Original article

Predictors of under-five childhood diarrhea: Mecha District, West Gojam, Ethiopia

Muluken Dessalegn[1], Abera Kumie[2], Worku Tefera[2]

Abstract

Background: Diarrheal disease is widely recognized as a major cause of child morbidity and mortality in developing countries, particularly in sub-Saharan Africa including Ethiopia. There exist variations in explanatory variables of diarrhea depending on the context of the study.

Objective: To examine the effects of selected environmental, socio-economic and behavioral factors on childhood diarrhea in Mecha District, West Gojjam, Ethiopia.

Methods: A community based cross-sectional study was carried out in February 2009. A proportionate stratified random sampling technique was used to select 768 households that had at least one under-five child. Data was collected using a pre-tested structured questionnaire by trained data collectors. Bivariate and multivariate logistic regression analyses were undertaken to identify predictors of childhood diarrhea.

Results: The prevalence of diarrhea among mothers and under-five children was 8.2% and 18.0%, respectively. Maternal education (AOR=5.6, 95% CI: 1.5 - 19.4), maternal history of recent diarrhea (AOR, 5.5; 95% CI, 2.9 - 9.8), availability of latrine facility (AOR, 1.9; 95% CI, 1.1-3.4), duration of breast feeding (AOR=2.7, 95% CI: 1.1- 7.3), and age of the child (AOR=2.8; 95% CI: 1.3 - 5.9) had a significant association.

Conclusion: From this study, variation in the level of diarrheal morbidity is well explained by maternal factors and presence of latrine facility. Educating mothers focusing on sustained behavioral changes in the use of latrine integrated with personal hygiene is an important intervention for the prevention and control of diarrhea among children. [*Ethiop. J. Health Dev.* 2011;25;(3):192-200]

Introduction

Diarrheal diseases kill an estimated 1.8 million people each year (1-3). Among children under-five years in developing countries, diarrhea accounted for 21% of all deaths (4). In addition, diarrhea was also responsible for 25 to 75% of all childhood diseases and accounted for about 14% of outpatient visits, and 16% of hospital admissions (5, 6). Of the estimated total 10.6 million deaths among children younger than five years of age worldwide, 42% occurred in the African region (7).

In Ethiopia, morbidity reports and community-based studies indicate that diarrheal diseases are a major public health problem that causes excess morbidity and mortality among children (5, 8, 9). Morbidity-Mortality-and Treatment (MMT) surveys conducted among under-five children in Ethiopia in 1991 and 1995 revealed five diarrheal episodes per child per year (5, 8, 10). Published studies conducted between 1994 and 2000 in Ethiopia on the prevalence of under-five diarrhea showed the variability of the diseases across the country, 11.4% to 37% (10).

Cause of child morbidity and mortality in developing countries is multi-factorial. Exposure of poor environmental, socio-demographic and behavioral factors are causes of morbidity and mortality in under five children (6, 11, 12). The child's morbidity depends on the interaction of socio-economic, physical, behavioral and environmental factors (13-15). Hence to understand children's morbidity one has to examine the linkage and interactions among the aforementioned factors. Therefore in this paper, we assessed the socio economic, environmental and behavioral determinants for the prevention of childhood diarrhea.

Methods

Study Design, Area and Population

A community-based cross-sectional study was conducted in Mecha District, West Gojjam in February 2009. All under-five children of the district and randomly selected households were the source and study populations, respectively. The *Woreda* has 3 urban and 39 rural *kebele*s. The major ethnic groups of the *Woreda* are Amhara. The population is predominantly Orthodox-Christian by religion. Agriculture is the main livelihood of the population with *Teff*, maize, millet, barley and legumes being the main crops cultivated in the *Woreda*.

