

Socio-demographic, environmental and behavioural factors of the prevalence of diarrhea among children age under-five years in Rural Ethiopia: A Cross-Sectional Study

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Research article

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Abstract

Background : Diarrhea is one of the major contributors to deaths for under age five children in Ethiopia. Studies conducted in different countries showed that rural children are highly affected by diarrhea than urban children. Thus, the purpose of this study was to identify the socio-demographic, environmental and behavioural risk factors of the prevalence of diarrhea among children age under five years in Rural Ethiopia. **Methods:** Data for the study was drawn from the 2016 Ethiopia Demographic and Health Survey. A total of 8,041 under-five children were included in the study. Bivariate and multivariable binary logistic regression were employed for the analysis of the data to assess the relationships between the prevalence of diarrhea and socio-demographic, environmental and behavioural risk factors among under five children. Data was analyzed using SPSS version 23. **Results :** The multivariable logistic regression analysis revealed that younger mothers' children and child's age 6-11 months (AOR: 3.5; 95% CI: 2.58-4.87), 12-23 months (AOR: 3.1; 95% CI: 2.33-4.04) and 24-35 months (AOR: 1.7; 95% CI: 1.26-2.34) were significantly associated with diarrhea. The two week prevalence of diarrhea was also significantly associated with male children (AOR: 1.3; 95% CI: 1.05-1.58), Children in rural Afar and Gambela regions, households who shared toilet facilities with other households (AOR: 1.4; 95% CI: 1.09-1.77), higher birth order number and households with 3 or more under-five children interacted with older mothers (AOR: 4.7; 95% CI: 1.64-13.45). **Conclusion:** The prevalence of diarrhea among under-five children was strongly associated with younger mothers, child's age between 6-35 months, male children, children in rural part of Afar and Gambela regions, children with higher birth order numbers, those who shared toilet facility with other households and households with 3 or more number of under-five children interacted with older mothers/primary caregivers. Thus, in order to reduce childhood diarrhea, I suggest that child's health care programs and other efforts in Ethiopia should give special attention to those categories of children who had highly affected by diarrhea.

Background

Diarrhoeal disease is the second leading cause of death in children under five years old, and is responsible for killing around 525,000 children every year. Globally, there are nearly 1.7 billion cases of childhood diarrhoeal disease every year [1]. Each year, an estimated 2.5 billion cases of diarrhea occur among children under five years of age, and estimates suggest that overall incidence has remained relatively stable over the past two decades. More than half of these cases are in Africa and South Asia. More than 80 percent of child death due to diarrhea occur in Africa and South Asia [2].

Low and lower-middle income countries are home to 62 percent of the world's under 5 population, but account for more than 90 percent of global pneumonia and diarrhea deaths [3]. In low-income countries, children under three years old experience on average three episodes of diarrhoea every year [1]. The 2005, 2011 and 2016 Ethiopia demographic and health survey reports showed that the percentage of children under age five who had diarrhea in the 2 weeks before the survey period were 18%, 13% and 12%, respectively. Even though the magnitude of diarrhea have reduced over the past periods, diarrheal

disease is still the major cause of morbidity and mortality among children in Ethiopia. Based on UNICEF report, in Ethiopia 15,500 diarrhoea deaths was occurred among children in 2015 [3].

In Ethiopia, studies conducted in different parts of the country documented many factors associated with under five diarrheal disease. Socio-demographic, economic, water, sanitation, and hygiene factors were predictors of the diarrheal illness. A study conducted in Benshangul Gumuz region, Ethiopia, revealed that low maternal education, improper child stool disposal methods, having more than two under-five children, high birth order and the age of children were the risk factors of childhood diarrhea [4].

Evidence based information is needed for child's health improvement strategy by preventing and reducing the severity of diarrheal in under-five children. Studies conducted in different countries showed that rural children are highly affected by diarrhea than urban children [11, 26, 27]. In rural Ethiopia, despite the high prevalence of diarrhea disease, there are limited studies available at District/Zone, but no at country level, to show the significant associated factors of diarrhea occurrence among under-five children in the rural part of the country. Thus, this study was planned to identify the socio-demographic, environmental and behavioral risk factors of the prevalence of diarrhea among children age under-five years in rural Ethiopia.

Methods

Study Design and Setting

Data for the study were drawn from the 2016 Ethiopia Demographic and Health Survey which was population based cross sectional study conducted from January 18, 2016, to June 27, 2016, based on a nationally representative sample that provides estimates at the national and regional levels and for urban and rural areas. The survey was the fourth survey in the country.

