Research Article

Determinants of Acute Bloody Diarrhea among Adult Outpatient Visits in Bibugn District, Northern Ethiopia

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ABSTRACT

Background: Acute bloody diarrhea (dysentery) is a medical emergency that warrants serious medical investigation for patients of all ages. It is also among weekly reportable disease in Ethiopia. However, studies related to its determinants have been limited.

Objective: To identify determinants of acute bloody diarrhea among adult outpatient visits in Bibugn district, northern Ethiopia.

Methods: We conducted a case-control study with 222 participants (56 cases and 166 controls) in Bibugn district governmental health facilities. A case was defined as a person of age ≥ 18 years, who attends adult outpatient department in selected governmental health facilities of Bibugn district with acute diarrhea containing visible blood in the stool between February and April, 2017. A control was defined as, non-diarrheal outpatient visitors of age ≥ 18 years who attends adult outpatient departments in the selected governmental health facilities of the district. Face to face interview with consecutive sampling method was used to collect data. Epi Data version 3.1 and SPSS version 22 were used for data entry and analysis respectively. Bivariate analysis was done and all covariates with p-value <0.25 were entered into multivariable logistic regression analysis. AOR with 95% CI were calculated to identify independent variables which were significantly associated with acute bloody diarrhea, p-value <0.05 were considered as determinants of acute bloody diarrhea.

Results: Storage of drinking water not separate from water for others uses (AOR=3.00 (1.39-6.48)), dipping use to draw drinking water from the storage container (AOR=2.49 (1.21-5.14)), refuse disposal in open fields (AOR=2.71 (1.37-5.38)) and using less than 20 L daily water consumption per capita (AOR=2.89 (1.28-6.49)) were independently associated with acute bloody diarrhea.

Conclusion: Daily water consumption per capita use of <20 L, storage of drinking water not separate from water for others uses, dipping use to draw water from storage container and open field refuse disposal practice were found to be associated with an increased riskof adult acute bloody diarrheal diseases.

Keywords: Acute bloody diarrhea; Adult outpatient visits; Bibugn district

Introduction

Diarrhea is defined as having loose or watery stools at least three times per day, or more frequently than normal for an individual. According to their clinical pattern, diarrheal diseases can be classified in to three as acute watery diarrhea (diarrhea without blood lasting less than 14 days), acute bloody diarrhea (diarrhea with blood lasting less than 14 days) or persistent diarrhea (diarrhea with or without blood that lasts at least 14 days). All of which are potentially life-threatening and require different treatment courses [1].

Acute bloody diarrhea (dysentery) is defined as an acute bout of diarrhea lasting less than 14 days in which subjects are passing grossly bloody stools. Strains of Shigella, Salmonella and Campylobacter are important causes of dysentery in all regions of the world. In developing tropical and semitropical regions, *Entamoeba histolytica* is an important cause of dysentery especially in older children and adults living in rural areas [2].

Transmission is fecal-oralroute including direct person-to-person contact. Two features of the disease facilitate person-to-person transmission: the infective dose is low (as few as 100 viable organisms), so minor hygiene omissions allow fecal-oral spread, and many persons have only a mild illness, so they remain in contact with and can transmit the infection to others [3,4]. Proper hygiene and sanitization interventions are critical to prevent shigellosis. This includes appropriate hand-washing after using the toilet, hand-washing before preparing or handling food, and properly sanitizing food contact [1]. Dysenteric diarrhea is associated with prolonged illness and complicated disease and can be associated with fatalities in children in the developing world and in the elderly or infirm living in the industrialized regions [2].

In Ethiopia, bloodydiarrhea reported weekly as part of priority diseases under Integrated Disease Surveillance and Response System (IDSR) in the Ministry of Health. Acute bloody diarrhea outbreaks have been reported during different times in Ethiopia however; information about risk factors associated with acute bloody diarrhea was limited in the country [5,6].

