Determinants of diarrhea among young children under the age of five in Kenya, evidence from KDHS 2008-09

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Abstract

This paper examines the relative contribution of household, demographic and maternal characteristics to the incidence of diarrhea in young Kenyan children. Data from the Kenya Demographic and Health Survey 2008-09 was used with a total of 3838 women included in the study. The measure of diarrhea in children was derived from woman's questionnaire. Logistic regression analysis showed that age of child [AOR, 0.796; 95% CI, 0.559-1.134] and residence of mother [AOR, 0.538; 95% CI, 0.324-0.895] are more likely to influence childhood diarrhea. Higher education level of mother was associated with lower incidence of childhood diarrhea [AOR, 0.187; 95% CI, 0.609-0.573]. Household characteristics that had statistically significant influence on childhood diarrhea included sources of drinking water [AOR, 1.644; 95% CI, 1.040-2.599] and household size [AOR, 1.334; 95% CI, 1.000-1.780]. This paper emphasizes the importance of mothers being literate and access to good quality drinking water sources in reducing childhood diarrhea.

Keywords: Childhood diarrhea; Sources of drinking water; Mother's education level; Kenya Demographic and Health Survey 2008-09

Résumé

Ce document examine la contribution relative des caractéristiques du ménage, démographiques et maternelle à l'incidence de la diarrhée chez les jeunes enfants kenyans. Les données de l'Enquête démographique du Kenya et de l'Enquête sur la santé 2008-09 a été utilisé avec un total de 3838 femmes incluses dans l'étude. La mesure de la diarrhée chez les enfants a été dérivé du questionnaire de la femme. Une analyse de régression logistique a montré que l'âge de l'enfant [AOR, 0,796, IC 95%, de 0,559 à 1,134] et résidence de la mère [AOR, 0,538, IC à 95% de 0,324 à 0,895] sont plus susceptibles d'influencer la diarrhée infantile. Niveau de l'enseignement supérieur de la mère a été associée à une plus faible incidence de la diarrhée infantile [AOR, 0,187, IC à 95% de 0,609 à 0,573]. Les caractéristiques des ménages qui avaient une influence statistiquement significative sur la diarrhée infantile inclus sources d'eau potable [AOR, 1.644, IC 95%, de 1,040 à 2,599] et la taille du ménage [AOR, 1,334, IC 95%, de 1,000 à 1,780]. Ce document met l'accent sur l'importance des mères étant lettré et l'accès aux sources d'eau potable de bonne qualité dans la réduction de la diarrhée infantile.

Mots clé: la diarrhée chez les enfants; les sources d'eau potable; le niveau de scolarité de la mère; du Kenya Enquête démographique et sanitaire 2008-09

Introduction

Childhood diarrhea accounts for nearly 1.3 million deaths a year among children under 5 years of age making it the second most common cause of childhood mortality globally after pneumonia (UNICEF and WHO. 2009). Mortality of children below the age of five in Africa is more than 80% (Akinyemi *et al*. 2013). Of the 15 countries in Africa where the under-five child mortality is 75%, Kenya is ranked at number 10. Causes of childhood mortality differ from one country to another but pneumonia and diarrhea remain the illnesses that are most often associated with child deaths (Mukhtar *et al.* 2009). In Africa, a child experiences five episodes of diarrhea per year, and 800,000 children die each

year from diarrhea related dehydration (Woldemichael, 2001). In Kenya, the mortality rate of children under the age of five years due to diarrhea is very high about 16% surpassing deaths from HIV and Malaria combined (Njuguna and Muruka, 2011).

There is a relationship between environmental factors and the occurrence of diarrhea in children. Such factors include: water quantity, access to improved water sources, availability of toilet facilities, compound hygiene, housing condition, and refuse disposal (Woldemichael, 2001). Globally, more than 125 million children under-five years of age live in households without access to an improved drinking-water source, and more than 280 million of these children live in households without access to improved sanitation facilities (Black *et al.* 2003). In the developing world, unsafe drinking water, inadequate availability of water for hygiene and lack of access to sanitation together contribute to about 88 % of deaths from diarrheal diseases or more than 1.5 million deaths in children under- five each year (Black *et al.* 2003).