Sample Size and Sampling Procedure

EPI INFO window version 3.5.1 was used to calculate the sample size using single population proportion formula based on an assumption that 50% of the under five children had two-week prevalence of diarrhea; with

[1]School of Health Sciences, Debre-Berhan University P.O. Box: 445 Tel: +251912-009692, Email: mulusef@yahoo.com;
[2]School of Public Health, Addis Ababa University P.O. Box: 9086, Fax- +251115517701, Tel: +251911-882912, - Email: aberakumie2@yahoo.com;
[2]School of Public Health, Addis Ababa University P.O. Box: 9086, Fax-+251115517701, Tell: +251913-620514; - Email: workutefera2000@yahoo.com

marginal error of 5%, a standard score corresponding to 95% certainty, design effect of 2, accounted for multistage sampling; and urban to rural ratio of 1:2. The calculated total sample size was 768 households that had at least one under-five child. A two-staged stratified sampling method was employed for the selection of the study subjects. In the first stage, one urban and three rural *kebeles* were randomly selected after stratifying the existing *kebeles* by residence. Residency was assumed to make a difference in diarrheal outcomes. In the second stage, proportional to size allocated, households with under-five children were randomly selected using a sampling frame that came out of the source population census that was done prior to this study.

The youngest child was selected to collect information on the child's demographic and health characteristics. The youngest child, who was vulnerable to main explanatory variables (2, 7, 16), the child who was not chronically ill and without persistent diarrhea was included in the study.

Data Collection Methods

A pretested structured questionnaire was adapted from WHO core questionnaire that was designed to explore factors related to diarrhea (17). Respondents for the administered questionnaire were mothers or caretakers in their absence, in the household that had under-five child/children and lived in the household for the preceding six months. Twelve data collectors, who completed 12 (or 10+2) grades and resided in the study area were recruited and trained for 3 days on the techniques of interviews and data collection. Four health extension workers (HEWs) were trained and involved as supervisors in the survey. The data collection tool was piloted on the 3rd day of training in another similar village in order to sort out language barriers and contextual differences.

Study Variables

Outcome variable: the occurrence of childhood diarrhea as outcome variables

Explanatory variable

- *Socioeconomic status (*included family economic status, place of residence, household size, maternal age, education, ethnicity, number of children, etc.)
- *Environmental sanitation (*included type of water source, distance to the water source, amount of daily water consumption, availability of latrine, refuse disposal, and the like)
- *Behavioural factors (*includes method of water drawing and storage, feeding habits, action for diarrhoea, duration of breast-feeding, time of introducing supplementary feeding, and so on.

Operational Definitions

Diarrhea: is defined as having three or more loose or watery stool in a 24-hour's period in the household within the two weeks period prior to the survey, as reported by the mother/caretaker of the child.

Prevalence of diarrhea: the total number of diarrhea cases at the time of the interview divided by the total number of under-five children in the study area.

Maternal education was categorized into high and low. Low education is used to refer to mothers with less than secondary education while high education refers to those with at least secondary education. This distinction derives from previous research that suggested a minimum threshold of secondary education as necessary to realize the reproduction related benefits of maternal education (18).

Wealth of family: (19-21) categorized as *low* (those families who had no radio, television, bicycle, or telephone), *medium* (those families who had at least one of those goods), *high* (those families who had three of these (radio, television, bicycle, and/or telephone).

Improved water sources: included household connections, public standpipes, protected dug wells, protected springs. Water sources that are considered as "unimproved" are: unprotected dug wells, unprotected springs. An "Improved" source is one that is likely to provide "safe" water.

Proper disposal is a way of disposal refuses that which included burning, burying in a pit or storing in a container and disposing in designed site, whereas disposing in open fields considered as unimproved disposal method.

Data Management and Quality

The supervisors and principal investigator had closely followed the day-to-day data collection process and ensured completeness and consistency of questionnaire administered each day. Five percent of the households were re-interviewed by the supervisors and the principal investigator to ensure the consistency of collected data.

Data was coded, entered and cleaned using EPI INFO windows -version 3.5.1 statistical software; and analyzed using SPSS version-16 after exporting. Both descriptive and analytical statistical procedures were employed. Binary and multiple logistic regression analysis methods were used to detect possible association, and to control confounding effects.

Ethical Considerations

The study was approved by the Institutional Ethical Review Board (IRB) of the Faculty of Medicine, Addis Ababa University. Informed verbal consent was obtained from the mothers/caretakers of the children. Confidentiality and privacy were maintained during data collection, analysis and reporting. Children, who were found with diarrhea during the visits, were given ORS and severe cases were advised to consult the nearby health facility for better management.

