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Authors: Birasa, Dame Fiseha, Donacho, Dereje Oljira, Gil, Ruot Gatwech, and Debele, Gebiso Roba

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Dame Fiseha Birasa[1], Dereje Oljira Donacho[2], Ruot Gatwech Gil[3] and Gebiso Roba Debele[1]

[1]Department of Public Health, Mattu University, Mettu, Ethiopia. [2]Department of Health Informatics, Mattu University, Mattu, Oromia, Ethiopia. [3]Gambela Regional Health Bureau, Ministry of Health, Gambella, Ethiopia.

ABSTRACT: The use of toilet facilities is a major sanitation intervention, as it reduces the spread of diarrheal diseases. In areas where toilets are misused, human excreta may be disposed of in open fields, bushes, and other open places. However, information about the level of utilization of toilet facilities in developing regions of Ethiopia is limited. Therefore, this study aimed to identify open defecation (OD) levels and determinants of OD among household-owned toilets in Gambella town, Ethiopia. A cross-sectional survey was conducted among 561 households in Gambela Town, using systematic random sampling and questionnaires. The level of OD was analyzed using frequency and percentage. The determinants of OD were assessed using binary logistic regression. Variables with a *P*-value less than .25 in univariable logistic regression were entered into the multivariable logistic regression model, and statistical significance was declared at a *P*-value less than .05. The model's fit was tested using Hosmer and Lemeshow's goodness of fit. The study found that OD was 47.2% [95% CI: 43.2%-51.4%] among those who owned toilet facilities. The determinants of OD were: occupation of household head [AOR: 5.27, 95% CI: 3.08-9.00], toilet facilities lacking a superstructure [AOR: 2.0, 95% CI: 1.16-3.43], toilet facilities lacking doors [AOR: 3.23, 95% CI: 1.97-5.27], large family size [AOR: 2.16, 95% CI: 1.29-3.60], knowledge of the respondents [AOR: 2.40, 95% CI: 1.50-3.99], and respondents with negative attitude [AOR: 1.76, 95% CI: 1.12-2.74]. Therefore, key stakeholders should focus on improving toilet utilization, considering those factors in their interventions.

KEYWORDS: Latrine utilization, open defecation, households, Gambella Town

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CORRESPONDING AUTHOR: Dereje Oljira Donacho, Department of Health Informatics, Mattu University, Mattu, Oromia 318, Ethiopia. Email: dodbau3687@gmail.com

Introduction

Inadequate sanitation is a major cause of illness and mortality in low-income countries,[1,2] as open defecation increases the risk of disease transmission.[3] Improved sanitation, on the other hand, can dramatically reduce the transmission of diarrheal illnesses.[4] Access to toilet facilities[5] and proper utilization are crucial aspects of sanitation interventions.[6] Latrine use in households involves all family members using the toilet, with indicators such as fresh excreta, urine splash, spider web absence, and anal cleansing material.[7] Open field defecation is defined as "the practice of defecating in fields, forests, bushes, bodies of water, or other open spaces."[8] It is a common practice among households without toilet facilities,[9] is also linked to human behavior and is not limited to those who miss toilet facility access.[10]

Globally, an estimated 892 million people practice open defecation.[11] About 90% of all open defecation (OD) occurs in rural regions.[12] The vast majority, 82%, of persons who practice open defecation presently live in low- and middle-income countries.[3] Coverage of sanitation grew from 24% in 1990 to 31% in 2015.[13-15] However, many countries, particularly low-income countries, have low coverage of toilet facility utilization.

OD is a significant health issue in Ethiopia, causing an increased risk of communicable diseases. Basic steps to prevent transmission include proper disposal of human excreta, water, hygiene, and proper disposal of human excreta.[3] This concept highlights the relevance of toilet facility utilization in the prevention of fecal-oral diseases. For instance, proper latrine utilization can prevent cholera by 66% and worm infestations by 12% to 86%.[2,3] However, toilet utilization in Ethiopia is low,[6] contributing to the high prevalence of communicable diseases. Despite significant latrine coverage improvements in Ethiopia,[13] open defecation remains common,[16] calling for an investigation of the level of utilization among those who own the facility.