Every child in Kenya under the age of five experiences an average of three bouts of diarrhea every year (KNBS and ICF Macro, 2010). This could be attributed to the quality of the water supply, mother's literacy, housing conditions, and the level of development of the villages in which the children live (Vani, 2004). Maternal education has been found to influence the perception of mothers on childhood diarrhea and increased child health improvements. In others studies, the relationship between maternal characteristics such as education, wealth and child diarrhea is not direct but rather is moderated by other factors such as residence differences (Njeri and Muriithi, 2013). There is need to understand the determinants of diarrhea as it has far reaching consequences on child nutrition, survival and development (Weisz *et al.* 2011).

The purpose of this paper seeks to examine the predictors to the incidence of diarrhea in young Kenyan children. Employing data from the Kenya Demographic and Health Survey 2008-09, this study sought to find out the relationship between childhood diarrhea and household characteristics such as source of drinking water, water treatment, toilet facilities, household size and bottle-feeding in Kenya, maternal characteristics such as age of the mother and the level of education and lastly the socio-demographic characteristics which include; age of child, sex of child, residence, region and wealth status. Given the high mortality rates of children under the age of 5 years due to diarrhea, there is a clear need to assess association between the determinants of diarrhea in children and identify opportunities for intervention that will help to reduce it.

Literature review and theoretical framework

Maternal factors such as mother's age and education level and household factors such as sources of drinking water, toilet facilities, water treatment, household size, number of children and bottle feeding are important in explaining child health outcomes. Several studies have found that demographic variables play a role in diarrhea prevalence. For example, children of more educated mothers tend to have lower diarrhea prevalence, irrespective of water and sanitation conditions and this is due to better understanding of proper hygiene (Ahiadeke, 2000). Other studies have found that child diarrhea incidence was significantly lower when mothers had secondary education, compared to mothers with no education. Mother's education was a significant determinant of diarrhea (Ahiadeke, 2000; Boadi and Kuitunen, 2005). Other socio-demographic variables that significantly predicted lower diarrhea incidence among children under five included: higher family income (Boadi and Kuitunen, 2005), older child's age (Arif and Ibrahim, 1998), urban residence (Arif and Ibrahim, 1998), and female sex (Van Derslice and Briscoe, 1995; Arif and Ibrahim, 1998).

A number of studies found association between water quality as intervening variable and diarrhea incidence. For example, in a 2002 logistic regression analysis of data from three East African countries, indicated that households with piped water connections did not have significantly lower diarrhea likelihood than households that lacked piped water (Tumwine *et al.* 2002). Non protected sources of drinking water have been significantly associated with an increased risk of diarrhea in a number of studies (Ekanem *et al.* 1991; Manun'Ebo *et al*. 1994; Mock *et al*. 1995). In a comparison of urban and rural communities, this association held true only for the latter (Mock *et al*. 1995).

The protective effect of exclusive breast feeding against diarrhoeal disease in the first 4–6 months of life has been reported (Golding *et al.,* 1997). This is attributed to the immune properties of breast milk and less exposure to pathogens in contaminated milk, food, bottles, or teats (Lawrence and Lawrence 1999). These contamination and inadequate sterilization pose less of a problem in

developed than developing countries, hence the greater risk of child diarrhea through breast feeding in developing countries where poverty, poor hygiene, and infectious diseases are common. Quigley et al., (2006) report that breast feeding was associated with significantly less diarrhoeal disease and formula fed infants experienced more diarrhoea if their bottles/teats were not sterilized.

Research has suggested that children in the 6 to 18 month age range are most likely to develop persistent diarrhea (Moy *et al*. 1991; Thea *et al*. 1993). An association between age and increased rates of persistent diarrhea has however not been consistently demonstrated in other developing countries (WHO, 1988).

From the above evidence, independent variables such as demographic and maternal characteristics influence childhood diarrhea either directly, or through intervening variables such as water and sanitation, household size and child feeding practices. The conceptual framework in Figure 1 below is used to illustrate the potential associations among socio-demographic characteristics, household characteristics, maternal characteristics and childhood diarrhea based on available KDHS 2008-09 data.

