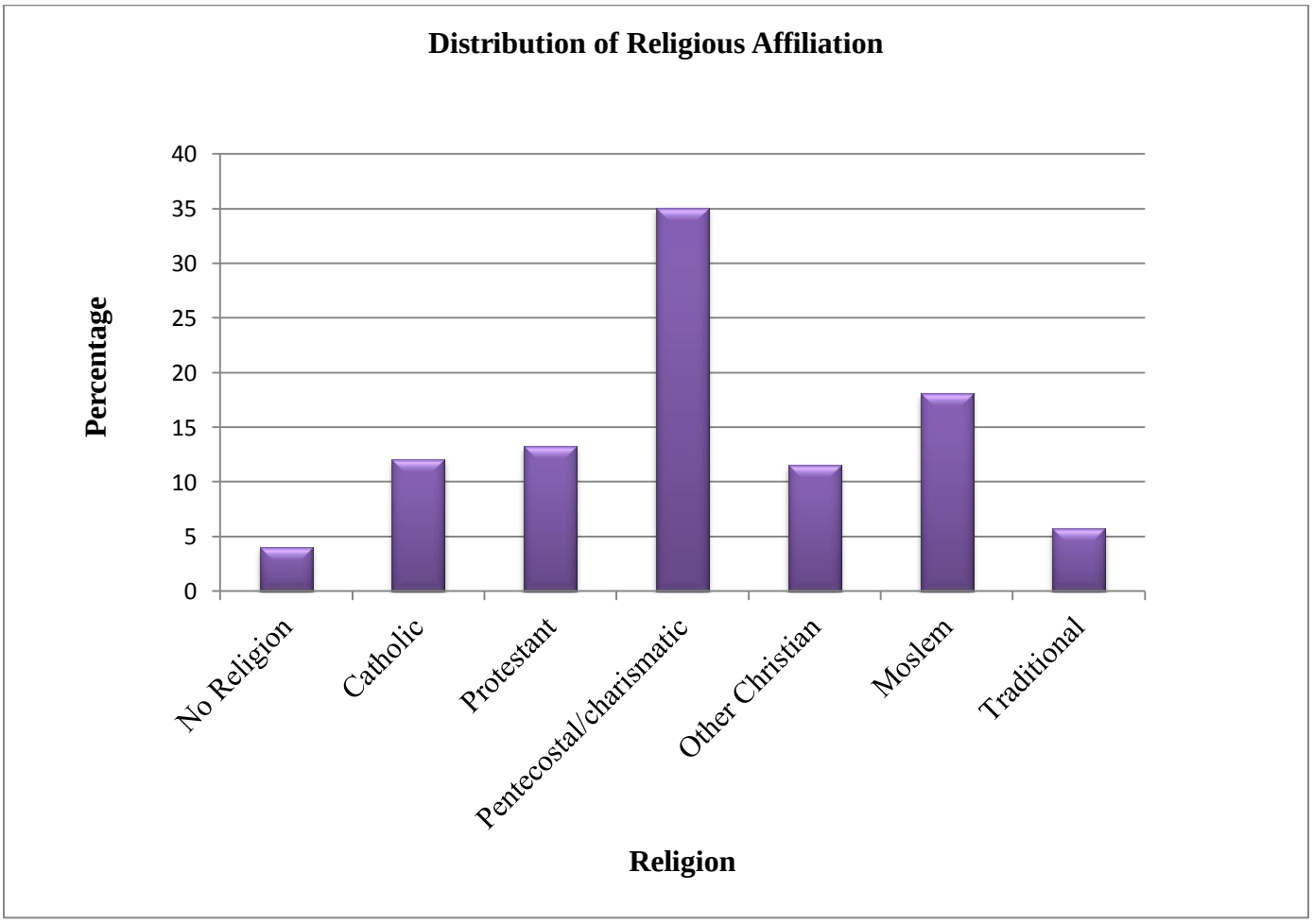


Source computed from 2008 GDHS

4.1.5 Religious affiliation

The Figure 4.5 presents the various religious groups of the respondents in the survey. The Figure indicates that, 4.0% of the women have no religion, which is the lowest among the group, whiles 35.1% which is the highest religious group is represented by the Pentecostal/Charismatic denomination. The Catholic religion represents 12.1%; the Protestant religion represents 13.3%; Other Christian represents 11.6%; whiles the Moslem religion represents 18.1% and the Traditional religion represents 5.8%.

Figure 4.5 Percentage Distribution of Religious Affiliation



Source computed from 2008 GDHS

4.1.6 Type of toilet facility

The percentage distribution of type of toilet facility is shown in Table 4.6. The table shows that, 62.1 percent of respondents use an improved toilet facility whiles 37.9 percent uses a non-improved toilet facility. The table indicates that, more women use an improved toilet facility compared to women who use an unimproved toilet facility.

Table 4.6 Percentage Distribution of Type of Toilet Facility

Toilet facility	Frequency	Percentage
Improved Toilet facility	**1246**	**62.1**
Flush to piped sewer system	24	1.2
Flush to septic tank	126	6.3
Flush to pit latrine	36	1.8
Ventilated improved pit latrine	742	37.0
Pit latrine with slab	315	15.7
Composting toilet	3	0.2
Unimproved Toilet facility	**759**	**37.9**
Flush to somewhere else	1	0.0
Pit latrine without slab/open pit	211	10.5
No facility/bush/field	532	26.7
Bucket/pan toilet	15	0.7
Total	**2005**	**100.0**

Source computed from 2008 GDHS

4.1.7 Source of Drinking water

The Table 4.7 shows the percentage distribution of main sources of drinking water among the respondents. The table illustrates that, out of a population of 2005 respondents, 76.9% of women use an improved source of drinking water; whiles 23.1% of women use a non-improved source of drinking water.

