Original article

Determinants of diarrhoeal morbidity: The case of children under five years of age among agricultural and agro-pastoralist community of southern Ethiopia

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Abstract

Background: Diarrhoea is a leading cause of morbidity and mortality among the under-five children in low-income countries. Despite improvements in water and sanitation coverage, studies show that diarrhoea is still a major public health problem in Ethiopia. This study was designed to determine the magnitude and risk factors of diarrhoea in the agricultural and agro-pastoralist communities of the rural Sidama zone, Southern Ethiopia.

Methods: a cross-sectional study was conducted in July 2013. Interview and questionnaire were the main data gathering instruments used in the study. Data for the study was collected from 1939 mothers/caregivers of the children. The children were under five years of age during the data collection period. Structured questions were used to collect data for the study. SPSS software V 19 was used to analyze the data based on a predefined conceptual model, including interrelated determinants. Bivariate and multivariable logistic regression was computed to assess independent factors of childhood diarrhoea.

Results: Slightly over 95% of the participants were from Sidama ethnic background and about 88% of them were Participants. The number of male children in the study was slightly higher (53%) than that of the female participants. The mean and median ages of the children were 33.53 and 35 months, respectively. The prevalence of diarrhoea in the two weeks prior to the study was 25.6%.

The occurrence of diarrhea was significantly associated with household heads following traditional religion (Odds Ratio (OR): 2.40; 95% Confidence Interval (CI) =1.49-3.88)), living in rented or shared houses (OR: 2.00; 95% CI=1.14 -3.51), living in agro-pastoralist (OR: 1.84; 95% CI=1.29-2.63), and Midland agriculturalists areas (OR: 1.50; 95% CI=1.04-2.14).

In addition, storing drinking water for more than two days (OR: 1.74; 95% CI=1.27-2.37), the presence of diarrhoea in the family members other than the index child (OR: 1.35; 95% CI=1.05-1.74), children being in the age group of 6-12 months (OR: 2.459; 95% CI=1.676-3.608) and 13-24 months (OR: 1.619; 95% CI=1.103-2.377) were strongly associated with the under-five diarrhoeal morbidity ($p \leq 0.05$).

Conclusions: The study showed that diarrhoea was a major health problem of the under five among the agro-pastoralist communities. Socioeconomic, environmental, household and childcare related factors have influenced the transmission of diarrhoea in the study setting. Delivery of improved sanitation and hygiene suitable for agro-pastoralist communities may have a significant importance on the child health and survival in the study area. [*Ethiop. J. Health Dev.* 2018;32(1):18-26]

Keywords: Diarrhoea, Ethiopia, Agro-pastoralist, Sanitation, Water, Under-five children

Introduction

Diarrhoea is the passage of 3 or more loose or liquid stools per day, or more frequently than is normal for the individual. It is usually a symptom of gastrointestinal infection which can be caused by a variety of bacterial, viral and parasitic organisms (1). These microorganisms spread through unclean water and contaminated food. They can also spread from one person to another. Microorganisms are most widespread in settings with poor access to clean drinking water and sanitation (2). Diarrhoea is a common public health problem, especially in developing countries (3). In Africa, diarrhoea is estimated to account for 25.2% of deaths for children 1–59 months of age, compared to a multi-cause estimate of 25.3% of deaths in this age group (4).

Research has revealed the association between diarrhoea and the people's low socioeconomic status. A similar association has also been established between diarrhoea and lack of access to improved water sources, hygiene and toilet facilities in a community. Monthly family income, status of maternal and paternal education, condition of water sources were yet other factors worth considering in discussing childhood diarrhoea. Equally important in the discussion of diarrhoea among children are issues connected with the disposal of wastewater, refuse and child faeces. Needless to mention, there is a close association between childhood diarrhoea and mothers' or caregivers' practices of hand washing at critical times (5-10).

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Providing improved water and sanitation facilities, nutrition, and vaccination can reduce diarrhoeal disease and improve the growth of children. Healthy growth among children ensures an eventual increase in the productivity of the general public (5, 11-13).