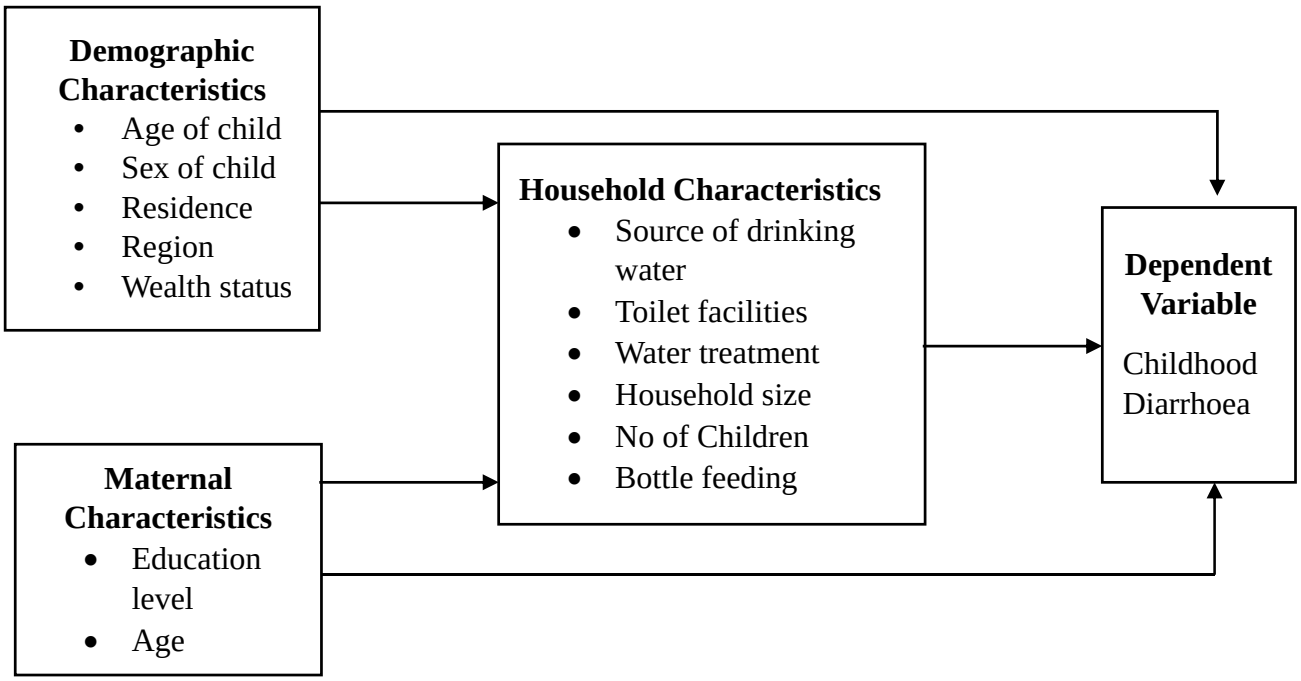

Figure 1: Conceptual Framework developed for the study of determinants of diarrhea among under five year olds in Kenya.

Data and methods

To address the hypothesis, that there was no association between childhood diarrhea and household, socio-demographic and maternal characteristics, data for the study were obtained from the Kenya Demographic and Health Survey 2008-09.

This study used specifically the dataset on woman's recode as the unit of analysis since most of the child information is found in this recode. Merging of the Household and Woman's recode was necessary so as to include other variables that are important in the study. Sample selection had a question on whether or not the child had suffered from diarrhea in the last two weeks preceding the survey. This question was used as the filter question, leaving only data on the respondents who had answered in the affirmative. (N = 3838).

Childhood diarrhea: the measure of diarrhea in children was derived from woman's questionnaire. It was used as the main outcome/dependent variable. The independent variables used to measure the dependent variable included: the maternal characteristics such as age of the mother and the level of education, socio-demographic characteristics which include; age of child, sex of child, residence, region and wealth status and lastly household characteristics such as source of drinking water, water treatment, toilet facilities, household size and bottle-feeding in Kenya.

