Original article

A case control study on determinants of diarrheal morbidity among under-five children in Wolaita Soddo Town, Southern Ethiopia

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Abstract

Background: Diarrheal disease is the most common cause of illness and the second leading cause of child death in the world. The disease accounts for 4.3% of the total global disease burden; the burden being greatest in the developing world including Ethiopia.

Objective: The aim was to assess potential determinant factors associated with diarrheal morbidity among under-five children in Wolaita Soddo Town, South Ethiopia.

Methods: A community-based case control study on 198 cases and 396 controls was conducted in Southern Ethiopia; cases were under-five children with diarrhea in the last 15 days of recall period. Three *kebeles* (one *kebele* from each sub-city) were first selected by a lottery method. Then a house to house survey was conducted to enumerate under-five children in the selected *kebeles*. During the enumeration identification number was given for the households with name and age of the child which was used as a sampling frame for the selecting cases and controls. .For each case, two controls were selected randomly. Odds ratios with 95% confidence intervals were calculated to show the strength of association.

Results: The odds of developing diarrheal morbidity was 2.6 times higher among children with fathers having no formal education compared to those with fathers educational status of high school completed (Adj OR=2.56, 95% CI:1.25, 5.25). Cases were about 4 times higher among families perceived that were to be economically very poor compared to families perceived rich or medium (Adj OR=.3.84, 95% CI:1.25, 11.82). Children in households with no latrine were about 13.5 times (Adj OR=13.45, 95% CI:3.58, 50.49) more likely to develop diarrhea compared to children with households with latrines. Treatment of drinking water showed a significant odds (Adj OR=2.34, 95% CI:1.33, 4.14) of developing diarrhea. Similarly, diarrheal diseases were higher among children whose mothers have poor knowledge of transmission methods and those who washed hands less frequently compared to those who did.

Conclusion: Poor housing, poor sanitation conditions, poor personal hygiene, and lack of relevant knowledge are strongly associated with the occurrence of diarrheal disease among children of under-five years of age. Health education should be given to the public especially to mothers and caretakers on personal hygiene. [*Ethiop. J. Health Dev.* 2012;26(2):78-85]

Introduction

Diarrhea remains one of the most common illnesses of children and one of the major causes of infant and childhood mortality in developing countries (1-3). Estimated worldwide episodes of acute diarrhea were 1.5 billion per year in 2008. Of these episodes 1.5–2 million deaths occur in children aged under-five (4, 5). The burden is greatest in the developing world where access to safe water, sanitation, and medical care are often limited. More than 70%, of which 90% being children, of annual global deaths from diarrheal disease are accounted for by eleven countries (6). Diarrhea continues to be one of the most common causes of morbidity and mortality among infants and children in Ethiopia. According to the Ethiopian Demographic and Health Survey 2005 (7), the two week period prevalence of diarrhea among under-five children was estimated to be 18%. Other estimates indicate that the two-week period prevalence in rural areas vary from 17% to about 37% in Ethiopia (8-12).

The prevalence varied across regions; the highest (25%) being in Southern Nations, Nationalities and Peoples Region (SNNPR) (12). Previous studies have also indicated that the occurrence of diarrhea is associated with poor housing and sanitary conditions and a lack of safe and adequate water supply. Age of the child, lower maternal education, bigger family size and lower socio economic status are also reported to have an impact on the incidence of diarrhea in children, (13-18).

Almost all of the above studies conducted in Ethiopia being cross-sectional surveys, they may not have adequate power to ascertain the association of diarrheal disease with socio-demographic and environmental conditions. Thus, this study was undertaken in Wolaita Soddo Town with the aim of assessing determinant factors of diarrheal morbidity using a case-control study approach.