Ethiopia adopted Community Led Total Sanitation and Hygiene as a means of sanitation and hygiene promotion. This helped the country to decrease the proportion of the population that practices open defecation from 92 percent in 1990 to 29 percent in 2015 (14). As a result, several kebeles and villages have been declared to be *open defecation frees* (ODF). Diarrhoea, however, has remained a major public health problem in the country. For example, the prevalence of childhood diarrhoea was found to be 19.6% and 30.5% in Sebedino and Arba Minch Districts of South Ethiopia respectively (15, 16). Other studies also reported the prevalence of the under-five diarrhoea to be 18 % in Mecha District, Northwest Ethiopia (17); 22.5% in Kersa district, Eastern Ethiopia (18); and 22.1% in Benishangul-Gumuz Regional State, North West Ethiopia (9).

In Southern Nations, Nationalities and Peoples Region, including Sidama Administrative Zone, outbreaks of acute watery diarrhoea (AWD) have repeatedly occurred since the year 2006. The outbreaks were linked to a lack of basic sanitation and safe water supply. This, in turn, took away the lives of thousands of people (19) in the areas.

According to reports of various epidemiological studies, a wide range of factors account for the occurrence of childhood diarrhoea. The extent of each factor's contribution to the occurrence of diarrhoea in a community, however, depends on the interaction between the socio-economic, environmental and behavioural variables (20-22). Despite the prevalence of childhood diarrhoea in several places in the country, pertinent reports from population-based studies are scarce. Apparently, it is this scarcity of reports that has made assessing the magnitude and risk factors of the disease in areas such as the agro-pastoralist community difficult. The impetus for this study partly arose from this recognition. This study was, therefore, conducted to determine the magnitude of the occurrence of childhood diarrhoea among the agro-pastoralist community of Sidama Zone, Southern Ethiopia and identify the risk factors for the occurrence of the disease in the study area.

Methods

Study Design, Setting, and Population: A community-based cross-sectional study was conducted in Sidama zone, SNNPR, southern Ethiopia in July 2013. According to the report obtained from the finance and economy department of the administrative zone, Sidama zone is categorized into Highland, Moist Midland, and Dry midland and lowland agro-ecological sectors (23). The majority of the people in the lowland area are agro-pastoralists. The study was conducted in five districts of the administrative zone. This means four agro-ecological divisions; namely, Hulla (highland district), Dale and Wondo-genet (moist-midland districts), Boricha (dry midland district), and Loka Abaya (lowland district) were the areas considered in the study. The districts have been used by Hawassa University to serve as demographic surveillance and health research center. The districts are divided into kebeles (i.e., kebeles are the lowest administrative unit). Each 'kebele' consisted of about five hundred families or the equivalent of 3,500 to 4,000 persons.

Sample Size and Sampling Procedure: The sample size determination procedure adapted in the study considered the magnitude of diarrhoeal morbidity and assessment of risk factors for diarrhoea. The adequacy of the sample size for each objective was determined, and the sample size was calculated using the formula for estimation of single proportion.

$$n = \frac{Z^2 \times P(1-P)}{d^2}$$

The value of Z is 1.96, and that of P is (30.5%). A two-week prevalence of diarrhoea among children under-five years old was taken from a similar article conducted in southern Ethiopia (15). In this case, d is the margin error of estimation which was assumed to be 3% (0.03). This provided a sample size of 908 children. To account for clustering at agro-ecological and kebele level, a design effect of 2 was assumed. A predicted 10% non-response rate was added. This raised the final sample size to 1987 children.

The sampling procedure was conducted in two stages. First, in each agroecological zone, two kebeles were randomly selected from the available list of kebeles. This made the total number of the kebeles covered in the study eight. The total sample size calculated was distributed equally to the four agro-ecological categories. On the other hand, the distribution of the sample size to each of the two kebeles was proportional to the total number of the under-five population size in each agroecological zone. Second, the study population was selected using a simple random sampling technique from registries found in health posts of each kebele. The first household interviewed was identified using a modified random walk method. During the interview, in the cases where the mother or caretaker was absent, the next nearest household was interviewed. The data obtained from most of the Dry Midland and Lowland agro-ecological communities were merged with the data collected from agro-pastoralists from the lowland category for analysis.