Though mortality rates among older children, adolescents and adults are lower than those observed in children under five, diarrhea still poses a substantial burden accounting for approximately 2.8 billion diarrhea episodes among older children, adolescents and adults [7]. For patients of all ages acute bloody diarrhea (dysentery) is a medical emergency that warrants serious medical investigation [8].

Dysentery continued to be one of the major outbreaks in Africa with over half million cases reported in 2006. The most common isolate confirmed was *Shigella dysenteriae* type I, resistant to cotrimoxazole [6]. The emergence of antibiotic resistant Shigella and Salmonellais serious problems in antimicrobial therapy globally and the incidence varies with the area of isolation of these strains. The progressive increase in antibiotics resistance among these pathogens in developing countries is becoming a critical area of concern [9]. A study conducted in Gondar town health institutions, Ethiopia revealed that isolates of Shigella and Salmonella showed high rate of drug resistance to the commonly used antibiotics (Ampicillin, Amoxicillin and Tetracycline) [10].

Ethiopia 2015/2016 annual performance report showed that a total of 267,489 dysentery cases and 229 deaths were reported from all regions of the country. Majority of cases were reported from Oromia and Amhara Regions (83,980 (31.4%) and 60,877 (22.8%), respectively. The incidence rate was highest in Benishangul Gumuz Region (1,751/100,000 population) [11]. There was an epidemic of dysentery in Jimma city of Ethiopia from December 12 to 22, 2008 due to *Shigella flexnneri*, with a total of 566 cases and the majority of cases (52.8%) were students from Jimma University [5]. Therefore, the objective of this study was to identify determinants of acute bloody diarrhea among adult outpatient department visitors of governmental health facilities in Bibugn district, northern Ethiopia.

Materials and Methods

Study setting, design and population

The study was conducted in Bibugn district, which is found in East Gojjam Zone, Amhara national regional state, Ethiopia. It is located at 381 km North of Addis Ababa and the total projected population of the district for 2016/2017 is 94,566; male accounts 49.0% of the total populations. The district has three urban and 15 rural Kebeles (the smallest administrative unit in Ethiopia). Four health centers, 18 health posts, five private clinics and four drug vendors provided Health services in the district. Case-control study design was used among adult outpatient department visitors attending in governmental health facilities found in the districtbetween February and April, 2017.

Enrolment of cases and controls

Case was a person of age ≥ 18 years who attends adult outpatient department in governmental health facilities with acute diarrhea containing visible blood in the stool within the study period. A clinician diagnosed acute bloody diarrhea based on history of visible blood in stool for less than 14 days as recommended in WHO Surveillance standards [12]. We used cases that were already diagnosed by health professionals at outpatient departments in selected governmental health facilities of the district.

Control was a non-diarrheal outpatient visitor of age ≥ 18 years who attends adult outpatient departments in governmental health facilities within the study period.Controls were also identified by health professionals at outpatient departments in the selected governmental health facilities of the district as non-diarrhea outpatient visitor.

Inclusion and exclusion criteria

All adult outpatient visitors who have lived in the district for more than six months were eligible for the study.Controls that had a history of diarrhea within the past two weeks and cases with concomitant known causes of blood in the stool like hemorrhoid, trauma and other local anorectal bleeding were excluded from the study. Cases and controls were selected only once as study participants (repeated visitors were excluded).

Sample size determination and sampling technique

Sample size was calculated by Kelsey formula using Epi Info Version 7.0.8.3 software, considering one variable assumed to bring difference in the two groups. So th0at sample size calculation was based on the following assumptions: Two-sided confidence level (CI)=95%, Power=80%, Ratio of cases to controls=1:3 and from a similar study conducted in Kenya; separate storage of drinking water from water for others uses were taken as main predictor of the outcome (acute bloody diarrhea). In this study the percent of controls exposed (proportion of non-diseased with storage of drinking water separate from water for others uses) was 57.9% with Odds ratio (OR) of 0.412 [12]. Thus, the total sample size was 222 (56 Cases and 166 Controls).