Table 4.7 Percentage Distribution of Source of Drinking Water

Source of Drinking water	Frequency	Percentage
Improved Source of water	**1540**	**76.9**
Household connection	196	9.8
Public stand pipe	526	26.2
Borehole	697	34.8
Protected dug well	108	5.4
Protected spring	2	0.1
Rain water	11	0.6
Un-improved source of water	**465**	**23.1**
Unprotected well	53	2.7
Unprotected spring	16	0.8
Rivers or ponds	242	12
Vendor-provided water	3	0.1
Bottled water	141	7.0
Tanker truck water	10	0.5
Total	**205**	**100.0**

Source computed from the 2008 GDHS.

4.1.8 Disposal of youngest child stool

The table 4.8 indicates that, 41.9 percent of women properly dispose of their child stool, whiles 58.1 percent of women do not dispose of the child stool of children safely. The table shows that more women practice unsafe disposal of child stool compared to women who practice safe disposal.

Table 4.8 Percentage Distribution of Child stool disposal

Child Stool disposal	Frequency	Percentage
Safe disposal	**840**	**41.9**
Always use toilet/latrine	118	5.9
Put/rinsed into toilet/latrine	722	36.0
Un-safe disposal	**1165**	**58.1**
Put/rinsed into ditch or drain	230	11.5
Thrown into garbage	708	35.3
Buried	103	5.1
Let in the open space/not dispose of	63	3.2
Other	61	3.0
Total	**2005**	**100.0**

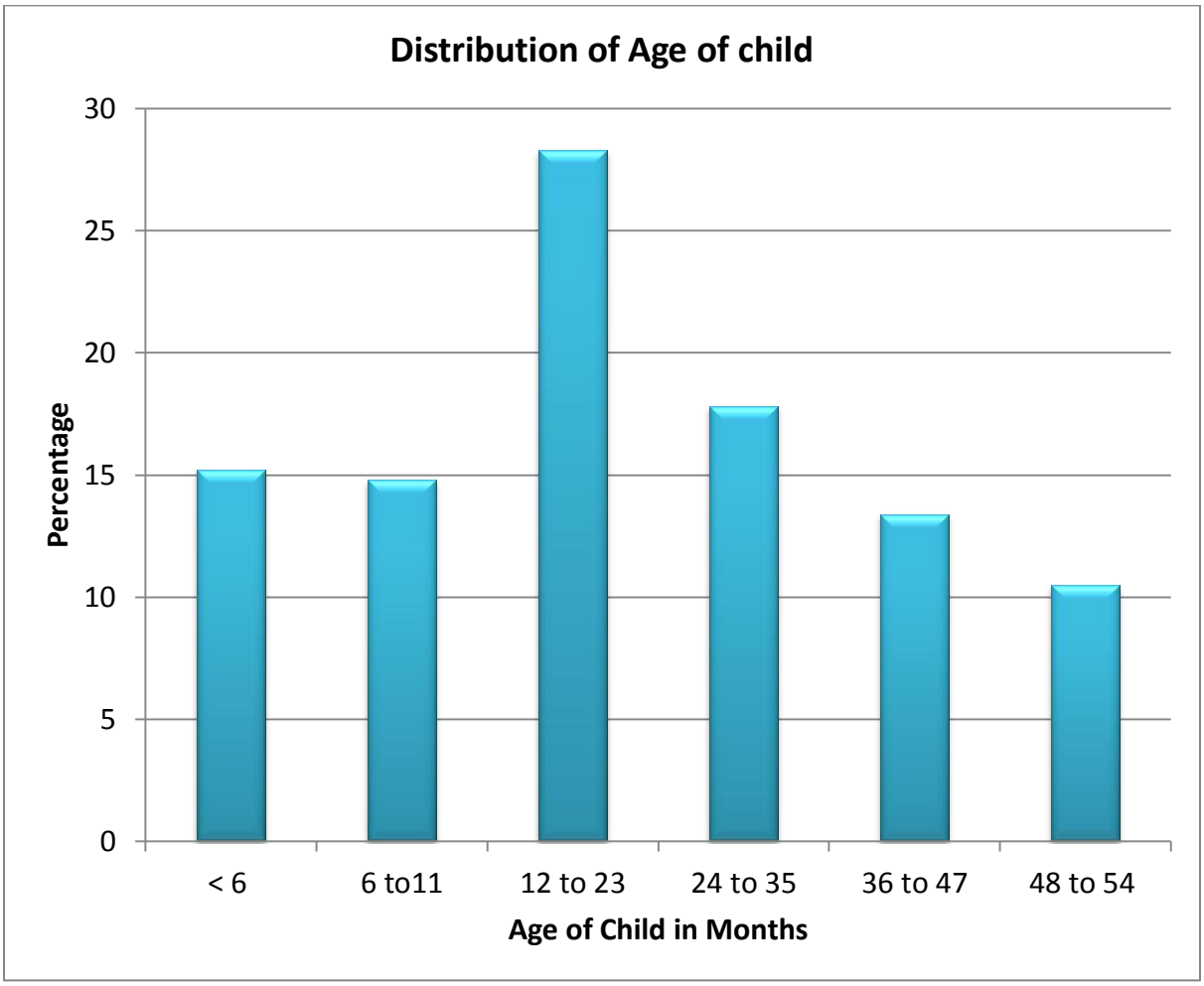
Source computed from 2008 GDHS

4.1.9 Age of Child

The Figure 4.9 shows the percentage distribution of children less than the age of five years. The Figure illustrates that 15.2% of the children are less than six months old, 14.8% are 6-11 months old, 28.2% are 12-23 months old, and 17.8% are between the

ages of 24-35 months old. Also, 13.4% are 36-47 months old whiles 10.5% are 48-59 months old.