Sampling Design

The sampling frame used for the 2016 EDHS was the frame of the Population and Housing Census conducted in Ethiopia in 2007 and provided by the Central Statistical Agency (CSA). The 2016 EDHS sample is stratified and was selected in two stages. Each region was stratified into urban and rural areas, which yielded 21 sampling strata. Samples of EAs were selected independently in each stratum in two stages. In 2016 EDHS a representative sample of approximately a total of 10,641 under five children representing the number of live births born to the interviewed mothers in the period of five years preceding the date of the survey were included. Out of these children, 9,916 interviewed mothers/caregivers gave complete response about the two week prevalence of diarrhea among their under-five children in Ethiopia. Then, after a certain rearrangement and reorganization of the data 8,041 children with complete information were used as the data for this study.

Study Variables

The response variable was the reported occurrence of diarrhea. The respondent/primary caregiver was asked if the child had diarrhea in the last two weeks including the last 24 hours prior to data collection

time.

The independent variables included in the study were identified from literatures conducted earlier and associated with occurrence of diarrheal occurrences among children under five years of age. These are the Socio-demographic variables (respondents current age, sex of child, current age of child, child lives with whom, region, respondents educational level, respondents religion, birth order, respondents work status, household wealth index, number of children under five in the household, current marital status, current breastfeeding status, number of household members), Environmental and behavioural variables (source of drinking water, type of toilet facility, if toilet facility is shared with other households, disposal of youngest child's stools when not using toilet and main floor material).

Data Analysis Methods

After the extracted data were checked for completeness and coded, the analyses were done using both SPSS Version 23. Both descriptive and inferential data analysis methods were used in the study. Data was described and summarized through frequency distribution tables, Cross-tabulation (Contingency tables) and charts.

To study the effect of the different predictor variables on the outcome variable, bivariate and multivariable analysis were used. In bivariate analysis, Chi-square test of association and Crude odds ratio were estimated to assess the association between each of the predictor variables and the outcome variable. Significant variables at P-value < 0.25 in the bivariate analysis were only used in the multivariable analysis.

In multivariable analysis, **multilevel** binary logistic regression was proposed to handle the effect of the variation of average value of the response variable among the study regions. However, during the analysis, the variation of the intercepts among the regions were not statistically significant in the random effect result meaning the regions did not differ with respect to the average value of the prevalence of diarrhea. As a result, multivariable binary logistic regression was used instead to study the overall effect of the socio-demographic, environmental and behavioural risk factors on the response variable (Prevalence of diarrhea).

Backward stepwise method was used to select variables for the best reduced model and Wald-test was used to test individual significance of the coefficients of the model. The overall goodness of the final model was checked using Hosmer-Lemeshow goodness-of-fit test. Interpretations of the strength of the associations between the risk factors and the response variable were based on significant Adjusted Odds Ratios (AOR) with 95% confidence intervals at 5% level of significance (P-value <0.05).

Results

Descriptive Results of Socio-demographic, Environmental and behavioural characteristics

The study included 8,041 under-five children and their mothers or caregivers. Out of these 49% were females, 11.1% of children were less than 6 months old and 40.6% of them were age greater than 35 months. The majority of the children (67.9%) were currently breastfeeding at the time of the survey, very few children (1.7%) were lives with someone else. Regarding mothers/caregivers, 5,801(72.1%) had no formal education, 95.2% were married, 50.7% mothers were between 25-34 years old, 24.7% were 35 years old and above. Around 60% of the households had 6 and above family members [Table 1].

Out of the total 8,041 households, 46.7% have used unimproved source of drinking water, 61.2% of mothers/caregivers were not properly removed youngest child's stools, there were 41% unimproved sanitation (toilet facility) and 51.6% no toilet facility in the household [Table 2].

Table 1: Socio-demographic characteristics of respondents among under-five children and their bivariate analysis with Prevalence of Diarrhea in Rural Ethiopia