Results

Socio-economic Characteristics

A total of 768 households were included in the study with a response rate of 100%. Of the total households, 256 (33.3%) and 512 (66.7%) were from an urban and ten rural *kebeles*, respectively. Mean (±SD) age of mothers at the birth of the index child was 25.8 (±5.9). The majority of mothers were married, 726 (94.1%); illiterate, 573 (74.6%); Orthodox by religion, 743 (96.8%); and Amahra (99.6%) by ethnicity. Four hundred eighty four (63.0%) mothers were farmers. The mean household family size of the study population was 5.1 (±1.8) persons. Three hundred and ninety one (50.1%) households had no functional radio.

Environmental Characteristics

From the total of 768 households, 575 (74.9%) had dwellings with corrugated roofs. Of these, 248 (96.7%) and 327 (63.9%) were in urban and rural, respectively. Of all the households, 224 (29.2%) of then dwellings had no partitioned room, and 286 (37.2%) had two rooms. In 286 (37.2%) of the households, animals shared shelters with the family: rural, 269 (52.5%) and urban, 17 (6.6%).

Four hundred forty three (58%) of the households among in the study population had no latrine facility. Of the total, which had latrine facility, 285 (87.7%), 40 (12.3%) had traditional pit latrine and Ventilated Improved Pit (VIP), respectively. More than half, 433 (56.4%) of the study households disposed their refuse in open fields. More than two-third of the households (69.1%) used unsafe sources as the main source of their drinking water. Five hundred twenty (67.7%) households accessed water within a 30 minute walking distance (round trip) from their home. Only 32.3% of the households spent more than 30 minutes to fetch water. The mean (±SD) per capita per day drinking water consumption in study area was calculated to be 7.7 (±4.4) liters.

Behavioral and Child Demographic and Health Characteristics

Among a total of 768 mothers/caretakers, 107 (13.9%) breast fed their children exclusively. About one-third of the mothers (32%) stopped to breastfeed their child before the age of one year. Out of those mothers who initiated additional food for their children, 444 (60.2%) mothers started supplementary feeding for their children after the child reached 6 months and above.

Of the total 768 mothers/caretakers, 63 (8.2%) had diarrhea in the preceding two weeks of the survey. The method of drawing water from storage was dipping, 681 (88.7%), which was a common practice in the study area. The overall prevalence of diarrhea among under-five index children (n=768) in the district was 138 (18.0 %), i.e. 32 (12.5%) in urban and 106 (20.6%) in the rural of the study area. The mean (±SD) age of the index children was 2.047 (±1.36) years. Of the total 636 children whose age was 9 months and above at the time of the survey, 604 (95%) of them were claimed to get immunized for measles.

Factors Associated with Childhood Diarrhea, Bivariate Results

Table 1 presents the households' selected socio-economic and demographic variables and their relation to childhood diarrhea. Except maternal age and family size, other variables showed significant association with diarrheal morbidity. Based on the bivariate analysis those children whose mothers were below secondary level education, living in rural area and family wealth of low and medium income were highly vulnerable to diarrhea at p-value <0.05.

Table 2 indicates the bivariate analysis of environmental condition with respect of diarrhea. Drinking water source, latrine availability and waste disposal had an association with childhood diarrhea. Families who had unimproved drinking water source, being rural and improper refuse disposal had a significantly increased the risk of childhood diarrhea.

The crude analysis of behavioral and child care practice determinants in relation to childhood diarrhea as shown in Table 3, children, who were partially on breast milk (COR [95% CI]= 2.4 [1.24, 4.88]) were more likely to have diarrhea than children who were exclusively on breast milk. The odds of diarrhea were significantly higher for those children who had <1 year of breast feeding (COR [95% CI] =3.1[1.78, 5.43]) and for those who were between one and two years (COR [95% CI] = 3.9 [2.24, 6.65]) as compared with 2 years and above. Maternal history of diarrhea had a significant risk on their children's diarrhea status. The likelihood of developing diarrhea among children was five times higher for those children whose mothers had a history of diarrhea as compared to those whose mothers did not have diarrhea (COR [95% CI]=5.0 [2.85, 8.87]).

