

Predictors of Diarrhea Among Children Under the Age of Five Years in Ghana: Multivariate analysis of data from the 2014 Ghana Demographic and Health Survey

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Abstract

Background

Globally, childhood diarrhea is a major public health concern. Despite numerous interventions that have been put in place to reduce its incidence over the years, childhood diarrhea remains a problem and is the fourth leading cause of child mortality in Ghana. This study examined the predictors of diarrhea among children under the age of five in Ghana.

Methods

Data from the Ghana Demographic and Health survey, a cross-sectional study, was used for the purpose of this study. A total of 2,547 children under the age of five were included in this study from the 2014 GDHS. Logistic regression analysis was performed to establish the factors associated with childhood diarrhea and ascertain explanatory variables.

Results

The prevalence of diarrhea was 11.7%. Children aged younger than 35 months of age, maternal age and education, sex of children and region of residence were the predictors of diarrhea among children under the age of five years in this study.

Conclusion

To lessen the prevalence of diarrhea among children under five in Ghana, existing interventions must be evaluated in the context of the predictors identified. Various stakeholders including government and non-governmental agencies should take into account the predictors of diarrhea established in the design of interventions to effectively reduce morbidity and mortality associated with childhood diarrhea.

Background

According to the World Health Organization, diarrhea is a condition that manifests as the passing of three or more loose or liquid stools per day for an individual or the passing of those stools too frequently (World Health Organization, 2017). Over the years, diarrheal disease has been a significant public health concern, especially in developing nations like those in Asia and sub-Saharan Africa that experience high morbidity and mortality rates among children under the age of five (Liu et al., 2015) (Walker et al., 2013).

Diarrhea is often classed as acute or chronic based on clinical symptoms and presentation (Mwenda et al., 2010). Acute diarrhea is common and is thought to be the primary cause of illness, dehydration, and death in young children (Farthing et al., 2013) (Walker et al., 2013). On the other hand, chronic diarrhea can lead to various gastrointestinal and neurological issues that may have an impact on a child's development and growth. In order to distinguish between acute diarrhea, which typically resolves on its own, and chronic diarrhea, which may require some intervention or therapy, an increase in the frequency of defecation or stool is sometimes employed as a primary criterion (Schiller et al., 2017).

Even though most regions of the world have seen a decline in the number of fatalities due to diarrhea over the years, diarrhea continues to be a major cause of disease and mortality, particularly among young children living in low- and middle-income countries (Santosham et al., 2010). Young children are thought to be affected by roughly 63 percent of diarrheal illnesses worldwide, with most cases occurring in low- and middle-income countries (Walker et al., 2013). When compared to other parts of the world, Africa reports the slowest reduction rates for diarrhea and the least decrease in death rates associated with diarrhea (Boschi-Pinto et al., 2006). Numerous attempts to lessen the worldwide burden of diarrheal diseases have been hampered by the lack of information on the efficacy of programs (Sreeramareddy et al., 2017) (Alemayehu et al., 2021).

In Ghana, diarrheal illness is the fourth primary cause of death among young children. It explains approximately 9% of all mortality among young children (under the age of five), with an estimated 113,786 diarrhea cases recorded per year for children under five years, as at 2011 (Black et al., 2010). Severe dehydration occurred in 2,314 instances of diarrhea in 2011; at that time, 354 deaths were reported (Anyorikeya et al., 2016). When it comes to the onset and subsequent prevention of diarrhea, the difficulties of inadequate water sources, poor sanitation, poor hygiene habits, as well as the complicated roles various pathogens play, should not be overlooked (Darvesh et al., 2017) (Cairncross et al., 2010) (Bado et al., 2016). Thus, the incidence of childhood diarrhea can be prevented and decreased by increasing the quantity and quality of water, using oral rehydration salts, breastfeeding infants during the first six months of life, and encouraging good hand hygiene (World Health Organization & Unicef, 2013) (Kamara et al., 2017).

To address the hygiene crisis in Ghana, several organizations have developed health initiatives aimed at preventing hygiene-related illnesses in Ghana. UNICEF's Ghana 'IWASH' handwashing project is one of such initiatives which seeks to educate school children particularly those living in rural areas on the health effects of not washing their hands. Other initiatives like the rehydration, breastfeeding and clean water projects by UNICEF in Ghana also exist to provide basic preventive and curative services (Gibson, 2018).

