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Dejene Mosisa
Ambo University

Mecha Aboma (abomamecha@gmail.com)
Ambo University

Teka Girma
Ambo University

Abera Shibru
Ambo University

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Determinants of Diarrheal Diseases among Under Five Children in Jimma Geneti District, Oromia Region, Ethiopia, 2020: a case-control study

Dejene Mosisa[1], Mecha Aboma[1*], Teka Girma[1], Abera Shibru[1]

[1] Department of Public Health, Medicine and Health Sciences College, Ambo University, Ambo, Ethiopia

* Corresponding author

Email address:

Mecha Aboma: abomamecha@gmail.com; P.O.BOX:19; Mobile: +251912060826

Abstract

Background: Globally, in 2017, there are nearly 1.7 billion cases of childhood diarrheal diseases and it is the second most important cause of morbidity and mortality among under-five children in low-income countries including Ethiopia. Sanitary conditions, Poor housing, unhygienic environment, inadequate safe water supply, cohabitation with domestic animals that may carry human pathogens, and lack of storage facilities for food combining with socio-economic and behavioral factors are the common determinates of diarrhea diseases and had a large impact on diarrhea incidence in most of the developing countries

Methods: A Community-based unmatched case-control study design was conducted on 407 systematically sampled under-five children of Jimma Geneti District (135 with diarrhea and 272 without diarrhea) from May 01 to 30, 2020. Data was collected using an interview administered questionnaire and observational checklist adapted from the

WHO/UNICEF core questionnaire and other related literature. Descriptive, bivariate, and multivariate binary logistic regression analysis were done by using SPSS version 20.0

Result: Socio-demographic determinants such as being a child of 12-23 months age (AOR 3.3, 95% CI 1.68-6.46) and parents/legal guardian's history of diarrheal diseases (AOR 7.38, 95% CI 3.12-17.44) were significantly associated with diarrheal diseases among under-five children. Environmental and Behavioral factors such as unavailability of handwashing facility nearby latrine (AOR 5.22, 95% CI 3.94-26.49), lack of hand-washing practice at critical times (AOR 10.6, 95% CI 3.74-29.81), improper domestic solid waste disposal practice (AOR 2.68, 95% CI 1.39-5.18) and not vaccinated against rotavirus (AOR 2.45, 95% CI 1.25-4.81) were found important determinants of diarrheal diseases among under-five children.

Conclusion: Unavailability of hand-washing facility nearby latrine, parent's/legal guardian's history of last two weeks diarrheal diseases, improper latrine utilization, lack of hand-washing practice at critical times, improper solid waste disposal practices, and rotavirus vaccination status were the determinants of diarrheal diseases among under-five children identified in this study. Thus, promoting households through the provision of continuous and modified health information on the importance of sanitation, personal hygiene as well as vaccination against rotavirus, which is fundamental to decrease the burden of diarrheal disease among under-five children.

Key words: *Unmatched, Case-Control, Determinants, Diarrhea, Jimma Geneti, District*

Back ground

The World health organization (WHO) define diarrhea as the passage of three or more loose or liquid stools per day due to abnormally high fluid content of stool or an abnormal increase in daily stool fluidity, frequency, and volume from what is considered normal for an individual and caused by bacterial, viral, protozoa, and parasitic organisms (1).

Rotavirus and Escherichia coli are the two mainly common etiological agents of moderate-to-severe diarrhea in low-income countries (2). It is more common when there is a lack of adequate sanitation and hygiene and safe water supply for drinking, cooking, and cleaning, improper feeding practices, and poor housing situation (3).

Globally, in 2017, a large number of mortality and an estimated 1.7 billion diarrhea episodes occurred annually among under-five children. Despite the global achievement in the reduction of all-cause of diarrheal diseases particularly mortality in the past 30 years, worldwide diarrhea remains the second most important cause of death due to infections among children under five years of age. And it is responsible for killing around 760,000 children every year and about 2,195 children every day and around 1 in 9 child deaths. It is more than the death of children due to Acquired Immune deficiency syndrome (AIDS), malaria, and measles combined(1,4).

Similarly, diarrheal disease is the most important community health problem in Sub-Saharan Africa and was accountable for greater than 50% of childhood illnesses and 50–80% of childhood death in the county (5, 6). Diarrheal diseases are one of the main leading causes of under-five illness, death and, under-nutrition in emerging countries. Averagely per year, every single child suffers from five episodes of diarrhea in African regions including Ethiopia (7). In spite of different continual efforts, 15,000 under five years of age children die every year due to diarrheal diseases related to inadequate environmental sanitation and hygiene practices (8). Ethiopia is one of the emerging sub-Saharan-African regions contributing to the tall burden of diarrheal illness and death (9).

In the year 2016 alone, generally, 1 in every 15 children die before reaching the fifth birthday, among these deaths, diarrhea kills almost fifteen thousand under-five children in Ethiopia (8). These were due to living conditions, high incidence of illness, lack of safe drinking water supply, sanitation and, hygiene, as well as poorer overall health and

nutritional status (6). Poor sanitation, lack of access to clean water supply, and inadequate personal hygiene are accountable for 90% of diarrheal disease occurrence, this problem can be easily improved by health promotion and education (10).

In spite of all advances in health technology, improved management, and increased use of oral rehydration therapy in the past decades, diarrheal diseases still continue to be a major cause of morbidity and mortality and there is no dramatically changed evidence whether the health extension strategy has been made an effect on the risk factors of childhood diarrhea (11). And studies done in different parts of Ethiopia had shown that diarrhea is still a major public health concern (12, 13).

According to Ethiopia Demographic and Health Surveys (EDHS), under-five mortality declined from 166 deaths per 1,000 live births in 2000 to 67 deaths per 1,000 live births in 2016. This represents a 60% decrease in under-five mortality over a period of 16 years. According to this survey, the prevalence of diarrheal disease in under-five children in the 2 weeks before the survey has dropped from 13% in 2011 to 12% in 2016. But, the under-five mortality rate in the Oromia region was 79 per 1000, which is higher than the national figure (8).

Additionally, as Jimma Geneti district Health Office performance report on the first quarter of 2019/2020 showed, the prevalence of diarrheal diseases among under-five children is 13.5%. Despite the emphasis given by the Ethiopian ministry of health, respective regional health offices, Zonal department, and district health offices to improve child health, still many children are dying due to diarrheal disease in Ethiopia and specifically in Jimma Geneti district(14). Therefore, identifying the determinants of diarrheal diseases among under-five children in the study area has an important public

health implication for suitable interventions and appropriate strategies to decrease the impact of diarrheal disease (Figure 1).