$$n_1 = \frac{(Z_\alpha + Z_{1-\beta})^2 \overline{p}\overline{q}(\mathrm{r}+1)}{r(p_1 - p_2)^2} \; and \; n_2 = rn_1$$

Where,

n_1=Number of cases

n_2=Number of controls

$Z_{\alpha/2}$=Standard normal deviate for two-tailed test based on alpha level (relates to the confidence interval level)

Z_β=Standard normal deviate for one-tailed test based on beta level (relates to the power level)

Ratio of control to cases:

P_1=Proportion of cases with exposure and q_1=1-p_1

P_2=Proportion of controls with exposure and q_2=1-p_2

Both cases and their controls were selected from the same adult outpatient department visitors who were diagnosed by the same health professionals. Cases were selected consecutively from all health centers during the data collection period until the required sample size was reached. For each case, the next three controls were selected consecutively from the same adult outpatient department based on fulfillment of inclusion and exclusion criteria.

Study variables and measurements

The independent variableswere comprised of socio-demographic and economic factors like age, sex, educational status,place of residence,occupation,marital status,average family monthly income andfamilysize. Behavioral related factors included in this study were practices of home drinking water treatment and storage and hand washing practice.In addition, environmental related factorswere availability of latrine, presence of hand washing facility after toilet, type of water source, type of drinking water collection container, amount of daily water consumption, distance to the water source, refuse disposal and presence of livestock in the house.

In this study drinking water sources were classified as improved and non-improved water sources; an individual was considered as using an improved water source if the drinking water source was protected from outside contamination, in particular from contamination with fecal matter. This includes protected spring, protected dug well, bottled water and piped water sources. A study participant was considered as using non-improved water source if the drinking water source was from river; pond, unprotected dug well and unprotected spring. Per capita water consumption is calculated by considering frequency of water collection in a day, capacity of container and family size i.e. per capita water is equal to frequency of collection times capacity of container divided by family size. Then, a household daily water consumption per capita was categorized into either using <20 L per individual per day or using ≥ 20 L per individual per day.

Latrine ownership was classified into private and shared latrines. A household was classified as having private latrine if it was used only by members of one household. A household was classified as having shared latrine if it was used by members of more than one household.

Hand washing practices related variables includes always washed hands after defecation in the last one month, washed hands after last defecation, always washed hands after disposing child's stool in the last one month, always washed hands before food preparation in the last one month and always washed hands before eating in the last one month. These variables were categorized into either yes or no categories to test associations between yes and no groups.

Refuse in this study includes such solid wastes as ash, cow dung, home-sweepings; but not human excreta and classified into; open field refuse disposal and not open field refuse disposal. Not open field refuse disposal includes pit, burning or garbage can refuse disposal users.

Data processing, analysis and quality control

Data were checked for completeness; coded and entered using Epi data Version 3.1 and exported to SPSS version 22 for further analysis. Bivariate analysis was done to nominate variables for multivariate analysis and all variables with p-value <0.25 were entered into multivariable logistic regression analysis. AOR with 95% CI were calculated using multivariate logistic regression to assess independently associated variables with p-value <0.05 levels of significance. The findings of the study were presented using narration and tables.

Pre test were done on 5% of the study participants to check data collection instruments and research procedures in Motta health center (the nearby health center to Bibugn district) and the result of the pretest was consistent with the expected data. Training was given to eight data collectors and two supervisors on data collection instruments and procedures. Data was checked daily for its completeness and consistency throughout the data collection period.

Results and Discussion

Socio-demographic characteristics

Participants enrolled into the study were 222 (56 cases and 166 controls) with a 100% response rate. The mean age of the cases was 37.1 (± 14.43) years with a range of 18 to 75 years while the mean age of controls was 33.3 (± 13.00) years with a range of 18 to 77 years. The proportion of females was 55.4% among cases and 50.6% among controls. About 83.9% of the cases and 85.5% of the controls resided in the rural areas. All cases and controls were followers of Orthodox Christians religion and ethnically all of the study participants were from Amhara. Majority of the cases 17 (30.40%) were from Wabir health center 17 (30.4) followed by Woyn Wuha Health Center 15 (26.80%).

