

The Association Between Diarrheal Morbidity and ODF Status Among Under Five Children in Southeast, Ethiopia

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Abstract

Background: Diarrheal disease remains one of the leading killers of children around the world. Most cases of diarrhea spread in settings with poor hygiene and lack of access to clean drinking water and sanitation. In Ethiopia, diarrheal disease is more common and kills almost fifteen thousand under-five children in year 2016. Therefore, this study determined diarrheal morbidity among under five children and its association with open defecation free status.

Methods: A community-based comparative cross-sectional study was conducted on 732 households that had at least one under-five children. Multistage sampling technique was used to select households. Informed verbal consent was obtained from study participant. Multivariable logistic regression was performed to identify factors associated with diarrheal morbidity among under five children. Odd ratios with 95% confidence interval were reported and p-value of <0.05 was considered as statistical significance.

Results: A total of 709 mothers or caregivers of under-five children were interviewed making the response rate 97%. The past two-week diarrhea morbidity in the study area was 20.2%. Multivariable analysis showed that unsanitary disposal of children`s feces (adjusted odds ratio [AOR]= 2.68, 95% confidence interval [CI]: 1.66, 4.30), exclusive breast feeding (AOR=0.43 [0.26, 0.71), mother not attend formal education (AOR=1.93, 95% CI: 1.18, 3.15) and child age (AOR=1.93, 95% CI: 1.04. 3.57) were significantly associated with diarrheal disease. Conversely, there is no association between open defecation free status and childhood diarrhea among under-five children (AOR=0.89, 95% CI: 0.55, 1.44).

Conclusions: The prevalence of diarrhea was slightly higher among children from non-open defecation free households when compared to children living in open defecation free households. However, open defecation free status was not significantly associated with diarrhea morbidity during multivariable logistic analysis.

Background

Diarrhea is characterized by the passage of three or more loose or liquid stools per day (or more frequent passage than normal for the individual) [1]. Globally, there are about 1.7 billion cases of childhood diarrheal disease annually, and close to half a million children die every year from diarrheal diseases, accounting for approximately 8% of all deaths among children under age 5 in year 2017 [1,2].

Worldwide, diarrhea is a leading killer of children under age five, despite the availability of simple effective treatment [2]. Diarrheal infection is more common when there is a shortage of adequate sanitation facilities and safe water supply for drinking, cooking, and cleaning [1]. Lack of sanitation facilities is a serious health risk and in effect peoples practice open defecation (OD), thereby increasing the risk of diarrheal disease transmission that will affect children`s health [3]. In low and middle-income countries, 58% of all cases of diarrhea or 842, 000 deaths could be attributed to inadequate water, sanitation, and hygiene (WASH) [4].

The 2030 Agenda for Sustainable Development Goal (SDG) six aims to end open defecation and achieve universal access to WASH for all [4,5].

The World Health Organization and United Nations Children's Fund (WHO/UNICEF) Joint Monitoring Program (JMP) report estimated that ending open defecation will be a challenge for all countries since, still 673 million or 9% of the World population practice open defecation worldwide in year 2017 [5]. Open defecation practice can contaminate people, food, drinking water and flies may carry pathogens to food, through the F-diagram pathways which can cause diarrheal disease following ingestion [4].

According to Ethiopian demographic and health survey (EDHS) 2016 report, 28.3 million (29%) of the Ethiopian population practice open defecation [6]. The JMP 2019 report also showed that, Ethiopia alone contributes the highest proportion of population who practice OD which is more than 3% of the total World population [5]. The EDHS 2016 survey reported that, 12% of under-five children's experienced diarrhea two-week preceding the survey [6]. Moreover, different studies conducted in different parts of the country also reported high prevalence of childhood diarrhea ranges from 11%–31% [7–11].

In Ethiopia, diarrheal disease is more common, and OD contributes to high rates of diarrhea-related morbidity and mortality. In year 2016 alone, diarrhea kills almost fifteen thousand under-five children [12]. According to UNICEF 2013 data, in Ethiopia, an estimated 64,540 children could be saved every year by improving WASH in the country [13].