Data collection and management: A semi-structured questionnaire was the main data gathering instrument used in this. Core questions in the questionnaire were adapted from the Multiple Indicator Cluster Survey of the United Nations Children's Fund (UNICEF), Demographic and Health Survey (24) and World Health Organization (WHO). The questionnaire was first written in English, and later, translated into Amharic. The Amharic version was again translated into English to ensure accuracy of the translation. The feedback obtained from pretesting the questionnaire

was used to improve the final version of the questionnaire.

Trained Environmental Health Officers and Nurses, who were fluent speakers of the local language, were involved in collecting the data used in the study. To avoid desirability bias, the data collectors were assigned to collect data from places outside of their regular places of work. The data desired for use in the study specifically focused on children between the ages of 6 and 59 months old. In addition to face-to-face interviewing of selected target respondents at each household, the data collection activities involved observation of the housing conditions, latrines, and other neighborhood environmental conditions.

The respondents were primarily mothers of eligible children. In cases where mothers were absent, the next caregivers were interviewed. During data collection, supervisors and the principal investigator closely followed the day-to-day data collection activities. This ensured the completeness and consistency of the data collection procedures in all of the cases considered in the study setting.

Study Variables: The primary outcome variable was the occurrence of diarrhoea in the 2-week period prior to the survey. Explanatory variables were indicated in three hierarchical blocks (levels) of socioeconomic, environmental and child-related variables (Table 1). The order of blocks of variables indicates the interaction of variables in hierarchical order where the socioeconomic variables (the distal variables in one block) influence environment related variables (intermediate variables in block 2). Block two variables can influence the general status of the child, and this, in turn, influences the occurrence of childhood diarrhoea.

Table 1: **The Hierarchical Model Proposed for Diarrhoea Risk Factors, 2013**

Block 1 **Socioeconomic variables** Maternal education, monthly income, family size, maternal age, residential area, household ownership, ethnicity, religion, and wealth
Block 2 **Neighborhood and household environmental conditions** Water (source, treatment, type and length of storage, quantity, method of drawing); latrine (availability and type); soap availability, solid waste disposal, presence of a separate kitchen, sharing living rooms and kitchen with domestic animals, and occurrence of adult diseases
Block 3 **Variables related to the child** Age, gender, vaccine at their age, illness other than diarrhoea
Diarrhoeal morbidity

Operational *Definitions of Words/Phrases*

***Improved* water source**: this refers to water source that, due to its construction, adequately protects the source from human excreta and other outside contaminations.

Improved sanitation facility: is the sanitation facility that separates human excreta from human contact.

Uninterrupted drinking water sources: are sources that give water throughout the year without interruption either from drought or system failure.

Indiscriminate solid waste disposal: This refers to the dumping of solid waste in yard or compound.

Narrow-mouthed containers: water transportation and storage containers that have an opening of 3 cm or less.

Data Analysis: Data were entered with a template prepared in EpInfo version 6 and analyzed using SPSS v.19 statistical software. The statistical analysis was conducted in accordance with the predefined conceptual model based on interrelated determinants (table 1). This approach has been used in similar epidemiological studies (20-22, 25). Both descriptive and analytical statistical procedures were employed. Binary and multiple logistic regression analysis methods were used to detect a possible association, and control confounding effects. The variables that presented $P<0.1$ in the univariate analyses were included in the next analysis. For each block of variables, a simultaneous entry method was used to identify significant risk factors. The set of variables with $P<0.1$ from the intra-block multivariable analysis in each block was put to hierarchical analysis following the order defined in the conceptual framework. To reduce the number of variables and the resulting instability of the model, only variables with significance $P < 0.1$ in the bivariate and intra-block multivariable analysis were included in the multivariable model analysis. Variables with $p < 0.05$ in the multivariable analysis were considered significant.