Bivariate analysis results

Socio demographic related factors: From the total eight socio demographic related factors considered in bivariate analysis, age and family size were nominated for multivariable analysis (Table 1). Seven environmental related factors; having shared latrine ownership, dispose refuses in open fields, using pots as water collection container, using plastic bucket as water collection container, storage of drinking water not separated from water for other use, less than 20 L daily water consumption per capita and absence of hand washing facility after toilet were nominated (Table 2). From behavioral related factors; three factors were nominated for multivariable logistic regression analysis; always washed hands after defecation in the last one month, do not washed hands after last defecation and dipping method use to draw drinking water from the storage container (Table 3).

Multivariable logistic regression analysis results: This study revealed that adults who did not separately store their drinking water from water for other uses were three times (AOR=3.00 (1.39-6.48))more likely to develop acute bloody

Table 1: Socio-demographic factors of study participants related to acute bloody diarrhea in Bibugn district, northern Ethiopia, 2017.

Factors	Category	Cases n (%)	Controls n (%)	COR (95% CI)	P-value
Age (years)	18-40	37 (66.1)	121 (72.9)	1	
	41-60	10(17.9)	34(20.5)	0.96 (0.43-2.13)	0.924
	≥ 61	9 (16.1)	11 (6.6)	2.68 (1.03-6.95)	0.043*
Sex	Male	25 (44.6)	82 (49.4)	1	
	Female	31 (55.4)	84 (50.6)	1.21 (0.66-2.22)	0.538
Family size	01-Feb	9 (16.1)	45 (27.1)	1	
	03-May	27 (48.2)	80 (48.2)	1.69 (0.73-3.90)	0.221*
	>5	20 (35.7)	41 (24.7)	2.44 (1.00-5.96)	0.050*
Place of residence	Urban	9 (16.1)	24 (14.5)	1	
	Rural	47 (83.9)	142 (85.5)	0.88 (0.38-2.03)	0.769
Educational status	No formal	37 (66.1)	104 (62.7)	1.28 (0.44-3.70)	0.647
	Primary	14 (25.0)	44 (26.5)	1.145 (0.36-3.65)	0.818
	Secondary and above	5 (8.9)	18 (10.8)	1	
Marital status	Married	44 (78.6)	136 (81.9)	1	
	Single	6 (10.7)	16 (9.6)	1.16 (0.43-3.14)	0.772
	Divorced	6 (10.7)	14 (8.4)	1.33 (0.48-3.66)	0.587
Average family monthly income (birr)	<500	17 (30.4)	55 (33.1)	0.89 (0.44-1.93)	0.77
	500-1000	22 (39.3)	62 (37.3)	1.02 (0.49-2.13)	0.957
	>1000	17 (30.4)	49 (29.5)	1	

*nominated factors for multivariable logistic regression analysis (P<0.25)

Table 2: Bivariate analysis of environmental related factors of study participants related to acute bloody diarrhea in Bibugn district, northern Ethiopia, 2017.