Figure 4.9 Percentage Distribution of Age of child

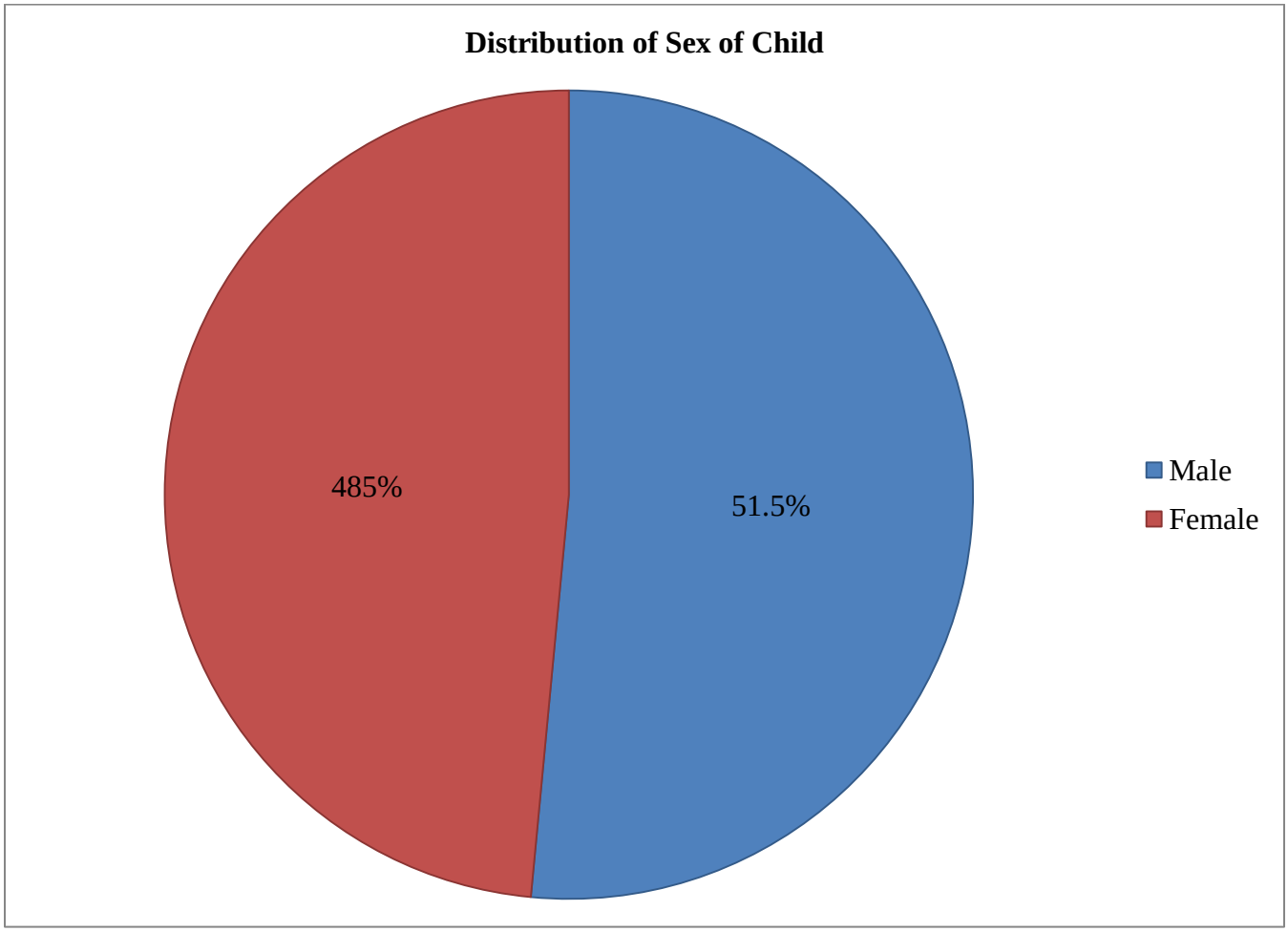


Source computed from 2008 GDHS

4.1.10 Sex of Child

From Figure 4.10 below, there are 51.5% male children and 48.5% female children. The Figure indicates that there are more male children compared to female children.

Figure 4.10 Percentage Distribution of Sex of Child



Source computed from 2008 GDHS

4.1.11: Diarrhoeal morbidity.

The Table 4.11 indicates that, 77.8% of the respondents had no incidence of diarrhoeal disease among their under-five year's children, whiles 22.2% of the respondents reported incidence of diarrhoeal disease among their children.

Table 4.11 Percentage distributions of women whose children suffered from diarrhoeal disease in the two weeks preceding the survey

Incidence of diarrhoea	Frequency	Percentage
Yes, suffered diarrhoea	446	22.2
No, did not suffer diarrhoea	1559	77.8
Total	**2005**	**100.0**

Source computed from 2008 GDHS

CHAPTER 5

SOCIO ECONOMIC CHARACTERISTICS AND DIARRHOEAL DISEASE

5.0 Introduction

A woman's demographic and socio-economic characteristics may affect the incidence of diarrhoeal disease among children under the age five year category. This chapter investigates how each of the socio economic characteristics of women, influences the under-five childhood diarrhoea. The bivariate analyses were intended to gain insight into the socio-economic factors of women that significantly affect the incidence of diarrhoea among children under five years.

5.1.1 Type of place of residence and Diarrhoeal disease.

The table 5.1 indicates that, women from the rural areas reported 23.9% of diarrhoea morbidity, whiles women from the urban areas reported 19.8% incidence of diarrhoea among their children under age five. The table indicates that, children under five whose mothers live in rural areas recorded a higher diarrhoea incidence, compared to children under five whose mothers live in the urban areas.

This result may be due to the fact that, women from the urban centers have more access to sanitation facilities and may practice good hygienic behaviour, compared to women from the rural areas. The link between the type of place of residence and diarrhoea morbidity shows a statistically significant association.

