Environmental factors of diarrhea prevalence among under five children in rural area of North Gondar zone, Ethiopia

Atalay Getachew¹, Alebachew Tadie²*, Mulat G.Hiwot¹, Tadesse Guadu¹, Daniel Haile¹, Teklay G.Cherkos³, Zemichael Gizaw¹ and Marta Alemayehu³

Abstract

Background: In the sub-Saharan countries, many of the children including found in health facilities are not having sufficient care of diarrhea. Diarrheal disease in these countries is one of the main causes of deaths for under-five children.

Methods: A community-based cross-sectional study design was used to collect data from May–June, 2016 to determine environmental factors of diarrhea prevalence among under five children in North Gondar Zone. Structured interview questionnaire and observational checklist were used to collect data. Using probability proportion to size, number of households was determined in each district. The multivariable binary logistic regression analysis with a 95% confidence interval and \(p < 0.05\) was used to identify environmental factors associated with childhood diarrheal disease.

Results: Of the total 736 individuals surveyed from 736 households, a total of 163 (22.1%) with 2 week period diarrhea prevalence. Roof material [AOR: 1.99, 95% CI (1.1–3.82)], hand washing facility [AOR: 0.52, 95%CI (0.33–0.82)], presence of Latrine facility [AOR: 1.65, 95% CI (1.01–2.72)], presence of feces around the pit hole [AOR: 1.65, 95% CI (1.01–2.72)], presence of feces around the house compound [AOR: 1.65, 95% CI (1.01–2.72)] and risk of contamination of household storage had significant associations with diarrheal morbidity.

Conclusion: The prevalence of childhood diarrheal disease among under–five children in rural settings of northwest Ethiopia was high. Type of roof material, hand washing facility, presence of Latrine facility, presence of feces around the pit hole, presence of feces around the house compound and risk of contamination of household storage had significant associations with diarrheal morbidity.

Keywords: Diarrhea, Environmental factors, Under-five children, North Gondar zone

Background

In the sub-Saharan countries, many of the children including found in health facilities are not having sufficient care of diarrhea. Diarrheal disease in these countries is one of the main causes of deaths for under-five children [1]. One child passed away from the world within each 15 s due to diarrheal disease [2]. Moreover, in the developing countries alone about two millions of people most of which are under five children die annually [3]. Therefore, there should be an increased work at health care facilities and among the community for the childhood diarrhea care quality [1].

Many factors are responsible for the diarrheal disease. They are socio-economic [4, 5], behavioural like breastfeeding [6, 7] and environmental factors such as water, sanitation and waste disposal mechanism [8–11]. Different studies have been conducted in different parts of Ethiopia on diarrhea prevalence and reported 12.2, 35.6, 22.5, 9.9, and 28.9% [6–10], respectively.
Environmental factors like the type of water source, presence of sanitation facilities, solid waste disposal system and floor type in the kitchen are found to be crucial contributors for the high prevalence of diarrheal diseases. Particularly, diarrhea occurrence is more associated with unsafe/ unprotected water sources e.g. ponds, wells, rivers, lakes [12]. Other more environmental health risk factors of childhood diarrhea include improved sanitation, hand washing facilities, poor knowledge on diarrheal cases, and improved latrine [8, 11]. Therefore, the current study was designed to determine the prevalence of diarrheal disease in under five children and assess the associated environmental factors in the rural areas of North Gondar zone, Ethiopia.

Method

Study area
A community-based cross-sectional study was conducted in North Gondar Zone from April to June 2016. Gondar town is located 739 km far from Addis Ababa to the Northwest of Ethiopia and 180 km in the north direction of Bahir Dar (Capital of Amhara Region). North Gondar is one of the eleven zones in Amhara Regional State having 22 administrative districts. As the data gained from North Gondar Zonal Health Department, the total projected population of North Gondar Zone in 2015/16 is 3,704,740. The majority of which 2,920,007 (78.8%) populations reside in rural areas whereas the rest 784,733 (21.2%) are in urban areas.