Ethical Considerations: Ethical clearance was granted from the Ethical Review Board of Addis Ababa University, College of Health Sciences. Permission to conduct the study was obtained from the Health Bureau of Southern Nations, Nationalities, and Peoples' Region, Sidama Zone Health Department, and district health offices. During data collection, participants were informed about the purpose of the study, confidentiality, and the right not to participate or the right to withdraw at any time. Children who had diarrhoea during the survey were referred to health centers for oral rehydration therapy and further management.

Results

Descriptive Summary of Variables: The study assessed the prevalence and risk factors of childhood diarrhoea in the agricultural and agro-pastoralist communities (26). The data used in the study was collected from 1939 study participants. The response rate of participants was 97.6%. The mean and median ages of the children considered in the study were 33.53 and 35 months respectively. Out of 1939 children, 497 had diarrhoea two weeks before the survey. The mean of the 2 weeks period prevalence of diarrhoea was

25.6% [95% confidence interval (CI) 23.7% - 27.6%]. The prevalence of diarrhoea by socio-economic, environmental and behavioral characteristics is shown in Table 2.

The ethnic background of over 95% of the children was Sidama. About 88% of them were Protestants. The number of male children was slightly higher (53%) than the number of female children. Close to three-fourths (68%) of the study participants were from families who earned less than 1000 birr (50 USD equivalent at the time of the study) per month. More than 62% of the children's mothers were under the age of 30 years.

In connection with environmental factors, nearly all of the participants got less than 10 liters of water per head per day. Only about a quarter of the participants reported having treated drinking water at home. Filtering with cloth, adding chloride related chemicals, and boiling were among the main water treatment methods the study participants reported to have used. Nearly three-fourths (74%) of the participants who reported treating their drinking water at home, started the practice not long before the survey. Only 5.8% of the children got water of special quality (treated, boiled, or filtered). More than 93% of the study participants stored their drinking water in narrow-mouthed containers. Nearly all of the latrines used by the households were simple pit type. Ninety-one percent of the reported latrines were made up of wood and mud slab. The latrines had no proper superstructure, and thus, could not provide privacy to users. Lack of handwashing facilities was also a problem observed – i.e., 93.3% of the latrines had no handwashing facilities for use after visiting the toilet. Similarly, nearly all participants reported sharing living rooms with domestic animals.

Determinants of Diarrhoea, Bivariate, and Multivariable Results: The bivariate and multivariable analysis results are summarized in table 3. The analysis was made based on a predefined group of variables (Table 1) linked hierarchically. In Table 3, Model 1 indicates the ORs of the socioeconomic, environmental and child-related variables analyzed in each variable blocks. Model 2 shows the changes in ORs when socioeconomic and environmental variables are analyzed together. The 3rd is the final model when the child-related variables are introduced to socioeconomic and environmental factors.

In the bivariate analysis, socioeconomic factors such as information on whether the participants were from agro-pastoralist area or Midland agricultural area as well their religion was considered. Attempts were also made to associate data on variables such as the participants' residential status and monthly income with diarrhoeal prevalence ($p \leq 0.05$).

Among environmental factors, length of storage of drinking water, type of water container used for storing water, whether member of the family other than the index child had diarrhoea, condition of living room/house, and condition of solid waste disposal were associated with diarrhoea in univariate analysis ($p \leq 0.05$). Among child-related factors, children in the lower age group were associated with diarrhoea in the univariate analysis ($P \leq 0.05$).

In model 1, the multivariable analysis of socioeconomic variables**,** following traditional religion (OR: 2.72; 95% CI=1.73-4.28), residing in agro-pastoralist area (OR: 2.39; 95% CI= 1.78-3.21), and living in rented or shared households (OR: 2.10; 95% CI=1.22-3.66) were found to be significant. When multivariable analysis was made within blocks of environment related variables like: having drinking water sources which did not last year round, storing water for more than two days, storing water in a wide-mouthed container, presence of any illness in other members of the family in the last two weeks before the survey were found to be associated with diarrhoeal illness ($p \leq 0.05$).

In model 2, the following variables remained significant with $P \leq 0.05$. These were: believing in traditional religion, living in a rented or shared house, living in lowland agro-pastoralist area or Midland areas, storing drinking water beyond two days, and presence of diarrhoea among other members of the family of the index child.

