

Association of Sanitary Latrine Ownership and Clean Water Availability with Open Defecation Practices in 14 Ulu Village, Seberang Ulu II District, Palembang City

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Abstract. Open defecation (OD) remains a major sanitation problem in 14 Ulu Village, Palembang City, with serious public health and environmental impacts. This cross-sectional quantitative study aimed to examine the association between sanitary latrine ownership, clean water availability, and OD practices. A total of 96 respondents were selected through simple random sampling. Data were collected via structured interviews and direct observation, then analyzed using univariate, Chi-square, and logistic regression methods. Significant associations with OD were found for education ($p = 0.006$), sanitary latrine ownership ($p = 0.001$), and availability of clean water ($p = 0.001$). Age, occupation, and the role of health workers showed no significant relationships. Multivariate analysis identified sanitary latrine ownership as the most dominant factor influencing OD practices ($p < 0.001$). Strengthening access to sanitary latrines and clean water is therefore essential to accelerate the achievement of Open Defecation Free (ODF) status.

Keywords: Sanitation behavior, household infrastructure, water sanitation and hygiene (WASH), community-based total sanitation, cross-sectional study.

1 Introduction

Sanitation remains a critical global public health concern, particularly in developing and low-income countries where access to basic infrastructure is still limited. According to [1] around 3.5 billion people worldwide lack access to adequate sanitation, and approximately 419

million individuals continue to practice open defecation (OD). Open defecation not only reflects inadequate sanitation infrastructure but also indicates a lack of awareness and behavioral adaptation regarding hygiene [2,3]. This practice contributes significantly to environmental contamination, particularly of soil and water sources, which can lead to the spread of communicable diseases such as diarrhea, helminth infections, and other intestinal parasitic diseases [4,5]. In addition, chronic exposure to poor sanitation has been associated with malnutrition and stunting among children, making it a major concern in achieving global health and sustainable development goals [6,7].

In Indonesia, significant progress has been made in improving access to sanitation; however, disparities between urban and rural areas remain evident. The Central Bureau of Statistics [8] reported that the national coverage of adequate sanitation facilities reached 83.60%, yet 3.20% of the population still practices open defecation, particularly in regions with limited infrastructure and poor water supply systems. These challenges highlight that infrastructure development alone is insufficient without accompanying efforts to promote behavioral change and community participation [9,10]. To address this issue, the Indonesian government launched the Open Defecation Free (ODF) initiative through the Community-Based Total Sanitation (*Sanitasi Total Berbasis Masyarakat*, STBM) program, which aims to transform community hygiene behavior, encourage the construction and use of sanitary latrines, and ensure sustainable access to clean water [11]. Despite these national efforts, several regions have not yet fully achieved ODF status, reflecting persistent structural and behavioral barriers that continue to hinder sanitation improvement [9]. One such region is South Sumatra Province, where sanitation challenges remain considerable. According to BPS [12], only 80.54% of households in South Sumatra have access to proper sanitation facilities, leaving 19.46% without adequate sanitation. This situation is influenced by socioeconomic disparities, geographic constraints, limited water supply systems, and low public awareness of healthy sanitation practices [10,13]. In addition, rural and riverbank communities often rely on natural water bodies for daily activities, increasing the risk of environmental contamination from fecal waste [14,15]. The uneven implementation of STBM programs and differing levels of community engagement further contribute to the persistence of open defecation practices in the province.

One of the areas still facing serious sanitation problems is 14 Ulu Village, located in Seberang Ulu II District, Palembang City. Preliminary observations revealed that many households in this village do not yet have sanitary latrines or reliable access to clean water, particularly in densely populated areas along the Musi River. Residents in these areas often discharge human waste directly into the river, which is also used for bathing, washing, and even as a source of household water. Such conditions not only perpetuate open defecation but also increase the risk of waterborne diseases, including diarrhea and skin infections, and may contribute to child stunting and environmental degradation [4,7]. The persistence of these behaviors indicates the need for strengthened local interventions focusing on sanitation infrastructure, water supply, and health education.

Previous research has consistently demonstrated that ownership of sanitary latrines and availability of clean water are critical determinants of community sanitation behavior and open defecation reduction [16,17]. Limited access to either of these facilities often correlates with a higher prevalence of open defecation practices, particularly in low-income and riverbank settlements [18,19,20]. Considering the existing sanitation challenges in 14 Ulu

Village, it becomes essential to identify and analyze the key factors influencing open defecation in this community. Therefore, this study aims to analyze the association between sanitary latrine ownership and clean water availability with open defecation practices in 14 Ulu Village, Seberang Ulu II District, Palembang City. The findings are expected to provide evidence-based recommendations for local governments and health authorities to accelerate ODF achievement, strengthen sanitation policies, and enhance the overall public health and environmental quality of the community.

This study is timely and important because it provides empirical evidence on the relative influence of sanitary latrine ownership and clean water availability in a community that has not yet achieved Open Defecation Free (ODF) status. Scientifically, this research contributes to the sanitation literature by clarifying the relative strength of structural and behavioural determinants of open defecation within an urban riverbank context. Practically, the findings offer actionable insights for local governments and health authorities to prioritize sanitation infrastructure and water access as key intervention strategies, thereby supporting the acceleration of ODF achievement and the broader goals of sustainable urban sanitation.