In Ethiopia, toilet utilization is much lower than toilet facility access, which calls for dealing with the issue of OD among households that own toilets. In the review of existing literature on toilet utilization, the level of toilet facility utilization in Ethiopia ranges from 41% to 99%, showing a great variation that is attributed to different factors.[6,17-23] The factors include socio-demographic factors, sanitation facility-related factors, user knowledge, and user attitudes.[24-27] Factors affecting open defecation in households' toilets vary across settings, especially in less developed regions, and there is limited information on this issue.

The Ethiopian government is working toward reducing communicable disease exposure in urban areas due to poor sanitation and hygiene practices. Despite improvements since

Dame Fiseha Birasa is currently affiliated to Gambella Field Office, International Rescue Committee, Gambella, Ethiopia.

the implementation of the urban health extension program,[13] it's still too far to reduce OD,[16] and there's limited information on toilet utilization among households' owned latrines. Urban households in most towns suffer from a lack of sanitation facilities that is linked to different socio-economic factors, technological factors, and cultural factors.[5,28,29] More importantly, in low-income settings like Gambela Town, evidence about sanitation practices is limited to planning interventions.

In terms of sanitation access, the Gambella region is among the poorest sanitation service access areas in Ethiopia.[15] Gambela is the capital town of the Gambella region. In the transit visits in areas in the town, there are observable night soils that call for a household survey of latrine utilization among households owned toilet facilities. To this end, exploring the level of OD practice among households owned toilet facilities is subject to the need for evidence to close the gap. Therefore, this study aimed to identify the level of OD and factors associated with OD among households owned latrines in Gambella town. The study's findings could significantly benefit health workers, NGOs, researchers, and local health offices by providing up-to-date information on OD and local factors. This information can be used to improve toilet utilization, especially for urban health extension programs in the region.

Methods and Materials

Study setting, design, and study period

A community-based cross-sectional study was conducted in the Gambella region of Ethiopia from June to July 2023. The region, located in the southwestern Ethiopian lowlands, has a population of 498 671 according to the 2013 E.C. population projection. The Gambella People's Regional State has 3 administrative zones: 12 woredas, 1 city administration, 1 special woreda, 261 kebeles, 1 general hospital, 4 primary hospitals, 34 health centers, and 138 health posts. Particularly, the study was conducted in Gambela town, which is the capital city of the region and has 5 kebeles with an estimated 3102 households.

Population

The study involved randomly selected latrine-owned households in Gambella Town, with household heads as the study unit. All households in selected kebeles owned toilet facilities, and households absent in the second round were excluded.

Sample size determination

The sample size was calculated using a single population proportion formula[30] with the following assumptions: P = is the proportion of poor latrine utilization from south Ethiopia, Dawuro zone (33%),[18] and $Z\ \alpha\ /2$ = refers to the cut of the value of the normal distribution and is based on a 95% confidence interval.

$$n = \frac{\left(Z\frac{\alpha}{2}\right)^2 \left(P^*(1-P)\right)}{d^2} = \frac{(1.96)^2\left(0.33^*(1-0.33)\right)}{(0.05)^2} = 340$$

Considering design effect = 1.5 since selection stages, and 10% non-response rate, the final sample size was 561 households.

Sampling technique and procedure

A random sampling technique was used in this study. Three kebeles out of 5 were selected using the lottery method. The calculated sample was allocated proportionally based on the total households in each kebele. A systematic random sampling technique was used to select the households in each selected Kebele community health information system as a sampling frame to determine the proportion of households. To determine the sampling interval, the *K*th value was calculated. The first house was selected randomly by the lottery method. In the absence of household heads, mothers or any adult family member were involved (Figure 1).

Data collection tool, procedure, and measurements

The data was collected using structured questionnaires that included socio-demographic characteristics, latrine condition, attitudes, and knowledge. The questionnaire was first prepared in English and translated to the local language, Amharic, by language experts to ensure the internal consistency of the study (S1). Four BSc nurses collected data. Two environmental health professionals supervised the overall data collection process. Then, the data were collected through a face-to-face interview after obtaining written consent from the study participants. Before the actual data collection, a pretest was conducted on 5% of the sample size at a non-selected kebele in the nearby town of Bonga.