Data was analyzed using STATA 12 (Statacorp, 2011). The descriptive statistics are presented as percentages since most of the variables are

categorical. The bivariate analyses included Chi-square tests to assess significant differences in proportions experiencing outcomes by demographic, maternal characteristics and household sub-groups. The multivariate analyses are all based on logistic regression to establish differences in odds of experiencing the outcome of interest between various subgroups, when the other important factors are controlled for. For the multivariate analysis of childhood diarrhea, other important variables namely age, sex of child, residence, region, wealth status, education level of the mother, age of mother are included as covariates so that their effects are controlled for. For both descriptive and logistic regression svy set command in Stata 12 was used to adjust for the complex sampling scheme used in KDHS, with all statistical testing performed at 95% significance level.

Results

Descriptive analysis of socio-demographic, maternal and household characteristics

A total of 3838 women were included in the study.

Table 1: Percent distribution of children who experienced diarrhoea by their socioeconomic characteristics, Kenya DHS 2008-9

Socio-demographic characteristics		Had diarrhea?	
Sex of child	**Number**	**Yes (%)**	**No (%)**
Male	1939	16.50	83.50
Female	1899	16.27	83.83
Age of Child			
0-11	814	20.39	79.61
12-23	753	27.49	72.51
24-35	763	16.91	83.09
36-47	745	10.34	89.66
48-59	763	6.29	93.71
Residence			
Urban	907	15.88	84.12
Rural	2931	16.48	83.52
Region			
Nairobi	253	11.07	88.93
Central	327	13.76	86.24
Coast	531	21.47	78.53
Eastern	526	11.79	88.21
North eastern	420	17.14	82.86
Nyanza	621	17.87	82.13
Rift Valley	707	16.27	83.73
Western	453	17.66	82.34
Wealth status			
Poorest	1165	19.23	80.77
Poorer	665	15.04	84.96
Middle	610	15.90	84.10
Richer	604	17.38	82.62
Richest	794	12.72	87.28

Children between the ages of 12-23 months are at high risk of childhood diarrhea than those ranging between 36-59 months represented by under 10% as shown in Table 1. The sex of the child did not show clear difference in terms of diarrhea episodes (Table 1). There was no much difference in diarrhea cases between the urban and the rural residences. The poorest family showed a higher prevalence of childhood diarrhea 19% than the richest family 12.7%. Regionally, it was observed that the Coast province recorded the highest cases of diarrhea 21%, then followed by Nyanza. Nairobi province had the lowest cases of diarrhea in children under the age of five 11% (Table 1).

Table 2: Percent distribution of children who experienced diarrhea by maternal characteristics, Kenya DHS 2008-9

Maternal characteristics		**Had Diarrhea?**	
Age group	**Number**	**Yes (%)**	**No (%)**
15-19	149	27.52	72.48
20-24	952	17.65	82.35
25-29	1101	15.62	84.38
30-34	861	16.38	83.62
35-39	522	14.94	85.06
40-44	184	10.33	89.67
45-49	69	11.59	88.41
Mothers Education level			
No Education	878	19.7	80.3
Primary	2112	16.43	83.57
Secondary	646	14.71	85.29
Higher	202	5.94	94.06

Maternal age played a significant role in the occurrence of childhood diarrhea. In the present study teenage mothers had the highest risk of experiencing childhood diarrheal diseases at 27.52%. The occurrence of childhood diarrhea decreased with maternal age. Mothers aged 40-44 years had the lowest risk of their children suffering from diarrhea 10.33% (Table 2). Children of mothers who had no education were about 3 times more likely to have diarrhea when compared to children of mothers who had higher education and above.

Table 3: Percent distribution of children who experienced diarrhea by household characteristics, Kenya DHS 2008-9

Household characteristics		Had Diarrhea	
Toilet facility	**Number**	**Yes (%)**	**No (%)**
Flush	365	10.68	89.32
Pit	2448	15.16	84.84
Other	1025	21.17	78.83
Water treatment			
Yes	1542	15.63	84.37
No	2296	16.81	83.19
Source of Drinking Water			
Piped	1068	14.51	85.49
Well	1029	17.69	82.31
Surface water & Springs	1592	16.96	83.04
Others	149	13.42	86.58
Household Size			
Small	2117	15.12	84.88
Big	1615	17.65	82.35
Bigger	106	20.75	79.25
Number of children			
Few	2997	15.85	84.15
More	841	18.07	81.93
Bottle feeding			
No	3471	16.05	83.95
Yes	367	19.07	80.93

The household using unprotected water points such as wells as their sources of drinking water had 17.69% cases of childhood diarrhea which is higher than the other sources of drinking water. (Table 3) Houses with more number of children had 18.07% higher cases of childhood diarrhea than houses with few numbers of children. This was also true for households with bigger household sizes 20.75%. Mothers who used bottle feeding had 19.07% higher cases of contracting the disease than mothers who did not.

