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Prevalence of diarrhea and associated risk factors among children under-five years of age in Eastern Ethiopia: A cross-sectional study

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ABSTRACT

Diarrhea remains a major cause of mortality in children under 5 years of age in Sub-Saharan countries in Africa. Risk factors for diarrhea vary by context and have important implications for developing appropriate strategies to reduce the burden of the disease. The objective of this study was to assess the prevalence of diarrhea and associated risk factors among children under 5 years of age in Kersa district, located in Eastern Ethiopia. A community-based cross-sectional study was conducted among 1456 randomly selected households with at least one child under 5 years of age. A questionnaire and an observational check list were used for collecting information on socio-economic characteristics, environmental hygiene and behavioral practices, and occurrence of diarrhea among children under 5 years of age. Logistic regression was used to calculate the adjusted odds ratio of 95% confidence interval. The two-week prevalence of diarrhea among children under 5 years of age was 22.5% (95% CI: 20.3 - 24.6). Improper refuse disposal practices (OR = 2.22, 95% CI: 1.20 - 4.03), lack of hand washing facilities (OR = 1.92, 95%CI: 1.29 - 2.86), living in rural area (OR = 1.81, 95% CI: 1.12 - 3.31), the presence of two or more siblings in a household (OR = 1.74, 95% CI: 1.33 - 2.28), and age of the child (OR= 2.25, 95% CI; 1.5-3.36) were the major risk factors for diarrhea. This study demonstrated that diarrhea morbidity was relatively high among children under 5 years of age residing in Eastern Ethiopia. Efforts to reduce childhood diarrhea should focus on improving household sanitation, personal hygiene, and child birth spacing.

Keywords: Diarrhea; Risk Factor; Children under 5 Years; Ethiopia; Cross-Sectional Study; Hygiene

1. INTRODUCTION

Diarrhea remains the leading cause of morbidity and mortality in children under 5 years old worldwide. The burden is disproportionately high among children in low- and middle-income countries. Young children are especially vulnerable to diarrheal disease and a high proportion of the deaths occur in the first 2 years of life. Worldwide, the majority of deaths related to diarrhea take place in Africa and South Asia. Nearly half of deaths from diarrhea among young children occur in Africa where diarrhea is the largest cause of death among children under 5 years old and a major cause of childhood illness [1-4].

Although some of the factors associated with diarrhea in children in Ethiopia such as Acute Respiratory Infection (ARI), maternal history of recent diarrhea, maternal education, well source of water, obtaining water from storage container by dipping, availability of latrine facilities, living in a house with fewer number of rooms, not breast feeding, duration of breast feeding, and age of the child, have been identified, diarrhea is still a major public health problem among children under 5 years old [5-8].

Epidemiologic studies show that factors determining the occurrence of diarrhea in children are complex and the relative contribution of each factor varies as a function of interaction between socio-economic, environmental and behavioral variables [5,9-11]. Recent research indicated that studies in differing environment and

[*]The authors declare that they have no competing interest.

prioritizing interventions based on context would be useful to prevent deaths from diarrhea [12]. In Ethiopia, despite the high prevalence of the disease, reports from population-based studies are sparse. The study would be helpful in planning and implementation of prevention strategies at the community level. Thus, the objective of this study was to assess the prevalence of diarrhea and associated factors among children of age under five.

2. METHODS

The study was conducted in Kersa Demographic Surveillance and Health Research Center (KDS-HRC) field site, located in Eastern Ethiopia in January 2011. The study site is approximately 482 kilometers from Addis Ababa, and it is divided into 2 urban and 10 rural kebeles (the smallest administrative unit in Ethiopia), with total population of 55,394 residents. Agriculture is the main source of the district's livelihood. Health services in the district are provided by six health centers and28 health posts. At the kebele level, health care is delivered by extension workers who are assigned to render health services at the local level [13].

The sample size was calculated using the formula for estimation of single proportion [14], $n = Z^2*P(1 - P)/r^2$. Where: Z value is 1.96: P is the prevalence of diarrhea among children under-five years old that was assumed to be 18% [15]; and r is the margin error of estimation that was assumed to be 2% (0.02). This provided a sample size of 1417 children. To account for predicted 5% non-response rate, the final sample was 1488 children.

Households with at least one child under 5years of age were eligible for the study. Study participants were selected using a simple random sampling technique from a sampling registry obtained from Kersa Demographic Surveillance and Health Research Center (KDS-HRC) registration book. For households with two or more children under 5 year of age, the index child was selected by a lottery method.