The probabilities of children developing diarrhea from mothers who were having diarrhea were five-fold more than children of mothers who did not in the preceding two weeks (AOR [95% CI] = 5.4[2.96, 9.76]). Age of index child 12-23 months (AOR [95% CI] = 2.8[1.28, 5.95]) and duration of breast feeding < 1 yr (AOR [95% CI] = 2.7[1.02, 7.25]) showed significant association with diarrhea morbidity.

Table1: **Socio-economic Determinants in Relation to Childhood Diarrhoea among Under-fives in Mecha District, West Gojjam, Ethiopia, Feb. 2009**

Characteristic	Diarrhea (n=768)		COR (95% CI)
	Yes	No	
Residence			
Rural	106 (20.6)	406 (79.5)	1.83 (1.17, 2.87)*
Urban	32 (12.5)	224 (87.5)	1.00
Mothers age at birth			
15 – 24	67 (19.3)	281 (80.7)	1.00
25 – 34	58(16.2)	300 (83.8)	0.81 (0.54,1.22)
>34	13(21.0)	49(79.0)	1.11(0.54, 2.26)
Wealth of family			
Low	68 (17.8)	313 (82.2)	3.44 (1.30, 8.57)*
Medium	65 (21.3)	240 (78.2)	4.17 (1.62, 10.73)*
High	5 (6.1)	77(93.9)	1.00
Mothers education			
Low education	135 (19.7)	551 (80.5)	6.45 (2.01, 20.75)*
High education	3 (3.7)	79 (96.3)	1.00

*Statistical significance, COR= Crude Odds Ratio

Table 2: **Environmental Determinants in Relation to Childhood Diarrhea among Under-fives in Mecha District, West Gojjam, Ethiopia, Feb. 2009**

Characteristic	**Diarrhea (n=768)**		**COR (95% CI)**
	Yes	**No**	
Drinking water source			
Unimproved	110 (20.7)	421 (79.3)	1.95 (1.22, 3.13)*
Improved	28 (11.8)	209 (88.2)	1.00
Latrine facility			
No	99 (22.3)	344 (77.7)	2.11 (1.39, 3.22)*
Have	39 (12.0)	286 (88.0)	1.00
Waste disposal			
Improper disposal	96 (22.2)	337 (77.8)	1.99 (1.32, 3.01)*
proper disposal	42 (12.5)	293 (87.5)	1.00
Number of rooms			
1	40 (17.9)	184 (82.1)	1.12 (0.68,1.85)
2	56 (19.6)	230 (80.4)	1.25 (0.76,1.96)
≥ 3	42 (16.3)	216 (83.7)	1.00

*Statistical significance

Table 3: **Behavioral and Child care Practice Determinants in Relation to Childhood Diarrhea among under-fives children in Mecha District, West Gojjam, Ethiopia, Feb. 2009**

Characteristic	Diarrhea (n=768)		Crude OR (95% CI)
	Yes	No	
Water drawing			
Dipping	127 (18.6)	554 (81.4)	1.584 (0.82, 3.07)
Pouring	11 (12.6)	176 (87.4)	1.00
Mothers/caretakers know flies can transmit disease			
No	91 (23.2)	301 (76.8)	2.12 (1.42, 3.17)*
Yes	47 (12.5)	329 (87.5)	1.00
Current breast feeding status			
Exclusive	12 (11.2)	95 (88.8)	1.00
Partial	98 (23.5)	319 (76.5)	2.43 (1.24, 4.88)*
No breast feeding	28 (11.5)	216 (88.5)	1.03 (0.48, 2.24)
Duration of BF			
<1year	49 (22.2)	177 (7.7)	3.1 (1.78,5.43)*
1-2	59 (26.2)	166 (73.8)	3.85 (2.24,6.65)*
≥ 2	24 (8.5)	260 (91.5)	1.00
Maternal diarrhea			
Yes	30 (47.6)	33 (52.4)	5.03 (2.85, 8.87)*
No	108 (15.3)	597 (84.7)	1.00
Child characteristics			
Age of the *index child*			
0-5 month	6 (10.7)	50 (89.3)	1.00
6-11 month	17 (22.4)	59 (77.6)	2.40 (0.81, 7.43)
12-23 month	85 (27.2)	228 (72.8)	3.11 (1.22, 8.37)*
24 month and above	30 (9.3)	293 (90.7)	0.85 (0.32, 2.41)
Sex			
Male	87(19.9)	350 (80.1)	1.36 (0.94,1.99)
Female	51(15.4)	280 (84.6)	1.00
Birth order			
First	28 (17.6)	131 (82.4)	1.00
Second	28 (14.7)	162 (85.3)	0.81 (0.44,1.49)
Third	32 (17.9)	147 (82.1)	1.02 (0.56,1.85)
Fourth +	50 (20.8)	190 (79.2)	1.23 (0.72,2.13)
Measles vaccination©			
No	7 (21.8)	25 (79.2)	1.53 (0.59,3.83)
Yes	109 (18.0)	495 (82.0)	1.00