Bivariate analysis

In bivariate analysis, a number of risk factors including current age of child ($p<0.001$), age of mother, education level and toilet facility ($p<0.05$) appeared to be significantly associated with under five childhood diarrhea (Table 4).

Table 4: Bivariate analysis of characteristics associated with childhood diarrhea, KDHS 2008-09

Variables	P Value CI's	X^2
Socio-demographic characteristics		
Current age of the child	0.0000***	174.50
Sex of child	0.9988	0.00
Residence	0.2050	5.22
Region	0.1789	25.98
Wealth index	0.4836	8.43
Maternal characteristics		
Age of Mother	0.0394*	27.25
Education Level	0.0014**	34.00
Household characteristics		
Source of drinking water	0.5762	5.31
Toilet facilities	0.0083**	27.49
Water treatment	0.9564	0.01
Household size	0.4639	2.62
No of Children	0.4829	1.37
Bottle feeding	0.1117	5.19

*P < 0.05, **P < 0.01 and ***P < 0.001

Multivariate analysis

Table 5. Multivariate analysis of determinants of childhood diarrhea (adjusted odds ratio), KDHS 2008-09.

Variable	Adjusted odds ratio	95% CI
Demographic characteristics		
Age of child		
0-11	1.000	
12-23	1.298	0.934-1.804
24-35	0.796***	0.559-1.134
36-47	0.352***	0.231-0.538
48-59	0.198	0.122-0.321
Sex of child		
Male	1.000	
Female	0.987	0.785-1.241
Residence		
Urban	1.000	
Rural	0.538*	0.324-0.895
Region		
Nairobi	1.000	
Central	1.351	0.528-3.458
Coast	1.681	0.812-3.480
Eastern	1.063	0.472-2.393
North eastern	0.913	0.383-2.176
Nyanza	1.140	0.508-2.559
Rift Valley	1.131	0.505-2.531
Western	1.553	0.654-3.690
Wealth status		

Table 5. Cont'd

Poorest	1.000	
Poorer	1.113	0.784-1.582
Middle	1.195	0.775-1.842
Richer	1.498	0.912-2.459
Richest	0.922	0.509-1.668
Variable	**Adjusted odds ratio**	**95% CI**
Maternal characteristics		
Age group		
15-19	1.000	
20-24	0.776	0.407-1.480
25-29	0.707	0.376-1.327
30-34	0.791	0.390-1.606
35-39	0.580	0.278-1.213
40-44	0.526	0.207-1.339
45-49	0.527	0.164-1.698
Education level		
No education	1.000	
Primary	0.637	0.405-1002
Secondary	0.683	0.361-1.294
Higher	0.187*	0.609-0.573
Households characteristics		
Sources of drinking water		
Piped	1.000	
Well	1.644*	1.040-2.599
Surface water	1.441	0.884-2.348
Others	1.692	0.728-3.930
Toilet facility		
Flush	1.000	
Pit	0.884	0.459-1.704
Other	1.567	0.734-3.341
Water treatment		
Yes	1.000	
No	1.157	0.849-1.576
Household size		
Small	1.000	
Big	1.334*	1.000-1.780
Bigger	0.796	0.372-1.703
Number of children		
Few	1.000	
More	0.798	0.552-1.154
Bottle feeding		
No	1.000	
Yes	1.058	0.729-1.535

*p<0.05, **p<0.01, ***p<0.001

Determinants of childhood diarrhea

The multivariate analysis confirms that children aged 12-23 months, male children, children residing in the urban areas, households in the coast province, richer

household, maternal age 15-19 years, mothers with no education, unprotected sources of drinking water, poor toilet facility, use of non-treated water, big household size, few number of children and use of bottle for feeding infants have the highest chances of developing diarrhea.