In the 3rd and final model, the following variables remained with $P \leq 0.05$. These were: believing in traditional religion (OR: 2.40; 95% CI=1.49-3.88); living in a rented or shared house (OR: 2.00; 95% CI=1.14-3.51); living in agro-pastoralist areas (OR: 1.84; 95% CI=1.29-2.63); and living in agricultural midland areas (OR: 1.50; 95% CI=1.04-2.14). Similarly, storing drinking water for more than two days (OR: 1.74; 95% CI=1.27-2.37); presence of illnesses including diarrhoea among other members in the family of the index child (OR: 1.35; 95% CI=1.05-1.74); and being in the age group between 6-12 months (OR: 2.46; 95% CI=1.68-3.61) and 13-24 months (OR: 1.62; 95% CI=1.10-2.38) were the variables that remained with $P \leq 0.05$. Table 3 below summarizes this.

Table 2: **Socio-economic, environmental, and child-related factors of diarrhoea among children between 6 and 59 months of age in Sidama Zone, Southern Ethiopia, 2013**

Variables	No diarrhoea n=1442 (%)	Diarrhoea n=497 (%)
Religion: Respondents were:		
Protestants	1287(89.3)	416(83.7)
Followers of Orthodox Christianity	47(3.3)	10(2.0)
Followers of traditional religion	40(2.8)	44(8.9)
Muslim	68(4.7)	27(5.4)
Ownership status of family house		
Private	1405(97.4)	471(94.8)
Others	37(2.6)	26(5.2)
Educational status of mothers		
Illiterate	663(46.0)	229(46.1)
Informal education	30(2.1)	14(2.8)
First cycle	367(25.5)	131(26.4)
Second cycle	280(19.4)	99(19.9)
Secondary school +	102(7.1)	24(4.8)
Monthly income in birr		
<=500	606(42.0)	234(47.1)
501-1000	350(24.3)	142(28.6)
1001-2000	203(14.1)	58(11.7)
2000+	283(19.6)	63(12.7)
Residential areas		
Lowland agropastoral	656(45.5)	307(6.8)
Midland Agricultural	377(75.9)	119(3.9)
Highland Agricultural	409(28.5)	71(14.3)
Water source status		
Improved (protected)	807(56.0)	258(51.9)
Unimproved(unprotected)	635(44.0)	239(48.1)
Length of water storage		
One day	958(66.4)	271(54.5)
Two days	331(23.0)	127(25.6)
Above 2 days	153(10.6)	99(19.9)
Latrine status		
Improved	265(18.4)	95(19.1)
Unimproved	1177(81.6)	402(80.9)
Disposal of child faeces		
Toilet	709(49.2)	240(48.3)
Open field	733(50.8)	249(51.7)
Children's sex		
Male	786(54.5)	246(49.5)
Female	656(45.5)	251(50.5)
Child age		
6-12 months	197(13.7)	125(25.2)
13-24 months	234(16.2)	88(17.7)
25-36 months	326(22.6)	107(21.5)
37-48 months	414(28.7)	115(23.1)
>=49 months	271(18.8)	62(12.5)
Vaccination		
Yes	1355(94.0)	440(88.5)
No	87(6.0)	57(11.5)
Vitamin A supplemented		
Yes	1355(93.8)	440(88.5)
No	87(6.2)	57(11.5)
Other illnesses in the two weeks prior to survey	289(20.0)	122(24.5)
Yes	1153(80.0)	375(75.5)
No		

Table 3: **Multivariable analysis of risk factors for diarrhoea among children 6-59 months of age in Sidama Zone, Southern Ethiopia, 2013**