Table 5.1 Percentage of diarrhoeal disease by Type of place of residence

$\chi 2 = 6.306$	Degree of Freedom = 2			p-value = 0.031
Place of Residence	**Had Diarrhoea recently**			
	Yes	**No**	**Total**	**Number**
Urban	19.8	80.2	100.0	808
Rural	23.9	76.1	100.0	1197
Total	**22.2**	**77.8**	**100.0**	**2005**

Source computed from GDH 2008

5.1.2 Diarrhoea and Wealth quintile

The Table 5.2 shows that, poorest women reported the highest diarrhoea morbidity of 28.2%, whiles the richest women reported the least diarrhoea prevalence of 12.7%. Poorer women reported 25.8% incidence of diarrhoea among their under five children, middle wealthy women reported 24.6% and the richer women reported 16.8% of diarrhoea morbidity among the less than five year old children. The table shows that, higher wealth quintile is related to less diarrhoea morbidity. Thus, the richer the women are, the lesser their children under five records diarrhoea morbidity.

This finding agrees with other studies (like, Martinez et al. 1993; Alam, 1995; Ketema and Lulseged, 1997), which conclude that children living in poor households have higher rates of diarrhoea than their wealthy counterparts. This they conclude may be due to inadequate access to environmental facilities, unsanitary environments in the home, and

poor child hygiene. The relationship between diarrhoea and wealth index, shows a statistically significant association.

Table 5.2 Percentage of Diarrhoeal disease by Wealth index

$\chi 2 = 6.306$	Degree of Freedom = 2	p-value = 0.000		
Wealth quintile	**Had Diarrhoea recently**			
	Yes	**No**	**Total**	**Number**
Poorest	28.2	71.8	100	457
Poorer	25.8	74.2	100	445
Middle	24.6	75.4	100	378
Richer	16.8	83.2	100	417
Richest	12.7	87.3	100	308
Total	**22.2**	**77.8**	**100.0**	**2005**

Source computed from 2008 GDHS

5.1.3 Education and Diarrhoea

The Table 5.3 shows that, women with no education reported higher diarrhoea among children under five years, represented by 26.9%. Women with primary education reported 21.5% of the diarrhoeal disease among the children who are less than five years of age. Women with middle/JHS education reported 21.9% of the diarrhoeal disease among the children who are less than five years. There is a reduction of the diarrhoeal disease among the under five children by women who have completed secondary education and this is represented by 12.0%. However, women who have acquired more than secondary education reported a lower incidence of the diarrhoeal disease among their under five children, represented by 8.3%. The table shows that, the incidence of diarrhoeal disease among children under five tends to decrease as women attain more education.

This finding conforms to a study by Timaeus and Lush (1995) who concluded that lower levels of maternal education are associated with high incidence of diarrhoea in urban areas in Ghana. A study also by Tagoe (1995) concluded that, educated mothers practice good hygiene and better child feeding, all of which increases a child's resistance against infectious diseases. The table shows a statistical significant association between diarrhoea and education.

Table 5.3 Percentage of diarrhoeal disease by Educational Level

$\chi 2 = 15.306$	**Degree of Freedom = 2**			**p-value = 0.002**
Educational level	**Had Diarrhoea recently**			
	Yes	**No**	**Total%**	**Number**
No Education	26.9	73.1	100	619
Primary	21.5	78.5	100	475
Middle/JHS	21.9	78.1	100	713
Secondary	12.0	88.0	100	150
Higher	8.3	91.7	100	48
Total	**22.2**	**77.8**	**100.0**	**2005**

Source computed from 2008 GDHS

5.1.4 Occupation status and Diarrhoea

The Table 5.4 indicates that, women who are working reported 22.1 percent of the diarrhoeal disease among their under five children, whiles women who are not working reported 23.6% of the diarrhoeal disease among their under five children. However the relationship between employment status and diarrhoeal disease is not statistically significant.

Table 5.4 Percentage of diarrhoeal disease by Occupational status

$\chi 2 = 0.256$	**Degree of Freedom = 1**		**p-value = 0.613**	
Occupation	**Had Diarrhoea recently**			
Status	**Yes**	**No**	**Total%**	**Number**
Employed	22.1	77.9	100	1802
Unemployed	23.6	76.4	100	203
Total	**22.2**	**77.8**	**100.0**	**2005**

Source computed from 2008 GDHS

5.1.5 Religion and Diarrhoea

The table 5.5 illustrates that, women who adhere to the Moslem religion reported higher diarrhoea incidence with 30.7%, among their under five children, whiles women who practice the traditional religion reported 29.3 % of diarrhoea among the under-five children. Women who had no religion also reported 23.8% of the diarrhoeal disease

among their under five children, whiles the other Christian denomination reported 22.8% of the diarrhoeal disease among their under five children. The Catholic respondents reported a 21.4%; whiles the Protestant religious denomination reported the least incidence with 15.0% of the diarrhoea prevalence among their children two weeks prior to the survey. There is a significant association between religious affiliation and diarrhoeal disease.

Table 5.5 Percentage of diarrhoeal disease by Religious Affiliation

$\chi 2 = 29.801$	**Degree of Freedom = 2**			**p-value = 0.000**
Religious Affiliation	**Had Diarrhoea recently**			
	Yes	**No**	**Total%**	**Number**
No Religion	23.8	76.2	100	80
Catholic	21.4	78.6	100	243
Protestant	15.0	85.0	100	267
Pentecostal/Charismatic	19.4	80.6	100	705
Other Christians	22.8	77.2	100	232
Moslem	30.7	69.3	100	362
Traditional	29.3	70.7	100	116
Total	**22.2**	**77.8**	**100.0**	**2005**

Source computed from 2008 GDHS

5.1.6 Toilet facility and Diarrhoeal disease

Table 5.6 indicates that, 19.8% of respondents who use an improved toilet facility, reported of diarrhoea occurrence among their children. However, respondents who use a non-improved toilet facility reported 26.4% occurrence of diarrhoea among their children. Thus, one may conclude that, children who dwell in households with an improved toilet facility are less likely to experience diarrhoea morbidity, compared to children who live in households with a non-improved toilet facility. This finding conforms to similar studies found in the literature. Thus, Songsore and McGranhan (1993) found that neighborhood outdoor defecation creates potential dangers of infections from fecal pathogens in contaminated grounds. Children who play on grounds contaminated with fecal matter risk contracting diarrhoea. There is a statistically significant association between toilet facility and diarrhoea.