Conceptual Frame Work

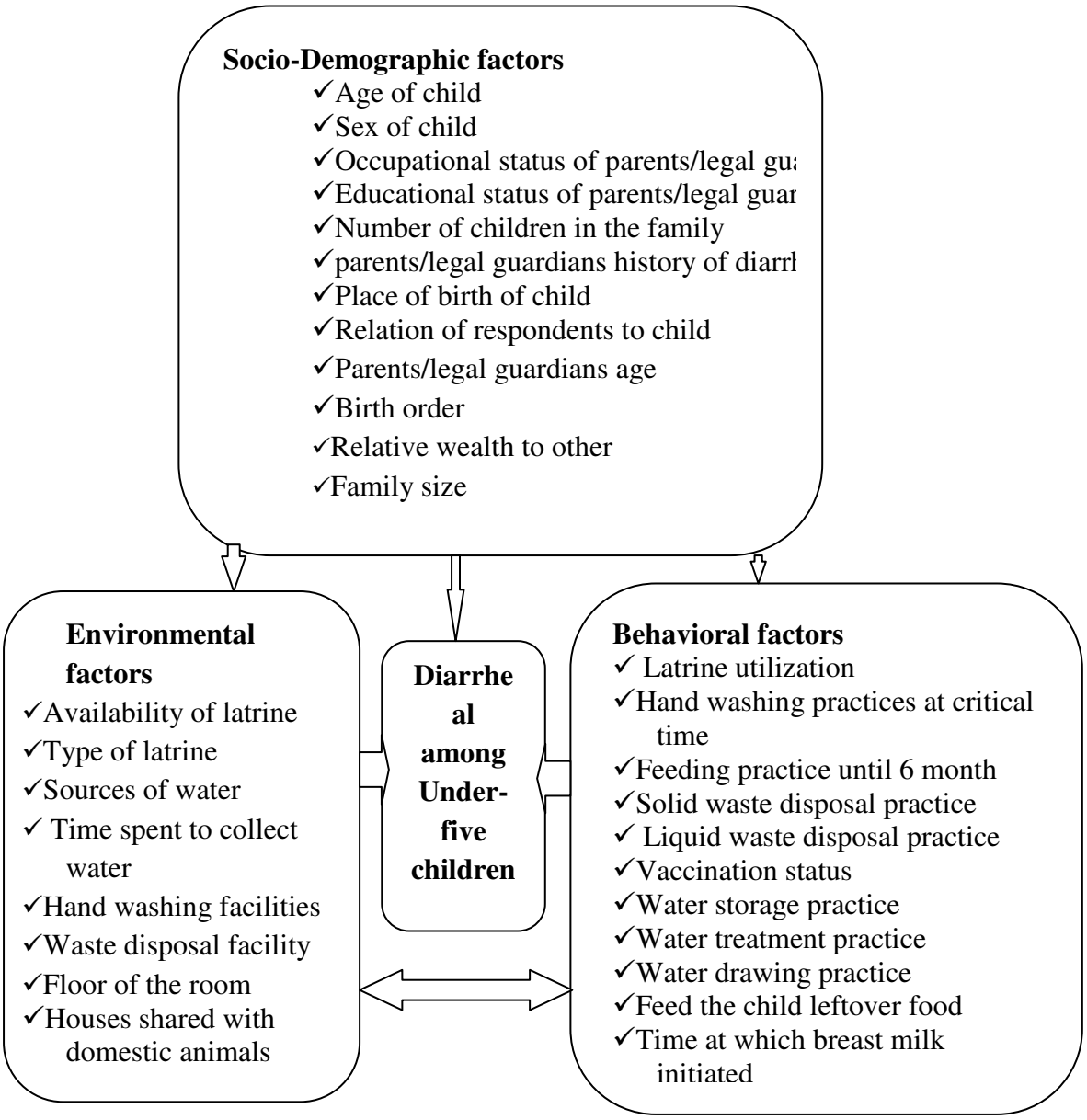

Figure 1: Conceptual framework on Determinants of Diarrheal Diseases among under-five Children in Jimma Geneti district, Oromia regional state, Western Ethiopia, May, 2020 (15, 16).

Methods and Materials

Study Area and Period

The study was conducted in Jimma Geneti District, from May 01 to 30, 2020. Jimma Geneti District is located in Horo Guduru Wollega Zone, Oromia Region, the western part of Ethiopia, 273km from the Capital City, Addis Ababa. Jimma Geneti district has a total population of 90,364 which are 44,278 males and 46,086 females among which 5,755 (6.4%) urban and 84,609 (93.6%) rural and 18,826 total households.There are 19,998 women of reproductive age and 14,848 under-five children (14) (Figure 2).

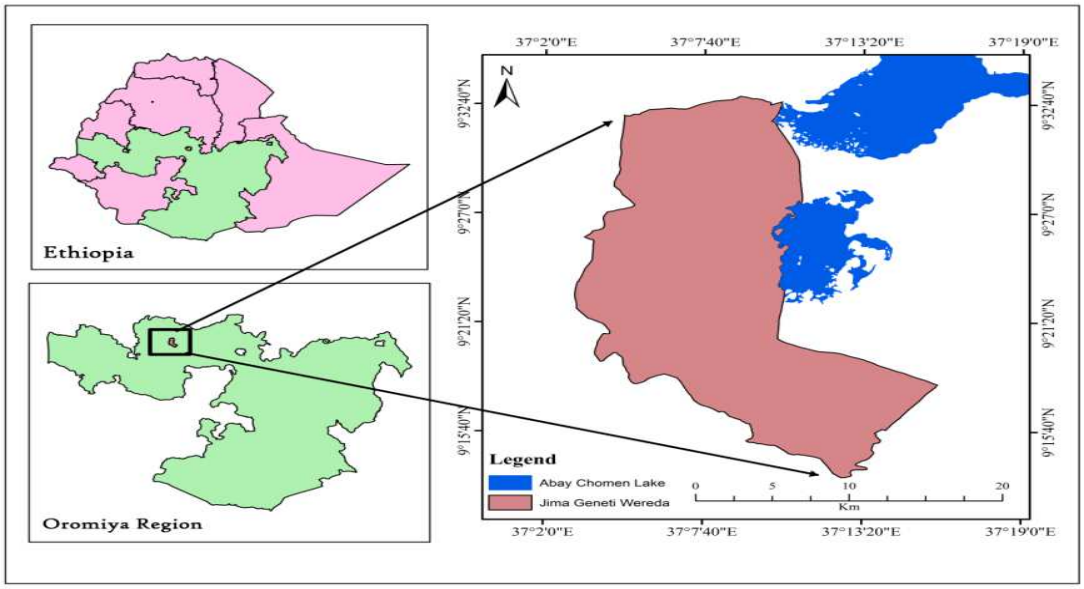

Figure 2: Location map of Jimma Geneti District: Nation, Region and, District, Oromia Regional state, Western Ethiopia, May, 2020 (14).

Study Design Sample Size and Sampling Procedures

A community-based unmatched case-control study design was conducted to assess determinants of diarrheal diseases among under-five children. The households who had under-five years old children and residents of the study area in randomly selected kebele was a sampling unit of this study while randomly selected under-five children with diarrhea for cases and without diarrhea for controls were the study unit of this study.

Randomly selected under-five children in the households, with a report of diarrhea in the preceding two weeks before the survey, were cases while randomly selected under-five children in the households, without report of diarrhea in the preceding two weeks before the survey, were controls

The sample size was determined using unmatched case-control of OpenEpi with the assumptions of power = 80%; confidence level = 95%; case to control ratio = 1:2; P1= proportion of diarrheic children that had not used latrine for disposal of child feces, P2 = proportion of children non-diarrheic that had not used latrine for disposal of child feces as the main predictors of the outcome which was 33.0% and 19.1% among cases and controls respectively (12).