Data were collected using questionnaire tested previously and administered by an interviewer and the observational check list. The questionnaire was prepared based on the Multiple Indicator Cluster Survey (MICS), Demographic and Health Survey (DHS) and World Health Organization (WHO) core questionnaires related to diarrhea. The questionnaire was written in English, translated into Affan Oromo (local language), and then translated back into English to assure its accuracy. The respondents were primarily mothers of eligible children under 5 years of age, but in the absence of the mother, the next primary caregiver was interviewed.

Thirteen individuals who were trained, and experienced in the KDS-HRC questionnaire administration, and were fluent speakers of Affan Oromo collected the data. The data collection was supervised by 3 supervisors at the center. Their role was to daily check the consistency and completeness of the collected questionnaires and re-interview randomly selected 5% of the households to check the data quality. Trained data clerks double entered the data using EpiData 3.1 software.

The primary outcome variable was the occurrence of diarrhea in the 2-week period preceding data collection. The independent variables included socio-economic (residence, family size, caregiver's age, occupation, educational status, parental age, occupation, educational status, number of children under 5 years of age in the household and wealth), environmental (the availability of hand washing facility, latrine, type of and distance from water source, refuse and stool disposal) and behavioral and child-related (child feeding practice, measles vaccination, age and gender of the child) factors.

In this study, diarrhea was defined as the passage of three or more loose stools over 24 hours period or more frequently than normal for a child [16]. Water from protected springs and/or wells, from pipe and from distribution post was considered as improved source [17]. Disposal of child's stool was considered proper if the stool was put into the latrine or buried. The economic status of the households was categorized into poor, middle and better off using wealth index, which was calculated from the households' assets using principal component analysis [18].

Descriptive statistics were used to summarize the study variables. Logistic regression analysis was performed separately for three variable blocks estimated the effect socio-economic, environmental, and behavioral and child related factors. The final model estimated the overall effect of the three blocks of variables. All models used simultaneous entry procedure to select the significant determinants and adjusted for confounding factors. All data were analyzed using SPSS v.16 statistical software (IBM SPSS, Almaden, NY, US).

To reduce excessive number of variables and resulting instability of the model, only variables with significance $P < 0.1$ in the bivariate analysis were considered for inclusion in the multivariable analysis. Variables with $P < 0.05$ in the multivariable analysis were considered significant. Multi-colinearity of variables was assessed by calculating Variance Inflation Factor (VIF).

The study was approved by the Ethic Committee at the College of Health and Medical Sciences of Haramaya University. Mothers or caregivers of children were informed about the study and its objectives before enrollment. A written informed consent was obtained from the mother or caregiver of each participating child. All collected records were kept confidential.

3. RESULT

A total of 1456 households participated in the study with a response rate of 97.8%. Almost all respondents were biological mothers (98.4%), married (97.3%) and housewives (96.7%), most had no formal education (82.2%) and were from rural area (85.3%). Mean children age was 26.6 ± 13.5 months. There was slightly more male (51.9%) than female children (51.9% and 48.1%).

Out of 1456 children, 327 had diarrhea two weeks before the interview, provided a prevalence of 22.5% [95% confidence interval (CI) 20.3% - 24.6%]. Children in the age group 6 - 11 months had the highest prevalence of diarrhea followed by the age groups 12 - 23 months. The distribution of prevalence of diarrhea by socio-economic, environmental and behavioral characteristics is shown in **Tables 1-3**.

Factors Associated with Diarrhea

Multivariate analyses were carried out to identifythe risk factors associated with diarrhea. In the first block logistic regression model, diarrhea was significantly higher among children living in the rural than urban area. In the second model, childhood diarrhea was significantly associated with lack of hand washing facility, domestic water supply from unimproved sources and open dumping of refuse around the house. In the third model, diarrhea was significantly associated with age of the child and number of under-five children in the household.

In the final logistic regression model, diarrhea was independently associated with open dumping of refuse,

Table 1. Socio-economic determinants of diarrhea among children under 5 years of age in Kersa District, Eastern Ethiopia, 2011.

Variables	Diarrhea (N = 1456)		COR (95%) CI
	Yes	No	
Residence			
Urban	27	188	1
Rural	300	941	2.22 (1.45 - 3.39)
Age of mother/caregiver			
15 - 24	70	194	0.75(0.55 - 1.02)
25 - 34	211	778	0.81(0.53 - 1.24)
>34	46	157	1
Education of mother/caregiver			
No formal education	284	950	1.30(0.88 - 1.81)
Primary and above	42	179	1
Occupation of mother/caregiver			
Housewife	317	1091	1.10(0.54 - 2.24)
Other	10	38	1
Education of father			
No formal education	197	719	1.15(0.89 - 1.49)
Primary and above	130	410	1
Family size (persons per household)			
≤4	94	398	1
>4	233	731	1.35(1.03 - 1.76)
Wealth index			
Low	112	373	1.09(0.8 - 1.50)
Middle	106	379	1.03(0.93 - 1.41)
Better off	101	385	1

Table 2. Environmental exposure variables associated with diarrhea among children under 5 years of age in Kersa district, Eastern Ethiopia, 2011.