Despite these initiatives, childhood diarrhea continues to be a significant public health issue in Ghana. A number of studies focusing on the prevalence and trends of diarrhea among young children have been conducted in various districts and health facilities in Ghana such as that of Tetteh et al. in the Jasikan district of Ghana and Anyorikeya et al. in the Upper West region of Ghana (Tetteh et al., 2018) (Anyorikeya et al., 2016). These studies have been beneficial in identifying the patterns of diarrhea over a given time period, the reasons for changes in trend of diarrhea, factors associated with diarrhea such as the particular age group, sex, and environmental conditions, amongst others that should receive priority attention with regards to childhood diarrhea.

However, there is still a knowledge gap in determining the burden, the precise contributing elements for variations in the prevalence of diarrhea, and the specific variables that influence diarrhea. Since most of these studies are carried out at the community and facility levels rather than at the national level, it has also been difficult to generalize the findings from these studies, which has made evaluating the effectiveness of various interventions that have been implemented over the years difficult.

Children under the age of five are thought to be the age group most susceptible to developing diarrhea, hence, this study concentrated on assessing the determinants of diarrhea among children under the age of five based on evidence from the 2014 Ghana demographic and health survey.

Methods

Study design

The 2014 Ghana Demographic Health Survey employed a cross-sectional design and it is the sixth edition of the series. The data collection process used a two-stage sample design. In the first stage, Enumeration Areas (EAs) in both rural and urban areas were chosen as clusters, and in the second stage, households from the selected EAs were systematically sampled for the survey. A total of 12,831 houses were included in the sample size, with about 30 being chosen from each cluster. As a result of the almost similar sample sizes in each region used in this survey, the sample did not self-weight at the national level; therefore, weighting factors were added to the data file to ensure that the results are proportional at the national level (Ghana Statistical Service (GSS) et al., 2015).

Study population/ setting

Our analysis was based on the 2014 Ghana Demographic and Health Survey (GDHS), and it is important to note that, until 2018, Ghana was divided into 10 administrative regions (Ghana Statistical Service, 2010). Ghana is a country in Western Africa with a population of roughly 31 million people, with females making up about 50.7% of the total (Ghana Statistical Service, 2021). Ghana has a wide range of medical facilities, the bulk of which are found in urban regions. In Ghana, majority of households (92 percent) had access to an improved source of drinking water as of 2021. The majority of household members defecated in open fields, gutters, or bushes since roughly 18 percent of families lacked access to toilet facilities (Ghana Statistical Service, 2022). The need for this study to evaluate the determinants of diarrheal disease among children under five years of age in Ghana was driven by the fact that diarrheal disease has been identified as one of the top 10 causes of death in Ghana but there is no current literature on its determinants from a nationwide perspective (IHME, 2022).

Study participants

Children under the age of five who were reported by their mothers to have had diarrhea two weeks before the survey were the target population that were included in the analysis in this research study. Data from this age group was obtained from the women's questionnaire. Mothers were questioned during the survey if their child (children) had diarrhea in the two weeks before the survey. Children under the age of five were classed as "Yes" if they had ever experienced diarrhea; otherwise, they were classified as "No."

Data source

Data on childhood diarrhea from the 2014 Ghana Demographic and Health Survey were used to achieve the objectives of this study (Ghana Statistical Service (GSS) et al., 2015). The primary goal of the Survey is to enhance and institutionalize the collection and use of data for program monitoring and evaluation as well as for decisions regarding the development of public policy. The sample for this study consisted of children who had experienced diarrhea for two weeks prior to the study (Ghana Statistical Service (GSS) et al., 2015).

A review of all the records of diarrheal disease among children younger than five from the 2014 GDHS was used for this study. To identify the determinants of childhood diarrhea, multivariate logistic regression was conducted on the 2014 GDHS dataset (most recent) after, the dataset was limited to include only the last child and in some cases the only child of the family who had had diarrhea.