And an adjusted odds ratio (AOR= 2.09) and 10% of none response rates were considered. Finally, 407 (135 from cases and 272 from controls) sample size was generated. The district had 14 kebeles (small unit of administration) and from these 4 kebeles were selected by lottery method. Cases and controls were identified by the census, then a total of 3745 households with under-five children (156 with diarrhea and 3589 without diarrhea) in the selected kebeles were registered and coded through a house-to-house survey. Afterward, the calculated sample size for control was proportionally allocated to the size of households with under-five children for each selected kebeles. Finally, a total of 272 controls were selected by using the systematic random sampling technique, and all of the registered 135 cases were taken and included in the study (Fig 3).

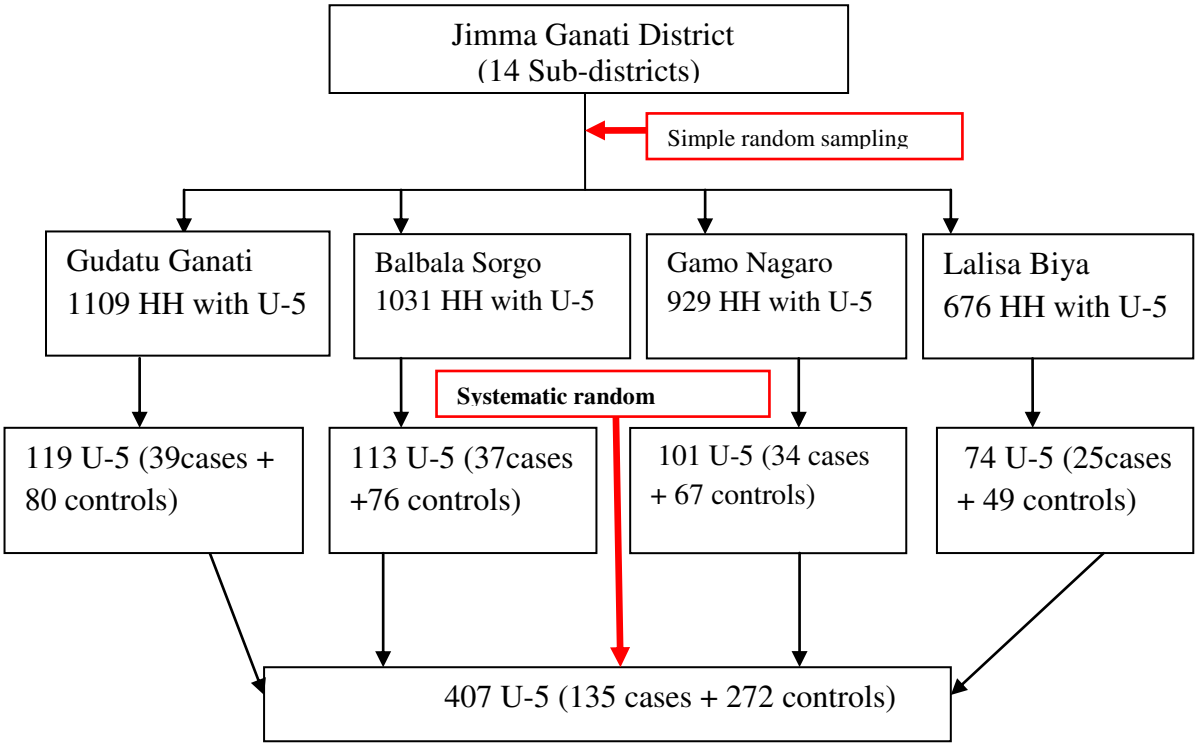

Figure 3: Diagrammatic presentation of sampling technique of under-five children in Jimma Geneti district, Oromia Regional state, Western Ethiopia, May, 2020.

Data Collection Tool and Personnel

Data were collected by eight trained BSc Nurses under the supervision of four Health officers using a pretested structured questionnaire adapted from the WHO/UNICEF core questionnaire and other related literature (15, 16, 17). In addition, an observational checklist was used to observe water storage containers, the presence or absence of feces around the latrine and compound, availability, and types of the latrine, and the presence or absence of handwashing facilities nearby the latrine.

Data Quality control and Analysis

Data quality was assured through pre-test on 5% of the total sample size in different sub-districts of the study area. Data collectors and supervisors were trained for one day by the principal investigator on the study instruments and consent form, how to interview and, data collection procedures. The data collection processes were closely supervised by

supervisors and investigators. Before data entry, the questionnaires were checked for completeness, consistency, and correction measures made by supervisors and investigators. Then, the data were coded and entered into Epi Info and was exported to SPSS for data processing, cleaning, and analysis. Descriptive analysis like frequency and percentage was carried out to describe socio-demographic characteristics of the respondents and environmental and behavioral determinants of diarrhea among under-five children and results were presented in texts and tables. The bivariate and multivariate analyses were done using binary logistic regression to identify factors associated with diarrheal diseases among under-five children. Candidate variables for the final model (multivariate binary logistic regression) were identified using binary logistic regression model at a p-value less than 0.25 and the final model multiple logistic regression was done to see the independent effect of each explanatory variable on the study variable at a p-value of less than 0.05.

The Hosmer and Lemeshow goodness-of-fit (P-value = 0.348) was checked to test for model fitness. The independent variables were tested for multi co-linearity using the Variance Inflation Factor (VIF) and the Tolerance tests and no variables found to have VIF greater than 2 to be omitted from the analysis.

Terms and Operational Definition

Diarrhea: is defined as having three or more loose or watery stool in a 24 hour period in the household within the two weeks period before the survey administered as reported by the parents/legal guardians of the child (8).

Parents/legal guardians: mother/father/caregiver or a person who is responsible for taking care of a child; the person can be a male or female relative of the child or non-relative.

Relative Wealth to other: Households is categorized based on the number and kinds of domestic animals they own, ranging from a hen to cow/ox, in addition to farmland ownership with the amount of productivity per year and housing characteristics such as consumer goods, toilet facilities, and flooring materials. Ranking each household by their living standard, and then dividing the distribution into three categories Model, Middle, and poor (18).

Improved water sources: It includes piped water into the dwelling, piped water to the yard, tube well, or borehole, public standpipes, protected dug wells, protected springs, and rainwater. An improved source is one that is likely to provide "safe" water (4).

Improper waste disposal: is the disposal of waste in a way that has an impact on the environment. Examples include littering, hazardous waste that is dumped into the ground, and not recycling and disposing of a refuses in open fields (4).

Hand washing during the critical time: refers to parents'/legal guardians' hand-washing practice after utilization of latrine, after helping your child defecates, before food preparation, and before self-feeding and child-feeding. If yes for all critical times of handwashing, it concluded as good, otherwise poor practice.

Proper latrine utilization: Households with functional latrines and at least no observable feces in the compound, observable fresh feces through the squat hole, and the foot-path to the latrine were uncovered with grasses.

Good awareness towards diarrhea: Respondents who mentioned at least three causes of diarrhea such as microorganisms, flies, contaminated food/water, three ways of transmission such as by eating contaminated food, by flies, and by physical contact with the diseased person and its prevention such as vaccination of rotavirus vaccine, early

initiation, and exclusive breastfeeding, use safe water for drinking and food preparation, proper waste disposal.