Table 5.6 Percentage of diarrhoeal disease by Toilet facility

$\chi 2 = 11.840$	**Degree of Freedom = 2**			**p-value = 0.001**
Type of Toilet facility	**Had Diarrhoea recently**			
	Yes	**No**	**Total%**	**Number**
Improved toilet facility	19.8	80.2	100	1246
Un-improved toilet facility	26.4	73.6	100	759
Total	**22.3**	**77.7**	**100.0**	**2005**

Source computed from 2008 GDHS

5.1.7 Source of drinking water and Diarrhoeal disease

The Table 5.7 indicates that, 22.4% of respondents, who use improved source of drinking water, reported diarrhoeal disease among their children, whiles 21.7% of respondents who use an unimproved source of drinking water reported diarrhoea incidence among their children. This result happens to be contrary to what was expected although not statistically significant. This may be due to the fact that, respondents who use unimproved drinking water source, may try to improve the water through boiling and other means so as to make it safe for drinking. Whiles respondents who use improved drinking water source may not handle their water with care, thereby exposing them to the diarrhoeal disease.

The result, however contradicts findings by Chekley et al (2004), which concludes that, more reliable water sources diminish the risk of contaminated water, decrease diarrhoeal incidence, and improve linear growth in children. It also contradicts another study by Jalan and Ravallion (2001) whose findings conclude that, there is a significantly lower prevalence and duration of the diarrhoeal disease for children living in households with piped water, compared to a comparison group of households without piped water, matched on the basis of their propensity scores.

Table 5.7 Percentage of diarrhoeal disease by source of drinking water

$\chi 2 = 0.096$		**Degree of Freedom = 2**		**p-value = 0.757**
Source of drinking water	**Had Diarrhoea recently**			
	Yes	**No**	**Total%**	**Number**
Improved drinking source	22.4	77.6	100	1540
Un-improved drinking source	21.7	78.3	100	465
Total	**22.2**	**77.8**	**100.0**	**2005**

Source computed from 2008 GDHS

5.1.8 Child stool disposal and Diarrhoeal disease.

The Table 5.8 indicates that, respondents who practice safe disposal of child stool reported 17.3% incidence of diarrhoea among their children less than five years of age. However there is an increase of 25.8% of diarrhoea incidence among children whose mothers do not practice safe disposal of child stool. This may be attributed to the fact that, diarrhoea is caused by a variety of bacterial, viral, and parasitic entero-pathogens. Transmission occurs through the fecal-oral route as a result of direct person to person contact (such as hand to mouth) and exposure to contaminated food, water, and objects (Yolken et al., 1987; Huttly et al., 1997). The study indicates a highly statistical significant association, between child stool disposal and diarrhoea disease.

Table 5.8 Percentage of diarrhoeal disease by Child stool disposal

$\chi 2 = 20.749$	**Degree of Freedom = 2**			**p-value = 0.000**
Child stool disposal	**Had Diarrhoea recently**			
	Yes	**No**	**Total%**	**Number**
Safe Disposal	17.3	82.7	100	840
Un-safe Disposal	25.8	74.2	100	1165
Total	**22.2**	**77.8**	**100.0**	**2005**

Source computed from 2008 GDHS

5.1.9 Age of child and Diarrhoea

The Table 5.9 depicts that, children less than 6 months have the lowest diarrhoeal disease occurrence which is represented by 10.2%. The situation increases from age 6-11 months (27.3%) and reaches its peak at age 12-23 months (31.0%). The diarrhoeal disease tends to decrease from age 36-47 months with a 17.1% diarrhoea incidence and a further decrease to 12.4% in age 48-59 months.

This finding tends to support other studies. A study by Wodemicael (2001) indicates that, risk of diarrhoea peaks at age 6-11 months and then decreases as the child grows older. The low risk of diarrhoea during the age 0-5 months indicates the protective effect of exclusive breastfeeding in the first months of life. There is however a strong statistical association between diarrhoea and age of child.

Table 5.9 Percentage of diarrhoeal disease by Age of child

$\chi 2 = 71.603$	**Degree of Freedom = 2**			**p-value = 0.000**
Age of child in months	**Had Diarrhoea recently**			
	Yes	**No**	**Total%**	**Number**
<6 months	10.2	89.8	100	305
6-11 months	27.3	72.7	100	297
12-23 months	31.0	69.0	100	568
24-35 months	24.1	75.9	100	357
36-47 months	17.1	82.9	100	269
48-59 months	12.4	87.6	100	209
Total	**22.2**	**77.8**	**100.0**	**2005**

Source computed from 2008 GDHS

5.1.10 Sex of child and Diarrhoea

The Table 5.10 illustrates that, female children who were under five had more diarrhoea cases than their male counterparts. This is represented by 21.3% of diarrhoea incidence among male under five children and 23.3% of diarrhoea incidence among the female under five children.

This finding happens to confirm a study by Mitra et al 2000, who found that, several indices of severe infections were identified more frequently among females than males. Females with severe infections were less frequently brought to the hospital than their male counterparts. The time lapse between onset of symptoms and hospital admission

was significantly higher in females than males. However there is no statistical significant association between sex of child and diarrhoeal disease.