Variables	Diarrhea		COR (95%) CI
	Yes	No	
Availability of latrine			
Yes	68	325	1
No	259	804	1.54(1.14 - 2.07)
Availability of hand washing facilities			
Yes	40	254	1
No	287	875	2.08(1.45 - 2.98)
Main source of domestic water			
Improved	194	761	1
Unimproved	133	368	1.41(1.10 - 1.82)
Separate room for cooking			
Yes	163	589	1
No	164	540	1.09(0.85 - 1.40)
Refuse disposal			
Waste Pit/burning	57	275	1
Open dumping	27	39	3.34(1.89 - 5.89)
Used for manure	241	813	1.43(1.03 - 1.96)
Child stool disposal			
Proper	106	441	1
Improper	221	688	1.33(1.03 - 1.73)
Time to obtain drinking water (round trip)			
< 15 minutes	118	472	1
15 - 30 minutes	117	392	1.19(0.89 - 1.59)
More than 30 minutes	92	265	1.38(1.01 - 1.89)
Number of sleeping rooms			
One	299	965	1.81(1.19 - 2.76)
Two and more	28	164	1

lack of hand washing facility, rural residence, and number of siblings under 5 years in a household and age of the child. More specifically, children in the households who open dumped refuse around the house had 2.22 times higher odds of having diarrhea compared to children in the households who used a waste disposal pit (OR = 2.22, 95% CI 1.2 - 4.03). The odds of diarrhea was 1.74 times higher in children from the households with two or more siblings compared to children in the households with only one sibling (OR = 1.74, 95% CI 1.33 - 2.28). Children in the households without hand washing facilities had 1.92 times higher odds of having diarrhea compared to children in the households with no hand washing facility(OR = 1.92, 95% CI 1.29 - 2.86) (**Table 4**).

4. DISCUSSION

This study investigated the prevalence and socio-economic, environmental and behavioral risk factors of diarrhea morbidity in children <5 years old in Eastern Ethiopia. The two-week prevalence of diarrhea among the children was 22.5% (95% CI: 20.3 - 24.6). The occurrence

Table 3. Behavioral, child and care related risk factors for diarrhea among children under 5 years of age, Kersa District, Eastern Ethiopia, 2011.

Variables	Diarrhea		COR (95%) CI
	Yes	No	
Bottle feeding (n = 737)			
Yes	36	104	1.05(0.68 - 1.59)
No	159	438	1
Currently breast feeding (n = 737)			
Yes	140	417	1
No	55	125	1.31(0.90 - 1.89)
Duration of breast feeding (n = 737)			
<1 year	121	345	1.07(0.76 - 1.5)
≥1 year	74	197	1
Feeding children soon after food preparation			
Yes	204	668	1.14(0.88 - 1.47)
No	123	461	1
Serving uncooked food to children			
Yes	50	203	0.82(0.58 - 1.15)
No	277	926	1
Measles vaccination (n = 1302)			
Yes	163	610	1
No	130	399	1.21(0.93 - 1.58)
Child sex			
Male	166	590	1
Female	161	539	1.06(0.83 - 1.35)
Number of under 5 sibling per household			
One	144	698	1
Two and more	183	431	2.05(1.60 - 2.64)
Child age (in months)			
0 - 5	4	47	0.40(0.14 - 1.15)
6 - 11	61	114	2.54(1.73 - 3.73)
12 - 23	86	223	1.83(1.31 - 2.56)
24 - 35	84	308	1.29(0.93 - 1.80)
>35	92	437	1

*Measles vaccination is calculated for children 9 months and above; *bottle feeding and breast feeding is calculated for children < 2 years of age.

of diarrhea was positively associated with rural residence, aged 6 to 23 months, open dumping of refuse around the house, lack of hand washing facility and presence two or more children under <5 years old in the household.

The two-week period of diarrhea occurrence used as a criterion in our study is comparable with studies conducted in Western Ethiopia [5], Egypt [19] and India [20]. Such high rate of childhood diarrhea, despite considerable improvements in water sources and sanitation facilities, indicates the need for more attention.