Results

Socio-demographic Characteristics of Study Participants

Totally, 407 under five-children (135 cases and 272 controls) were sampled for this study. However, data were gathered from 399 under-five children of study participants (127 among cases and 272 among controls) made a response rate of 98.03% in both study groups. Among those studied children, 76 (59.8%) of cases and 156 (57.4%) of controls were male children and 44 (34.6%) cases and 128 (47.1%) controls were found in the age group of 24–59 months. The mean (+SD) of the age of cases and controls was 18.79 (+5.2) and 21.09 (+5.9) months respectively. Among these children, 107 (84.3%) of cases and 231 (84.9%) of controls were born at the health facility.

Of all parents/legal guardians 118 (92.9%) among cases and 266 (97.8%) among controls were biological mothers. Out of the total parents/legal guardians 106 (81.9%) cases and 247(87.9 %) controls were found in the age group of 25-35 years.

The majority of parents/legal guardians, in both groups, 108 (85%) cases, and 201 (73.9%) controls were housewives by occupation. Most of parents/legal guardians, 115 (90.6%) cases, and 255 (93.8%) controls were married. More than half of the parents/legal guardians in both study groups; 69 (54.3%) cases and 151 (55.5%) controls had no formal education

Out of the total, 90 (70.9%) parents/legal guardians of the cases and 196 (72.1%) of the controls were protestant religion followers. About, 126 (99.2%) of cases and 267 (98.2%) of controls were from Oromo by ethnicity.

Regarding the family size of the households in both groups, 62 (48.8%) of cases and 139 (51.1%) of controls were had >=5 members and the number of under-five children in the households in both groups was one among more than half of the households, 65 (51.2%) of cases and 153 (56.2%) of controls.

Among all households, 34 (26.8%) parents/legal guardians of cases, and 14 (5.1%) parents/legal guardians of controls had last two-week history of diarrheal (Table 1).

Table 1: Socio-demographic characteristics of study participants in Jimma Geneti District, Oromia Regional state, Western Ethiopia, May, 2020

Socio-demographic characteristics of study participants (n=399)	Frequency	
	Number/Percent of cases of cases (n=127)	Number/Percentage of controls (n=272)
Sex of Child		
Male	76 (59.8)	156 (57.4)
Female	51 (40.2)	116 (42.6)
Age of child		
0-5 months	12 (9.4)	17 (6.3)
6-11months	27 (21.3)	48 (17.6)
12-23 months	44 (34.6)	79 (29)
24-59 months	44 (34.6)	128 (47.1)
Place of Delivery		
Health facility	107 (84.3)	231 (84.9)
Home	20 (15.3)	41 (15.1)
Age of the respondents		
18-24 years	2 (1.6)	9 (3.3)

25-35 years	104 (81.9)	239 (87.9)
>35 years	21 (16.5)	24 (8.8)
Relation of the respondents		
Mother	118 (92.9)	266 (97.8)
Caregiver	9 (7.1)	6 (2.2)
Ethnicity of respondents		
Oromo	126 (99.2)	267 (98.2)
Amhara/other	1 (0.8)	5 (1.8)
Marital status		
Married	115 (90.6)	255 (93.8)
Single	10 (7.9)	11 (4)
Divorced/Widowed	2 (1.6)	6 (2.2)
Education status		
No formal Education	69 (54.3)	151 (55.5)
Grade 1-8	39 (30.7)	63 (23.2)
Grade 9-12	13 (10.2)	34 (12.5)
Grade12+	6 (4.7)	24 (8.8)
Occupational status		
Housewife	108 (85.0)	201 (73.9)
Government employee	3 (2.4)	18 (6.6)
Private/other	16 (12.6)	53 (19.5)
No of U-5 children in HH		
1	65 (51.2)	153 (56.2)
>=2	62 (48.8)	119 (43.8)

Relative wealth to other		
Poor	25 (19.7)	59 (21.7)
Middle	65 (51.2)	140 (51.5)
Model	37 (29.1)	73 (26.8)
Parents/legal guardians history of diarrhea		
Yes	34 (26.8)	14 (5.1)
No	93 (73.2)	258 (94.9)

Environmental related characteristics of study participants respondents

The majority of households, 117 (92.1%) among cases and 258 (94.9%) among controls had latrine facilities in their compound. From these households that had latrines, more than half, 66 (56.4%) among cases and 160 (62.0%) among controls were used pit latrine without a slab.

About 92 (72.4%) of cases and 201 (73.9%) of controls of households were used improved sources of water supply and 36 (28.3%) of cases and 87 (32.0%) of controls of households were traveled greater than thirty minutes to collect water from the sources.

More than half of households latrines, 73 (57.5%) of cases and 163 (59.9%) of controls had the hand-washing facility and 70 (55.1%) of cases and 163 (59.9%) of controls had a waste disposal facility in their compound.

The majority of the floor of houses of the households, 94 (74.0%) of cases, and 214 (78.7%) of controls were made of soil. About 112 (88.2%) of cases and 258 (84.9%) of controls of households had separated kitchen from their houses. From the total households,

275 104 (81.9%) from the cases and 251 (92.3%) from the controls were not shared houses
276 with domestic animals (Table 2).

277 Table 2: Environmental related characteristics of study participants in Jimma Geneti
278 District, Oromia Regional State, Western Ethiopia, May, 2020 (n=399)

Environmental related characteristics of study participants (n=399)	Frequency	
	Number/percent of cases of cases (n=127)	Number/percentage of controls (n=272)
Latrine availability		
Yes	117 (92.1)	258 (94.9)
No	10 (7.9)	14 (5.1)
Types of latrine		
Pit latrine without slab	66 (56.4)	160 (62.0)
Pit latrine with slab	7 (6.0)	41 (16.0)
Ventilated improved pit latrine	44 (37.6)	57 (22.0)
Sources of water		
Improved	92 (72.4)	201 (73.9)
Unimproved	35 (27.6)	71 (26.1)
Time spent to collect water		
</= 30 min	91 (71.7)	185 (68.0)
> 30 min	36 (28.3)	87 32.0)
Availability of hand washing facility		
Yes	73 (57.5)	173 (63.6)
No	54 (42.5)	99 (36.4)
Availability of waste disposal		

facility		
Yes	70 (55.1)	163 (59.9)
No	57 (44.9)	109 (40.1)
Ownership status of the house		
Private	103 (81.1)	219 (80.5)
Rented	24 (18.9)	53 (19.5)
Floor of house		
Soil	94 (74.0)	214 (78.7)
Wood	3 (2.4)	17 (6.3)
Cement	30 (23.6)	41 (15.1)
Availability of separated kitchen		
Yes	112 (88.2)	258 (84.9)
No	15 (11.8)	14 (5.1)
Houses shared with domestic animals		
Yes	23 (18.1)	21 (7.7)
No	104 (81.9)	251 (92.3)

Behavioral Characteristics of study participants

Regarding behavioral characteristics majority of households 75 (59.1%) among cases, and 220 (80.9%) among controls were properly practiced latrine utilization. Greater than three fourth, 102 (80.3%) among cases and 265 (97.4%) among controls of respondents have washed their hands at critical times. Sixty-four (50.4%) of households from cases and 176 (64.7%) of households from controls were disposed domestic solid refuse properly while 65 (51.2%) from cases and 113 (41.5%) from controls were disposed of liquid waste improperly.