Study design and period
A community based cross-sectional study design was used to collect data from May–June 2016.

Sample size determination and sampling procedures
Epi info version 3.5.3 was used to calculate the sample size based on an assumption that 18% of the under-five children had two-week prevalence of diarrhea in North Gondar (26) with marginal error of 4%, a standard score corresponding to 95% certainty, design effect of 2, accounted for two-stage sampling and none response rate 5%. The total sample size that was included in the study is 743 households that should have at least one under-five child. From randomly selected four districts (Dembia, Gondar Zuriya, Chilga, and Sanja) of the 22 total districts of North Gondar Zone, multi-staged sampling procedure was employed. Using probability proportional (PPS) to size, the number of households was determined in each district. Then, 25% of total kebeles was selected from each district by simple random sampling technique and systematic sampling technique was applied to select study households. In case, where there are more than one under-five children in the same household, index child was selected by lottery method to collect information on child’s health characteristics. The first household interview was identified by a modified random walk method and if there is no mother/care taker or under five child in the selected household, the next nearest household was included in the survey.

Data collection methods and tools
The data were collected by using face to face interview with pretested structured questionnaires and observational checklists which were prepared in English and translated to the local language, Amharic. To improve the quality of data collection, two-day training was given to 16 data collectors and 8 supervisors about way of interview, the nature of questionnaires, rechecking of filled questionnaires and approaches to household heads.

Data analysis
All data collection forms were checked for completeness and reliability before entry into software. Data entry and cleaning were done using Epi info version 3.5.3 computer software. Data were analyzed by using SPSS ver.20. Descriptive analyses were deployed for both dependents and independent variables. The frequency distribution of both dependent and independent variables were worked out. Logistic regression analysis was used to see the relationship of selected variables to diarrheal disease. Eight variables with P-value less than 0.2 in bivariate analysis were included in the multivariate logistic regression. Finally, data were presented in the form of tables and figures.

Ethical considerations
Ethical clearance was obtained from the Institutional Ethical Committee of the University of Gondar. Moreover, the consent of participants was obtained from the respective district health offices. The confidentiality of information was maintained during and after an interview in which coding was used for all the data collected. Participants in the study had given verbal consent.

Results

Socio-demographic characteristics of the study participants
In this study, a total of 736 respondents of households participated whose mean (±SD) age was 30 ± 7 years nearly half, 362 (49.2%) respondents were aged between 25 and 34 year. The majority, 690 (93.8%) of participants religion were orthodox and more than half of the respondents 431 (58.5%) were unable to read. Most of the respondents 693 (94.2%) were married and housewives 632 (85.8%). Majority, 463(62.9%) of the respondents had a family size less than five individuals and 423 (57.3%) of the respondent had income less than 1000 ETB (Table 1).
Environmental characteristics

Out of the 736 respondents interviewed, majority of respondents 562 (76.4%) had less than two rooms per household whose most living room floor and roof type is mud 725 (98.5%) and corrugated iron 667 (90.6%) respectively. Only 173 (23.5%) of the household have separate house for animals. Most of the households, 395 (82.0%) used the Pit latrine without slab and only half of the households, 396 (53.8%) used piped water source for drinking. From sanitary risk assessment survey, majority of the source water, 356 (48.4) and household storage, 314 (42.7) had medium risk of contamination. Moreover, the majority of households 556 (75.5%) used open field solid waste disposal (Table 2).

Prevalence of diarrhea

From a total of 736 under five children, 163 under – five children had diarrhea in the 2 week period prior to data collection. Therefore, the 2 week period prevalence of diarrhea was found to be 22.1% [95% CI (19.1–25.1)].