Methods

The study was conducted in Wolaita Soddo Town, capital of Wolaita Zone from December, 2009 to June, 2010. Wolaita is one of the 13 zones in Southern Nations Nationalitis and Peoples Region. It is centrally located in the region, bordered by Kambata and Tembaro and Hadiya Zone in the north, Gamogofa Zone in the south, Dawro Zone in the west, Sidama Zone and Oromiya Region in the east. Malaria, tuberculosis, malnutrition and HIV/AIDS complicated by overcrowding are the main health problems of the zone (19). The study area,

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Wolaita Soddo Town, is 385 km south of Addis Ababa and 160 km west of the regional capital, Hawassa. The total population of the town is estimated to be 76,780, with male to female ratio of 1.12:1. Based on the 2007 Ethiopian census, in SNNPR urban areas the average family size of 4.2, the total number of households in the town was 18,281 (20). The town is structured in three sub-cities (*kifle ketema*) and eleven *kebeles*. There are one government and one NGO hospitals, one government health center, ten clinics, two pharmacies, one drug distribution store, three drug stores and eight drug vendors in the town.

A community-based case control study was conducted to determine factors of diarrheal morbidity among under-five children in Wolaita Soddo. Cases were children who experienced diarrhea within the last two weeks of recall period before the survey.

The sample size was calculated using the following double proportion formula:

$$n_1 = \frac{\left[Z\alpha/2\sqrt{\left(1+\frac{1}{r}\right)\bar{P}(1-\bar{P})} + Z\beta\sqrt{P1(1-P1)+\frac{P2(1-P2)}{r}}\right]^2}{(P1-P2)^2}$$

$n_2=n_1r$, where
n_1 = Number of cases, n_2 = Number of controls
p_1= Proportion of exposure in cases,
p_2 = Proportion of exposure in controls
$p = (p_1+p_2)/2$
r = Case to control ratio
$Z\beta$= Coefficient at level of power
$Z\alpha/2$ =coefficient at level of significance

Taking the proportion of 0.32 for cases and 0.21 for controls of feeces seen in the compound, as one of the determinant factors of diarrheal morbidity, from previous study (14), with 95% confidence interval and 80% power, the required sample size was 198 cases and 396 controls.

Three *kebeles* (one *kebele* from each sub-city) were first selected by a lottery method. Then a house to house survey was conducted to enumerate under-five children in the selected *kebeles* by five nurses recruited for the study. During the enumeration identification number was given for the households with name and age of the child which was used as a sampling frame for selecting cases and controls. The mother or a caretaker was asked if the child had diarrhea with a recall period of 15 days before the date of enumeration. Diarrhea was defined as the passing of three or more loose or watery stools or one stool with blood or mucus in a 24 hour period.

A total of 213 cases and 426 eligible controls were identified during the enumeration. Finally, a simple random sampling method was applied to select 198 cases and 396 age controls.
Eight female nurses who did not participate in the enumeration were recruited to administer the interview. Data collectors were given the identification numbers of households, name and age of the child, but did not know the diarrheal status of study subjects. A structured questionnaire was used to interview the mother or caretaker of the child. The collected data was checked by the principal investigator on a daily basis for any incompleteness and/or consistency. If any incompleteness and/or inconsistency appeared, corrections were made by going back to the specific household.

Data were entered into Epi-Info 3.3.2 for windows and exported to SPSS 15.0 for windows for analysis. The strength of association between dependent variable and independent variables (covariates) was expressed in odds ratio (OR) with 95% confidence interval. A stepwise multiple logistic regression technique was used to evaluate the independent effect of determinant factors on the outcome variable by controlling the effect of others. All the explanatory variables that showed significant association during the crude analysis were included in the logistic regression model used to calculate adjusted ratios.

Ethical clearance was obtained from the institutional review board (IRB) of the Medical Faculty, Addis Ababa University. Permission was also obtained from Wolaita Town Administration before the study was undertaken. An information sheet was prepared and read to the eligible participants to obtain verbal consent.

Results

As shown in Table 1, the mean (±SD) age of cases and controls were 29.8 (±14.7) and 30.6(±14.1) months, respectively. One hundred eighty two (91.9%) of the cases and 359 (90.70%) of the controls were born to mothers of age 18-35 years; 11(5.6%) of the cases and 24 (6.1%) of the controls were born to mothers of age 35 years and above. One hundred eighty one (91.4%) of the cases and 366 (92.4%) of the controls had their mothers as caretakers, while 17(8.6%) of the cases and 30 (7.6%) the controls had caretakers other than the mothers.