Table 4. Multivariable analysis of risk factors of diarrhea among children under 5 years of age in Kersa district, Eastern Ethiopia, 2011.

Risk factors	Model I AOR (95% CI)	Model II AOR (95% CI)	Model III AOR (95% CI)	Final model AOR (95% CI)
Area of residence				
Urban	1			1
Rural	2.15(1.35 - 3.43)*			1.81(1.12 - 3.31)*
Education mother/caretaker				
No formal education	1.14(0.76 - 1.69)			1.23(0.79 - 1.92)
Primary and above	1			1
Family size				
≤4	1			1
>4	1.30(0.98 - 1.71)			1.13(0.84 - 1.51)
Availability of latrine facility				
Yes		1		1
No		1.13(0.77 - 1.67)		1.14(0.75 - 1.73)
Availability of hand washing facility				
Yes		1		1
No		1.80(1.22 - 2.66)*		1.92(1.29 - 2.86)*
Main source of domestic water		1		1
Improved				
Unimproved		1.35(1.02 - 1.80)*		1.16(0.86 - 1.55)
Time to fetch water (round trip)				
< 15 minutes		1		1
15 - 30 minutes		1.03(0.75 - 1.40)		1.02(0.72 - 1.44)
More than 30 minutes		1.06(0.74 - 1.51)		1.04(0.71 - 1.51)
Refuse disposal				
Waste pit/burning		1		1
Open dumping		2.68(1.51 - 4.79)*		2.22(1.20 - 4.03)*
Used for manure		1.22(0.87 - 1.72)		1.12(0.77 - 1.60)
Child stool disposal				
Proper		1		1
Improper		1.23(0.88 - 1.70)		1.29(0.92 - 1.81)
Number of sleeping rooms				
One		1.43(0.88 - 1.70)		1.40(0.91 - 2.20)
Two or more		1		1
Number of children under 5 in the household				
One			1	1
Two or more			1.93(1.5 - 2.49)*	1.74(1.33-2.28)*
Child age (months)				
0 - 5			0.39(0.13 - 1.11)	0.36(0.12 - 1.04)
6 - 11			2.31(1.56 - 3.41)*	2.25(1.50 - 3.36)*
12 - 23			1.71(1.22 - 2.4)*	1.83(1.29 - 2.60)*
24 - 35			1.30(0.99 - 1.81)	1.34(0.95 - 1.88)
>35			1	1

*= P < 0.05.

The importance of refuse in transmitting diarrhea pathogens has been documented [21]. In our study, open disposal of refuse around the house was an independent risk factor for diarrhea. This is in agreement with other studies conducted elsewhere [22,23]. The simple explanation might be that inappropriate disposal of refuse provides breeding site for insects, which may carry diarrhea pathogens from the refuse to water and food.

Studies showed the importance of hand washing in reducing the occurrence of childhood diarrhea [24,25]. However, monitoring correct hand washing behavior at critical times is challenging. Hygiene behavior related observational studies showed wide discrepancy between what people said and did and suggested that reported hand washing behavior over estimate observed behavior [26-28] and supported the availability of water and soap in places of hand washing as indicator of hand washing behavior [29]. In this study, there was a significant positive association between the availability of hand washing facility with childhood diarrhea.

The study showed that diarrhea was significantly associated with children in the age groups 6 - 11 months and 12 - 23 months compared to children aged above 35 months. This finding is in agreement with other studies [5,9]. The peak prevalence of diarrhea at the age of 6 - 11 months can be explained by the introduction of contaminated weaning foods [30]. In addition, crawling starts at this age and the risk of ingesting contaminated materials may cause diarrhea. The risk of diarrhea decreases subsequently after 6 - 11 months; this is probably because the children begin to develop immunity to pathogens after repeated exposure [31].

The odds of diarrhea were higher among rural children than urban ones and this was consistent with the findings in Uganda [11] and Egypt [19]. This could be attributed to the fact that the lack of access to water and sanitation facilities in the rural areas was more than in the urban areas [32].

In this study, diarrhea was significantly associated with the presence of two or more under five children in the family. This is in agreement with a study done in Pakistan [33]. Other study also indicated that number of children born was a predictor of diarrhea among under five children [34]. This might be due to the incapability of the caregiver to care for a large number of children [19]. It is possible to suggest that child birth spacing might have a positive influence on prevention of diarrhea.

In conclusion, childhood diarrhea remains an important health concern in the study community. Occurrence of diarrhea could be decreased by interventions aimed to improve sanitation, hygiene and child birth spacing.

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