Bias

The GDHS data were collected in a way that minimized bias, including using questionnaires that had already been translated in cases where communication was hampered by the use of English, protecting participant privacy during the interview, assuring participant confidentiality, and obtaining informed consent (ICF International, 2012).

Study size

Data available for the 2014 GDHS was limited to include only the last child or in some cases the single child of the family who had been affected with diarrhea. The sample used was a subset of the entire dataset which was achieved by considering only the information on children provided by women in the sample. The sample size for this study included about 2,547 children under the age of five.

Study variables

The parameters that this study measured were divided into dependent and independent variables. The dependent variable for this study was diarrheal disease among children under the age of five. The independent variables consisted of some selected socio-demographic, economic as well as environmental variables relating to the mother and child. Child-related factors included age of child and the sex of child. Maternal factors included the age of the mother, region, educational level, place of residence, marital status, wealth index and employment status of the mother. Environmental factors included source of drinking water, type of toilet facility, and method of stool disposal.

Data analysis techniques

Data was extracted from the 2014 GDHS dataset's children recode file and analyzed using Stata version 17.0 developed by StataCorp LLC. The primary sampling unit and sample strata for sampling errors were utilized to account for clusters or stratification, which restored the survey's representativeness and produced a trustworthy statistical estimate once the data had been weighted. Two layers of analysis were done on the data. Firstly, percentage was used to summarize the prevalence of diarrhea among the target population. Next, cross-tabulation was used to look at how diarrhea varied across explanatory factors. The predictor factors for the outcome variable were then determined using multivariate logistic regression models. Two models were built to examine the factors associated with childhood diarrhea. The first model (Model 1) consisted of child characteristics and environmental factors. Model 2 contained child characteristics, environmental factors and all other explanatory variables. Adjusted odds ratios (AOR) were used to present the study's findings together with the corresponding 95% confidence intervals.

Model fit and Specifications

We assessed the fitness of all models with Akaike's information criterion (AIC) and Bayesian information criterion (BIC). Prior to fitting these models, the existence of multicollinearity between independent variables was examined. The variance inflation factor (VIF) test resulted in a mean VIF of 1.46, indicating that there was minimal multicollinearity between the variables. For test of significance we used the 95% confidence interval.

Ethical issues

This study included participation of human subjects. The 2014 GDHS final report states that the Institutional Review Board of ICF International and the Ethical Review Committee of the Ghana Health Service examined and

approved the survey protocol, which included the collection of biomarkers. Written or verbal consent was obtained from each research subject.

Results

Background characteristics of the study population

From the children's characteristics analyzed, 52.8% of the children were males (Table 1). The highest proportion of these children (22.7%) were aged 12 to 23 months and the least proportion (9.1%) were those aged 6 to 11 months. The majority of the children and their caregivers lived in rural areas, with about 17.5% living in the Ashanti region. For the maternal characteristics analyzed, the age structure for the mothers revealed 45.1% of them were between the ages of 30 to 39 years. Mothers aged less than 20 reported the least proportion of 3.5%.

Regarding the level of education of mothers, the highest proportion (48.0%) was recorded for those who had completed secondary education, whilst the least proportion was recorded for those who had completed tertiary education (3.1%). Higher proportions of mothers (82.4%) had some form of employment within a year prior to the survey, with a few being employed as at the time of the survey, whilst about 17.6% were unemployed. Regarding the marital status of mothers, 6 out of 10 of the mothers were married, and the least proportion of mothers (1.0%) were divorced. In terms of wealth index, 23.0% of the respondents were within the poorest wealth index bracket with about 18.2% in the richest wealth index bracket. These proportions represented the highest and lowest proportions with regards to the wealth status of families.

Higher proportions of the respondents had improved sources of drinking water and toilet facilities at 86.7% and 66.8%, respectively. Regarding the method of stool disposal, the highest proportion (48.7%) admitted to throwing or disposing of stool products into their garbage. The least proportion (4.0%) buried stool whilst about 7.3% had access to a toilet facility in their homes. Table 1 shows the background characteristics of the study population.

Diarrhea prevalence by socio-demographic characteristics

The overall prevalence of Diarrhea among children below the age of five years was 11.7%. The majority of the children that presented with diarrhea were between the ages of 12 to 35 months. Male children and those living in rural areas, particularly in the Brong Ahafo region recorded the highest prevalence of diarrhea. Also, the highest prevalence of diarrhea was recorded among children with young mothers and mothers with no education and employment.