Table 5.10 Percentage of diarrhoeal disease by Sex of child

$\chi 2 = 1.208$	**Degree of Freedom = 2**			**p-value = 0.272**
Sex of Child	**Had Diarrhoea recently**			
	Yes	**No**	**Total%**	**Number**
Male	21.3	78.7	100	1035
Female	23.3	76.7	100	970
Total	**22.2**	**77.8**	**100.0**	**2005**

Source computed from 2008 GDHS

CHAPTER 6

MULTIVARIATE ANALYSIS OF THE RELATIONSHIP BETWEEN SANITATION, AND DIARRHOEAL DISEASE AMONG CHILDREN UNDER FIVE YEARS

6.0: Introduction

The binary logistic regression is employed in this section to examine the joint effects of the various independent variables and under five diarrhoeal diseases. The utilization of a binary logistic regression model is justified by the fact that, the dependent variable is measured by diarrhoea morbidity of the child, which is dichotomous (whether a child suffered diarrhoeal or not, two weeks preceding the survey). Reference categories were created for each of the variables for easy comparison using the odd ratios (exponential β).

The results of the binary logistic model were interpreted at two different levels. The first approach looks at whether there is a significant relationship between a particular independent variable and under five diarrhoeal diseases using a 95% confidence level. Variables with a P value of less than or equal to 0.05 were considered to be significantly related to the under-five diarrhoeal disease.

The second approach looks at the probability of an event occurring when compared to a reference category by utilizing the odd ratios (exponential β) calculated. A result of zero β coefficients means little or no difference between the categories under consideration

and the reference category. A finding of negative β coefficients indicates that the likelihood decreases while positive β coefficient indicates that the likelihood increases.

6.1.1 Interpretation of binary logistic results: Model 1

The output from the logistic regression model presented in Table 6.1 revealed that, when only the sanitation variables (environmental contamination) are applied in the model, whiles controlling for other variables, the significant predictors of under-five diarrhoeal disease were toilet facility and child stool disposal. The respondents' source of drinking water was not a significant predictor of under -five diarrhoeal diseases. The model in table 6.1 explains about 2.1% of the variation between the sanitation variables and under five diarrhoeal diseases.

The Table 6.1 indicates that, children whose mothers use an unimproved toilet facility are as 1.357 times more likely to experience diarrhoeal disease compared to children whose mothers use an improved toilet facility. The table also indicates that, children whose mothers use an unimproved drinking water source are as 0.884 times less likely to experience diarrhoeal disease compared to children whose mothers use an improved drinking water source. The last indicator is that children whose mothers dispose of their child stool unsafely are as 1.587 times more likely to experience diarrhoeal disease compared to children whose mothers dispose of their child stool safely.

Table 6.1 Results of a binary logistic regression analysis showing the relationship between sanitation and diarrhoeal disease.

	Diarrhoeal Disease				
	Nagelkerke R^2 = 0.021				
	Co-efficient (β)	**Standard Error (S.E)**	**Wald**	**Significance (P-value)**	**Odds Ratio [Exp (B)]**
Intercept	-1.622	0.099	268.550	0.000	0.198
Toilet Facility					
Improved Toilet facility (RC)					1.000
Unimproved Toilet facility	0.283	0.113	6.308	0.012	1.327
Source of Drinking water					
Improve Drinking source (RC)					1.000
Unimproved drinking source	- 0.123	0.130	0.898	0.343	0.884
Fecal Disposal					
Safe Disposal (RC)					1.000
Unsafe Disposal	0.462	0.116	15.799	0.000	1.587

Source computed from 2008 GDHS

6.1.2 Interpretation of binary logistic regression results: Model 2

The output from the logistic regression model presented in Table 6.2 revealed that, with the inclusion of socio-economic determinants, maternal factors and child characteristics, the significant predictors for under-five diarrhoeal disease were wealth of mother, child stool disposal and the age of child. Other variables that were significant at the bivariate level that had lost their significance were place of residence, highest level of education, religion of mother, employment status and toilet facility. The remaining variables which were, source of drinking water and sex of child were also not significant predictors of under-five diarrhoeal disease in the model.

The Table 6.2 reveals that children whose mothers live in rural areas are as 0.750 times less likely to experience diarrhoea compared to children whose mothers live in urban areas. This is contrary to what was expected. The explanation for this may include that, many people are now moving to urban areas to look for better socio economic

opportunities. This movement to urban areas has not been accompanied by the needed infrastructural and environmental development. Thus many poor urban areas are faced with unsanitary conditions, slum settlements and poverty.

The Table 6.2 reveals that, children whose mothers are poorer are as 0.988 times less likely to experience diarrhoeal disease compared to children whose mothers are in the poorest category of the wealth index. The table indicates that, children whose mothers are middle richer are as 0.899 times less likely to experience diarrhoea compared to children whose mothers are poorest. Children whose mothers are richer are as 0.520 times less likely to experience diarrhoeal disease compared to children whose mothers are poorest. Children whose mothers are richest are as 0.387 times less likely to experience diarrhoea compared to children whose mothers are poorest. This finding confirms a study by Mara et al. (2010), who concluded that, the diseases associated with poor sanitation are particularly correlated with poverty. Also children living in poor households have higher rates of diarrhoea than their wealthy counterparts, probably due to inadequate access to environmental facilities, unsanitary environments in the home and poor child hygiene. The relationship between the household socio-economic characteristics and childhood diarrhoea has been amply demonstrated in the literature (Martines et al., 1993; Alam, 1995; Ketema and Lulseged, 1997; Timaeus and Lush, 1995). The finding therefore allows for the null hypothesis to be accepted; thus, children from lowest wealth quintile are more likely to experience diarrhoeal disease compared to children from highest wealth quintile.

The table 6.2 indicates that children whose mothers have primary education are as 0.914 times less likely to experience diarrhoeal disease compared to children whose mothers have no education. The table indicates that children whose mothers have Secondary education are as 1.125 times more likely to experience diarrhoea compared to children whose mothers have no education. The table also indicates that, children whose mothers have higher education are as 0.608 times less likely to experience diarrhoea compared to children whose mothers have no primary education. The secondary education category is contrary to what was expected, although statistically not significant. On the whole the finding confirms a study by Timaeus and Lush (1995) who concluded that, lower levels of maternal education are associated with high incidence of diarrhoea. The incidence of diarrhoea reduces with basic and secondary or higher levels of maternal education. Another study also concluded that educated mothers practice good hygiene and better child feeding, all of which increase a child's resistance against infectious diseases. Education thus enables care givers to avoid health threats and deal with illness more easily (World Resource Institute, 1998). The hypothesis which argues that, children whose mothers have higher education, are less likely to experience diarrhoeal disease compared to children whose mothers have no education will be accepted.