In this regard, Ethiopia began to adopt a Community-Led Total Sanitation (CLTS) approach which concentrates on empowering local people to analyze the extent and risk of OD and aimed at creating open defecation free (ODF) community [14–15]. Nonetheless, as in other countries such as India and Kenya [16–17], the effect of open defecation free status on diarrheal disease was not yet well explored in Ethiopia. It is hypothesized that ODF status will have significant statistical association with diarrheal morbidity.

Therefore, it is critically important to described and quantified whether ODF status has been made an effect on the under-five diarrheal morbidity. The study has a paramount importance for redesigning or expanding the CLTSH program in the study area. Besides, it could also be used as an input for local policy makers and program managers of the study area. The study tried to determine prevalence of diarrhea and factors associated with diarrheal morbidity. Furthermore, the study assesses the association of ODF status with diarrheal morbidity.

Methods

Study setting and period

Goba district is found in Oromia region Bale administrative zone, at the Southeast of the country and 445 km far from the center of the country, Addis Ababa. In year 2017, from 15 Sub-districts almost half of

Sub-districts (7) were verified as open defecation free Sub-districts by the Woreda Health office. The study was conducted from March to April 2017.

Study design and population

A community-based comparative cross-sectional study design was implemented. All households that had at least one under-five children in ODF and non-ODF sub-districts of Goba Districts were the source population. The study population were all randomly selected households that had at least one under-five in selected ODF and non ODF Sub-districts of Goba District.

Inclusion and exclusion criteria

Only those sub-districts that declare ODF status before one year was included in ODF setting. In addition, a sub-district that declared ODF at village ('*gare*' local name) level but not declared as ODF status at Sub-districts level were excluded. Those households with critically ill mother or care givers during the survey were excluded from the study.

Sample size determination and sampling techniques

The sample size was determined using Epi-info version 7 statistics software by considering prevalence of diarrhea in ODF sub-districts 24.7% from study done in Northwest Ethiopia [18], 95% confidence interval (CI), 80% power, ratio of ODF to non-ODF Sub-districts 1:1, to detect 2 odd ratio (OR), design effect of 2 and 10% non-response rate. Accordingly, the sample size was 732 (366 from ODF and 366 from non ODF) households that had at least one under five-children were included in the study.

A multistage sampling technique was employed to select study participants. In the first stage, all Sub-districts were classified by their OD status into ODF and non-ODF Sub-districts (7 ODF and 8 non-ODF). Accordingly, three ODF and three non-ODF Sub-districts were randomly selected using lottery method. Then the calculated sample size was allocated proportional to size of households for each selected sub-district. In the second stage using health post family folder as sampling frame households with under-five children were selected by systematic random sampling. After determining the K^{th} interval, the first household was selected randomly, and the next household was identified systematically onwards by adding cumulatively K^{th} intervals to the first selected household.

Data collection instruments and technique

The questionnaire was adapted from WHO and UNICEF [5], ICF International [19], EDHS [6.20], and from other related literatures and modified contextually. Data were collected by trained female healthcare workers using pre-tested structured questionnaire and observational checklist. The reason for selecting female data collector was for ease of communication since the study participants were female who may easily communicate with female health workers.

To check consistency of the data collection tool, it was translated to local language (Afan Oromo) and re-translating back to English was done by another individual who is expertise in both languages. Throughout the data collection process close supervision was carried out to assure data completeness and consistency. During data collection Sub-districts were coded and all data collectors were blinded regarding household ODF status.

Study variables

Dependent variable: Diarrheal prevalence among under five children

Independent variables: -

Socio-economic and demographic factor: -family monthly income, age of the mother/caregiver, age of the index child and educational status of the mother/caregiver.

Environmental factors: ODF status, availability of latrine, ownership of latrine, latrine type, the presence of feces around latrine, latrine cleanliness status, and hand washing facility.

Behavioral factors: breast feeding practice, and child feces disposal method.

Operational definition

Open Defecation (OD): is a practice whereby human feces are disposed of in fields, forest, bushes, open bodies of water, beaches/other open spaces or disposed of with solid waste [5].

Open defecation free status: - is a status given by an independent, third-party group of relevant stakeholders for a given community whether village, sub districts, district, or an entire region has 100 percent latrine coverage and totally free of open defecation practices as per the ministry of health ODF verification and certification criteria [15].