Variables	Had Diarrhea recently		Total (%)	-test
	No (%)	Yes (%)		P-value
Current Age of respondent (year)				0.040
15-24	1724 (21.4)	248 (3.1)	1972(24.5)	
25-34	3610 (44.9)	470(5.8)	4080 (50.7)	
35-49	1803(22.4)	186(2.3)	1989(24.7)	
Sex of child				0.042
Male	3613(44.9)	490(6.1)	4103(51.0)	
Female	3524(43.8)	414(5.1)	3938(49.0)	
Current Age of child				0.000
<6 month	816(10.1)	75(.9)	891(11.1)	
6-11	650(8.1)	151(1.9)	801(10.0)	
12-23	1243(15.5)	274(3.4)	1517(18.9)	
24-35	1378(17.1)	189(2.4)	1567(19.5)	
>35 month	3050(37.9)	215(2.7)	3265(40.6)	
Education of Mother/caregiver				0.005
No formal education	5182(64.40)	619(7.70)	5801(72.10)	
Primary	1667(20.70)	245(3.00)	1912(23.80)	
Secondary	235(2.90)	35(0.40)	270(3.40)	
higher	53(0.70)	5(0.10)	58(0.70)	
Region				0.000
Tigray	726(9.00)	94(1.20)	820(10.20)	
Afar	787(9.80)	92(1.10)	879(10.90)	
Amhara	725(9.00)	113(1.40)	838(10.40)	
Oromia	1250(15.50)	164(2.00)	1414(17.60)	
Somali	1032(12.80)	74(0.90)	1106(13.80)	
Benishangul	692(8.6)	73(0.90)	765(9.50)	
SNNPR	946(11.80)	158(2.00))	1104(13.70)	
Gambela	431(5.40)	60(0.70)	491(6.10)	
Harari	320(4.00))	44(0.50)	364(4.50)	
Dire Dawa	228(2.80)	32(0.40)	260(3.20)	
Number of under 5 children in h.h.				0.001
2 or less	5589(69.50)	753(9.40))	6342(78.90)	
3 and above	1548(19.30)	151(1.90)	1699(21.10)	
Wealth index of the household				0.015
Poor	4649(57.80)	545(6.80)	5194(64.60)	
Middle	1167(14.50)	165(2.10)	1332(16.60)	
Rich	1321(16.40)	194(2.40)	1515(18.80)	
Birth order number				0.185
1 st order	1195(14.90)	167(2.10)	1362(16.90)	
2 nd	1103(13.70)	121(1.50)	1224(15.20)	
3 rd	1011(12.60)	141(1.80)	1152(14.30)	
4 th	935(11.60)	127(1.60)	1062(13.20)	
5 th and above	2893(36.00)	348(4.30)	3241(40.30)	
Religion of the respondent				0.011
Orthodox	1859(23.10)	249(3.10)	2108(26.20)	
Catholic	40(0.50)	6(0.10)	46(0.60)	
Protestant	1291(16.10)	201(2.50)	1492(18.60)	
Muslin	3801(47.30)	431(5.40)	4232(52.60)	

Traditional/other	146(1.80)	17(0.20)	163(2.00)	
Respondent's Current work status				0.053
Not working	5390(67.00)	656(8.20)	6046(75.20)	
Working	1747(21.70)	248(3.10)	1995(24.80)	
Respondent's Marital status				0.242
Married/Living with partner	6805(84.60)	854(10.60)	7659(95.20)	
Widowed/separated/never in union	332(4.10)	50(0.60)	382(4.80)	
Number of household members				0.046
5 and fewer	2872(35.70)	395(4.90)	3267(40.60)	
6 and above	4265(53.00)	509(6.30)	4774(59.40)	
Child lives with whom				0.141
Respondent	7010(87.20)	894(11.10)	7904(98.30)	
Someone else/Lives elsewhere	127(1.60)	10(0.10)	137(1.70)	
Currently breastfeeding				0.002
No	2333(29.00)	249(3.10)	2582(32.10)	
Yes	4804(59.70)	655(8.10)	5459(67.90)	

X^2 = Chi-square

Table 2: Environmental and Behavioral characteristics of respondents among under-five children and their bivariate analysis with Prevalence of Diarrhea in the selected regions of Ethiopia

Variables	Had Diarrhea recently		Total (%)	-test
	No (%)	Yes (%)		P-value
Source of drinking water				0.689
improved water	3763(47.30)	478(6.00)	4241(53.30)	
unimproved	3305(41.60)	408(5.10)	3713(46.70)	
Type of toilet facility				0.034
improved sanitation	530(6.70)	59(0.70)	589(7.40)	
unimproved sanitation	2863(36.00)	399(5.00)	3262(41.00)	
No Facility/bush/field	3675(46.20)	428(5.40)	4103(51.60)	
Toilet facilities shared with other h.h.				0.041
No	2648(68.80)	338(8.80)	2986(77.50)	
Yes	745(19.30)	120(3.10)	865(22.50)	
Disposal of youngest child's stools				0.07
proper disposal	1754(33.80)	259(5.00)	2013(38.80)	
improper disposal	2816(54.30)	355(6.80)	3171(61.20)	
Main floor material				0.634
Natural floor	6594(82.90)	819(10.30)	7413(93.20)	
Rudimentary floor	63(0.80)	9(0.10)	72(0.90)	
Finished floor	411(5.20)	58(0.70)	469(5.90)	