The OD was assessed using a list of observation checklists as an indicator of toilet use. Accordingly, observations of the presence of fresh excreta inside the squat, the presence of fresh footpath, a lack of spider web on the squat, a splash of urine, the presence of feces in an open place around the household residences, and the presence of anal cleaning material were checked to determine whether the householders were using the facility. Additionally, the characteristics of the toilet facility (condition of the facility) were observed during the data collection.

In this study, the knowledge of the heads of households was assessed using 7 questions with "yes" or "no" responses. Knowledge-related questions included the benefits of latrine utilization in reducing fly populations, preventing diarrheal disease, providing privacy for individuals, preventing fecal-oral disease, preventing environmental populations, and the negative health consequences of OD. The sum of knowledge questions was computed, and the median was calculated. Nine Likert scale questions were used to assess the attitude of the respondents

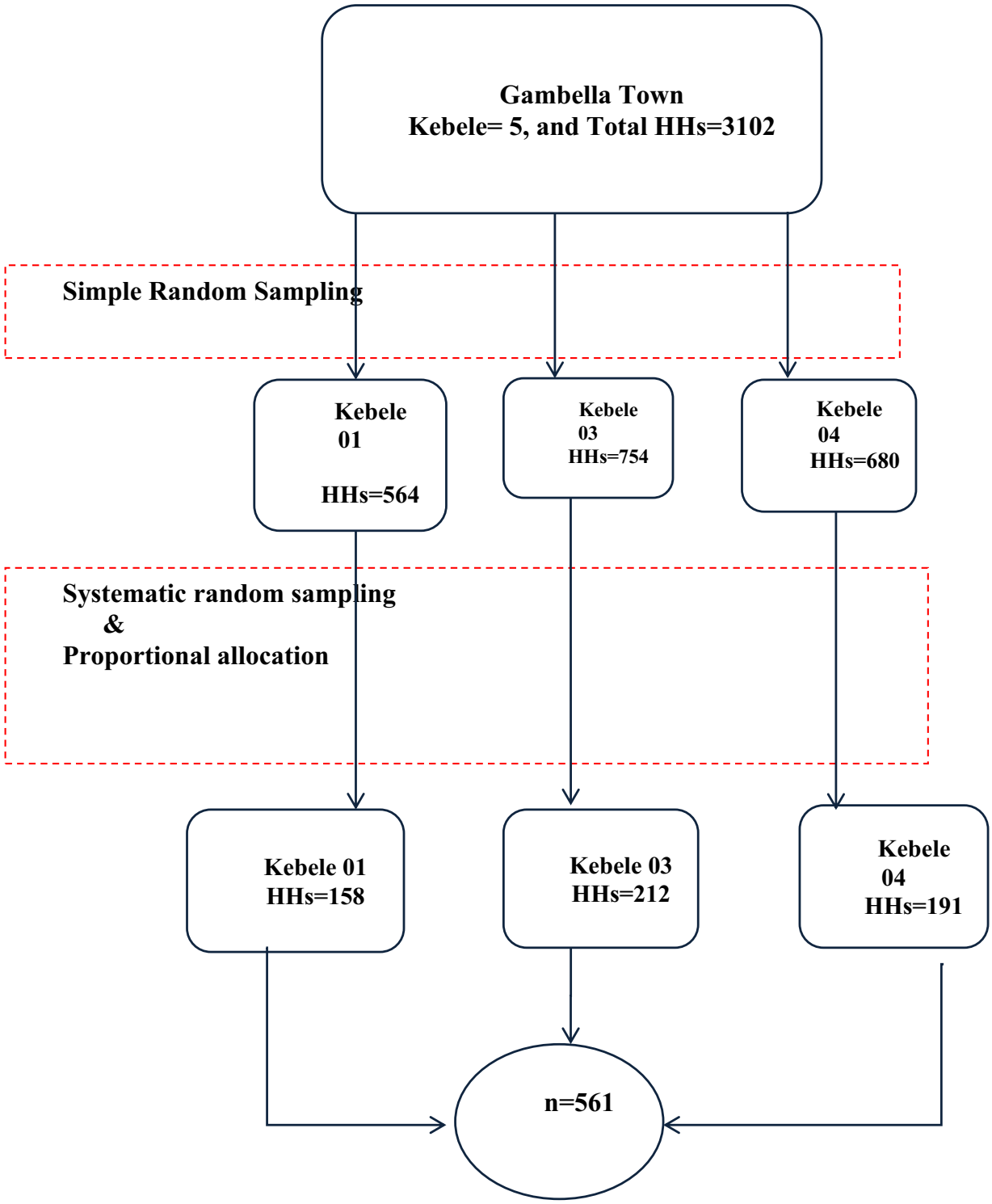

Figure 1. Schematic presentation of sampling procedure on latrine utilization and its associated factors among households in Gambella Town, 2023.