*Statistical significance: p<0.05 © n=636

The age of the children showed curvilinear effect on the risk of diarrhea, the risk being highest in the age group 6-11 months (COR [95% CI] =2.4[0.81, 7.43]) and 12-24 months (COR [95% CI] =3.1 [1.22, 8.37]) and least at 0-5 months and above 24 months.

Determinants of Diarrhea, Multivariate Results

A hierarchical logistic regression technique was used to assess the relative effect of the explanatory factors on under-five diarrhea. To avoid an excessive number of variables and unstable estimates in the subsequent model, only variables that reached a p-value less than 0.3 were kept in the subsequent analyses (22).

The multivariate logistic regression analysis identified maternal education, latrine facility, history of maternal diarrhea, duration of breast feeding of the index child, and the age of the index child had a significant association (Table 4). The analysis showed low educated mothers' children had more than five times higher odds of having diarrhea than those children having higher educated mothers (AOR [95% CI] =*5.6[*1.52, 19.4]*)*. The odds of having diarrhea in children who lived in households which had no latrine facility two times higher the odds than in children who lived in households which had latrine facility (AOR [95% CI]= *1.9[*1.03,3.38]).

Table 4: **Summary of the Hierarchical Logistic Regression Analysis of Socioeconomic, Environmental and Behavioral Factors on the Prevalence of Childhood Diarrhea in Mecha District, West Gojjam, Ethiopia, Feb. 2009.**

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI) Model 1	Model 2	Model 3
Behavioral and child characteristics				
Maternal diarrhea				
Yes /No*	5.03 (2.85,8.87)**	5.12 (2.87,9.12)**	5.02 (2.81,8.97)**	5.38 (2.96, 9.76)**
Water drawing				
dipping /pouring*	1.584 (0.82,3.07)	1.98 (0.669, 1.34)	0.96 (0.462,2.01)	
Breast feeding status				
Partial/ Exclusive*	2.43 (1.24,4.88)**	2.01 (0.726,5.57)	1.97 (0.713,5.45)	1.823 (0.65, 5.11)
No breast feeding/ **Exclusive***	1.03 (0.48, 2.24)	0.89 (0.458,1.73)	0.89 (0.46,1.74)	0.846 (0.42,1.68)
Duration of breast feeding				
<1/>=2*	4.38 (2.01, 9.87)**	2.85(1.10,7.46)**	2.83 (1.13,7.40)**	2.71 (1.02,7.25)**
1-2/>=2*	3.39 (1.59, 7.50)**	2.27 (0.97, 5.37)	2.39 (1.01,5.55)	2.31 (0.96, 5.55)
Age of the index child				
0-5 month	1.00	0.635 (0.169,2.38)	0.65 (0.174,2.42)	0.636 (0.27, 2.38)
6-11 month	2.40 (0.81, 7.43)	2.16 (0.78,5.98)	2.12 (0.76, 5.88)	2.36 (0.82, 6.75)
12-23 month	3.11 (1.22, 8.37)**	2.56 (1.23, 5.99)**	2.43 (1.18,5.26)**	2.76 (1.28,5.95)**
24month & above	0.85 (0.32, 2.41)			
Environmental				
Drinking water source use				
Unimproved/ **Improved***	1.95 (1.22,3.13)**		1.377 (0.76, 2.28)	1.72 (0.85,3.48)
Latrine facility				
NoLatrine/Have **Latrine***	2.11 (1.39, 3.22)**		1.43 (0.8, 2.56)	1.92 (1.03,3.38)**
Waste disposal				
Improper/ proper*	1.99 (1.32, 3.01)**		1.17 (0.65, 2.08)	
Socio-demographic				
Mothers education				
Low/High*	6.45 (2.01,20.75)**			5.55 (1.52, 19.4)**
Residence				
Rural/urban*	1.83 (1.17, 2.87)**			2.14 (0.93, 4.76)
Mothers age at birth				
15 – 24	1.00			0.171 (0.013, 2.19)
25 – 34	0.81 (0.54,1.22)			1.42 (0.66, 3.05)
>34	1.11 (0.54, 2.26)			
Wealth of family				
Low/ High*	3.44 (1.30, 8.57)**			1.02 (0.35, 3.53)
Medium/ High*	4.17 (1.62,10.73)**			1.6 (0.53, 5.00)