More than half of under-five children, 73 (62.9%) from cases and 198 (77.6%) from controls were vaccinated for the measles vaccine. And 73 (57.5%) of cases and 208 (76.5%) of controls were received rotavirus vaccine. From all parents/legal guardians, 78 (61.4%) among cases and 171 (62.9%) among controls had good awareness towards diarrheal morbidity (Table 3).

Table 3: Behavioral characteristics of study participants in Jimma Geneti District, Oromia Regional State, Western Ethiopia, May, 2020 (n=399).

Behavioral characteristics of study participants (n=399)	Frequency	
	Number/Percentage of cases (n=127)	Number/Percentage of controls (n=272)
Latrine Utilization		
Proper utilization	75 (59.1)	220 (80.9)
Improper utilization	52 (40.9)	52 (19.1)
Hand washing at critical time		
Yes	102 (80.3)	265 (97.4)
No	25 (19.7)	7 (2.6)
Feeding practice until 6 months		
Exclusive breastfeeding	99 (78.0)	245 (90.1)
Mixed feeding	26 (20.5)	24 (8.8)
Formula feeding	2 (1.6)	3 (1.1)
Feed the child leftover food		
Yes	13 (10.2)	15 (5.5)
No	114 (89.8)	257 (94.5)
Solid waste disposal		

Proper	64 (50.4)	176 (64.7)
Improper	63 (49.6)	96 (35.3)
Liquid waste refusal		
Proper	62 (48.8)	159 (58.5)
Improper	65 (51.2)	113 (41.5)
Measles Vaccine		
Vaccinated	73 (62.9)	198 (77.6)
Unvaccinated	43 (37.1)	57 (22.4)
Rotavirus Vaccine		
Vaccinated	73 (57.5)	208(76.5)
Unvaccinated	54 (42.5)	64 (23.5)
Water treatment at home		
Yes	49 (38.6)	154 (56.6)
No	78 (61.4)	118 (43.4)
Ways of collected water drawn		
By dipping	22 (17.3)	33 (12.1)
By pouring	105 (82.7)	239 (87.9)
Time of initiating breastfeeding		
Within one hour	103 (81.1)	231 (84.9)
After one hour	24 (18.9)	41 (15.1)
Awareness towards diarrhea		
Good	78 (61.4)	171 (62.9)
Poor	49 (38.6)	101 (37.1)

Determinants of Diarrheal disease among under-five children

Socio-demographic characteristics of the respondents, environmental factors, and behavioral factors were analyzed with bivariate logistic regression to see the factors associated with diarrheal diseases among under-five children. Bivariate logistic regression analysis showed the age of the child, the age of parents/legal guardians, the relation of respondents to the child, marital status, educational status, occupational status, availability of handwashing facility nearby latrine, types of the floor of the house of households, availability of separated kitchen, parents/legal guardians last two weeks history of diarrhea, latrine utilization, hand washing practice at a critical time, feeding practice until 6 months, feeding the child with leftover food, domestic solid/liquid waste disposal practice, the status of measles and rotavirus vaccine, homemade drinking water treatment, ways of collected water drawn from storage and house of households shared with domestic animals were factors associated with diarrheal diseases among under-five children. Variables that were associated with diarrheal diseases among under-five children at P-value, less than 0.25 in the bivariate binary logistic regression analysis were included in multivariate binary logistic regression analysis to identify the independent predictors of diarrheal diseases among under-five children. Age of child, availability of hand-washing facility nearby latrine, parents/legal guardians history of last two weeks diarrheal disease, latrine utilization, hand-washing practice during a critical time, domestic solid waste refusal practice, and rotavirus vaccination status was found significantly associated with diarrheal diseases among under-five children at a p-value less than or equal to 0.05.

The odds of developing the diarrheal disease among under-five children were 2.5 and 3 times higher among children of age 6-11 and 12-23 months respectively as compared to children of age 24-59 months (AOR= 2.46; 95%CI: 1.09-5.57 and AOR= 3.3; 95%CI: 1.68-6.46).

Odds of developing the diarrheal disease among under-five children from households who had no hand-washing facility near their latrine were 5 times higher when compared to counterparts (AOR= 5.2; 95%CI: 3.94-26.49). Under-five children whose parents'/legal guardians' had a history of diarrheal disease in the last two weeks had 7 times more likely to developed the diarrheal disease as compared with their counterparts (AOR= 7.38; 95%CI: 3.12- 17.44)

The odds of developing the diarrheal disease among under-five children was about 2 times higher among households who had not utilized latrine properly when compared to households who have properly utilized latrine (AOR= 2.34; 95%CI: 1.16, 4.75). The odds of developing the diarrheal disease were 10.6 times higher among under-five children whose parents'/legal guardians' did not wash their hands during critical time compared with under-five children whose parents'/legal guardians' did wash their hands during critical times (AOR= 10.6; 95%CI: 3.7-29.8).

Odds of developing the diarrheal disease among under-five children whose parents'/legal guardians' practiced improper domestic solid waste disposal were about 2.7 times higher than under-five children whose parents'/legal guardians' practiced proper domestic solid waste disposal (AOR= 2.68; 95%CI: 1.39-5.18).

Unvaccinated under-five children were 2.5 times more likely to develop diarrhea disease compared to rotavirus vaccinated children, (AOR= 2.45; 95%CI: 1.25-4.81) (Table 4).

Table 4: Determinants of diarrheal disease among under-five children in Jimma Geneti District, Oromia Regional State, Western Ethiopia, May 2020 (n=399)

Variables	Diarrheal diseases status among under-five children				
	Case= 127,	Control= 272,	COR (95%CI)	AOR (95%CI)	P-Value

	No (%)	No (%)			
Age of child					
0-5 months	12 (9.4)	17 (6.3)	1.88 (0.82, 4.33)+	1.48(0.61,3.61)	.387
6-11months	27 (21.3)	48 (17.6)	1.64 (0.91, 2.93)+	**2.46(1.09,5.57)***	.030
12-23 months	44 (34.6)	79 (29)	1.66 (1.00, 2.74)*	**3.30(1.68,6.46)***	.001
24-59 months	44 (34.6)	128 (47.1)	1.00		
Relation					
Mother	118 (92.9)	266 (97.8)	1.00	1.00	
Caregiver	9 (7.1)	6 (2.2)	3.38 (1.18, 9.72)*	0.58 (0.32,1.06)	.073
Hand washing facility					
Yes	73 (57.5)	173 (63.6)	1.00	1.00	
No	54 (42.5)	99 (36.4)	1.29 (0.84, 1.99)+	**5.2(3.94,26.49)****	<.001
Parental/legal guardians' history of diarrhea					
Yes	34 (26.8)	14 (5.1)	6.74 (3.46, 13.1)*	**7.38(3.1,17.44)****	<.001
No	93 (73.2)	258 (94.9)	1.00	1.00	
Latrine Utilization					
Proper	75 (59.1)	220 (80.9)	1.00	1.00	
Improper	52 (40.9)	52 (19.1)	2.93 (1.84, 4.67)*	**2.34 (1.16,4.75)***	.018
Critical time					