The Table 6.2 indicates that, children whose mothers are employed are as 0.903 times less likely to experience diarrhoea compared to children whose mothers are unemployed. Thus women who are employed may have access to household amenities and facilities including those related to better hygiene and environmental health, (Cerrutti, 2000).

The Table 6.2 indicates that, children whose mothers are Catholics are as 0.916 less likely to experience diarrhoea compared to children whose mothers have no religion. Children whose mothers are Protestants are as 0.627 less likely to experience diarrhoea compared to children whose mothers have no religion. Children whose mothers are Pentecostal/Charismatic are as 0.890 less likely to experience diarrhoea compared to children whose mothers have no religion. Children whose mothers belong to the other Christian denomination are as 1.081 times more likely to experience diarrhoea compared to children whose mothers have no religion. Children whose mothers are Moslems are as 1.386 times more likely to experience diarrhoea compared to children whose mothers have no religion. Children whose mothers belong to the Traditional religion denomination are as 1.189 times more likely to experience diarrhoea compared to children whose mothers have no religion. Religion affords an unusually effective vehicle for change in attitude and behaviour because of its ability to link what people say and do with what they think (Zanden, 1990).

The Table 6.2 reveals that, children whose mothers use unimproved toilet facility are as 1.037 times more likely to experience diarrhoeal disease compared to children whose mothers use improved toilet facility. This finding confirms other studies like, Songsore and McGranahan (1993) who found that neighborhood outdoor defecation creates potential dangers for infections from fecal pathogens in contaminated grounds. Another study by Boadi and Kuitunen (2005) revealed that, lack of access to a toilet facility is associated with high incidence of diarrhoea. The hypothesis which says that, children whose mothers use improved toilet facility are less likely to experience diarrhoea

compared to children whose mothers use unimproved toilet facility, will be accepted in this study.

The Table 6.2 indicates that children whose mothers use unimproved source of drinking water are 0.920 times less likely to experience diarrhoea compared to children whose mothers use improved source of drinking water. This finding is contrary to what was expected. This may be explained by the fact that, although more women use improved source of drinking water, their handling of water and water storage for use may expose them to diarrhoeal disease. Thus water treatment, good storage practices and personal hygiene may be needed to help reduce the incidence of diarrhoeal disease among children. This finding is contrary to many other studies like Chekley et al (2004) who concluded that, more reliable water sources diminish the risk of contaminated water, decrease diarrhoeal incidence and improve linear growth in children.

The Table 6.2 indicates that, children whose mother disposes of their child stool unsafely are as 41% more likely to experience diarrhoeal disease compared to children whose mothers dispose of their child stool safely. This finding confirms to a study by Mara et al. (2010) which demonstrated the major faeco oral disease transmission pathways and illustrated the importance of particular interventions, notably the safe disposal of faeces, in preventing disease (diarrhoeal) transmission.

The Table 6.2 shows that, children who are 6 to 11 months old are as 3.515 more likely to experience diarrhoeal disease compared to children who are less than 6 months old. The table shows that, children who are 12 to 23 months old are as 4.262 more likely to experience diarrhoea compared to children who are less than 6 months old. Children who

are 24 to 35 months are as 2.969 more likely to experience diarrhoea compared to children who are less than 6 months old. Children who are 36 to 47 months old are as 1.957 more likely to experience diarrhoea compared to children who are less than 6 months old. Children who are 48 to 59 months old are as 1.549 more likely to experience diarrhoea compared to children who are less than 6 months old. The finding of this study supports the findings of other studies. A study by Wodemicael (2001) indicates that, risk of diarrhoea peaks at age 6 to 11 months and then decreases as the child grows older. The low risk of diarrhoea during the age 0 to 5 months indicates the positive effect of exclusive breastfeeding in the first months of life.

The Table 6.2 finally indicates that, female children are as 1.077 times more likely to experience diarrhoeal disease compared to male children. This again is contrary to what was expected. This may be explained by the fact that, diarrhoeal incidence among children may be due to some maternal factors like wealth and child stool disposal and the environment, and therefore the sex differentials among children may not influence under-five diarrhoea. The relationship between sex of child and diarrhoeal disease is not significant.

Table 6.2 Results of a logistic regression analysis showing the relationship between mother's background characteristics, sanitation (environmental contamination), child characteristics and diarrhoeal disease.

	Diarrhoeal Disease				
	Nagelkerke R^2 = 0.108				
	Co-efficient (β)	**Standard Error (S.E)**	**Wald**	**Significance (P-value)**	**Odds Ratio [Exp (B)]**
Intercept	- 1.958	0.434	20.350	0.000	0.141
Place of residence					
Urban (RC)					1.000
Rural	- 0.287	0.159	3.266	0.071	0.750
Wealth quintile					
Poorest (RC)					1.000
Poorer	- 0.012	0.174	0.005	0.944	0.988
Middle	- 0.107	0.208	0.263	0.608	0.899
Richer	- 0.654	0.234	7.795	0.005	0.520
Richest	- 0.950	0.286	11.037	0.001	0.387
Education					
No Education (RC)					1.000
Primary	- 0.090	0.160	0.314	0.575	0.914
Secondary	0.118	0.159	0.546	0.460	1.125
Higher	- 0.498	0.549	0.822	0.365	0.608
Employment status					
Not Working (RC)					1.000
Working	- 0.101	0.186	0.297	0.586	0.903
Religious Affiliation					
No Religion (RC)					1.000
Catholic	- 0.088	0.315	0.078	0.780	0.916
Protestant	- 0.466	0.328	2.018	0.155	0.627
Pentecostal/Charismatic	- 0.116	0.292	0.159	0.690	0.890
Other Christian	0.78	0.319	0.060	0.807	1.081
Moslem	0.327	0.297	1.208	0.272	1.386
Traditional	0.173	0.346	0.251	0.617	1.189
Toilet Facility					
Improved (RC)					1.000
Unimproved	0.036	0.136	0.072	0.788	1.037
Source of Drinking water					
Improved source (RC)					1.000
Un-improved source	- 0.083	0.139	0.360	0.548	0.920
Child stool Disposal					
Safe Disposal (RC)					1.000
Un-safe Disposal	0.345	0.125	7.595	0.006	1.412