* Only variables that reached p-value less than 0.3 were kept in the subsequent analyses, and displayed in the Table.
* Reference group ** Significant at p<0.05.

Discussion

The overall prevalence rate of diarrhea, 18% in the district is consistent with recent World Bank estimates and with the findings in Keffa-Sheka Zone (15%), in Adami-Tulu District (22.7%), North Gondar Zone (17.9%), as reported in the 2005 EDHS report (18%) (23-25) as well as in Ghana (18).

From all the environmental variables considered in this study, only availability of latrine facility remained significant after controlling for possible confounding

variables. In this study, children living in households without latrine facilities were about 92% more likely to develop diarrhea than children living in households with such facilities, which is consistent with the study in Ghana on maternal education and child morbidity (26). A latrine facility provides some notion of a household's sanitary conditions and as such an indication of the possibility of transmission of the diarrheal pathogens through fecal contamination (12). The absence of association between types of water source with diarrheal morbidity after controlling other factors may be explained by differences in the utilization water within the sample households. In addition to this, as mentioned in the result the majority (88.7%) of the households' practice of water drawing was dipping, hygienic practiced of the family also matters and this might be the possible contamination, despite the type of water source. Even though the source is protected, water may be contaminated at or following collection, i.e., during transport and/or storage.

From all socioeconomic variables tested in maternal education remained significant after controlling other variables. The findings on maternal education suggested that mothers with secondary and above education experienced better chance of a child being free of diarrhea, which is consistent with a cross-sectional study in Ethiopia (27, 28) and Ghana (18) and a cohort study in Zaire (29). The study in Ghana (18) indicated that the prevalence of diarrhea varies according to education of mothers being significantly lower among children of secondary or higher educated mothers than among children of mothers with no or primary education. Educated mothers practice good hygiene, better child feeding and weaning practices, and the interpretation of symptoms and enhance timely action on childhood illness, all of which increase a child's resistance against infectious diseases (26). Experience in Sri Lanka and India (31, 32), had led to the suggestion that for every year of schooling for girls, a 10 percent reduction in infant mortality is reasonably expected.

It is well documented that maternal child care and hygiene practices have important impacts on the occurrence of diarrhea in children (20, 33). In this study, maternal history of diarrheal morbidity was found to be significant predictors of diarrheal morbidity in children. The five-fold increase in the odds of getting diarrhea in children whose mothers had diarrhea may be explained by the fact that maternal morbidity may be considered as a sign of disease exposure in a family. This is so because mothers are food handlers of the family and they are usually the main child care providers (20, 21). Moreover, the care of the child may be compromised if the mother herself is sick. A similar finding was observed in Congo (21) where maternal diarrheal morbidity was associated with a two-fold increase in the odds for diarrheal disease in children. Mother's exposure to diarrhea may also indicate poor hygienic practice in the household that results in disease incidence for the child/children.