Socio-demographic characteristics

After adjustment for other factors (Table 5) with respect to childhood diarrhea, the child's age emerges as the most significant factor. The odds of having diarrhea is highest among children aged 12-23 months (AOR 1.298, CI 0.934-1.804), followed by those aged 0-11 months, and the lowest for children aged 48-59 months. The trend shows an increase up to 23 months then a declining trend from 24 to 9 months (Inverted j curve/relationship).

Residence of child showed significance effect on diarrhea with children living in rural areas having lower odds of contracting diarrhea than those in the urban areas (AOR 0.538, CI 0.324-0.895). This difference was statistically significant. Childhood diarrhea with region and wealth status did not show statistical significance. However, there was an increase in diarrhea cases with wealth status from poor to richer (AOR 1.498 CI 0.912-2.459) then a sharp decline at richest households (AOR 0.922 CI 0.509-1.668). Coast province showed the highest odds of childhood diarrhea (AOR 1.681 CI 0.812-3.480) while North eastern Province had the lowest odds of childhood diarrhea (AOR 0.913, CI 0.383-2.176).

Maternal characteristics

The risk of childhood diarrhea steadily declines with maternal age, with children of mothers aged 15-19 years having higher odds of diarrhea than mothers aged 35 years or over. Majority of mothers between the age group of 40-44 had the lowest odds of children suffering from diarrhea (AOR 0.526 CI 0.207-1.339) with no much difference with age group of 45-49 (AOR 0.527 CI 0.164-1.698).

Children of mothers with higher education level have lower odds of contracting diarrhea (AOR 0.187, CI 0.609-0.573) than children of mothers with no education. Children whose mothers have some education reduce their chances of having diarrhea.

Household characteristics

Households with unprotected drinking water sources had higher odds of contracting childhood diarrhea than protected sources (AOR 1.692, CI 0.728-3.930). Well source of drinking water had slightly higher odds of contracting diarrhea than surface water (AOR 1.441, CI 0.884-2.348). The difference was statistically significant. Pit latrines had the lowest odds of contracting childhood diarrhea than flush toilets and other toilet facility (AOR 0.884, CI 0.459-1.704). Other household characteristics that were found to be statistically significant were household size, as shown in Table 4. Holding all other factors constant, households which did not use treated water had higher odds of contracting childhood diarrhea than those which treated their drinking water. Children who were being bottle fed had the highest odds of contracting diarrhea (AOR 1.058, CI 0.729-1.535) than those breast fed.

Discussion

Childhood mortality is persistently high in Kenya over the last decade as a result of pneumonia and severe infant diarrhea (UNICEF and WHO. 2009). The deaths caused by infant diarrhea have been attributed to poor hygiene of mothers when handling water and food for their infants, poor sanitation, lack of reliable clean drinking water sources and toilet facilities. The results of this study are consistent with findings from other studies. With respect to the associations of the various variables with childhood diarrhea, the observed patterns by child age and maternal education level, conform to findings previously observed in other studies (Magadi, 2000).

Our findings do not support the null hypothesis that there is no association between socio-demographic, maternal and household characteristics with childhood diarrhea. It is evident that, age of child and place of residence of mother are more likely to influence childhood diarrhea. Although other factors such as the sex of child, region of residence and wealth status have effect on diarrhea, our study also strengthens other studies showing that maternal education level, sources of drinking water and use of treated water are more likely to reduce childhood diarrhea (Magadi, 2000).

Richest households had low odds of contracting childhood diarrhea as observed in this study. This could be attributed to the poor handling and storage of drinking water that takes place in majority of households due to lack of information on proper water handling. The results indicated that childhood diarrhea reduced with wealth status. These results agree with the general accepted norm that suggest that wealth has an inverse association with diarrhea likelihood (Amy Quinn, 2009).

Urban residence had higher odds of childhood diarrhea than rural areas and this could be due to poor sanitation as a result of congestion as observed in most of the urban centers thereby negatively affecting water storage and handling practices. Lack of proper and clean drinking water sources are main contributors of high childhood diarrhea cases in urban areas (UNICEF and WHO, 2009).