X^2 = Chi-square

Magnitude of under-five Diarrhea

The overall prevalence of diarrhea among under-five children two weeks before the survey was 11.2% in rural Ethiopia. Result displayed in Tables 1 and 2 showed that the prevalence of diarrhea was the highest among children lives with respondents (11.1%), who used unimproved sanitation (10.4%), and lived in natural floor material (10.3%). The highest magnitude of diarrhea was also observed on child's still breastfeeding (8.1%), non-educated mothers (7.7%), current age of mother's/caregivers 25-34 years (5.8%) and child's age 12-23 months (3.4%).

Results of Bivariate and Multivariable Logistic Regression Analysis

In Bivariate analysis, the chi-square test result in Tables 1 and 2 and the estimated crude odds ratios in Table 3 showed that there were a significant association between prevalence of diarrhea and variables respondent's current age, sex of child, current age of child, education of mother/caregiver, region, number of under-five children, wealth index of the household, religion, Number of household members, current breastfeeding status, Type of toilet facility and toilet facilities shared with other households at 5% level of significance.

In multivariable binary logistic regression, the overall effect of the socio-demographic, environmental and behavioural risk factors on the prevalence of under-five diarrhea was assessed. The result showed that mother's current age, current age of child, sex of child, region, birth order, toilet facilities shared with other households and number of under-five children interacted with mother's current age were statistically significant risk factors of diarrheal occurrence among under five children at 5% level of significance [Table 3]. The Hosmer-Lemeshow goodness-of-fit test result (Chi-square statistic value = 4.953, df =8, Sig. =0.763) showed that the final model was a good model to fit the data. For selected variables in the final model, the estimated crude odds ratio (COR), adjusted odds ratio (AOR) and their 95% confidence interval are included in Table 3.

Table 3: Multivariable binary logistic regression analysis of the effects of socio-demographic and environmental risk factors of prevalence of diarrhea among under-five children in Rural Ethiopia (the final reduced model)

Variables	Had Diarrhea recently		COR(95% CI)	AOR(95% CI)
	No (%)	Yes (%)		
Current Age of respondent (35-49)	1724 (21.4)	248 (3.1)	---	---
15-24	3610 (44.9)	470(5.8)	.905(.768, 1.067)	.659(.469, .926)*
25-34	1803(22.4)	186(2.3)	.717(.586, .877)**	.364(.230, .577)**
Sex of child (Female)	3524(43.8)	414(5.1)	---	---
Male	3613(44.9)	490(6.1)	1.154(1.005, 1.326)*	1.291(1.054, 1.581)*
Current Age of child (>35 month)	3050(37.9)	215(2.7)	---	---
<6 month	816(10.1)	75(.9)	1.304(.991, 1.715)	1.343(.908, 1.988)
6-11	650(8.1)	151(1.9)	3.296(2.63, 4.13)**	3.545(2.580, 4.872)**
12-23	1243(15.5)	274(3.4)	3.127(2.59, 3.78)**	3.071(2.334, 4.041)**
24-35	1378(17.1)	189(2.4)	1.946(1.58, 2.39)**	1.717(1.262, 2.336)**
Region (Tigray)	726(9.00)	94(1.20)	----	---
Afar	787(9.80)	92(1.10)	.903(.666, 1.224)	1.915(1.008, 3.640)*
Amhara	725(9.00)	113(1.40)	1.204(.899, 1.613)	1.512(.931, 2.456)
Oromia	1250(15.50)	164(2.00)	1.013(.774, 1.327)	1.237(.800, 1.913)
Somali	1032(12.80)	74(0.90)	.554(.403, .762)**	.417(.217, .802)**
Benishangul	692(8.6)	73(0.90)	.815(.590, 1.125)	.954(.597, 1.525)
SNNPR	946(11.80)	158(2.00)	1.290(.982, 1.695)	1.393(.904, 2.146)
Gambela	431(5.40)	60(0.70)	1.075(.761, 1.518)	2.117(1.177, 3.809)*
Harari	320(4.00)	44(0.50)	1.062(.725, 1.555)	.888(.486, 1.621)
Dire Dawa	228(2.80)	32(0.40)	1.084(.707, 1.663)	.721(.314, 1.655)
Birth order number (1st order)	1195(14.90)	167(2.10)	---	---
2 nd	1103(13.70)	121(1.50)	.785(.613, 1.006)	.915(.627, 1.337)
3 rd	1011(12.60)	141(1.80)	.998(.786, 1.268)	1.478(.985, 2.218)
4 th	935(11.60)	127(1.60)	.972(.760, 1.243)	1.811(1.175, 2.792)**
5 th and above	2893(36.00)	348(4.30)	.861(.707, 1.048)	1.853(1.220, 2.814)**
Toilet facilities shared with other household (No)	2648(68.80)	338(8.80)	---	---