toward latrine utilization. The sum of attitude questions was computed and then categorized based on the mean score.

Study variables

The study analyzed OD (lack of latrine utilization) as a dependent variable, with independent variables including demographic factors, latrine conditions, knowledge of latrine utilization, and attitude toward OD.

Data quality assurance

Data quality was assured through training, using standardized tools, and close supervision during fieldwork. Three days of training were given to data collectors and supervisors. Before the actual data collection, a pretest was conducted on 5% of the sample size. The data collection procedure was supervised carefully to increase the accuracy and completeness of the data every day during the fieldwork.

Data processing and analysis

The data was then entered into Epi Info version 7 and exported to SPSS version 25. Descriptive statistics were computed, and a bi-variable binary logistic regression was conducted to investigate the association between explanatory variables and OD. Explanatory variables with a *P*-value less than .25 were entered into a multivariable logistic regression model, and the Hosmer and Lemeshow tests were used to check the model's goodness of fit. A *P*-value of less than .05 was considered statistically significant.

Ethical consideration

The study received ethical clearance from the Mattu University College of Health Sciences review committee (IRB) and a supportive letter from the Gambella Town Health Office, obtaining verbal consent from each participant. They were informed about the purpose, benefits, risks, and discomfort and had the right to withdraw at any time. Privacy and confidentiality were maintained.

Results

Socio-demographic characteristics of the study participants

In this study, 561 study participants were approached for the study, and all of them were involved, resulting in an overall response rate of 100%. The majority (541, or 96.4%) of the study participants were male. Regarding education, 452 (80.6%) of the HH and 503 (89.3%) of the respondents had formal education (participants attended primary, secondary, or above education). On the other hand, 442 (78.8%) of the HH and 400 (71.3%) of the study participants were employed. More than half (292, 52%) of the respondents had a family size of 5 or above, and 343 (61.1%) of the study participants had no children under 5 (Table 1).

Table 1. Socio-demographic characteristics of study participants in Gambella Town, 2023.

VARIABLES (N=561)	CATEGORIES	FREQUENCY	PERCENT
Sex of respondent	Male	541	96.4
	Female	20	3.6
Education of respondent	Informal[a]	109	19.4
	Formal[b]	452	80.6
Education of mother	Informal	58	10.3
	Formal	503	89.3
Occupation of head of household (HH)	Employed	442	78.8
	Unemployed	119	21.2
Occupation of mother	Employed	400	71.3
	Unemployed	161	28.7
Family size	Less than 5	269	48.0
	5 and above	292	52.0
The presence of under-5 children in the household	Yes	218	38.9
	No	343	61.1

[a]Informal education means the participant reported that he or she didn't attend any formal education.
[b]Formal education means the participants attended primary, secondary, or above education.

Latrine condition and utilization

This study revealed that, for the great majority, 513 (91.4%) of the households owned their latrine for not less than 3 years. Similarly, 450 (80.2%) of the latrines had a superstructure. About 39.8% of the observed latrines had no doors. More than half, 349 (62.2%) of the observed latrines had no squat hole. Regarding hygiene, only 230 (41%) of the households utilized a hygienic latrine. About 218 (38.9%) of the households clean their latrine daily. The latrine utilization in the current study was 52.8% (296) [95% CI: 48.6%–56.8%] (Table 2).

Knowledge and attitude of respondents toward latrine utilization

The knowledge of the respondents on latrine utilization was measured using 7 yes-or-no questions. In the analysis, the overall knowledge was compiled as poor or good based on the cut point explained in the method section. Accordingly, the overall respondent knowledge of toilet utilization was good. About 300 (53.5%) of the respondents and the rest, 261 (46.5%), had poor knowledge (Table 3).