Age of the child, sex, region of residence, mother's age and level of education, wealth index and stool disposal had significant association with diarrhea among children under the age of five years in Ghana from the bivariate analysis. Table 2 below shows diarrhea prevalence by socio-demographic characteristics with corresponding level of significance.

Multivariate analysis

The table below indicates the results from a multivariate analysis conducted to examine the factors associated with childhood diarrhea.

1975.701, AIC = 1893.428) consisted of only child and environmental characteristics. The second model (BIC = 2112.669, AIC = 1877.604) focused on how child characteristics, environmental factors and all other variables were

associated with diarrhea. We reported findings from the second model because it is the only complete model. The variance inflation factor (VIF) test revealed that there is no multicollinearity among the socio-demographic variables (Min = 1.00, Max = 3.21, and Mean VIF = 1.46). From the multivariate analysis run, children aged 12 to 23 months were 3.8 times more likely to have diarrhea when compared to those who were aged below 6 months (AOR=3.78; 95% CI=2.34-6.11). Female children were 0.3 times less likely to be diarrheal when compared to male children (AOR=0.68; 95% CI=0.53-0.86).

The likelihood of diarrhea increased by 1.3 times for households that had improved sources of water as compared to those with unimproved water sources, although the association was not statistically significant (AOR=1.25; 95% CI=0.86-1.82). Similarly, there was an increased likelihood of diarrhea for households with an improved toilet facility which was also not statistically significant (AOR=1.09; 95% CI=0.80-1.50).

Children who lived in households where stool was buried were more likely to have diarrhea than children who lived in houses that used toilets (AOR=2.20; 95% CI=0.98-4.93). Also, children living in rural areas (AOR=0.77; 95% CI=0.55-1.10) and those living in the Volta region (AOR=0.75; 95% CI=0.37-1.53) were less likely to be diarrheal than their counterparts living in urban areas and the Western region.

Children who had mothers aged 40 to 49 years were less likely to be diarrheal than those who had mothers aged less than 20 years (AOR=0.37; 95% CI=0.18-0.74). The odds of developing diarrhea among children who had mothers with tertiary education was 0.5 times less likely when compared to children born to mothers with no education (AOR=0.51; 95% CI=0.20-1.34).

Furthermore, children living in the richest households were less likely to have diarrhea than their counterparts living in the poorest households (AOR=0.75; 95% CI=0.36-1.54). Lastly the odds of having diarrhea among children who lived in households where caregivers or mothers were employed (AOR=0.96; 95% CI=0.68-1.34) or living with their partners (AOR=0.84; 95% CI=0.47-1.48) were less likely than their counterparts who were unemployed or never married.

Discussion

The outcome variable in this study was diarrheal illness. The passing of loose, watery stool more than three times in a day for an individual is referred to as diarrhea (World Health Organization, 2017). This study sought to assess the predictors of diarrheal disease among children under the age of five in Ghana based on data from the 2014 GDHS. The association between a wide range of crucial elements including various socio-demographic, economic and environmental factors and diarrhea was assessed among young children in Ghana.

The total prevalence of diarrhea from this study was about 11.7% which is relatively lower than the reported prevalence of diarrhea among children under five years in Ghana from the 2008 GDHS which was 19.8% (Ghana Statistical Service (GSS) et al., 2015). Similarly, a study conducted on the trends and determinants of diarrheal disease among children under five in Ethiopia also reported a similar decrease in the prevalence of diarrhea from 26% in 2000 to 12% in 2016 (Negesse et al., 2021). Other studies in Plateau state, Nigeria however established an increasing trend in the prevalence of childhood diarrhea from 13% in 2013 to 24% in 2017 (Jiwok et al., 2021). The decrease in the prevalence of diarrhea in Ghana may be attributed to the improvements in sanitation over time, the rise in the number of health facilities and the various public health interventions that have been put in place over the years.