Environmental factors associated with diarrheal disease

In the Univariable binary logistic regression analysis type of roof material, hand washing facility, presence of Latrine facility, ownership of latrine, intermittent water supply, household water treatment, presence of feces around the pit hole, presence of feces around the house compound, risk of contamination of household storage had a p - value less than 0.2 and further analyzed by multivariable binary logistic regression. Finally type of roof material, hand washing facility, presence of Latrine facility, presence of feces around the pit hole, presence of feces around the house compound and risk of contamination of household storage had significant associations with diarrheal morbidity.

Children whose household roof material thatched had two times higher odds of diarrhea than children whose household roof material is corrugated iron [AOR: 1.99, 95% CI (1.1–3.82)]. The risk of developing diarrhea in children who had hand washing facility was 48% lower chance [AOR: 0.52, 95%CI (0.33–0.82)] compared to their counterparts (Table 3).

Children who had no latrine facility had two times higher odds of diarrhea than children who had latrine facility [AOR: 1.65, 95% CI (1.01–2.72)]. Presence of feces around the pit hole [AOR: 1.65, 95% CI (1.01–2.72)] and the house compound [AOR: 1.65, 95% CI (1.01–2.72)] had a significant association with diarrheal disease. The risk of developing diarrheal disease in children who had high sanitary risk of contamination of household storage had five times higher odds of diarrheal disease [AOR: 5.21, 95% CI (3.01–9.03)] compared to sanitary low risk of contamination of household storage. Moreover, children who had very high sanitary risk of contamination of household storage had strong statistically significant association [AOR: 126.6, 95% CI (15.5–1036)] with diarrheal disease (Table 3).

Discussion

The current study determined the prevalence of diarrhea and assessed the environmental factors of diarrhea prevalence among under-five children. The prevalence of diarrhea in the current study was 22.1%. This result is higher than 9.9% in Sebeta town, Oromiya Region of Ethiopia [8] and 19.6% in a rural area of Shebedino

| Variables | Number | Percent (%) |
|-----------|--------|-------------|
| Age       |        |             |
| < 15      | 3      | 0.4         |
| 15–24     | 149    | 20.2        |
| 25–34     | 362    | 49.2        |
| > 35      | 222    | 30.2        |
| Religion of parents |    |             |
| Orthodox  | 690    | 93.8        |
| Protestant| 6      | 0.8         |
| Muslim    | 40     | 5.4         |
| Educational level |      |             |
| Unable to read and write | 431 | 58.6        |
| Read and write    | 62    | 8.4         |
| 1–8        | 135    | 18.3        |
| 9–12       | 75     | 10.2        |
| > 12       | 33     | 4.5         |
| Marital Status  |    |             |
| Married    | 693    | 94.2        |
| Single     | 2      | 0.3         |
| Divorced   | 35     | 4.8         |
| Widowed    | 8      | 0.8         |
| Occupation of the mother | |         |
| Government employee | 24 | 3.3         |
| Housewife | 632    | 85.8        |
| Merchant   | 35     | 4.8         |
| Farmer     | 45     | 6.1         |
| Family size |      |             |
| ≤ 5        | 463    | 62.9        |
| > 5        | 273    | 37.1        |
| Income     |        |             |
| < 1000 Birr | 423 | 5.3         |
| 1000–1999 Birr | 284 | 25.8        |
| 2000–2999Birr | 21  | 47          |
| > 3000 Birr | 8    | 7           |

Table 1 Socio-demographic characteristics of the study participants in North Gondar Zone, June, 2016 (N = 736)
district, southern Ethiopia [13] and it is close with the result 22.5% of east Ethiopia [9]. However, it is lower than 26.1% in Hadaleala District, Afar Region of north-east Ethiopia [5], 27.3% in Jigjiga district, Somali region of Ethiopia [12], 35.6% in Enderta Woreda, Tigray Region of Ethiopia [6] and 32.6% in Burundi [14].