Factors	Category	Cases n (%)	Controls n (%)	COR (95% CI)	P-value
Latrine ownership	Private	45 (81.8)	151 (92.1)	1	
	Shared	10 (18.2)	13 (7.9)	2.58 (1.06-6.28)	0.037*
Refuse disposal method	Open field	27 (48.2)	43 (25.9)	2.66 (1.42-4.99)	0.002*
	Not open field	29 (51.8)	123 (74.1)	1	
Source of drinking water	Improved	29 (51.8)	102 (61.4)	1	
	Non-improved	27 (48.2)	64 (38.6)	1.48 (0.81-2.73)	0.205*
Types of water collection container	Jerry can	35 (62.5)	138 (83.1)	1	
	Pot	11 (19.6)	16 (9.6)	2.71 (1.16-6.36)	0.022*
	Plastic bucket	10 (17.9)	12 (7.2)	3.29 (1.31-8.22)	0.011*
Separate container for drinking water	Yes	11 (19.6)	70 (42.2)	1	
	No	45 (80.4)	96 (57.8)	2.98 (1.44-6.18)	0.003*
Daily water consumption	<20 L	46 (82.1)	108 (65.1)	2.47 (1.16-5.25)	0.019*
	≥ 20 L	10 (17.9)	58 (34.9)	1	
Time to fetch water from the source (round trip)	<15 min	45 (80.4)	122 (73.5)	1	
	≥ 15 min	11 (19.6)	44 (26.5)	0.68 (0.32-1.43)	0.305
Livestock in the house present	Yes	26 (46.4)	82 (49.4)	0.89 (0.48-1.63)	0.701
	No	30 (53.6)	84 (50.6)	1	
Hand washing facility present after toilet	Yes	41 (73.2)	143 (86.1)	1	
	No	15 (26.8)	23 (13.9)	2.27 (1.09-4.76)	0.029*

*nominated factors for multivariable logistic regression analysis (P<0.25)

diarrhea as compared to adults who stored separately.This finding is in agreement with a study done in Kenya [12]. The frequency of getting contact with water storage containers increases in the case of using the same container for both drinking and other purpose; this increased frequency of getting contact with the containers might increase the chance of introducing

Table 3: Bivariate analysis of Behavioral related factors of study participants related to acute bloody diarrhea in Bibugn district, northern Ethiopia, 2017.

Factors	Category	Cases n (%)	Controls n (%)	COR (95% CI)	P-value
Always washed hands after defecation in the last one month	Yes	36 (64.3)	135 (81.3)	1	
	No	20 (35.7)	31 (18.7)	2.42 (1.24-4.74)	0.010*
Washed hands after last defecation	Yes	39 (69.6)	143 (6.1)	1	
	No	17 (30.4)	23 (13.9)	2.71 (1.32-5.57)	0.007*
Always washed hands after disposing child's stool in the last one month	Yes	14 (70.0)	38 (71.7)	1	
	No	6 (30.0)	15 (28.3)	1.09 (0.35-3.35)	0.886
Always washed hands before food preparation in the last one month	Yes	19 (57.6)	59 (61.5)	1	
	No	14 (42.4)	37 (38.5)	1.17 (0.53-2.62)	0.694
Hand washing substitutes used after toilet	Soap and water	18 (41.9)	52 (34.9)	1	
	Ash and water	6 (14.0)	19 (12.8)	0.91 (0.32-2.64)	0.866
	Water only	19 (44.2)	78 (52.3)	0.70 (0.34-1.47)	0.348
Always reheat food before eating in the last one month	Yes	29 (51.8)	96 (57.8)	1	
	No	27 (48.2)	70 (42.2)	1.28 (0.70-2.35)	0.431
How do you draw drinking water from storage container	Pouring	35 (62.5)	138 (83.1)	1	
	Dipping	21 (37.5)	28 (16.9)	2.96 (1.50-5.82)	0.002*
Home drinking water treatment	Yes	6 (10.7)	17 (10.2)	1	
	No	50 (89.3)	149 (89.8)	0.95 (0.36-2.54)	0.920

*nominated factors for multivariable logistic regression analysis (P<0.25)

Table 4: Multivariable logistic regression analysis of determinants of acute bloody diarrhea among adult outpatient visitors in Bibugn district, northern Ethiopia, 2017.