Hand washing at critical time: if a mother/caregiver reported to practiced hand washings with soap before eating, before food preparation, before child feeding, after child cleaning and after latrine visiting was considered as “all practiced” unless considered as “partially practiced” [21].

Hygienic latrine: if there were no human or animal fecal matter present inside the facility—on seat, floor, door, or walls [22].

Index child: a child that is included in the study from a household to have information on the demographic and health characteristics and used to calculate the prevalence of diarrhea.

Unsanitary disposal of children’s feces: - includes put/rinsed feces into drain or ditch, feces were thrown into the garbage or feces left, or the child was not seen during defecation [19].

Method of Data analysis

Raw data were coded, entered, cleaned, and analyzed using statistical package for social science (SPSS) statistical software version 20. Descriptive statistics such mean, percentage and frequency table were computed to summarize data. Bivariate and multivariable analysis was done to identify independent factors associated with diarrheal disease in under-five. Variables in the bivariate analysis which were found at $p\text{-value} \leq 0.25$ were further considered in the multivariable binary logistic analysis to identify the independent predictor of diarrheal diseases.

Hosmer-Lemeshow statistic was used to test the goodness-of-fit of the model. Crude and adjusted odds ratios (AOR) with 95% confidence interval (CI) were used to measure the strength of association. The p values of less than 0.05 were considered as a statistical significance.

Results

A total of 709 (355 households from open defecation free (ODF) and 354 from non ODF) were participated in this study, which makes a response rate of 97%.

Socio-economic and demographic characteristics of respondents

The respondent's age ranges from 15 to 49 with a mean age of 30.7 and standard deviation (SD) of ± 7.4 . The total family size of the respondents ranged from 2 to 13 people with a mean of 5.3 and standard deviation of ± 1.8 . From total respondents, 668 (94.2%) were married and 427 (60.2%) reported that they were not attended formal education. Regarding income of the family, 221 (31.2%) of the family had monthly family income between 500 ETB and 1000 ETB (Table 1).

Environmental and behavioral related characteristics

The latrine coverage in the study area was 86.3%. From those households that have latrines, 506 (82.7%) of them owned the latrine privately and 84 (13.7%) of them have improved latrine. Regarding the source of drinking water, 293 (41.3%) households used improved water source. In this study, one out of ten respondents were wash their hands at all critical times and more than two third of households used sanitary disposal of children feces. From 691 (97.5%) of children who ever breast-fed, 491 (71.1%) of children were exclusively breast-fed. Ninety four (13.2%) of mother or caregiver reported that they had history of diarrhea in the past two week (Table 2).

Significance difference between ODF and non-ODF sub-districts

The latrine coverage was 92.3% in ODF and 80.2% non-ODF households with a significance difference between the two settings with chi-square values of 22.22 (df = 1; $P < 0.001$). Presence of feces in the compound was significantly higher in non-ODF households with $\chi^2 = 4.42$ (df = 1; $p = 0.03$). The practice of unsanitary disposal of children feces was significantly higher in non-ODF Sub-districts with $\chi^2 = 10.87$

(df = 1; p = 0.01). All variables that showed significance difference between the ODF and non-ODF households were environmental and behavioral characteristics (See Table 3).

Magnitude of Open Defecation and ODF Slippage

Overall, in the study area the magnitude of open defecation practice reached to 38.2%. Based on latrine absence only open defecation slippage rate in ODF Sub-districts reached to 27 (7.6%). When 12 (3.7%) mothers reported to practice open defecation after latrine constructed is added the slippage rate reaches to 39 (11.3%). In addition, there were feces observed in the compound of some households which have latrine facility. Therefore, the overall slippage rate reaches to 27.6% in ODF Sub-districts (See Figure 1).

Diarrheal disease prevalence

The overall past two-week diarrhea prevalence in the study area is 143 (20.2%) with 95% CI (17%, 23%). The prevalence of past two week's diarrhea morbidity among under-five children living in ODF districts was 61 (17.2%), which is lower than children living in non-ODF districts 82 (23.2%). A significance difference in the occurrence of under-five diarrheal was observed between ODF and non-ODF households in the study area with chi square value of 3.93 (df = 1; p = 0.04) (see table 3).