Yes	745(19.30)	120(3.10)	1.262(1.009, 1.578)*	1.387(1.088, 1.768)*
No. of under 5 children*Age of Mother ((2 or less)*(15-24))				---
NoChildU5() by ageM(25-34)				2.463(.963, 6.298)
NoChildU5() by ageM(35-49)				4.702(1.64, 13.45)**
Constant				0.059**

The reference categories are those indicated in brackets

*Statistically significant variables at $p < 0.05$; **statistically significant variables at $p < 0.01$

COR= crude odds ratio, AOR= adjusted odds ratio, CI= confidence interval

Discussion

Chi-square test of association and bivariate logistic regression analyses were conducted to assess the relation between prevalence of under-five diarrhea and the selected variables. The bivariate analysis result showed that there were a significant association between prevalence of diarrhea with respondent's current age, sex of child, current age of child, education of mother/caregiver, region, number of under-five children, wealth index of the household, religion, number of household members, current breastfeeding status, type of toilet facility and toilet facilities shared with other households.

As we have seen from Table 3 above, in the multivariable binary logistic regression analysis, the variables mother's current age, current age of child, sex of child, region, birth order, toilet facilities shared with other households and number of under-five children interacted with mother's current age were statistically significant at 5% level of significance and then for this study they become an important risk factors for under-five diarrhea disease occurrence. The constant was also significant. However, variables education of mother/caregiver, wealth index of the household, religion, number of household members, current breastfeeding status and type of toilet facility, which were significant in bivariate analysis, became insignificant in multivariable analysis.

The constant coefficient indicated that the odds of diarrhea occurrence in rural Ethiopia decreased by 94% (AOR: 0.059) if the effect of those factors included in the final model were zero.

Current age of mothers/primary caregivers had a significant association with diarrhea. The odds of diarrhea were higher among younger mothers' children than older mothers' children. The odds of diarrhea for children whose mothers' age between 25-34 years (AOR: 0.659; 95% CI: 0.469-0.926) and 35-49 years (AOR: 0.364; 95% CI: 0.230-0.577) were 34% and 53% lower than children whose mothers' age between 15-24 years keeping the effect of other variables as constant. This result was consistent with the findings in Northern Nigeria [10].

The odds ratios of under-five diarrhea for current child's age 6- 11, 12-23 and 24-35 months as compared to child's age greater than 35 months were 3.5(95% CI: 2.580-4.872), 3.1(95% CI: 2.334-4.041) and

1.7(95% CI: 1.262-2.336) respectively. These indicated that child's age group 6-11, 12-23 and 24-35 months had 3.3, 3.1 and 1.7 times more likely to be affected by diarrhea than child's age greater than 35 months respectively when adjusting the effect of other variables. In general, children age greater than 35 months had lower risk of having diarrhea than children whose age between 6-35 months. This may be due to the fact that children whose age between 6 and 23 months begin supplementary foods and also they start crawling and can touch contaminated materials in unclear environment and immediately return their hand to mouse, so it may cause them to easily vulnerable to diarrhea. This finding is in line with studies done in Benishangul region, Farta Woreda, Eastern Ethiopia, Enderta woreda, and Wolitta Soddo [4, 5, 11, 12, 13].

Sex of child had significant association with diarrhea prevalence. Male children had 1.3 times more likely affected by diarrhea than female children (AOR: 1.291; 95% CI: 1.054-1.581).

The study also revealed that prevalence of diarrhea was significantly associated with region of the respondent. Children in rural Afar and Gambela regions had around 2 times more affected by diarrhea as compared to children in rural Tigray region. However, rural Somali region's children were 45% less likely affected by diarrhea than rural Tigray region's children.

Children whose birth order number 4th (AOR: 1.811; 95% CI: 1.175-2.792) and 5th and above (AOR: 1.853; 95% CI: 1.220-2.814) were around 1.8 times more likely affected by diarrhea than 1st order children. This result was consistent with the findings in Benishangul Gumuz region [4].

Households who shared toilet facility with other households had a significant association with diarrheal disease. Children from households who shared toilet facility with other households had around 39% more risk for having diarrhea than children from households who did not shared toilet facilities (AOR: 1.387; 95% CI: 1.088-1.768).