Hand washing					
Yes	102 (80.3)	265 (97.4)	1.00	1.00	
No	25 (19.7)	7 (2.6)	9.28 (3.89, 22.1)*	**10.6 (3.7,29.8)****	<.001
Solid waste disposal					
Proper	64 (50.4)	176 (64.7)	1.00	1.00	
Improper	63 (49.6)	96 (35.3)	1.81 (1.18, 2.77)*	**2.68 (1.39,5.18)***	.003
Rotavirus Vaccine					
Vaccinated	73 (57.5)	208 (76.5)	1.00	1.00	
Unvaccinated	54 (42.5)	64 (23.5)	2.40(1.53,3.77)*	**2.45 (1.25,4.81)***	.009
Water treatment					
Yes	49 (38.6)	154 (56.6)	1.00	1.00	
No	78 (61.4)	118 (43.4)	2.08 (1.35, 3.19)*	1.06(0.57,1.97)	.867

Case = under-five children with diarrhea, Control = under-five children without diarrhea, Crude odds ratio (COR), Adjusted odds ratio (AOR), Confidence interval (CI), P-value derived from multivariate logistic regression based on likelihood ratio test, significant CI of the models are indicated in the bold letter, *p < 0.05; **p < 0.001.

Discussion

The result of this study showed that child's age group 6-11 and 12-23 months were 2.5 and 3 times more likely to develop diarrhea disease as compared to children of age group 24-59 months respectively. In general, children age greater than 24 months had a lower risk of having diarrheal diseases than children whose ages between 6-23 months. This result was concurring with the result of other case-control studies conducted in Medebay Zane District, Gobi District, and Rural Ethiopia (19, 20, and 21).

352 Similarly, this result was consistent with the study reported from Indonesia and
353 Guatemala (22, 23). The likely explanation for this risk might be children between the ages
354 of 6-23 months are introduced to foods in addition to breast milk; this may expose their
355 undeveloped immunity to infectious agents causing diarrheal diseases. Moreover, children
356 at these ages are starting to crawl and walk, thus they may pick dirty or other contaminated
357 objects and take them to their mouth. Likewise, the 2016 EDHS report revealed that
358 diarrhea prevalence remains high (18%) at the age of 12-23 months, for the reason that
359 mostly weaning and walking often occurs during these ages which contribute to the
360 increased risk of contamination from the environments (8).

361 The unavailability of a hand-washing facility near the latrine was positively associated
362 with childhood diarrheal disease. In this study, under five years old children from
363 households that had no hand-washing facilities adjacent to the latrines were about 5 times
364 more likely to have diarrheal diseases than under-five year's old children from households
365 that have hand-washing facilities adjacent to the latrines. The result of this study was
366 consistent with the study conducted in Jimma district and Yama Gulale (24, 25). This
367 might be expressed as where the hand-washing facilities were not available; the
368 parents/legal guardians lack the initiation to wash hands after toilet use and feed their
369 children with hands contaminated with fecal matters which causes diarrheal diseases.

370 Additionally, the finding of this study showed that parents'/legal guardians' history of
371 diarrheal diseases was significantly associated with diarrhea diseases among under-five
372 children. Children whose parents/legal guardians had diarrheal diseases in the last 2 weeks
373 prior to this study were 7 times more likely to develop diarrheal diseases than children
374 whose parents/legal guardians had no history of diarrheal diseases in the last two weeks.
375 The result of this study was similar to the study findings conducted in Ethiopia Harar
376 Town, Medebay Zana District, and Pawi Hospital, Northwest Ethiopia (13, 19, 26). The

377 fact that parents/legal guardians are the most food handlers of the family and the main
378 childcare providers; hence, the possibility of diarrheal diseases among children with
379 parents/legal guardians who had diarrheal diseases is a usual event. It also indicates poor
380 hygienic practice in the household results in the occurrence of diarrheal diseases among
381 under-five children. This might be due to parents/legal guardians with diarrheal diseases
382 were considered as a source of diarrhea diseases among under-five children. Moreover,
383 this could be due to the care of the child might be under question if the parents/legal
384 guardians got sick. According to WHO, globally an estimated 88% of diarrheal disease
385 mortality were due to unsafe water supply, inadequate sanitation, and poor hygiene
386 practices (1).

387 The result of this study also revealed that households who improperly utilized latrine were
388 2 times more likely at risk to develop diarrheal diseases among under-five children
389 compared to households that utilized latrine properly. This result was comparable with the
390 study finding reported from West Gojjam of Ethiopia (12) and Kawangware Slum in
391 Nairobi County, Kenya (27). This indicated that proper latrine utilization had a
392 significantly strong association with diarrheal morbidity. This showed that the presence of
393 a latrine alone does not ensure the prevention of diarrheal diseases among under-five
394 children unless properly utilized. When latrine properly utilized, many microorganisms
395 that cause diarrheal diseases might be under control.

396 The finding of this study indicated that children from parents/legal guardians who did not
397 practice hand washing during the critical time were affected with diarrheal disease 10.6
398 times more likely compared to those children whose parents/legal guardians have practiced
399 hand washing during a critical time. This finding was in line with the studies conducted in
400 Adama Rural and Harena Buluk woreda in Ethiopia (28, 29) and in Zambia (30). This
401 might be indicated that since the parents/legal guardians were the main caregivers for their

402 children they should wash their hands at a critical time to prevent diarrheal diseases.
403 Diarrheal diseases are largely spread through contaminated water and food supplies. This
404 contamination occurs mainly from inadequate hygiene and sanitation. Hand-washing with
405 soap at a critical time has been shown to reduce the incidence of diarrheal disease by 40%
406 (1).

407 The finding of this study revealed that improper domestic solid waste disposal practices
408 were 2.7 times more likely at risk of developing diarrhea diseases compared to their
409 counterparts. The result of this study was consistent with the studies conducted at
410 Medebay Zana District and Jamma District in Ethiopia (19, 25) and in Kenya (27). This
411 might be due to improper disposal of domestic solid waste serves as a source of infectious
412 agents and reproduction sites of insects. As well improper domestic solid waste disposal
413 practices create a favorable environment for flies that carry the pathogens and could be
414 sources of contamination for water, food, and food utensils these might cause children
415 exposed to contaminated environments and a leading risk factors for diarrheal diseases
416 among under-five children.

417 The result of our study finding indicated that children who were not received the rotavirus
418 vaccine were 2.5 times more likely to develop diarrheal diseases as compared to those
419 children who were received the rotavirus vaccine. This finding was in line with the studies
420 conducted at Harena Buluk Woreda, Bahir Dar, and Debre Berhan in Ethiopia (31, 28, 32)
421 and in sub-Saharan Africa, Cameroon, and Madagascar (33, 34). These findings were
422 reported that the rotavirus vaccine showed a significant association with the occurrence of
423 diarrheal diseases among under-five children. This revealed that the rotavirus vaccination
424 is one of the best ways to prevent diarrheal morbidity and its consequences. Thus, two-
425 dose rotavirus vaccines should be given for children as part of a comprehensive approach
426 to control diarrhea. Evidence from experts review on vaccines suggests that rotavirus

427 vaccines effectiveness provide sufficient prevention against rotavirus episodes among
428 under-five children thus reducing the morbidity of diarrhea among this age group (35, 36).