Variables	Model 1 Adjusted OR(95% CI)	Model 2 Adjusted OR (95% CI)	Model 3 Adjusted OR (95% CI)
Religion: Family head was			
Protestant	1	1	1
Orthodox or Catholic follower	0.68(0.34-1.38)	0.63(0.31-1.30)	0.67(0.32-1.4)
Follower of Traditional religion	2.72(1.73-4.28)*	2.33(1.46-3.72)*	2.40(1.49-3.88)*
Muslim	1.08(0.68-1.72)	1.04(.65-1.67)	1.09(0.67-1.76)
Ownership status of family house			
Private	1	1	1
Rented	2.10(1.22- 3.66)*	2.26(1.29-3.89)*	2.00(1.14 -3.51)*
Residential areas			
Argo pastoral	2.39(1.78-3.21)*	1.83(1.29-2.60)*	1.84(1.29-2.63)*
Agricultural (Midland)	1.55(1.10-2.19)*	1.52(1.06-2.17)*	1.50(1.04-2.14)*
Agricultural (Highland)	1	1	1
Length of drinking water storage			
One day	1	1	1
Two days	1.20(.88-1.63)	1.19(.92-1.54)*	1.20(0.92-1.54)
Above 2 days	2.72(1.83-4.05)*	1.74(1.28-2.36)*	1.74(1.27-2.37)*
Whether or not a family member had diarrhoea in the 2 weeks prior to the survey			
Yes	1.30(.97-1.74)	1.30(1.02- 1.65)*	1.35(1.05-1.74)*
No	1	1	1
Container type			
Wide mouth/both	1.52(1.02-2.26)*	1.32(0.88-1.99)	1.38(0.91-2.09)
Narrow moth	1	1	1
Child sex			
Male	0.83(0.68-1.02)	-	0.81(0.65-1.01)
Female	1		1
Age of child in months			
6-11	2.44(1.68-3.54)*	-	2.46(1.68-3.61)*
12-23	1.63(1.12-2.35)*	-	1.62(1.10-2.38)*
24-35	1.40(.99-2.00)	-	1.36(.94-1.96)
36-47	1.20(.85-1.70)	-	1.17(.82-1.68)
48+	1	-	1
Whether or not the child had other illnesses in the two weeks before the survey	1.24(.97-1.58)	-	1.15(0.88-1.49)
Yes	1		1
No			
Vitamin A			
Yes	1	-	1
No	1.36(.87-2.12)	-	1.30(0.89-1.91)

*Statistically significant (P≤0.05). Model 1 indicated the ORs of the socioeconomic, environmental and child-related variables analyzed in each variable block. Model 2 showed the changes in ORs when socioeconomic and environmental variables were analyzed together. Model 3 indicated the introduction of child-related variables to socioeconomic and environmental factors

Discussion

The study assessed the prevalence and risk factors of childhood diarrhoea among the agricultural and agro-pastoralist community. The 2-week period prevalence of diarrhoea was 25.6% (95% confidence interval 23.7-27.6). This is within the range of the findings of other studies conducted in different parts of Ethiopia, 18-30.5% (16-18, 27, 28). The present study revealed that socioeconomic, environment, household and childcare related factors have influenced transmission of diarrhoea. This was also reflected in other similar studies (20-22).

Children who were living in shared or rented houses were two times more likely to develop diarrhoea, compared to those who lived in private houses. The difference in the level of exposure to the illness may arise from the fact that people who live in their own houses have better ability and right to undertake the required housekeeping and maintenance activities to

reduce health risks. A similar study in Egypt supports this argument (29).

Research findings have shown that dissemination of health information through churches and faith-based programs can improve health outcomes (30, 31). Although the number was small, this study found that children with families who had traditional religion were 2.40 times more likely to have diarrhoea, compared to children from protestant (majority) religion background. The thought that believers in traditional religion get a narrower access to health messages may, to a limited extent, explain such an exaggerated difference in the children's exposure to the illness.

One of the main findings of this study was that children residing in the agro-pastoralist community and midland agriculturalist community were more likely to acquire diarrhoea, compared to those living in the highlands (beyond 2000 meter above sea level). Lowland areas have high temperature and low rainfall (26), and an increase in temperature is often correlated with waterborne disease outbreaks (32, 33). This is because the pathogens that cause waterborne diseases are generally temperature dependent. This means that rising water temperature results in increased growth of bacteria in water, and this, in turn, leads to increased rates of diarrhoeal diseases (34). Part of this community is also agro-pastoralist, who move from place to place in search of water and pasture for their cattle. This movement involves going away from home, leaving sanitation facilities behind.