Regarding maternal/caretaker educational status, 50 (25.3%) of the cases and 111 (28.0%) of the controls were high school graduates, 40 (20.2%) of the cases and 109 (27.5%) of the controls had completed elementary school and 108(54.5%) of the cases and 172(44.5%) of the controls had no formal education.

Concerning religion, 130 (65.7%) of the cases and 240 (60.6%) of the controls were followers of the protestant religion; and 65(32.8%) of the cases and 140 (35.4%) of the controls were orthodox Christians. Ethnically, 168 (84.8%) of the cases and 384 (87.9%) of the controls were from Wolaita; 8 (4.0%) of the cases and 19(4.8%) of the controls were from Amhara; and 9 (4.5%) of the cases and 11 (2.8%) were from Gamo.

Economically, 66 (33.3%) of the cases and 54 (13.6%) of the controls were from a family whose average monthly

income was below 400 Birr. Ninety nine (47.5%) of the cases and 224 (56.6%) of the controls were from a family whose monthly income was from 400 to 1000 Birr.

From the crude analyses shown in Table 2, being male (OR=1.90, 95% CI:1.34,2.69), having father with no job (OR=2.81, 95%CI:1.39,5.72), father with no formal education (OR=1.58, 95% CI:1.05,2.39), family perceiving that its economic status was very poor (OR=15.69, 95% CI:7.98,30.85), poor (OR=3.90, 95% CI:2.57,5.93) and family earning less than 400 Birr per month (OR=3.80, 95% CI:2.27,6.34) were significantly associated with diarrhea morbidity compared to their counterparts each.

Other socio-demographic characteristics including, educational status, age, marital status, ethinicity of the mother and family size were not significantly associated with diarrhea morbidity.

Table1: **Distribution of study subjects by selected socio-demographic characteristics, Wolaita, 2010.**

Demographic Characteristics	Cases (n=198) No. (%)	Controls (n=396) No. (%)
Sex of child		
Male	126 (63.6)	190 (48.0)
Female	72 (36.4)	206 (52.0)
Age of child(months)		
1-6	10 (5.1)	21 (5.3)
7-12	22 (11.1)	33 (8.3)
13-24	58 (29.3)	100 (25.3)
25-36	44 (22.2)	100 (25.3)
37-48	49 (24.0)	110 (27.8)
49-59	15 (7.6)	32 (8.1)
Mean ±SD	29.8 ± 14.7	30.6±14.1
Family size		
1-2	4 (2.0)	6 (1.5)
3-5	112 (56.6)	253 (63.9)
>5	82 (41.4)	137 (34.6)
Age of mother (years) at birth of child		
<18	5 (2.5)	13 (3.3)
18-35	182 (91.9)	359 (90.7)
>35	11 (5.6)	24 (6.1)
Relation of respondent with the child		
Mother	181 (91.4)	366 (92.4)
Caretaker	17 (8.6)	30 (7.6)
Educational status of mother/caretaker		
No formal education	108 (54.5)	176 (44.4)
Elementary completed	40 (20.2)	109 (27.5)
High school completed	50 (25.3)	111 (28.0)
Religion of mother/care taker		
Protestant	130 (65.7)	240 (60.6)
Orthodox	65 (32.8)	140 (35.4)
Muslim	3 (1.5)	16 (4.0)
Ethnicity of mother/caretaker		
Wolaita	168 (84.8)	384 (87.9)
Amhara	8 (4.0)	19 (4.8)
Gamo	9 (4.5)	11 (2.8)
Other	13 (6.6)	18 (4.5)
Monthly family income (in Birr)		
<400	66 (33.3)	54 (13.6)
400-1000	94 (47.5)	224 (56.6)
>1000	38 (19.2)	118 (29.8)

Table2: **Association of socio-demographic variables with diarrheal status, Wolaita, 2010**