Age of Child					
<6 months (RC)					1.000
6-11 months	1.257	0.233	29.088	0.000	3.515
12-23 months	1.450	0.213	46.405	0.000	4.262
24-35 months	1.088	0.230	22.418	0.000	2.969
36-47 months	0.671	0.253	7.017	0.008	1.957
48-59 months	0.438	0.288	2.315	0.128	1.549
Sex of Child					
Male (RC)					1.000
Female	0.074	0.112	0.435	0.510	1.077

Source computed from 2008 GDHS

CHAPTER 7

SUMMARY, CONCLUSION AND RECOMMENDATION

7.1 Summary

This chapter presents a summary of the main findings of how sanitation (environmental contamination), socio-economic variables, improved sanitation service delivery, maternal factors, and child characteristics affect under-five diarrhoeal disease in Ghana. The study sought to investigate how sanitation affects children under five year's diarrhoeal disease in Ghana.

Adapting part of Mosley and Chen's framework for the study of child survival in developing countries, a conceptual framework for this study was developed. This was based on the premise that, under five diarrhoea works through proximate factors and distal factors. The distal factors (such as mother's wealth), works through the proximate factors (such as environmental contamination) to influence a child's exposure to the diarrhoeal disease. The general objective of the study was to investigate the sanitation and diarrhoeal disease nexus. The specific objectives include, examining the incidence of diarrhoea among children less than five years in Ghana; investigate the relationship between selected socio-economic, and demographic factors and under five diarrhoeal diseases in Ghana; and to examine how environmental factors affect under five diarrhoeal diseases in Ghana.

Three main hypotheses were postulated in the study to investigate the relationship that exists between sanitation and under five diarrhoeal diseases. Thus, children whose

mothers use improved toilet facilities are less likely to experience diarrhoeal disease compared to children whose mothers use unimproved toilet facility. Children, whose mothers have higher education, are less likely to experience diarrhoeal disease compared to children whose mothers have no education. Children from lowest wealth quintile are more likely to experience diarrhoeal disease compared to children from highest wealth quintile. All three hypotheses were accepted in this study.

The 2008 GDHS was the main source of data used for the analysis in this study. At the multivariate level, two models of analysis were conducted. The first model considered only the sanitation variables (environmental contamination), whiles the second considered all the variables in the study. In the first model, toilet facility and child stool disposal remained significant when all other variables were controlled for, with source of drinking water not statistically significant. However when all other variables were included in the second model, child stool disposal, mother's wealth and age of child remained statistically significant whiles toilet facility lost its significance. Other variables that were significant at the bivariate level also lost their significance at the multivariate level. These were place of residence, highest level of education, religion, and employment status.

7.2 Conclusion

The study has been able to achieve some of the objectives and has tested the stated hypotheses. The study reveals that, child stool disposal, wealth of mother and ages of child were good predictors of diarrhoeal disease among children less than five years old

in Ghana. These results are consistent with several other academic findings, as described in chapter II of this study. The model for this study indicates that, 11% of the variation between the under-five diarrhoeal disease and sanitation is explained by the model. This indicates that, there may be other relevant predictors of under-five diarrhoeal disease that may be missing in this study due to some limitations of the study.

7.3 Recommendation

Since child stool disposal has been found to be important in determining children less than five years diarrhoea, it is recommended that education should be intensified on the potential threats of child stool, and the proper way of disposing of child stool. The way in which a mother disposes of her child's stools may, however, be closely correlated with a range of other behaviour which were not recorded in this study. Stool disposal behaviour may thus be acting as a proxy for other behaviour (for example, food hygiene, hand washing, disposal of stools of other children) which may be the real risk factors for admission to hospital with diarrhoea. It is therefore recommended that, mothers should be trained on general hygiene practices for over all wellbeing. The ministry of health in Ghana, with support from the government or the world health Organisation or UNICEF should take up the responsibility to address this recommendation.

Secondly, the fact that children whose mothers are in the highest wealth quintile are less likely to experience diarrhoea compared to children whose mothers are poorest, deliberate focus by government and other institutions should be directed at providing

improved sanitation service delivery accessibility to rural and urban slum dwellers. Rural sanitation options that do not require water, such as ventilated improved pit latrines and composting toilets, may be more cost-effective than urban and peri-urban sanitation options that require more water but reach more people. Nevertheless, the importance in previous studies of improvements in sanitation at promoting health for all levels of water availability, suggests that at least some level of improved sanitation in rural areas will produce health benefits in such areas.

Finally, since a child's age affects exposure to diarrhoeal disease, especially from ages 6 months and above, it is recommended that, women should not be educated only on how to handle complementary feeding practices of their children. Thus, focus should also be on personal and environmental hygiene practices among women, both at the household level and the community at large, the public health authority must take up the challenge to educate women on safe practices of child stool disposal and many other environmental hygiene practices. This will assist to avoid contamination of food by unhygienic practices of mother to help reduce the risk of children to diarrhoea. It is also recommended that the overall attitude of a mother to her child, and the priority which she assigns to childcare must be deeply highlighted in the Ghanaian society. Further studies to investigate other sanitation and hygiene behaviour and the correlation between these and maternal attitudes are encouraged to unveil other factors that may influence diarrhoeal disease among children less than five years of age.

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