The attitudes of the respondents toward toilet utilization were measured using nine 5-point Likert scale questions. The overall values were computed for the mean scores. Following the procedures explained in the method section of our study, the value below was considered a negative attitude, and the value of the mean and above was considered a positive attitude. Accordingly, about 271 (48.3%) have a positive attitude toward toilet utilization (Table 4).

Factors associated with OD among household-owned toilets

In the crude analysis, 15 variables were included as independent variables, and only 6 of them were significant at a *P*-value less than .25. Accordingly, occupation of the head household, toilet facilities lacking a superstructure, toilet facilities lacking doors, frequency of cleaning, attitude of the respondent toward toilet utilization, knowledge of the respondents and family size had a significant association with OD (Table 5).

Table 2. Latrine condition and utilization among households in Gambella Town, 2023.

VARIABLES (N = 561)	CATEGORIES	FREQUENCY	PERCENT
Since own latrine	<3 y	48	8.6
	⩾3 y	513	91.4
Having super structure	Yes	450	80.2
	No	111	19.8
Having doors	Yes	338	60.2
	No	223	39.8
Having squat hole	Yes	212	37.8
	No	349	62.2
Being hygienic	Yes	230	41.0
	No	331	59.0
Frequency of cleaning	Daily	218	38.9
	Rarely	343	61.1
Fresh footpath indicator	Yes	82	14.6
	No	479	85.4
Fresh excreta the observed in the toilet	Yes	214	38.1
	No	347	61.9
A splash of urine observed	Yes	456	81.3
	No	105	18.7
Anal cleaning indicators	Yes	20	3.6
	No	541	96.4
Spider web showing low visit	Yes	454	80.9
	No	107	19.1
OD practice	No	296	52.8
	Yes	265	47.2

The final model included all significant variables from the crude analysis, including head household's occupation, toilet facilities with superstructures and doors, frequency of cleaning, respondent attitude toward toilet utilization, and family size. Five variables were significant at a *P*-value less than .05. Accordingly, occupation of head household [AOR: 5.27, 95% CI: 3.08-9.00], toilet facilities having superstructure [AOR: 2.00, 95% CI: [1.16-3.43], toilet facilities having doors [AOR: 3.23, 95% CI: 1.97-5.27], family size [AOR: 2.16, 95% CI: 1.29-3.60], knowledge of the respondents [AOR: 2.40, 95% CI: 1.50-3.99], and respondents attitude toward toilet utilization [AOR: 1.76, 95% CI: 1.12-2.74] had a significant association with latrine utilization (Table 6).

Table 3. Knowledge of the respondents on latrine utilization and benefits of latrine use among households in Gambella Town, 2023.

VARIABLES (N = 561)	CATEGORIES	FREQUENCY	PERCENT
Know the benefits of using a toilet	No	183	32.6
	Yes	378	67.4
Using the toilet reduces flies	No	413	73.6
	Yes	148	26.4
Using toilet prevent diarrheal diseases	No	365	65.1
	Yes	196	34.9
Using the toilet helps with privacy during defecation	No	167	29.8
	Yes	394	70.2
Know the negative consequence of lack of toilet	No	398	70.9
	Yes	163	29.1
Knowing that using the toilet prevents disease	No	493	87.9
	Yes	68	12.1
Know OD pollutes the environment	No	342	61
	Yes	219	39
Overall knowledge of toilet utilization	Poor	261	46.5
	Good	300	53.5

Discussion

This study was aimed at assessing OD and associated factors among households owned latrines in Gambella town. The finding shows that OD was 47.2% [95% CI: 43.2%-51.4%]. This level of utilization is consistent with the national-level pooled result 49.98%,[31] the result from rural East Wollega 47.3%,[17] the result from the Dega Damot district West Gojjam Zone which shows 51.1%,[21] and Tullo District in West Hararge 46%.[20] This finding is higher than the study finding from Takussa district, north-west Ethiopia, which shows 41%.[19] The finding is lower than the urban reports of north-eastern Ethiopia, 71.8%,[22] Mehal Meda town, 91.2%,[23] rural findings of Dawuro, south-west Ethiopia, 67.1%,[18] Gurage Zone, south-west Ethiopia, 65.7%,[32] and the finding from rural India 64%.[33] This variation could be an intervention difference because most developing regions in Ethiopia have lower access to most infrastructures, including sanitation interventions. On the other hand, cultural variation among different communities may have different utilizations. Sanitation utilization in urban settings has in-depth challenges that may relate to the community culture.[28,29]

The level of OD was significantly associated with the unemployed head household, toilet facilities lacking a superstructure,

Table 4. Attitude of the respondents on latrine utilization among households in Gambella Town, 2023.