The odds of the occurrence of diarrhea was 4.7 times more likely to be higher among household with 3 or more under-five children interacted with older mothers as compared with 2 or less under-five children of younger mothers (AOR: 4.702; 95% CI: 1.64-13.45). The 95% confidence interval also suggest that the rate (relative risk of being affected by diarrheal disease) for household with 3 or more under-five children interacted with older mothers could be as low as 1.64 and as high as 13.45. This finding is consistent with a study done in Benishangul Gumuz region [4] and in eastern Ethiopia [11].

Conclusion

This study was intended to identify demographic, environmental and behavioural risk factors of the prevalence of diarrhea among under-five years children in rural Ethiopia based on 2016 EDHS data. Fourteen socio-demographic factors and five environmental and behavioural factors were included in the study. The results of the study identified that current age of mother/primary caregiver, current age of child, sex of child, region, birth order number, toilet facilities shared with other households and number of

under-five children interacted with mother's current age as an important risk factors for diarrhea occurrence among under-five children in rural Ethiopia.

High prevalence of diarrhea was associated with younger mothers, child's age between 6-35 months, male children, children in rural part of Afar and Gambela regions, children with higher birth order numbers, those who shared toilet facility with other households and more than or equal to 3 number of under-five children of older mothers/primary caregivers. Thus, in order to protect children from diarrhea disease, I recommend that child's health care programs, policies, plans and any other efforts in the study areas should give special attention to those categories of children who had highly affected by diarrhea.

List Of Abbreviations

AOR: Adjusted Odds Ratio

CI: Confidence interval

COR: Crude odds Ratio

CSA = Central Statistical Agency

DHS= Demographic and Health Survey

EDHS=Ethiopia Demographic and Health Survey

SNNPR: Southern Nations, Nationalities, and People's Region

Declarations

Ethics approval and consent to participate

Ethical clearance for the 2016 EDHS was provided by the Ministry of Health ethics committee, the National Research Ethics Review Committee (NRERC), the Institutional Review Board of Inner City Fund (ICF) at DHS program internationally, and the Government of Ethiopia. All respondents to the survey provided verbal informed consent. The Author obtained the 2016 EDHS data by written request from Central Statistical Agency in Ethiopia. Furthermore, the Author also obtained the 2016 EDHS data in different reading format by filling a request form online at the DHS program, USAID (www.DHSprogram.com).

Consent for publication

Not applicable.

Availability of data and materials

The general datasets are available from the Central Statistical Agency or the DHS Program data home, USAID. Specifically, the data used for this study is available from the corresponding author on reasonable request.

Competing interests

The author declares that he has no competing interests.

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Author's contributions

The Author, MMF, designed the study, performed the statistical data analysis, interpreted the results and prepared the manuscript. The author also read and approved the final manuscript.

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Reference

1. *Diarrhoeal Disease*: a report on May 02, 2017.
2. UNICEF/WHO. *Diarrhoea: Why Children are Still Dying and What can be done*, 2009.
3. *One is too many: Ending child deaths from pneumonia and diarrhea. Every breath count*. Published on November 2016.
4. Mihrete TS, Alemie GA, Teferra AS. Determinants of childhood diarrhea among under five children in Benishangul Gumuz regional state, North West Ethiopia. *BMC Pediatric*. 2014; 14(1):102.
5. Gedamu G, Kumie A, Haftu D. Research Magnitude and Associated Factors of Diarrhea among Under Five Children in Farta Wereda, North West Ethiopia. *Insight Medical Publishing Group: Quality in Primary Care*. 2017; 25 (4): 199-207.
6. *CHERG-WHO Methods and Data Sources for Child Causes of Death 2000 2012: Global Health Estimates Technical Paper*. 2014.