Duration of breast feeding was found to be a significant predictor of diarrheal morbidity in children. This is because breastfeeding is an effective means of protecting children from diarrheal disease (21, 34). In this finding the age of the child also showed a statistically significant effect on the risk of diarrhea, which is consistent with many studies of sub-Saharan Africa (35), Ethiopia (36), Nigeria (37). According a study conducted in Ghana (18, 20), the risk was highest at age segments of 6-11 months and 12-23 months and least at 0-5 months and 24 months and above. The low risk of diarrhea during the age 0-5 months observed in this study clearly indicated the protective effect of exclusive breast feeding, inborn immunity and less exposure to contaminated agents in the first six months of life. On the other hand, the prevalence peaks when the child has lost inborn immunity, weaning practices, and exposed to different types of infections from eating food prepared not hygienically. At these ages also, infants are either crawling or walking and, as such, can easily pick dirt or other contaminated objects if considerable care and attention are not taken.

Owing to the community-based study design, and the use of WHO standard questionnaire, we can assume that the findings could take greater proportion of the subjects and consistency in response. However, it shares the drawbacks of similar cross-sectional studies. The study was conducted in the dry season (February) and probably the might have underestimate diarrhea prevalence as compared to early rainy season, and a limitation to the generalizability of the result.

Generally speaking, from this study we conclude that the prevalence of under-five childhood diarrhea was 18%. The explanatory covariates for variation in the level of diarrheal morbidity are maternal education, latrine facility, maternal history of diarrhea, duration of breast feeding and age of the child. Overall, the findings have important policy implications for health intervention and support the view that investing in girls' education may have substantial benefits on child health and survival in our country. Reducing diarrhea involves providing better sanitation to the entire population: In this study, we have found that education provides a solution. Specifically, secondary or above level of education for girls must be achieved in order to improve childhood diarrhea morbidity.

Acknowledgements

The authors are very grateful to Mecha District Health Office for its administrative assistance. The School of Public Health, Faculty of Medicine, Addis Ababa University deserves acknowledgement for as financial support this study.

References

1. World Health Organization. Network on Household Water Treatment and Safe Storage. 2005. [http://www.who.int/household_water/en/]