429 Limitation of the study

430 One of the strengths of this study was conducted on community-based using case-control
431 study design and using WHO/ UNICEF core-based standard questionnaire for data
432 collection. Some behavioral practices including hand-washing practices at a critical time,
433 reports of parent's/legal guardian's history of last two weeks period of diarrhea, and
434 treatment of drinking water at home used in the analysis were self-reported by the
435 respondents which might be introduced imprecision and recall bias. Lack of including
436 social factors could be considered as an additional limitation of this study.

437 Conclusion

438 Unavailability of hand-washing facility nearby latrine, parent's/legal guardian's history of
439 last two weeks diarrheal diseases, improper latrine utilization, lack of hand-washing
440 practice at a critical time, improper solid waste disposal practices, and rotavirus
441 vaccination status were the determinants of diarrheal diseases among under-five children
442 identified in this study. Most of the identified determinants of diarrheal disease among
443 under-five children in the study area are preventable. Thus, promoting households through
444 the provision of continuous and modified health information on the importance of
445 sanitation (proper domestic solid waste disposal, and latrine utilization), personal hygiene
446 (hand-washing facility and proper handwashing practices at critical times), and vaccination
447 against rotavirus which is fundamental to decrease the burden of diarrheal disease among
448 under-five children.

449 Recommendations

450 District Health Office and Zonal Health Department should be encouraged the community
451 to install a hand-washing facility nearby the latrine motivate the community to utilize the

latrine properly and practiced hand-washing during a critical time and strengthen rotavirus vaccination for all under-five children

Health Extension Workers Should facilitate and give health information for parents/legal guardians on the importance of the availability of hand-washing facility near the latrine, personal hygiene, proper latrine utilization, hand-washing practice during a critical time, proper solid waste disposal practices, vaccination of rotavirus and homemade drinking water treatment practices. Local NGO Should work in collaboration with the District Health Office and other stakeholders on the construction of hand-washing facility nearby latrine, personal hygiene to protect the transmission of diarrhea disease from mother to child, on the initiation of handwashing practices during a critical time, and prepare places for proper solid waste disposal practices.

Abbreviation

AIDS, acquired immunodeficiency syndrome; AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; EDHS, Ethiopian demographic and health survey; HH, households; HO, health officer; PI, principal investigators; SD, standard deviation; SDG, sustainable development goal; SPSS, statistical package for social science; SSA, Sub Saharan Africa; U-5, under five years old children; UNICEF, United Nations Children's Fund

Ethical Approval and Consent to participate

Ethical clearance was obtained from the Ethical Review Board of Ambo University College of Medicine and Health Sciences, with the Ref. No of PGC/18/2020. Hierarchically all administrative bodies were communicated and permission was secured. Written informed consent was obtained from the parent/legal guardian for study subjects after explaining the objectives and procedures of the study and their right to participate or to withdraw at any time of the interview. The Research and Ethical Review Committee

also approved its ethical issues as there was no procedure that affects the study subject and the data is used only for research purposes. For this purpose, a one-page consent letter was attached to the cover page of each questionnaire stating the general purpose of the study and issues of confidentiality which were discussed by data collectors before proceeding to the interview. Parent/legal guardian who was found that their children are sick during the study time they were consulted about the causes of the disease and refer her/him to a health facility nearby. Lastly, we confirm that this study was conducted in accordance with the Declaration of Helsinki.

Consent for Publication

Not Applicable

Availability of data and materials

The dataset used and analyzed throughout the present study accessible from the corresponding author based on reasonable request.

Competing Interests

The authors declare that no competing interests.

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Authors Contribution

DM, MA, TG, ASH carried out all the conception and designing of the study, data collection, performed statistical analysis, wrote final report, reviewing and editing the final draft of the manuscript. All of the authors read and approved the final manuscript.

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502 Author information's'

503 Dejene Mosisa, and Mecha Aboma (BSc, MPH) Lecturer at Department of Public Health
504 Collage of Medicine and Health Sciences, Ambo University, Oromia Ethiopia.
505 Email address: dejenem1976@gmail.com and abomamecha@gmail.com
506 Teka Girma and Abera Shibru (BSc, MPH) Assistance Professor at Department of Public
507 Health Collage of Medicine and Health Sciences, Ambo University, Oromia Ethiopia
508 Email address: teka_girma@yahoo.com and abera.shibru@yahoo.com