7. Central Statistical Agency. The 2011 Ethiopian Demographic and Health Survey report; Addis Ababa, Ethiopia. 2013
8. Central Statistical Agency (CSA) [Ethiopia] and ICF. 2016. *Ethiopia Demographic and Health Survey 2016*. Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF.
9. Getachew A, Guadu T, Tadie A, Gizaw Z, Gebrehiwot M, Cherkos DH, et al. Diarrhea Prevalence and Sociodemographic Factors among Under-Five Children in Rural Areas of North Gondar Zone, Northwest Ethiopia. *Hindawi International Journal of Pediatrics*. Volume 2018; Article ID 6031594.
10. Hussein H. Prevalence of Diarrhea and Associated Risk Factors in Children Under Five Years of Age in Northern Nigeria: A Secondary Data Analysis of Nigeria Demographic and Health Survey 2013. *Uppsala University*, 2017. <https://pdfs.semanticscholar.org/4ba3/89920e9e707cc11f6791aa835d52fdfa8b97.pdf>
11. Mengistie B, Berhane Y, Worku A. Prevalence of diarrhea and associated risk factors among children under-five years of age in Eastern Ethiopia: A cross-sectional study. *Open Journal of Preventive Medicine*. 2013; Vol.3, No.7: 446-453.
12. Berhe H, Mihret A, Yitayih G. Prevalence of Diarrhea and Associated Factors among Children Under-Five Years of Age in Enderta Woreda, Tigray, Northern Ethiopia, 2014. *International Journal of Therapeutic Applications*, 2016; Vol 31: 32-37.
13. Alambo KA. The Prevalence of Diarrheal Disease in under Five Children and associated Risk Factors in Wolitta Soddo Town, Southern, Ethiopia. *ABC Research Alert*. 2015; V3:2.
14. Nsabimana J, Mureithi C, Habtu M. Factors Contributing to Diarrheal Diseases among Children Less than Five Years in Nyarugenge District, Rwanda. *J Trop Dis*, 2017; 5:3.
15. Alebel A, Tesema C, Temesgen B, Gebrie A, Petrucka P, Kibret G D. Prevalence and determinants of diarrhea among under-five children in Ethiopia: A systematic review and metaanalysis. *PLoS ONE*. 2018; 13(6). e0199684.
16. Charles OO. Risk Factors Associated With Under-Five Diarrhoea in Kenya. *University of Nairobi, Kenya*. <http://erepository.uonbi.ac.ke:8080/xmlui/handle/123456789/11395>
17. Hashi A, Kumie A, Gasana J. Prevalence of Diarrhoea and Associated Factors among UnderFive Children in Jigjiga District, Somali Region, Eastern Ethiopia. *Open Journal of Preventive Medicine*. 2016; 6: 233-246.
18. Messelu Y, Trueha K. Application of Multilevel Binary Logistic Regressions Analysis in Determining Risk Factors of Diarrheal Morbidity among under Five Children in Ethiopia. *Public Health Research*. 2016; 6(4): 110-118.
19. WHO/UNICEF. *Progress on sanitation and drinking-water: 2010 update*. 2012.
20. Ameyaw R, Ameyaw E, Acheampong AO, Appiagyeyi P. Diarrhoea among Children Under Five Years in Ghana. *Glob J Res Rev*. 2017; 4:2.
21. Dagneu AB, Tewabe T, Miskir Y, Eshetu T, Kefelegn W, Zerihunet K, et al. Prevalence of diarrhea and associated factors among under-five children in Bahir Dar city, Northwest Ethiopia, 2016: a cross-sectional study. *BMC Infectious Disease*. 2019; 19:417.

22. Mulugeta T. Socio-Economic, Environmental, and Behavioural Factors Associated With the Occurrence of Diarrhoeal Disease Among Under-Five Children, Meskanena Mareko Woreda, Southern Ethiopia. *Semantic Scholar*. 2003.
23. Bizuneh H, Getnet F, Meressa B, Tegene Y, Worku G. Factors associated with diarrheal morbidity among under-five children in Jigjiga town, Somali Regional State, eastern Ethiopia: a cross-sectional study. *BMC Pediatrics*. 2017; 17:182.
24. Woldu W, Bitew BD, Gizaw Z. Socioeconomic factors associated with diarrheal disease among under-five children of the nomadic population in northeast Ethiopia. *Tropical Medicine and health*. 2016; 44:40.
25. Beyene H, Deressa W, Kumie A, Grace D. Determinants of diarrhoeal morbidity: The case of children under five years of age among agricultural and agropastoralist community of southern Ethiopia. *J. Health Dev*. 2018; 32(1).
26. Bbaale E. Determinants of diarrhoea and acute re- spiratory infection among under-fives in Uganda. *Aus- tralasian Medical Journal*. 2011; 4:400-409. <http://dx.doi.org/10.4066/AMJ.2011.723>
27. El-Gilany AH and Hammad S. Epidemiology of diarrhoeal diseases among children under age 5 years in Dakahlia, Egypt. *Eastern Mediterranean Health Journal*. 2005; 11: 762-775.