Multivariable analysis of factors associated with diarrheal disease prevalence

Variables in the bivariate analysis of socio-economic and demographic, environmental, behavioral and child demographic and health characteristics with respect to childhood diarrhea; which were found at p-value ≤ 0.25 were further considered in the multivariable regression analysis [3,21]. In addition, multicollinearity test was done, and variables showed collinearity were removed from the multivariable analysis. Accordingly, unsanitary disposal of children's feces, history of exclusive breast feeding, maternal education and age of index child were factors significantly associated with diarrheal prevalence.

Children living in households that had unsanitary disposal of children feces were 2.68 times more likely to have diarrhea compared to their counterparts (AOR = 2.68, 95% CI: 1.66, 4.30). Children who were reported to be exclusively breast fed were 57% less likely to develop diarrhea when compared with children not exclusively breast fed (AOR = 0.43, 95% CI: 0.26, 0.71). The odd of developing diarrhea was almost two times higher among children whose mothers not attended formal education (AOR = 1.93, 95% CI: 1.18, 3.15). Moreover, children whose age were between 12–23 month were about 1.93 times more likely to develop diarrhea as compared to children whose age was between 36–59 months (AOR = 1.93, 95% CI: 1.04, 3.57). Crude odds ratio suggested that there was a difference in diarrheal prevalence among ODF and non-ODF districts. However, during multivariable logistic regression households ODF status was not significantly associated with childhood diarrhea when all possible confounders were controlled (AOR = 0.89, 95%CI: 0.55–1.44) (See table 4).

Discussion

The overall past two-week diarrhea prevalence in the study area was 20.2%. The finding was in argument with a study from eastern Ethiopia [7], West Gojam [8], northwest Ethiopia [10], and with the study conducted in Iraq [26]. This result was considerably higher than the national average which was 12% [6], and from study done in Wolita Sodo [11], and although comparably lower than similar studies done in Arbaminch [9]. The discrepancy from the studies might be due to study period difference as well as water sanitation and hygiene coverage of the community.

Children's whose families practiced unsanitary disposal of children feces were more than two-fold likely to develop diarrhea when compared to children whose families were practiced proper children feces disposal. Findings from other studies conducted in Dejen District (Ethiopia) [3], Iraq [26], and Indonesia [27] also revealed that unsafe disposal of child feces was strongly associated with increased odds of childhood diarrhea. In support of this finding, a study conducted in Addis Ababa (Ethiopia) [28] showed that presence of flies and feces on the floor and/or around the sanitation facilities was significantly associated with diarrhea. As with open defecation practice, unsanitary way of child feces disposal creates a good environment for flies, which may carry a higher pathogen load than adult feces to transmit diarrheal disease to anyone living or playing nearby through the f-diagram [4,29].

Several studies have shown the beneficial effects of breastfeeding in preventing diarrhea morbidity in under five age children. In this study children who were reported to be exclusively breast fed were less likely to develop diarrhea than children who were not exclusively breast fed. This was revealed in a study done in Achefer district, northwest Ethiopia [30], Qatar [31], and in Kenya [25]. This in line with the fact that breast feeding is an effective means of protecting children from diarrheal disease [8,30].

The odds of diarrheal disease prevalence were higher among children whose mothers attending formal education when compared to children whose mothers not attending formal education. A similar finding was observed with the study conducted in Ethiopia [21,24], Kenya [25], and Iraq [26] where the prevalence of diarrhea relatively high among children whose mother does not attend education. This could be because of educated mothers were able to reduce the risk of exposure from a contaminated environment or their knowledge allows them to easily adapt behavioral change and use health care facilities effectively [21].

Moreover, the result of this study showed that, children whose age was between 12–23 months were more likely to develop diarrhea when compared with children whose age was between 36–59 months. This result was consistent with other studies, where most diarrheal diseases occurred among children with young age group as shown in studies conducted in different parts of Ethiopia [7,9], and Kenya [25]. The risk being highest at age segments of 12–23 months age group reflects the time is stopping breast milk for most of the children which protect children from diarrheal disease. In contrary to this, a study conducted in Iraq [26], and in Eastern Ethiopia [7] showed that the risk of diarrhea was higher in the age group 6 – 11 months than the age groups 12–23 months. This difference might be due to the

implementation of CLTS program among half of households that may help children not to consume food and liquid contaminated with feces when the child starts to move around the house [14].