In this study, type of roof material, hand washing facility, presence of Latrine facility, presence of feces around the pit hole, presence of feces around the house compound and risk of contamination of household storage had significant associations with diarrheal morbidity.

Children whose household roof material thatched had two times higher odds of diarrhea than children whose household roof material is corrugated iron. This might be due to the poor sanitation of the house in thatched roof compared to the corrugated iron.

The risk of developing diarrhea in children who had hand washing facility was 48% lower chance compared to their counterparts. This finding is similar with studies done in Sebeta town of Ethiopia [15] and also in Adama District Rural Kebeles [16]. The hand washing facility is important to mothers to easily wash their hands at critical times during the day which is important to reduce fecal-oral transmission of disease.

| Variables                              | Number | Percent (%) |
|----------------------------------------|--------|-------------|
| Type of roof material                  |        |             |
| Thatched                               | 69     | 9.4         |
| Corrugated iron                        | 667    | 90.6        |
| Type of floor material                 |        |             |
| Mud                                    | 725    | 98.5        |
| Cement                                 | 11     | 1.5         |
| Number of rooms per household          |        |             |
| <=2 rooms                              | 562    | 76.4        |
| > 2 rooms                              | 174    | 23.6        |
| Animals live with human                |        |             |
| Yes                                    | 173    | 23.5        |
| No                                     | 563    | 76.5        |
| Presence of Latrine facility           |        |             |
| Yes                                    | 482    | 65.5        |
| No                                     | 254    | 34.5        |
| Type of Latrine facility (N = 482)     |        |             |
| Flush/pour flush latrine               | 14     | 2.9         |
| Ventilated improved pit latrine        | 39     | 8.1         |
| Pit latrine with slab                  | 34     | 7.1         |
| Pit latrine without slab               | 395    | 82          |
| Ownership of latrine (N = 482)         |        |             |
| Private                                | 369    | 76.6        |
| Shared                                 | 113    | 23.4        |
| Presence of feces around the pit hole  | N = 482|             |
| Yes                                    | 56     | 7.6         |
| No                                     | 426    | 57.9        |
| Presence of feces around the house compound | N = 482 |             |
| Yes                                    | 112    | 15.2        |
| No                                     | 624    | 84.8        |
| Source of drinking water               |        |             |
| Piped water                            | 396    | 53.8        |
| Orotected spring and well              | 190    | 25.8        |
| Unprotected spring and well            | 133    | 18.1        |
| River                                  | 17     | 2.3         |
| Intermittent of Water Supply           |        |             |
| Yes                                    | 461    | 62.6        |
| No                                     | 275    | 37.4        |
| Consumption in liter/capita/day        |        |             |
| < 20 L/Capita/day                      | 675    | 91.7        |
| >=20 L/Capita/day                      | 61     | 8.3         |
| Variable                        | Diarrhea prevalence | COR (95% CI) | AOR (95% CI) |
|--------------------------------|---------------------|--------------|--------------|
|                                | Yes, n (%)          | No, n (%)    |              |
| Type of roof material          |                     |              |              |
| Thatched                       | 20(29.0)            | 49(71.0)     | 1.49(0.86–2.59) | 1.99(1.1–3.82)* |
| Corrugated iron                | 143(21.4)           | 524(78.6)    | 1.00         | 1.00          |
| Number of rooms in the house   |                     |              |              |
| <=2 room                       | 124(22.1)           | 438(77.9)    | 0.98(0.65–1.47) |              |
| > 2 room                       | 39(22.4)            | 135(77.6)    | 1.00         |              |
| Hand washing facility          |                     |              |              |
| Yes                            | 63(18.3)            | 281(81.7)    | 0.66(0.46–0.93)* | 0.52 (0.33–0.82)* |