Factors	Category	Cases n (%)	Controls n (%)	AOR (95% CI)
Storage of drinking water separate from water for other uses	Yes	11 (19.6)	70 (42.2)	1
	No	45 (80.4)	96 (57.8)	3.00 (1.39-6.48)
How do you draw drinking water from storage container	Pouring	35 (62.5)	138 (83.1)	1
	Dipping	21 (37.5)	28 (16.9)	2.49 (1.21-5.14)
Refuse disposal method	Open field	27 (48.2)	43 (25.9)	2.71 (1.37-5.38)
	Not open field	29 (51.8)	123 (74.1)	1
Daily water consumption per capita	<20 L	46 (82.1)	108 (65.1)	2.89 (1.28-6.49)
	≥ 20 L	10 (17.9)	58 (34.9)	1

pathogenic microorganisms' into it. The other explanation might bebecause, logicallycontainers used for both purposes are bigger than container used for only drinking purposes; which might then be difficult to clean very frequently. If it isn't get cleansed frequently, the chance of being place forpathogenic microorganisms' increases.

Adults who draw drinking water by dipping were two point five times (AOR=2.50 (1.21-5.14)) more likely to develop acute bloody diarrhea than adults who draw drinking water by pouring. This might be due to the fact that, dipping inside drinking water storage contaminates pathogenic microorganisms' which might be there on the surface of the cup.That may finally lead them get acute bloody diarrhea.

Adults who dispose refuse in open fields were two point seven times (AOR=2.71 (1.37-5.38)) more likely of developing acute bloody diarrhea as compared to adults who did not dispose their refuse in open fields.The incidence of acute bloody diarrhea was related to poor general compound cleanliness and sanitation [12,13]. It is fact that poor environmental sanitation creates comfortable environment for pathogenic microorganisms' that are responsible for many diarrheal diseases including acute bloody diarrhea; which these pathogenic microorganisms' then get chance to rich on food and drinks and finally lead them to acute bloody diarrhea.

Adults who use less than 20 L of daily water consumption per capita were almost three times (AOR=2.89 (1.28-6.49)) more likely of developing acute bloody diarrhea as compared to adults who use ≥ 20 L per day per capita. This finding is supported by a meta-analysis finding done in developing countries [14].An adequate amount of water is necessary to reduce the risk of water-related disease, to provide for consumption, for cooking purposes and to ensure personal and domestic hygienic requirements [15]. In developing countries like in our study, quantities of water have greater impact than quality of water with respect to prevention of diarrheal diseases; because in most settings poor sanitation and hygiene of living environments were related as cause for diarrheal diseases. If peoples did not get enough water for daily consumptions, it will be difficult to produce their hygiene and sanitation and which might increase the chance of getting acute bloody diarrhea (Table 4).

Conclusion and Recommendation

The study identifies determinants of acute bloody diarrhea among adult outpatient visits in Bibugn district, northern Ethiopia. It was found that storage of drinking water not separate from water for others uses, dipping use to draw water from storage container, open field refuse waste disposal practice and daily water consumption per capita use of less 20 liters were found to be independently associated with an increased chance of adult acute bloody diarrheal diseases.The district health office and other responsible stakeholders should give due attentions to improve the proper handling and drawing from storage practices of drinking water at household level in the community; and also solid waste disposal practice. District water and Energy office in collaboration with health office should target on provision of adequate water supply and promoting importance of adequate water supply at the household level for prevention and control of acute bloody diarrhea.

DECLARATIONS

Ethics approval and consent to participate.

ETHICAL CONSIDERATIONS

The study was carried out after getting ethical approval from the Ethical Review Committee of Jimma University, Institute of Health. Then, government officials at various levels were consulted for permission before the start of data collection. Finally, study subjects were interviewed after informed verbal consent is obtained and the information from each interviewee were kept confidential.

CONSENT TO PUBLISH

Permission to disseminate the study finding through publication was obtained from study participants.

COMPETING INTERESTS

No conflict of interest prevails among researchers.

AVAILABILITY OF DATA AND MATERIAL

The dataset supporting the conclusions of this will be attached.

AUTHOR'S CONTRIBUTIONS

AB participated in the design of the study, data collection, performed statistical analysis and drafted the first manuscript. LD participated in the design of the study, performed statistical analysis and reviewed the manuscript. SB participated in the design of the study, performed statistical analysis, draft and reviewed the manuscript. All authors have read and approved the final manuscript.

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