The study attempted to determine whether ODF status can be a significant factor for diarrhea morbidity in the study area. However, our findings revealed that there is no association between ODF status and childhood diarrhea when multivariable logistic regression analysis was performed by controlling all confounding factors. This might be due to lack of adequate power to compare diarrhea prevalence among ODF and non-ODF Districts. The power of detecting difference between ODF and non-ODF was only 51.3% which is too small to detect difference between the two settings.

According to ODF verification and certification guideline all households found at ODF Sub-districts are supposed to have a latrine, but the coverage was found to be only 92.4%. End of open defecation and 100% latrine coverage were almost universally assumed to be directly linked to recognizing ODF communities and recommending them for their effort by the district administration [14,32]. This study contradicts ODF Sub-districts status since 7.6% of households have no latrine and 3.7% mothers reported to practice of open defecation in the presence of latrine with a slippage rate of 11.3%. This finding was in line with the study conducted in Ethiopia (8% in Shebenedo and 9% in Jimma) and Sierra Leone (11% in Port Lokosite) [32].

The overall slippage rate reaches to 27.6% in ODF Sub-districts when observable feces in the compound are added. The finding was similar with the study done in Ethiopia Sidama Zone (25%)[22], and in India (21%) [16]. The study also revealed that 272 (38.2%) households in the study at least one household member practice open defecation which is higher than the national average reported by EDHS and JMP country report [5,6].

Our findings should be interpreted considering certain limitations. First, the findings of this study rely on self-reported data and there is a probability of recall bias and social desirability bias. Again, the effect of food hygiene and knowledge of mother or caregiver on diarrhea was not assessed. Moreover, further research supported by qualitative study design should be done in this area to know the impact of open defecation free status on diarrheal disease in the long run.

Conclusions

The prevalence of under-five diarrhea slightly higher in non-ODF households compared to ODF households. However, ODF status does not show any statistically significant association with diarrhea morbidity. The level of diarrheal prevalence was well explained by safe child feces disposal practice, exclusive breast feeding, maternal education, and child age. Therefore, health education and promotion activities on personal hygiene and environmental sanitation should be strengthened to reduce burden of diarrheal morbidity in the study area.

Abbreviations

AOR: Adjusted odd ratio, CLTSH: Community Led Total Sanitation and Hygiene, CI: Confidence Interval, COR: Crude Odd Ratio, EDHS: Ethiopian Demographic and Health Survey, JMP: Joint Monitoring Program, LMIC, Low- and Middle-Income Countries, OD: Open Defecation, ODF: Open Defecation Free, OR: Odd Ratio, SPSS: Statistical Package for Social Science, UNICEF: United Nations International Children's Fund, WASH: Water, Sanitation and Hygiene

Declarations

Authors' contributions

SM conceived the study and drafted the proposal. SM, TB, & KHA monitored data collection, coordinated field work, & entered data. SM, BS carried out data analysis

and interpretation of the findings. BS & EB wrote the manuscript. KHA & TB edited the manuscript. All authors read and approved the final manuscript.

Authors' Information

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Ethics approval and consent to participate

Ethical clearance was obtained from Madda Walabu University Goba referral hospital public health department. A formal letter of permission was obtained from administrative bodies of the District and sub-district. Participation in the study was on a voluntary basis and confidentiality was assured. Before data collection informed verbal consent was requested from every study participant after explaining the purpose of the study. During data collection, if the child or the family have diarrhea, they advised to consult the nearby health institution for better management.

Consent for publication

"Not applicable"

Availability of data and materials

The data used to support the findings of this study are available from the corresponding author upon request.