VARIABLES	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE	MEAN	OVERALL	
							PA	NA
OD attracts flies	29 (5.2%)	56 (10%)	319 (56.9%)	111 (19.8)	46 (8.2)	3.16		
OD can pollute the environment	72 (12.8%)	-	406 (72.4%)	83 (14.8%)	-	2.89		
Open defecation causes diarrheal disease	174 (31%)	47 (8.4%)	107 (19.1%)	211 (37.6%)	22 (3.9%)	2.75		
OD practices increase the risk of getting diarrheal to Neighbor	-	463 (82.5%)	1 (0.2%)	97 (17.3%)	-	2.35		
Using latrine to prevent diarrheal diseases	-	245 (43.7%)	-	267 (47.6%)	49 (8.7%)	3.20	271 (48.3%)	290 (51.7%)
Using a latrine is essential and obligatory for every HH	167 (29.8%)	162 (28.9%)	123 (21.9%)	36 (6.4%)	73 (13%)	2.44		
Latrine is only important for rich people	58 (10.3%)	332 (59.2%)	-	99 (17.6%)	72 (12.8%)	2.63		
Children's faces may contain germs	155 (27.6%)	-	66 (11.8%)	187 (33.3%)	153 (27.3%)	3.33		
Latrines are only important for urban centers	98 (17.5%)	192 (34.2%)	69 (12.3%)	54 (9.6%)	148 (26.4%)	2.93		

Abbreviations: PA, positive attitude; NA, negative attitude.

Table 5. Univariable analysis of factors associated with latrine utilization among households in Gambella Town, 2023.

VARIABLES (N=561)	CATEGORIES	OD		COR [95% CI]	*P*-VALUE
		YES	NO		
Head of HH occupation	Employed	44	75	1	.012
	Unemployed	221	221	1.75 [1.12-2.58]	
Family size	Less than 5	96	173	1	<.001
	5 and above	169	123	2.47 [1.76-3.48]	
Toilet super-structure	Yes	191	259	1	<.001
	No	74	37	2.71 [1.75-4.19]	
Toilet having doors	Yes	146	192	1	.018
	No	119	104	1.5 [1.07-2.11]	
Frequency of cleaning	Daily	86	132	1	.003
	Rarely	179	134	1.67 [1.18-2.36]	
Attitude	Positive	117	154	1	.063
	Negative	148	142	1.37 [0.98-1.92]	
Knowledge	Poor	159	103	2.81 [1.99-3.96]	<.001
	Good	107	193	1	

Table 6. Multivariable logistic regression analysis on factors associated with latrine utilization among households in Gambella Town, 2023.

VARIABLES (N=561)	CATEGORIES	OD		CRUDE OR		ADJUSTED OR	
		YES	NO	COR [95% CI]	*P*-VALUE	COR [95% CI]	*P*-VALUE
Head of HH occupation	Employed	44	75	1	.012	1	<.001**
	Unemployed	221	221	1.75 [1.12-2.58]		5.27 [3.08-9.00]	
Family size	Less than 5	96	173	1	<.001	1	<.003**
	5 and above	169	123	2.47 [1.76-3.48]		2.16 [1.29-3.60]	
Toilet super-structure	Yes	191	259	1	<.001	1	.001**
	No	72	37	2.71 [1.75-4.19]		2.00 [1.16-3.43]	
Toilet having doors	Yes	146	192	1	.018	1	<.001**
	No	119	104	1.5 [1.07-2.13]		3.23 [1.97-5.27]	
Frequency of cleaning	Daily	86	132	1	.003	1	.221
	Rarely	179	134	1.67 [1.18-2.36]		1.31 [.86-1.95]	
Attitude	Positive	117	154	1	.063	1	.014*
	Negative	148	142	1.37 [0.98-1.92]		1.76 [1.12-2.74]	
Knowledge	Poor	159	103	2.81 [1.99-3.96]	<.001	2.40 [1.50-3.99]	<.001**
	Good	106	193	1			