Figures

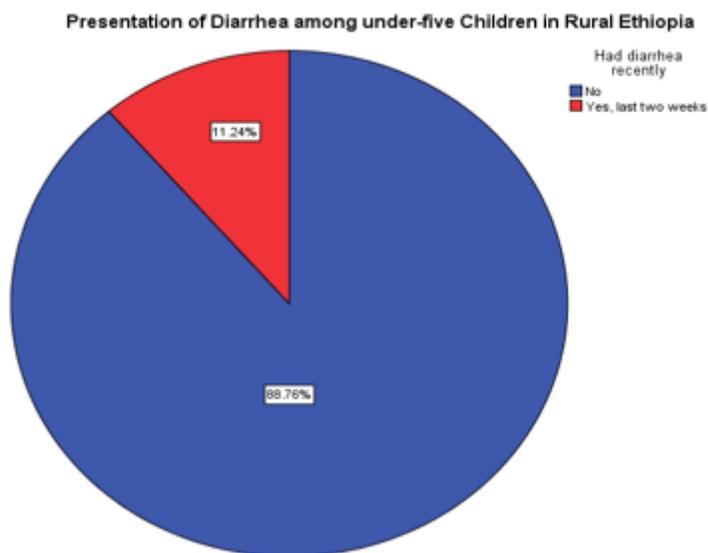


Figure 1

Overall prevalence of diarrhea among rural children in Ethiopia. A diagrammatic presentation using Pie-chart. The area colored red shows the proportion of diarrhea, which covered 11.24% of the total area of the chart.

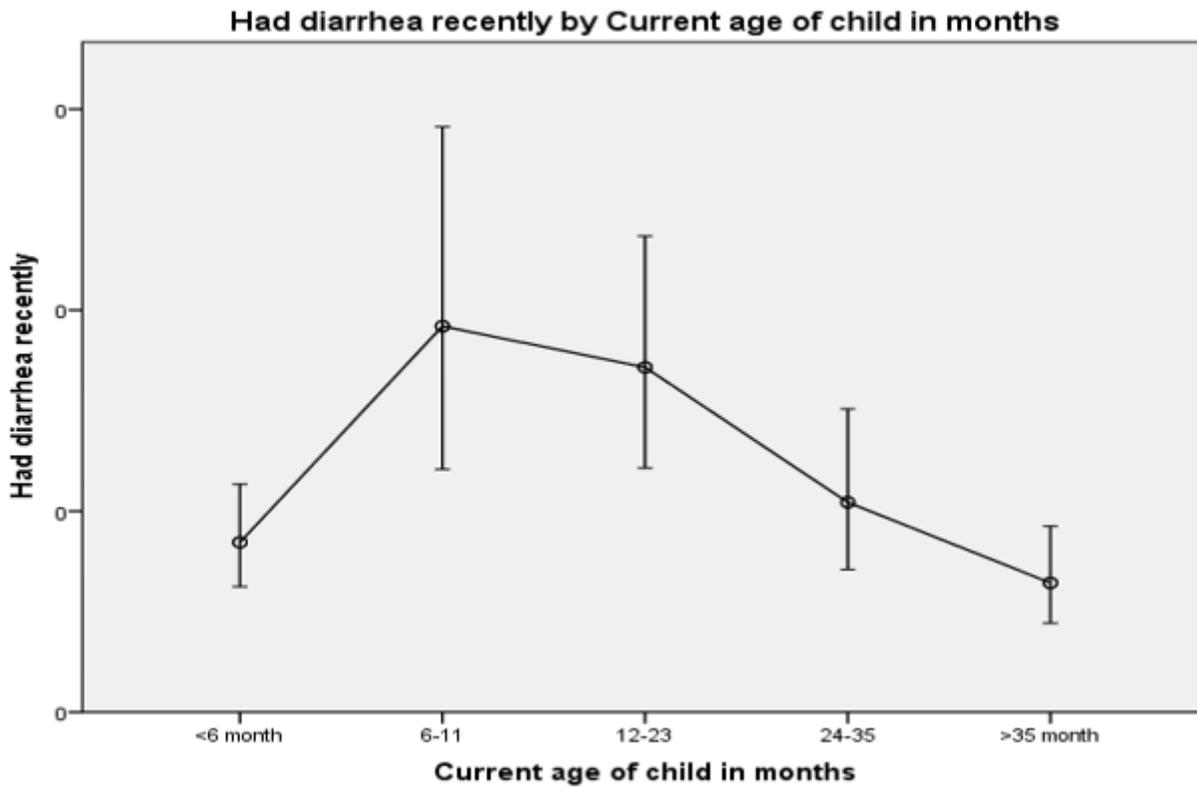


Figure 2

Estimated Marginal Means of age of children on Diarrhea occurrence. An output, estimated for top significant fixed effects, obtained in the multilevel logistic regression analysis. The line with its boundary shows the occurrence of diarrhea, on average, highly increases among children age from 6 months to 11 months, and gradually decreases to age 35 months and above.