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Figures

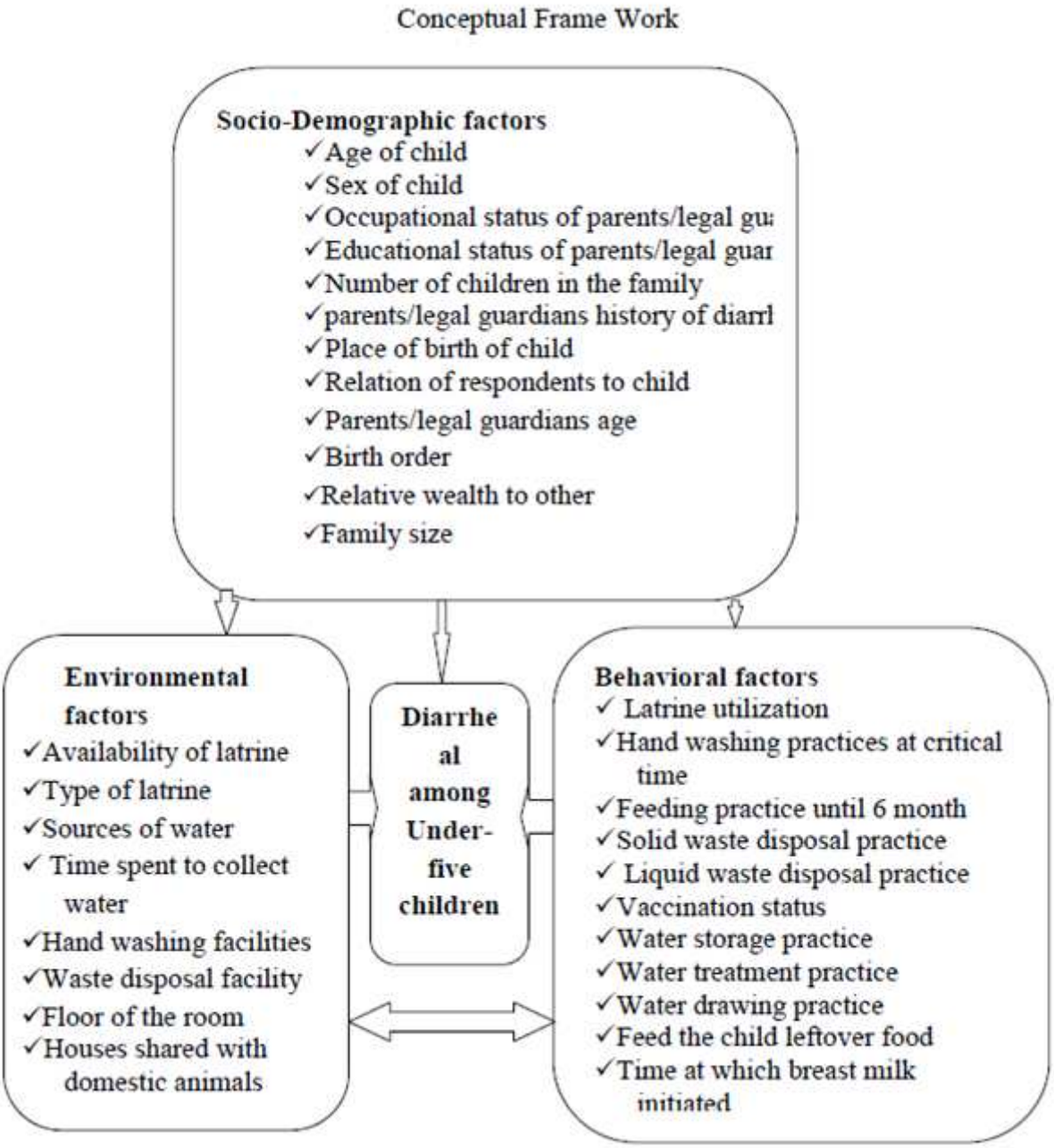

Figure 1

Conceptual framework on Determinants of Diarrheal Diseases among under-five Children in Jimma Geneti district, Oromia regional state, Western Ethiopia, May, 2020 (15, 16).

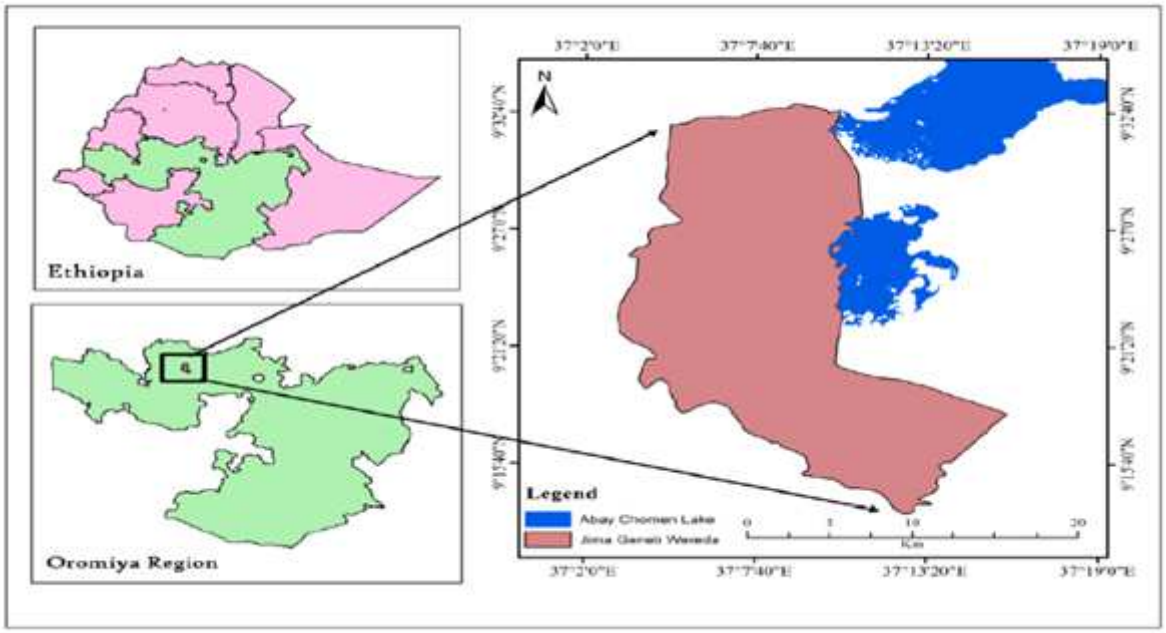

Figure 2

Location map of Jimma Geneti District: Nation, Region and, District, Oromia Regional state, Western Ethiopia, May, 2020 (14).

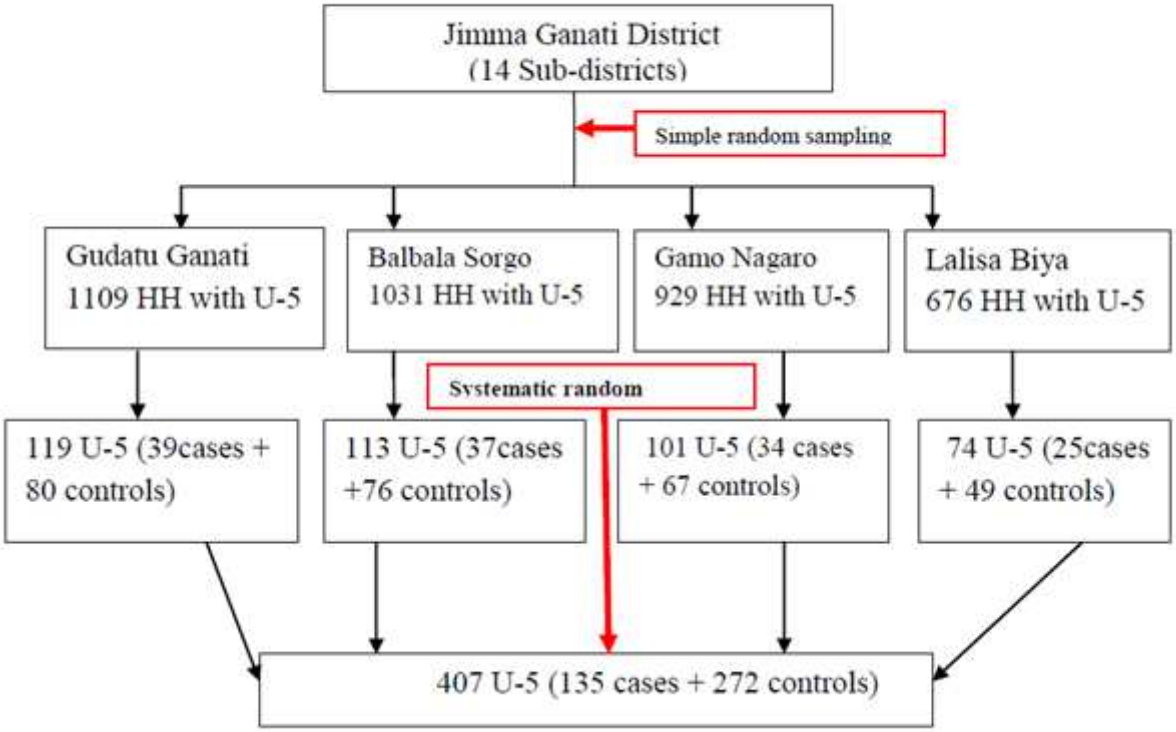

Figure 3

Diagrammatic presentation of sampling technique of under-five children inJimma Geneti district, Oromia Regional state, Western Ethiopia, May, 2020.