Demographic Characteristics	Cases (n=198)	Controls (n=396)	OR (95% CI
Sex of child			
Male			
Female	126	190	1.90 (1.34,2.69)
Age of child(months)	72	206	1.00
1-6	10	21	1.01 (0.39,2.68)
7-12	22	33	1.42 (0.63,3.22)
13-24	58	100	1.24 (0.62,2.48)
25-36	44	100	0.94 (0.46,1.91)
37-48	49	110	0.95 (0.47,1.91)
49-59	15	32	1.00
Family size			
1-2	4	6	1.11 (0.31,4.1)
3-5	112	253	0.74 (0.52,1.10)
>5	82	137	1.00
Number of <5 children in the house			
1-2	190	381	0.94 (0.39,2.24)
≥3	8	15	1.00
Age of mother (years) at birth of child			
<18	5	13	0.84 (0.24,2.94)
18-35	182	259	1.11 (0.53,2.31)
>35	11	24	1.00
Relation of respondent with the child			
Mother	181	366	0.87 (0.47,1.62)
Caretaker	17	30	1.00
Marital status of mother/caretaker			
Married	171	352	0.71 (0.32,1.56)
Single	16	28	0.83 (0.31,2.22)
Divorced/Widowed	11	16	1.00
Educational status of mother/caretaker			
No formal education	108	176	1.36 (0.89,2.10)
Elementary completed	40	109	0.82 (0.50,1.33)
High school completed	50	111	1.00
Educational status of father			
No formal education	72	106	1.58 (1.05,2.39)
Elementary completed	39	87	1.05 (0.67,1.65)
High school completed	87	203	1.00
Occupation of mother			
Housewife	141	258	1.04 (0.64,1.70)
Government employee	23	53	1.08 (0.55,2.14)
Private work	34	85	1.00
Occupation of father			
Government employee	64	144	1.0
Private work	109	232	1.06 (0.72,1.56)
No job	25	20	2.81 (1.39,5.72)
Monthly income of family			
<400	66	54	3.80 (2.27,6.34)
400-1000	94	224	1.30 (0.84, 2.02)
>1000	38	118	1.00
Perceived economic condition			
Very Poor	49	12	15.69 (7.98,30.85)
Poor	66	65	3.90 (2.57,5.93)
Medium/rich	83	319	1.00

Table 3 depicts crude association of housing conditions with diarrheal status. The odds of developing diarrheal morbidity was significantly higher among children living in households with poor sanitary conditions such as no latrine (OR=35.82, 95% CI:12.74, 100.74), compounds with feces (OR =16.28, 95% CI:8.88, 29.85), or dispose refuses in open fields (OR=4.57, 95% CI:2.52, 8.31). Similarly the odds of diarrhea morbidity were significantly higher among children of households with a single room and mud floor compared to others. Concerning source of water, the odds of diarrhea morbidity were significantly higher among children of households with unprotected (well/river/spring) sources (OR=15.89, 95% CI:9.03, 27.93) and protected well (OR=4.89, 95% CI:3.05, 7.83) as compared to households with pipe water source. Similarly, the odds of diarrhea morbidity were significantly higher among children of households that use pots as water containers (OR=4.27, 95% CI:1.57, 11.57) compared to those who used *jerrycans* and among those with no separate container for drinking water (OR=1.75, 95% CI:1.20, 2.56) compared with those who used separate continence. The ways of water collection and transportation have also significant effects on diarrhea morbidity (Table 3).

Table 3: **Association of housing and sanitation variables with diarrheal status, Wolaita, 2010**