Competing interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Tables

Table 1: Socioeconomic and demographic characteristics of study participants in Goba District, Southeast Ethiopia, 2017

Characteristic	Category	Frequency	
		N	%
Sex of the index child	Male	361	50.9
	Female	348	49.1
Age of the index child (months)	0-5	34	4.8
	6-11	96	13.5
	12-23	191	26.9
	24-35	181	25.5
	36 -59	207	29.2
Age of mother (years)	15-24 Years	167	23.6
	25-34 Years	305	43.0
	>= 35 Years	237	33.4
Family size	<=5	411	58.0
	>5	298	42.0
Marital status of the mother	Married	668	94.2
	Not married	41	5.8
Education level of mother	Formal education not attended	427	60.2
	Formal education attended	282	39.8
Occupation of the mother/caretaker	Housewife	571	80.5
	Farming/Livestock	117	16.5
	Others*	21	3.0
Average monthly net income from parents	Less than 500 ETB	105	14.8
	501-1000 ETB	221	31.2
	1001-2000 ETB	259	36.5
	2001 ETB and above	124	17.5

Note: * Others include employee, merchant, and daily laborer

Table 2: Environmental and behavioral characteristics of study participants in Goba District, Southeast Ethiopia, 2017

Characteristic	Category	Frequency	
		N	%
Availability of latrine (n=709)	Yes	612	86.3
	No	97	13.7
Ownership of the latrine (n=612)	Private	506	82.7
	Shared	106	17.3
Sanitation facility type (n=612)	Improved	84	13.7
	Unimproved	528	86.3
Open defecation after latrine constructed (n=612)	Yes	39	6.4
	No	573	93.6
Presence of feces in the compound (n=612)	Yes	165	27
	No	447	73
Latrine cleanliness status (n=612)	Hygienic	424	69.3
	Unhygienic	188	30.7
Household drinking water source (n=709)	Improved	293	41.3
	Unimproved	416	58.7
Hand washing at critical time (n=667)	At all critical time	69	10.4
	Partially practiced	598	89.6
Exclusive breast feeding (n=664)	Yes	491	71.1
	No	173	28.9
Unsanitary disposal of children's feces (n=709)	Yes	214	30.2
	No	495	69.8

Table 3: Comparisons of environmental and behavioral characteristics of ODF and non-ODF households in Goba District, Southeast Ethiopia, 2017

Characteristic	Category	ODF Households		Non-ODF Households		χ^2 (Chi-square Test)	P value
		N	%	n	%		
Availability of latrine	Yes	328	92.4	284	80.2	22.22	0.00
	No	27	7.6	70	19.8		
Ownership of the Latrine	Privately owned	281	85.7	225	79.2	4.42	0.03
	Shared with neighbors	47	14.3	59	20.8		
Feces seen around the pit hole, seat, or floor of latrine	Yes	82	25	95	33.5	5.58	0.01
	No	246	75	189	66.5		
Presence of feces in the compound	Yes	70	21.3	95	33.5	11.33	0.00
	No	258	78.7	189	66.5		
Latrine cleanliness status	Hygienic	239	72.9	185	65.1	4.27	0.03
	Unhygienic	89	27.1	99	34.9		
Unsanitary disposal of children's feces	Yes	87	24.5	127	35.9	10.87	0.01
	No	268	75.5	227	64.1		
Diarrhea occurrence in the past two weeks	Yes	61	17.2	82	23.2	3.93	0.04
	No	294	82.8	272	76.8		

Table 4: Multivariable logistic regression on diarrhea morbidity among under five children in Goba district, Southeast Ethiopia, 2017

Independent factor (n= 709)		A child with diarrhea		COR (95% CI)	AOR (95% CI)
		Yes	No		
ODF status	ODF	61	294	0.69 (0.47, 0.99) *	0.89 (0.55,1.44)
	Non ODF	82	272	1	1
Average monthly net income from parents	Less than 500 ETB	30	75	2.21 (1.16, 4.22) *	1.50 (0.59, 3.81)
	501-1000ETB	45	176	1.41 (0.78, 2.54)	1.22 (0.59, 2.51)
	1001-2000ETB	49	210	1.29 (0.72, 2.30)	1.05 (0.51, 2.14)
	2001 ETB and above	19	105	1	1
Age of the mother (years)	15-24	22	145	0.48, (0.28, 0.83) *	0.58 (0.29, 1.16)
	25-34	67	238	0.94 (0.62, 1.40)	1.08 (0.64, 1.80)
	>= 35	54	183	1	1
Age of the index child (months)	0-5	4	30	0.79 (0.26, 2.39)	0.52 (0.22, 2.15)
	6-11	13	83	0.92 (0.46, 1.86)	0.62 (0.25, 1.52)
	12-23	53	138	2.23 (1.37, 3.74) *	1.93 (1.04, 3.57) **
	24-35	43	138	1.84 (1.10, 3.08) *	1.44 (0.76, 2.73)
	36 -59	30	177	1	1
Education status of the mother or caretaker	No formal education	95	332	1.39 (1.95, 2.05) *	1.93 (1.18, 3.15) **
	Attend formal education	48	234	1	1
Presence of household latrine	Yes	110	502	0.42 (0.26, 0.68) **	0.31 (0.32, 1.57)
	No	33	64	1	1
Status of latrine cleanlines	Hygienic	66	358	0.60 (0.39,	0.74 (0.45,