Children aged 12 to 23 months recorded a higher prevalence of diarrhea when compared to other age groups. This study's results contradicts those from a study conducted in Nairobi, Kenya, which established that most diarrhea cases were seen in children aged 6–11 months (Mutama et al., 2019) and aligns with findings from a study conducted in Western Ethiopia that saw the largest peak of diarrhea amongst infants who were 12–23 months (Alemayehu et al., 2021). Results from our study further established there was a significant association between children aged below 35 months of age and diarrhea. Children in this age group also had the greatest likelihood of experiencing diarrhea. This finding corroborates results from a study conducted among children below the age of five years in Sudan where participants aged 6–35 months had a higher likelihood of experiencing diarrhea than those who were either younger or older (Siziya et al., 2013).

According to the study conducted in Sudan, several mechanisms, including maternal antibodies against enteric pathogens and ongoing breastfeeding, provided some protection against diarrhea in children under 6 months old, thus resulting in a lower likelihood of experiencing diarrhea in this age group. Additionally, the lower prevalence of diarrhea among children aged older than 35 months could be attributed to the intrinsic immunity of children within this age group that may have developed. On the other hand, it was determined that the introduction of supplemental foods and modifications in dietary practices were to blame for the high prevalence of diarrhea in children aged 6–35 months.

Our study found no significant association between improved drinking water sources and childhood diarrhea. These findings were consistent with findings from a study conducted in Ethiopia and India (Soboksa, 2021) (Bawankule et al., 2017). Even though ensuring that people have access to improved sources of water is crucial for lowering the prevalence of diarrheal disease, multiple studies have shown that simply collecting water from these sources does not necessarily lessen the risk of developing the condition. Water may be contaminated during its distribution to homes even after it has been treated (Clasen et al., 2007).

Similarly, our study did not find significant association between type of toilet facility and childhood diarrhea. Even though improved toilet facility has the tendency to reduce diarrheal infections, most households have toilets that may serve as potential risk factors for diarrhea and other fecal-oral disease transmission. Some toilets smell due to the fact that these facilities are not always flushed or washed immediately after use; thus, attracting houseflies and suggesting poor hygiene practices (Nyambe et al., 2020).

According to our study, there was significant association between regions in the northern parts of Ghana (transition and savannah zones) and diarrhea. These findings were consistent with findings from a study conducted in Ghana on the spatiotemporal patterns of diarrhea (Asare et al., 2022). One possible explanation to this finding is the varied performance of the rotavirus vaccine in Ghana, where the northern regions of the country has seen a reduced impact from the vaccine (Asare et al., 2020). Rotavirus is known to be the leading cause of diarrhea among children under the age of five years in Ghana (Enweronu-Laryea et al., 2011). Secondly, the sparse distribution of WASH infrastructure, particularly in the transition and savannah zones, could be a contributing factor.

Our study revealed the sex of children was significantly associated with diarrhea. The odds of developing diarrhea among female children was less likely than male children. This finding corroborates results from a study conducted in Yemen, which identified that more male children were affected by diarrhea than female children (Bahartha & Alezzi, 2015). Findings from this study were attributed to a possible variation in sampling techniques and size that might have been used in the study.

The odds ratio for the educational level of mothers indicates that children born to mothers with some form of education were less likely to have diarrhea than their counterparts who had mothers with no education. Evidence which exists to support the impact of maternal education on children's overall living conditions, feeding practices, health amongst others might have accounted for this finding (Desmennu et al., 2017). The wealth index of families showed a significant association with the occurrence of diarrhea in our bivariate analyses. Rather unexpectedly, the association became insignificant when other variables were included in the multivariate analysis. We found that children living in families with the highest wealth index were less likely to have diarrhea as compared to their poorer counterparts. This finding is supported by studies conducted in India (Pinzón-Rondón et al., 2015) (Bawankule et al., 2017). This finding might be due to the fact that children living in impoverished settings may not get access to improved environmental conditions and health care.

There was no significant association between childhood diarrhea and type of place of residence of children from our study. However, the odds of developing diarrhea were lower for children living in rural areas as compared to their counterparts living in urban areas. This finding contradicts findings from a study carried out by Alemeyahu et al. (2021) that concluded that diarrhea was more common in remote areas 24.8% than in metropolitan areas 21.7%. On the other hand, this study also goes in line with another study by Bahartha et al. in 2013, which suggested children living in urban areas were more susceptible to developing diarrhea than their rural peers.