Household characteristics	Cases	Controls	OR (95% CI)
Ownership status of the house			
Owned	84	209	1.00
Rented	114	187	1.52 (1.08,2.14)
Floor of the house			
Cement	74	229	1.00
Wood	9	16	1.74 (0.74,4.10)
Mud	115	151	2.36 (1.65,3.37)
Number of rooms			
Three or more	65	175	1.00
Two	86	164	1.14 (0.96, 2.08)
One	47	57	2.22 (1.37, 3.59)
Separate kitchen availability			
Yes	143	314	1.00
No	55	82	1.47 (0.99, 2.19)
Latrine availability			
Yes	145	392	1.00
No	53	4	35.82 (12.74,100.74)
Faces seen in the compound			
No	124	382	1.00
Yes	74	14	16.28 (8.88,29.85)
Refuse disposal			
Pit	26	82	1.00
Burning	114	274	1.31 (0.80,2.15)
Open field/water bodies	58	40	4.57 (2.52,8.31)
Refuse seen in the compound			
No	110	317	1.00
Yes	88	79	3.21 (2.21,4.66)
Source of water			
Pipe	77	332	1.00
Protected well	51	45	4.89 (3.05,7.83)
Unprotected well/spring/river	70	19	15.89 (9.03,27.93)
Source of water in the compound			
Yes	94	208	1.00
No	104	188	1.12 (0.87,1.72)
Type of water collection container			
Jerrycan	158	337	1.00
Pot	12	6	4.27 (1.57,11.57)
Plastic/iron bucket	28	53	1.13 (0.69,1.85)
Separate container for drinking water			
Yes	132	308	1.75 (1.20, 2.56)
No	66	88	
Transportation of water yesterday			
Covered Container	139	350	1.00
Uncovered container	59	46	3.23 (2.10,4.98)
How do you draw collected water			
Pouring	102	346	1.00
Dipping	96	50	6.51(4.34,9.78)
Home drinking water treatment			
Yes	44	189	1.00
No	154	207	3.20 (2.17,4.71)

Table 4 depicts the association of child caring, hygienic practice and knowledge of the mother about diarrheal morbidity. The odds of developing diarrhea were significantly higher among children whose mothers reported hand washing (before or after feeding) once a day (OR=7.17, 95% CI:4.60, 11.17) and twice a day (OR=4.54, 95% CI:2.33, 8.86) compared to those did so four or more times a day. The lower the knowledge of the caretaker on the cause and transmission mechanisms of diarrhea, the higher was the odds of morbidity (Table 4).

Table 4: **Association of child caring, hygienic practice and knowledge of mother with diarrheal status, Wolaita, 2010**

Child care and hygenic practices	Cases (n=198)	Controls (n=396)	OR (95% CI)
Place of birth of child	104	180	1.33 (0.94, 1.87)
Home/other			
Health facility	94	216	1.00
Time at which breast milk initiated after delivery			
After an hour	100	195	1.05(.75,1.48)
Within an hour	98	201	1.00
Frequency of hand washing per day			
Once	81	42	7.17(4.60,11.17)
Twice	22	18	4.54(2.33,8.86)
Three times	10	20	1.86(0.84,4.12)
Four or more times	85	316	1.00
Hand washing material			
Water only	27	39	1.47(0.87,2.49)
Ash	4	2	4.25(0.77,23.44)
Soap	167	355	1.00
Frequency of eating meat per month			
Less than 4 times	163	263	2.36 (1.55, 3.59)
4 or more times	35	133	1.00
Is microorganism cause of diarrhea			
No	77	95	2.02(1.40,2.91)
Yes	121	301	1.00
Knowledge of methods of transmissions of diarrhea			
None out of three	92	38	3.48(1.98,6.13)
One out of three	102	72	6.47(4.25,9.84)
Two out of three	12	35	1.57(0.76,3.21)
All the three	55	251	1.00

All variables found to be associated with diarrhea in the crude analyses were entered in to a stepwise logistic regression. From the total of 21 variables that were entered, nine were found to have significant independent associations with the diarrheal status (Table 5). The odds of developing diarrheal morbidity was 2.6 times higher among children with fathers having no formal education compared to those with fathers who completed high school (Adj OR=2.56, 95% CI:1.25, 5.25). Cases were about 4 times higher among families perceived that they were economically very poor when compared to families perceived they were rich or medium (Adj OR=.3.84, 95% CI:1.25, 11.82). Children in households with no latrine were about 13.5 times (Adj OR=13.45, 95% CI:3.58, 50.49) more likely to develop diarrhea compared to children of households with latrines. Treatment of drinking water showed a significant odds (Adj OR=2.34, 95%CI:1.33, 4.14) of developing diarrhea. Similarly, incidence of disease was higher among children whose mothers had poor knowledge about transmission methods of diarrheal diseases and those who washed hands less frequently compared to their counterparts, respectively.