			0.92) *	1.20)
Not hygienic	44	144	1	1

Note: COR : Crude Odds Ratio, AOR: Adjusted Odds Ratio, * p value< 0.05, ** p value <0.0

Figures

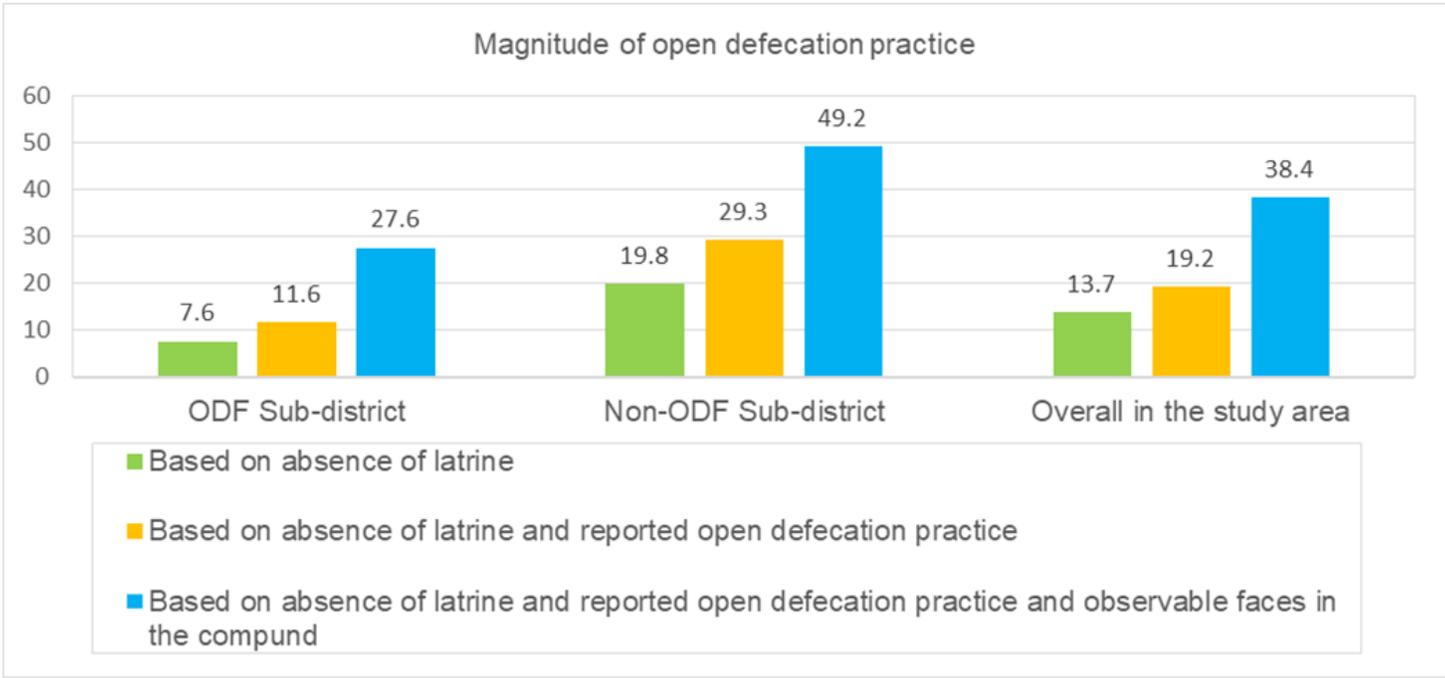


Figure 1

Percentage of overall open defecation practice by ODF and non ODF households Goba Woreda, South East Ethiopia from March to April 2017