| No                             | 100(25.5)           | 292(74.5)    | 1.00         | 1.00          |
| Animals live with human        |                     |              |              |
| Yes                            | 38(22.0)            | 135(78.0)    | 0.99(0.65–1.49) |              |
| No                             | 125(22.2)           | 438(77.8)    | 1.00         |              |
| Presence of Latrine facility   |                     |              |              |
| Yes                            | 100(20.7)           | 382(79.3)    | 1.00         | 1.00          |
| No                             | 63(24.8)            | 191(75.2)    | 1.26(0.88–1.81) | 1.65(1.01–2.72)* |
| Type of latrine facility       |                     |              |              |
| Unimproved                     | 84(21.3)            | 311(78.7)    | 1.20(0.66–2.17) |              |
| Improved                       | 16(18.4)            | 71(81.6)     | 1.00         |              |
| Ownership of latrine           |                     |              |              |
| Private                        | 83(22.5)            | 286(77.5)    | 1.00         | 1.00          |
| Shared                         | 17(15.0)            | 96(85.0)     | 0.61(0.34–1.08) | 1.09(0.58–2.07) |
| Source of drinking water       |                     |              |              |
| Unimproved                     | 33(22.0)            | 117(78.0)    | 0.98(0.64–1.53) |              |
| Improved                       | 130(22.2)           | 456(77.8)    | 1.00         |              |
| Intermittent water supply      |                     |              |              |
| Yes                            | 114(24.7)           | 347(75.3)    | 1.52(1.04–2.20)* | 1.23(0.79–1.91) |
| No                             | 49(17.8)            | 226(82.2)    | 1.00         | 1.00          |
| Water consumption in liter/capita/day |     |              |              |
| < 20 L/Capita/day              | 153(22.7)           | 522(77.3)    | 0.669(0.332–1.349) |              |
| >=20 L/Capita/day              | 10(16.4)            | 51(83.6)     | 1.00         |              |
| Household water treatment      |                     |              |              |
| No                             | 131(20.1)           | 521(79.9)    | 2.45(1.51–3.95) | 0.67(0.37–1.21) |
| Yes                            | 32(38.1)            | 52(61.9)     | 1.00         | 1.00          |
| Presence of feces around the pit hole |   |              |              |
| Yes                            | 22(39.3)            | 34(60.7)     | 1.96(1.07–3.6)* | 2.46(1.20–5.04)* |
| No                             | 78(18.3)            | 348(81.7)    | 1.00         | 1.00          |
| Presence of feces around the house compound | |              |              |
| Yes                            | 48(42.9)            | 64(57.1)     | 3.32(2.17–5.08)** | 2.09(1.24–3.54)* |
| No                             | 115(18.4)           | 509(81.6)    | 1.00         | 1.00          |
| Methods of solid waste disposal|                     |              |              |
| Pit                            | 56(33.3)            | 112(66.7)    | 80.76(0.00–) |              |
| Open field                     | 107(19.2)           | 449(80.8)    | 38.494(0.00–) |              |
| Burning                        | 0(0)                | 12(100)      | 1.00         |              |
Children who had no latrine facility had two times higher odds of diarrhea than children who had latrine facility. This finding is in agreement with studies done in West Gojam Ethiopia [17] and in Deresha district, Southern Ethiopia [18]. The presence of latrine increases the chance of its utilization which in turn facilitates the safe disposal of feces. This is one way of decreasing contact between causative organisms of diarrhoeal disease and the host. Presence of feces around the pit hole had a significant association with diarrheal disease. This result is comparable with studies done in Nekemte town, western Ethiopia [10] and in Addis Ababa, Ethiopia [19]. Presence of feces around the house compound had a significant association with diarrheal disease. This is due to the fact pathogens in feces disposed in compounds near the house can contaminate the environment and the food eaten by children which leads to diarrheal disease [20–23].

The risk of developing diarrheal disease in children who had high sanitary risk of contamination of household storage had five times higher odds of diarrheal disease compared to sanitary low risk of contamination of household storage. Moreover, children who had very high sanitary risk of contamination of household storage had strong statistically significant association with diarrheal disease. This finding is similar with studies done in Nigeria [24].