Table 5: **Independent factors associated with diarrhea morbidity based on the logistic regression model, Wolaita, 2010.**

Variables	Adjusted OR (95%CI)
Educational status of father	2.56 (1.25, 5.25)
No formal education	
Elementary completed	0.68 (0.34, 1.39)
High school completed	1.00
Perceived economic condition	
Very poor	3.84 (1.25, 11.82)
Poor	1.62 (0.87, 3.03)
Medium/rich	1.00
Latrine availability	
No	13.45 (3.58, 50.49)
Yes	1.00
Faces seen in the compound	
Yes	5.26 (2.17, 12.74)
No	1.00
Source of water	
Unprotected well/spring/river	9.79 (4.58, 20.97)
Protected well	3.40 (1.76, 6.58)
Pipe	1.00
Type of water collection container	
Plastic/iron bucket	0.51 (0.23, 1.10)
Pot	5.57 (1.18, 26.25)
Jerrycan	1.00
Treatment of drinking water	
No	2.34 (1.33, 4.14)
Yes	1.00
Frequency of hand washing per day	
Once	5.41(2.65, 11.04)
Twice	1.78 (0.611, 5.19)
Three times	0.99 (0.25, 3.98)
Four or more times	1.00
Knowledge about ways of transmissions of diarrhea	
None out of three	2.46 (1.07, 5.63)
One out of three	6.3 (3.20, 12.45)
Two out of three	1.94 (0.73, 5.20)
All the three	1.00

Discussion

This study tried to assess the contribution socio-demographic factors such as, housing and sanitation, and knowledge, about diarrhea, hygienic and child caring practice to diarrheal morbidity among under-five children.

The study showed that males had higher incidences of diarrhea diseases in two weeks recall period compared to females, by the crude analysis; but it disappeared during the multivariate analysis. Diarrheal morbidity had no variation by sex according to the Ethiopian DHS (7). Unlike previous studies (12, 15-18), our study was not able to show that child's age to have a significant association with diarrheal morbidity. This might be due to methodological differences, and time gap between the current and earlier surveys. On the other hand, as reported by previous studies (7, 13, 18), this study did not find significant association between maternal age and diarrheal morbidity. The consistency between the studies might be an indication to establish that maternal age does not affect diarrheal morbidity. But further studies are required to confirm these findings.

Education of mothers was not significantly associated with diarrheal status in the present study. This was also reported by studies in Eritrea (15), Egypt (17) and Meskanena Mareko *Woreda* (12). Educational status of fathers, however, was independently and significantly associated with diarrheal morbidity in the present study, which supports the findings of studies in Meskanena Mareko *Woreda* (12) and Egypt (17). This suggests that the higher the educational status of the head of the household, the better socio-economic situation that in turn could have a very important impact on the housing and sanitation conditions of households.

Our findings suggest that housing and sanitation conditions such as unavailability of toilets, open field waste refuse disposal, unprotected source of water and lack of proper handling of water do have strong effect on the incidence of diarrheal disease. These factors were also reported by previous studies (11, 13-16, 21). Consistent with our findings studies reported that the presence of excreta in the yard showed strong association with under-five childhood diarrheal morbidity (11,22).

This has an important implication that the mere presence of a latrine facility does not make a great contribution to the prevention of excreta-related diseases but proper utilization also plays a vital role and makes the difference.

In this study, home treatment of drinking water such as *woha-agar*, boiling and or filtering was found to reduce the odds of getting diarrhea when compared to those who did not. Similarly, the odds of developing diarrheal morbidity were higher among children whose mothers/caretakers had better knowledge about the causes of diarrhea and had hand washing practice.

In conclusion, our findings suggest that poor housing, poor sanitation conditions, poor personal hygiene, and lack of knowledge to be associated strongly with the manifestation of diarrheal disease among children of under-five years of age. Hence, health education should be given to the public in general and especially mothers and caretakers of children regarding personal hygiene, including proper utilization of latrine facilities and the transmission ways of diarrhea by concerned bodies including the media.

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