2. Bern C, Martines JD, Zoysa I, Glass RI. The magnitude of the global burden of diarrheal disease: a ten-year update. *Bulletin of the WHO*1992;70:705-14.
3. Kosek M, Bern C, Guerrant RL. The magnitude of the global burden of diarrheal disease from studies published 1992-2000 Bulletin of WHO 2003;81:197-204.
4. World Health Organization. Water, sanitation and hygiene: Public Health and the Environment. Geneva: WHO; 2007.
5. Ketsela T. Knowledge and practice of mothers/caretakers towards diarrhea and its treatment in rural communities in Ethiopia. *Eth Med J* 1991;29(4).
6. World Health Organization. Child Health Research Project. Childhood diarrhea in Sub-Saharan Africa. Special report. Apr. 1998;2(1).
7. Bryce J, Boschi-Pinto C, Shibuya K, E. BR. The Child Health Epidemiology Reference Group. WHO Estimates of the Causes of Death in Children Lancet 2005;365:1147-52.
8. Larson P, Ketsela T. Acute childhood diarrhea. In: Kloos H, Zein A (eds). The ecology of health and disease in Ethiopia. West View Press Oxford 1993:203-10.
9. Mekasha A, Lemma F, Shiferaw T. Child health problems in Ethiopia. EPHA Expert Group Report.1995 Contract No.: 3.
10. Larson P, Lulseged S, Kitsela T. Childhood diarrhea. In: Berhan Y, Haile Mariam D, Kloos H (eds). Epidemiology and ecology of health and disease in Ethiopia. 2006:339-49.
11. Teran MM. Early feeding patterns and children's health in Mexico Demographic and Health Survey World Conference; Washington, D. C August 5-7 1991:451-74.
12. Esrey S, Feachem R, Hughes J. Interventions for the control of diarrheal diseases among young children: Improving water supplies and excreta disposal facilities. *Bulletin of the WHO* 1985;63(4):757-72.
13. Freij L, Wall S. Exploring child health and its ecology: The Kirkos study in Addis Ababa. Acta Paediatrica Scandinavia1977 (Suppl. No. 267).
14. Mosley W, Chen L. An analytic framework for the study of child survival in developing countries. Population and Development Review. 1984;10:25-48.
15. UNECA. The impact of maternal and child health and family planning (MCH/FP) programs on fertility, infant and childhood mortality and maternal health. New York: UN 1989.
16. Esrey A. Water, waste and well-being: A multicounty study. *American Journal of Epidemiology* 1996; 143(6):608-23.
17. WHO/UNICE. Core questions on drinking-water and sanitation for household surveys. 2008:6-19.
18. Kwasi Owusu B MK. Childhood diarrheal morbidity in the Accra Metropolitan Area, Ghana: Socio-economic, environmental and behavioral risk determinants. *Journal of Health and Population in Developing Countries* 2003.
19. Faris K. Hygienic behavior and environmental conditions in Jimma town, Southwest. Ethiopia Ethiop J Health Dev 1999;13(2):77-86.
20. Woldemicael G. Diarrheal morbidity among young children in Eritrea: Environmental and Socio-economic determinants. *Journal of Health, Population and Nutrition* 2001;19(2):83-90.
21. Mock N, Sellers T, Abdoh A, Franklin R. Socioeconomic, environmental, demographic and behavioral factors associated with the occurrence of diarrhea in young children. *Soc Sci Med* 1993;36(6):807-16.
22. Victoria CG HS, Fuchs SC, Olinto MTA. The role of conceptual frameworks in epidemiological analysis: A hierarchical approach. *Int J Epid* 1997;26(1):224-7.
23. Tesfaye F, Enqusellassie F, Faris K, Wendimagegn G. ORS usage in acute childhood diarrhea, Adami-Tulu *Woreda*. *Ethiop Med J* 1996;34(3).
24. Tekle Mariam S, Getaneh T, Bekele F. Environmental determinants of diarrhoea morbidity in under-five children. Keffa-Sheka Zone. Southwest Ethiopia. *Ethiop Med J* 2000;38(1):27-34.
25. Mitike G. Prevalence of acute and persistent diarrhea in North Gondar Zone, Ethiopia. *East Afr Med J* Aug. 2001; 78(8):44-8.
26. Tagoe E. Maternal education and infant/child morbidity in Ghana: The case of diarrhea: evidence from the Ghana Demographic and Health Survey. In Paulina, M. and J. An-Magritte, (eds), Women's Position and Demographic Change in sub-Saharan Africa. Liege1995; IUSSP.
27. Yohannes AG, Streatfield K, Bost L. Child morbidity patterns in Ethiopia *Journal of Biosocial Science* 1992;24:143-55.
28. Mulugeta T. Socio-economic, environmental, and behavioral factors associated with the occurrence of diarrheal disease among under-five children, Meskana Mareko *Woreda*, Southern Ethiopia [MPH thesis]: AAU; 2003.
29. Manun'ebo M, Haggerty P, Kalengaie M, Ashworth A, Kirkwood B. Influence of demographic, socioeconomic, environmental variables on childhood diarrhea in a rural areas of Zaire. *J Trop Med Hyg* 1994; 97(1):31-8.
30. Kirkwood BR. Diarrhea. In Feachem, R.D, Jamison,D.T (eds): Disease and Mortality in Sub-Saharan Africa. New York. Oxford University Press1991:34-57.
31. World Resources Institute World Resources 1998-99: A guide to global environment. Environmental Change and Human Health. New York: Oxford University Press. 1998.
32. Amonoo-Lartson GJE, Lovel HJ. District Health Care: challenges for Planning, Organization and Evaluation in Developing Countries. Hong Kong: MacMillan. 1985.

33. Ezra M GE. Breastfeeding, birth intervals and child survival*:* Analysis of the 1997 community and family survey data in southern Ethiopia. *Ethiop* J *Health Dev* 2002; 16(1):41-51.
34. Getaneh T. Diarrhea morbidity in urban area of Southwest Ethiopia *East Afr Med J* 1997; 74(8):491-4.
35. Mensah P. Persistent diarrhea in Ghana. A report submitted to the Japan International Development Agency (JICA) 1997.
36. Habte Mariam G. Determinants of Child Health and Survival in Central Ethiopia, thesis. London l Medicine1994.
37. *Togunde OR.* Determinants of women's employment in urban Nigeria: the impact of socio-economic factors. *J Asian Afr Studies* 1999;34:279-97.