The rest variables like type of latrine facility, ownership of latrine, source of drinking water, intermittent water supply, and household water treatment were not significant variables in this study. But, they were significant in the previous studies conducted in different regions of Ethiopia [8, 11]. These discrepancy might be due to the strength of Ethiopia’s Health Extension Program (HEP) from time to time that has created greater awareness of how to prevent communicable diseases such as malaria, tuberculosis, HIV/AIDS and waterborne disease like diarrhoea to the community [25]. Moreover, the discrepancy can be due to difference in seasonal variation.

### Conclusion

In the current study, prevalence of diarrhea found to be high (22.1%). Type of roof material, hand washing facility, presence of latrine facility, presence of feces around the pit hole, presence of feces around the house compound and risk of contamination of household storage had significant associations with diarrheal morbidity.

### Abbreviations

AOR: Adjusted odd ratio; CI: Confidence interval; COR: Crude odd ratio; ETB: Ethiopian birr; PPS: Probability proportion to size; WHO: World health organization

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### Availability of data and materials

Data will be made available upon requesting the primary author.

### Authors’ contributions

AG: participated in the conception and design of the study, data collection and analysis, interpretation of the findings. AT: Participated in the design of the study, data collection, drafting the manuscript and write up, analysis and interpretation of the findings. MG: Participated in the design of the study, data collection. TG: Participated in the design of the study, data collection. DH: Participated in the design of the study. ZG: Participated in the design of the study, data collection. MA: Participated in analysis, interpretations of the findings. All authors read and approved the final manuscript.

### Ethics approval and consent to participate

Ethical clearance was obtained from University of Gondar. After thoroughly discussing the ultimate purpose and method of the study, a written consent was obtained from Institutional Ethical Committee of University of Gondar. Then, community consent was obtained from the respective community leaders. The privacy and confidentiality were maintained during interview. Therefore, only coding was included in the data collection tools. In addition, participants in the study that were not willing to take part in the study had full right to do so. Children that have diarrheal disease were referred to the near health facilities for treatment.

### Table 3

| Variable                          | Diarrhea prevalence | COR (95% CI) | AOR (95% CI) |
|-----------------------------------|---------------------|--------------|--------------|
|                                   | Yes, n (%)          | No, n (%)    |              |
| Risk of contamination of Household storage |                     |              |              |
| Low                               | 29(14.1)            | 177(85.9)    | 1.00         | 1.00         |
| Medium                            | 38(12.1)            | 276(87.9)    | 0.84(0.50–1.41) | 1.07(0.61–1.89) |
| High                              | 79(39.9)            | 119(60.1)    | 4.05(2.49–6.58)** | 5.21(3.01–8.97)** |
| Very high                         | 17(94.4)            | 1(5.6)       | 103(133–809.7)** | 126(15.5–1036)** |
| Risk of contamination of source water |                     |              |              |
| Low                               | 77(25.2)            | 229(74.4)    | 1.00         |              |
| Medium                            | 71(19.9)            | 285(80.1)    | 0.74(0.51–1.07) |              |
| High                              | 15(20.3)            | 59(79.7)     | 0.77(0.41–1.41) |              |

* Statistically significant with p-value < 0.05, **statistically significant at p-value < 0.001.
Consent for publication
This manuscript does not contain any individual person’s data.

Competing interests
The authors declare that they have no competing interests.

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Author details
1College of Medicine and Health Sciences, Institute of Public Health, Department of Environmental & Occupational Health & Safety, University of Gondar, P.O. Box 196, Gondar, Ethiopia. 2Department of Ecological and Systematic Zoology, College of Natural and Computational Science, University of Gondar, Gondar, Ethiopia. 3Department of Medical Microbiology, Institute of Biomedical Sciences, University of Gondar, Gondar, Ethiopia.

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