The results also show that young mothers and a few number of children living at home are associated with higher odds of diarrhea among children. These findings do not agree with those found by Omariba, 2001 who found out that, young mothers and higher number of children in their home correlates with higher prevalence child diseases. Young ages of mother would still record high diarrhea rates among children regardless of the number of children. It may also rightly be argued that older mothers are more experienced in taking care of children and in spite of the number of children at home being high, they take extra care of the young and hence reducing childhood diarrhea incidences. Age of mother comes with experience and younger mothers may lack experiences especially if the educational background is below secondary education.

Bottle feeding in children also increase the chances of contracting diarrhea among children due to the possibilities of contamination of the feeding bottle as a result of poor handling by the mother. A mother who observes proper hygiene when breast feeding is more likely to protect her young one from diarrheal diseases than one who doesn't clean her breast when breast feeding.

Although the type of toilet facility showed an association with the occurrence of childhood diarrhea in the bivariate analyses, it exhibited no significant association when other variables were controlled in the multivariate analyses. However, some studies indicated that the type of excreta disposal facility were strongly associated with the occurrence of diarrheal morbidity (Amy Quinn, 2009). In our study, significant association was observed between the source of drinking water and occurrence of childhood diarrhea which tend to agree with other studies that report drinking water source as an important environmental determinant of diarrheal morbidity (Mukiira and Ibisomi, 2010; Njeri and Muriithi, 2013).

Conclusion

Our findings show that there are associations between various socio-demographic, maternal and household characteristics with childhood diarrhea. Children between the ages of 24-47 months had lower odds of contracting diarrhea because of their maturity in size as compared to the infants. Urban mothers experienced childhood diarrhea as a result of lack of proper water handling practices and storage resulting from congestion in urban areas. This study clearly showed that mothers with higher level of education had the knowledge on tackling childhood diarrhea. Households using well as a source of water reported high episodes of childhood diarrhea as a result of source contamination, storage and handling problems. Bigger household sizes experienced high diarrheal cases in children as a result of poor water handling practices and low hygiene standards from congestion. Interventions to reduce the childhood diarrhea should be based on knowledge dissemination to the urban mothers on cheaper ways of treating water, handling and storage through seminars and workshops.

References

Ahiadeke, C. 2000. Breast-feeding, Diarrhoea and Sanitation as components of infant and child health: a study of large scale survey data from Ghana and Nigeria. *J. Biological Social Science* (32). p.47-61.

Akinyemi, J. O., Bamgboye, A. E. and Ayeni, O. 2013. New trends in under-five mortality determinants and their effects on child survival in Nigeria: A review of childhood mortality data from 1990-2008. *African Population Studies* 27, (1). p.25-42.

Amy Quinn, A. B. 2009. Diarrhea likelihood in Ghanaian Children: A Study of the Association between Diarrhea and Water and Sanitation Infrastructure. Faculty of the Graduate School of Arts & Sciences at Georgetown University, Georgetown University. Master of Public Policy.

Arif, G. M. and Ibrahim, S. 1998. Diarrhoea Morbidity Differentials among Children in Pakistan. *The Pakistan Development Review.* (37). p.3.

Black, R. E., Morris, S. S. and Bryce, J. 2003. 'Where and why are 10 million children dying every year?' *The Lancet.* (361). p.2226–2234

Boadi, K. O. and Kuitunen, M. 2005. Childhood diarrhea morbidity in the Accra Metropolitan Area, Ghana: Socio-economic, environmental and behavioural risk determinants. *Journal of health and population in Developing Countries.* (March). p.31-44.

Ekanem, E. E., Adedeji, O. T. and Akitoye, C. O. 1994. Environmental and behavioural risk factors for prolonged diarrhea in Nigerian children. *J. of Diarrl Disease.* (12). p.19-24.

Golding, J., Emmett, P. M. and Rogers, I. S. 2009. Gastroenteritis, diarrhoea and breast feeding. *Early Hum Dev*. 49(suppl) S83–103.103. [PubMed].