The study also found that storing drinking water for more than 2 days was associated with increased diarrhoeal morbidity. This was supported by a similar report (35). Lengthy storage of water at home increases the chance of contamination (36).

Children with a family member who had diarrhoea two weeks prior to the survey were 1.35 times more likely to develop diarrhoea themselves. This was supported by findings of a similar study (16, 37). Family members, mothers or caregivers, for example, are usually responsible for preparing food for children. This makes the transmission of infectious agents through food much easier. In addition, the occurrence of diarrhoea may indicate the existence of poor hygienic practice in the household.

Diarrhoea was significantly associated with children in the age group of 6-23 months, compared to the children aged above 48 months. This has been supported by similar studies (15, 18, 38). The greater prevalence of diarrhoea in this age group may get an explanation in the fact that children start to crawl and put things in their mouth at about this age. This might also be linked with the existence of poor child feeding practices for infants between 6 to 8 months in the study areas (32). The children might have also been provided with contaminated weaning food and drinking water (39). An increase in age resulted in a decrease in the magnitude of diarrhoea. For example, in this study, as age increased beyond 23 months, the magnitude of diarrhoea decreased. This might be due to the protective immunity to pathogens the children acquired with frequent exposure (40).

Although there was no association with diarrhoeal morbidity, most study participants reported sharing living households with domestic animals. This may contribute for the poor hygienic conditions around dwellings, and this, in turn, causes cross-contamination of food and water at home. No obvious association has been established between diarrhoeal morbidity and the participants' sharing of living houses with domestic animals in the present study, however.

Though the importance of hand washing after visiting a latrine is known to be effective in reducing diarrhoeal disease morbidity (7, 41), most of the households lacked handwashing facility. This minimizes the opportunities the households could get to wash their hands after visiting the latrine at home.

Absence of improved water sources and sanitation facilities among the participants and the practice of sharing living rooms with animals among the households were not associated with diarrhoeal morbidity. The absence of association might be due to differences like hygiene behavior and individual susceptibility to diarrhoea at individual levels. These differences were not measured. Differences between children's exposure to variables like microbial contamination of drinking water at home were also not measured.

This study had its own strengths and limitations. One example of the strength of the study was the questionnaire type used in the study – the questionnaire used in the study was adapted from WHO core questionnaire. Another important point worth mentioning as the strength of the study was that the nature of the design of the study was community-based. This yielded useful data on the status of latrine and household hygiene through observation. However, it is important to mention that the cross-sectional design used in the study did not show the effects of seasonal variations. This has made drawing causal inferences difficult.

There was also a potential for recall bias among the participants since the onset of diarrhoea and other variables were self-reported. However, this risk was minimized through using reported-incident cases within a 2 week period. The effect of potential recall bias was also minimized through using local language speakers as data collectors. A further point to mention is that the multi-stage cluster sampling technique could be less accurate than simple random sampling. However, considering a design effect to increase the sample size by two-fold has compensated for the potential limitation. There were a few observations in some categories of the variables which were significantly associated with diarrhoea. Some of these associations were feared to have occurred by chance.

The estimates made may have also been biased due to residual confounding of some unmeasured variables.

Further research is needed to determine the representativeness of the various environmental and behavioral risk factors. It is also important that future studies identify changes in the incidence of diarrhoea as a result of interactions among factors over time.

Conclusion

One major conclusion that can be drawn from the present study is that childhood diarrhoea is a major public health problem mainly in agro-pastoralist communities. The variation in the level of childhood diarrhoeal morbidity is explainable in terms of socioeconomic, environmental and childcare-related factors. Such factors include religion, ownership of household, residence in the agro-pastoralist area, length of storage of water, history of diarrhoea among family member and child age. The findings carry implications for the need for planning and implementation of appropriate intervention mechanisms that target agro-pastoralist communities. A further longitudinal research is recommended to investigate the determinants of diarrhoea in all community groups.

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Competing interests

The authors declare having no competing interests.

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