**Significant at *P*-value less than .001.
*Significant at *P*-value less than .05.

toilet facilities lacking doors, negative attitude, poor knowledge, and having large family size. This study found that OD is associated with socio-demographic characteristics like household occupation and family size. Accordingly, households headed by unemployed household heads were 5.3 times more likely to practice OD when compared with employed household heads. This may be due to the fact that unemployed household heads have poor economic status, which leads to poor utilization of toilets. Additionally, the household head's occupation may lead to a better income that supports improved family life, including toilet use.

Households with more family members (more than 5 people) were 2.16 times more likely to practice OD. This finding is consistent with the study findings from Mehal Meda Town in North Shewa Zone, Ethiopia, in which household head occupation is significantly associated with toile utilization.[23] Similarly, the current finding is consistent with the finding from northeastern Ethiopia, in which low family members are less likely to utilize toilet facilities.[22] This may be due to the householder's ability to maintain their basic needs, including sanitation infrastructure and utilization. A smaller family size may lead to a better lifestyle, which boosts latrine utilization. In the case of many members, they may be forced to wait, which may lead to a missed use of toilet facilities.

The study finding shows that respondents with a negative attitude toward toilet utilization were 1.8 times more likely to practice OD. Similarly, Households with poor knowledge were 2.4 times more likely to practice OD than their counter part, which is supported by a similar study from the Loma district, Dawuro Zone, Ethiopia, where positive attitudes have a positive association with toilet utilization.[18] Toilet facility utilities have a significant association with utilization. For instance, the current study shows that toilet facilities that lack superstructures were 2 times more likely to not be utilized, and toilet facilities that lack doors were 3 times more likely to not be utilized. This finding is consistent with the study findings from Tullo District, West Hararge, Eastern Ethiopia,[20] which show facilities with a superstructure are more likely to be used. Similarly, the finding supported by the study from Denbia district, Northwest Ethiopia, shows that utilization is positively associated with toilets having doors.[34]

In conclusion, the current study shows a high level of OD among latrine-owned households compared to the national target to end OD. Factors such as household characteristics and toilet facility conditions contributed to OD. The study suggests that implementing supper structures and doors in toilet construction and maintenance can boost usage. This is because users may feel uncomfortable with poor, quality toilets that lack doors, slabs, and supper structures due to privacy concerns, possibly due to a societal culture that favors toilets that support privacy. Therefore, decision-makers in the sanitation sector should focus on the quality of sanitation technologies and their use in urban settings, which may improve the health of urban dwellers. Additionally, the legal enforcement

of facilities without a superstructure, doors, and sanitation technologies of poor quality may contribute to the reduction of OD in urban settings. On the other hand, awareness creation, community mobilization, and integrating and advancing urban sanitation infrastructure may contribute to the solution. Because of the cross-sectional nature of the study, over time, changes in OD practice were not addressed, which needs follow-up studies in future works. Therefore, future interventions should also focus on behavioral changes toward a positive attitude toward toilet utilization. Longitudinal research is recommended to evaluate changes over time and improve sanitation access and toilet utilization in the community.

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Author Contributions

DFB and DOD have designed the survey, trained the research team, oversaw the fieldwork, and participated in drafting the manuscript. DFB, DOD, RGB, and GRD participated in the design of the survey, approved the survey, and oversaw the critical revision of the manuscript. All authors read and approved the final version of the manuscript.

Ethical Approval and Consent to Participate

Ethical clearance was obtained from Mattu University, College of Health Science Institutional Research Ethics Review Committee, Mattu Ethiopia with Ref. No RPG/318/15. Before each interview, data collectors sought verbal informed consent from each respondent.

Consent for Publication

All authors agreed to the publication of this manuscript.

ORCID iD

Dereje Oljira Donacho https://orcid.org/0000-0001-6145-2914

Availability of Data and Materials

The datasets used during the current study are available from the corresponding author upon reasonable request.

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