Kenya National Bureau of Statistics (KNBS) and ICF Macro. 2010. Kenya Demographic and Health Survey 2008-09. Calverton, Maryland: KNBS and ICF Macro.

Lawrence, R. A. and Lawrence, R. M. 1999. Breastfeeding. A guide for the medical profession. St Louis: Mosby.

Magadi, M. 2000. Maternal and Child Health among the Urban Poor in Nairobi, *Kenya African Population Studies Supplement* B(19).

Manun'Ebo, M. N., Haggerty, P. A., Kalengaie, M., Ashworth, A. and Kirkwood, B. R. 1994. Influence of demographic, socioeconomic and environmental variables on childhood diarrhoea in a rural area of Zaire. *Journal of Tropical Medicine.* (97). p.31-38.

Mock, N. B., Sellers, T. A., Abdoh, A. A. and Frankin, R. R. 1995. Socioeconomic, environmental, demographic, and behavioral factors associated with occurrence of diarrhea in young children in Congo. *Social Science Medicine.* 3 (36). p.807-816.

Moy, R. J. D., Booth, I. W., McNeish, A. S. and Choto, R. G. 1991. Definitions of diarrhoea. *Journal of Diarrhoeal Diseases Research* (9). p.335.

Mukhtar, A., Subish P., Mohamed, I. and Ibrahim, M. 2009. "The role of mothers in the management of childhood diarrhoea in Nepal." *Australasian Medical Journal*. 1(14). p.235-238.

Mukiira, C. and Ibisomi, L. 2010. "Health care-seeking practices of caregivers of under-five children with diarrheal diseases in two informal settlements in Nairobi, Kenya."

Njeri, G. and Muriithi, M. 2013. "Household Choice of Diarrhea Treatments for Children under the age of five in Kenya: Evidence from The Kenya Demographic and Health Survey 2008-09". *European Scientific Journal.* 9 (6). p.77-91.

Njuguna, J. and Muruka, C. 2011. "Diarrhoea and Malnutrition among children in a Kenyan District: A Correlational Study". *Journal of Rural and Tropical Public Health* (10). p.35- 38.

Omariba, D. W. R. 2001. "Child Morbidity in Kenya: Does Women's Status Matter?." *PSC Discussion Papers Series* 15(9). Article 1.

Quigley, M. A., Cumberland, P., Cowden, J. M. and Rodrigues, L. C. 2006. How protective is breast feeding against diarrhoeal disease in infants in 1990s England? A case-control study *Arch Dis Child.* 91(3). p.245-250.

StataCopr. 2011. Stata Statistical Software: Release 12. College Station, TX: StataCopr LP

Thea, D. M., St. Louis, M. E., Atido, U., Kanjinga, K., Kembo, B. and Matondo M. 1993. A prospective study of diarrhea and HIV-1 infection among 429 Zairian infants. *New England Journal of Medicine.* (329). p.1696-1702.

Tumwine, J. K., Thompson, J., Katua-Katua, M., Mujwajuzi, M., Johnstone, N., Wood, E. and Porras, I. 2002. Diarrhoea and effects of different water sources, sanitation and hygiene behaviour in East Africa. *Tropical Medicine and International Health* 7(9). p.750–756.

UNICEF and WHO. 2009. Diarrhea: Why children are still dying and what can be done. *The Lancet*

Van Derslice, J. and Briscoe, J. 1995. Environmental interventions in developing countries, interactions and their implications. *Am. J. Epidemiol*. (141). p.135–144.

Vani K. Borooah. 2004. On the incidence of diarrhoea among young Indian children. *Economic and Human Biology* (2). p.119-138.

Weisz, A., Meuli, G., Thakwalakwa, C., Trehan, I. and Maleta, K. 2011. The duration of diarrhea and fever is associated with growth faltering in rural Malawian children aged 6–18 months. *Nutrition J.* (10). p.25.

Woldemichael, G. 2001. Diarrheal morbidity among young children in Eritrea: Environmental and socioeconomic determinants. *J Health Popul Nutr.* 19(2). p.83-90

World Health Organization. 1988. Persistent diarrhea in children in developing countries: Memorandum from a WHO meeting. *Bulletin of WHO*. (66). p.709-717.