Lastly, although stool disposal showed a significant association with diarrhea in the bivariate analysis, it was not significant when other variables were included in the analysis. In the multivariate analysis conducted, we found that there was an increased risk of childhood diarrhea among children who lived in households where stool was disposed improperly. This is in line with a study conducted in Nairobi, Kenya, which concluded, improper stool disposal was more likely to cause diarrhea (AOR = 2.05, CI = 1.36, 3.10) (Guillaume et al., 2020). This finding is also consistent with findings from a study conducted in Bangladesh and some sub-Saharan countries (Nigeria, Niger, and Burkina Faso) (Messelu & Dumga, 2016) (Bado et al., 2016) (Tambe et al., 2015). A likely explanation to this observation is that burying stool in the home and poor disposal of refuse and used diapers could potentially serve as a reservoir for various micro-organisms and pathogens, which may eventually potentiate the spread of diarrheal diseases, especially when insect vectors carry these pathogens from refuse to food items in the home (Cairncross et al., 2010).

Limitations of this study

The definition of the dependent and independent variables for this study was limited to the information collected by the Ghana Demographic and Health Survey Program; hence other variables of interest could not be explored. Another limitation of this study was that the classification for the prevalence of diarrhea was according to the symptoms and signs reported by the mothers of children surveyed, and therefore was not validated by any medical personnel. Also, there was a possibility for recall bias since the mothers were asked about past events they might have forgotten about, leading to the acquisition of incorrect responses. Lastly, due to the cross-sectional nature of the study, all of the data used in the regression analysis were collected at the time of the survey, therefore they can only indicate statistical relationships between the predictor and dependent variables and not a cause-and-effect link.

Conclusion and recommendations

This study aimed at establishing the predictors of diarrhea among children below the age of five years in Ghana. Children aged younger than 35 months of age, maternal age and education, sex of children and region of residence were the predictors of diarrhea among children under the age of five years identified in this study. The use of a sizable, nationally representative dataset for this study makes the findings of this study suitable to be generalized for the entire Ghanaian population. Based on observations deduced from this study, the Ministry of Health, Ghana Health Service and other health regulatory agencies should intensify monitoring and awareness in the various regions, particularly in the transition and savannah zones on the causes, risk factors, and methods of preventing diarrhea in children under five. Also, policymakers and health practitioners should consider the predictors of diarrhea identified from this study in the design of interventions to help reduce the prevalence of diarrhea in Ghana. Finally, maternal and caregiver education has being identified as a key predictor of childhood diarrhea in Ghana, hence, a special focus should be placed on strengthening and expanding health promotion programs towards this target group regarding the methods of diarrhea transmission, proper waste management, safe water storage, amongst others.

Abbreviations

AIC	Akaike Information Criterion
AOR	Adjusted Odds Ratio
BIC	Bayesian Information Criterion
CI	Confidence Interval
DHS	Demographic and Health Survey
GDHS	Ghana Demographic and Health Survey
GSS	Ghana Statistical Service
UNICEF	United Nations International Children’s Emergency Fund
VIF	Variance Inflation Factor
WASH	Water, Sanitation and Hygiene

Declarations

Competing interests

The authors affirm that they have no competing interests.

Ethical approval and consent to participate

Ethical consent to use the 2014 DHS data for the analysis of predictors of diarrhea among children under five years in Ghana was sought and approval granted by the DHS data originators (ICF Macro International and USAID). Permission and approval were duly granted to publish this manuscript.

Consent for publication

No identifiable personal information, pictures, or videos are provided, thus publication consent is not required.

Availability of data and materials

The GDHS data sets are accessible through the Measure DHS website (<http://www.dhs program.com>) by submitting an online request and describing the study's purpose. The data used to support the study findings are available from the corresponding author upon request.

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Author's contribution

The entire study was conceptualized by MYK. SBK, EKS, MOB, and SM contributed to developing the manuscript and ensuring it's consistency. Each author reviewed and subsequently gave consent for submission of the final version.

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Tables

Tables 1 to 3 are available in the Supplementary Files section.

Supplementary Files

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