2 Materials and methods

2.1 Research procedures

This study employed a quantitative cross-sectional design to examine the association between socio-demographic factors, sanitary latrine ownership, clean water availability, and open defecation practices among households in 14 Ulu Village, Seberang Ulu II District, Palembang City. Cross-sectional studies are appropriate for assessing the prevalence of health-related behaviours and their associated factors at a single point in time [41]. The study population consisted of 2,475 households registered in 14 Ulu Village. A sample of 96 respondents was selected using simple random sampling to ensure that each household had an equal probability of selection. Respondents were either household heads or adult family members who were directly responsible for sanitation-related practices. Data collection was conducted through face-to-face interviews using a structured questionnaire to obtain information on socio-demographic characteristics, sanitation behaviour, and water access. In addition, direct observation was carried out to assess the availability and condition of household sanitary latrines using an observation checklist. This combined interview–observation approach was applied to improve data accuracy and reduce reporting bias [41,42].

2.2 Data analysis

The data analyzed in this study consisted of one dependent variable and several independent variables. The dependent variable was open defecation behaviour, categorized as “yes” or “no.” The independent variables included age, education level, occupation, ownership of a sanitary latrine, availability of clean water, and the role of health workers. Univariate analysis was conducted to describe the frequency and percentage distribution of each variable. Bivariate analysis using the Chi-square test was applied to assess the association between each independent variable and open defecation behaviour. Variables with a p -value < 0.05 in the bivariate analysis were subsequently included in the multivariate analysis. Multivariate analysis was performed using multiple logistic regression to identify the most dominant

factors associated with open defecation behaviour while controlling for potential confounding variables. All statistical analyses were conducted using RStudio version 4.4.2 [21], with a significance level set at $\alpha = 0.05$.

3 Result and discussion

3.1 Distribution of respondent characteristics

Based on **Table 1**, it was found that among the 96 respondents, the majority were aged >40 years (52 respondents; 54.2%), while those aged ≤ 40 years accounted for 44 respondents (45.8%). In terms of education level, respondents with low education comprised 47 individuals (49%), which was almost equal to those with higher education (49 individuals; 51%). Regarding employment status, most respondents were employed (57 respondents; 59.4%), whereas 39 respondents (40.6%) were unemployed. For the variable of sanitary latrine ownership, the majority of respondents owned sanitary latrines (68 respondents; 70.8%), while 28 respondents (29.2%) did not. In terms of clean water availability, most respondents reported not having access to clean water (53 respondents; 55.2%), whereas 43 respondents (44.8%) had access. Furthermore, regarding the role of health workers, most respondents stated that health workers had no active role (85 respondents; 88.5%), while only 11 respondents (11.5%) indicated that health workers played a role.

Table 1. Respondents' characteristics

Variables	Category	<i>n</i>	%
Age	≤ 40 years	44	45.8
	≥ 40 years	52	54.2
Education	Low	47	49.0
	High	49	51.0
Occupation	Unemployed	39	40.6
	Employed	57	59.4
Ownership of Sanitary Latrine	No	28	29.2
	Yes	68	70.8
Availability of Clean Water	Not available	53	55.2
	Available	43	44.8
Role of Health Workers	Not Active	85	88.5
	Active	11	11.5

Note: *n* represent amount of respondents

3.2 Relationship between respondent characteristics and open defecation (OD) behavior

The examination of the correlation between respondent characteristics and open defecation (OD) behaviour was presented in **Table 2**. The findings indicated that age was not significantly correlated with open defecation habit ($p = 0.235$; $PR = 0.650$; 95% CI: 0.351–1.204). Individuals over 40 years exhibited a greater prevalence of open defecation (38.5%) than those aged 40 years or younger (25.0%).

The level of education exhibited a notable correlation with open defecation practices ($p = 0.006$; $PR = 2.548$; 95% CI: 1.312–4.952). Individuals with a lower level of education were

more predisposed to practice open defecation (46.8%) compared to those with a higher level of education (18.4%). The occupation category variable exhibited no statistically significant association with open defecation behaviour ($p = 0.627$; PR = 0.804; 95% CI: 0.436–1.483), despite employed respondents (35.1%) indicating marginally higher open defecation behaviour than their unemployed counterparts (28.2%).

Table 2. Relationship between respondent characteristics and open defecation practices

Variables	Category	Open Defecation Behavior		p – value	PR (95% CI)
		Yes	No		
Age	≤ 40 years	11 (25.0%)	33 (75.0%)	0.235 ns	0.650 (0.351–1.204)
	≥ 40 years	20 (28.5%)	32 (61.5%)		
Education	Low	22 (46.8%)	25 (53.2%)	0.006 *	2.548 (1.312–4.952)
	High	9 (18.4%)	40 (81.6%)		
Occupation	Unemployed	11 (28.2%)	28 (71.8%)	0.627 ns	0.804 (0.436–1.483)
	Employed	20 (35.1%)	37 (64.9%)		
Ownership of Sanitary Latrine	No	27 (90.0%)	3 (10.0%)	0.001*	14.850 (5.701–38.678)
	Yes	4 (6.1%)	62 (93.9%)		
Availability of Clean Water	Not available	24 (57.1%)	18 (42.9%)	0.001*	4.408 (2.105–9.231)
	Available	7 (13.0%)	47 (87.0%)		
Role of Health Workers	Not Active	28 (32.9%)	57 (67.1%)	0.972 ns	1.208 (0.439–3.321)
	Active	3 (27.3%)	8 (72.7%)		

Note: PR = Prevalence Ratio; CI = Confidence Interval; ns = not significant. Statistical significance was determined at $\alpha = 0.05$ using the Chi-square test. Variables marked with an asterisk (*) indicate a significant association with open defecation behavior.

The possession of sanitary latrines exhibited a substantial correlation with open defecation ($p = 0.001$; PR = 14.850; 95% CI: 5.701–38.678). Individuals lacking sanitary latrines exhibited a significantly higher propensity for open defecation (90.0%) in contrast to those possessing sanitary latrines (6.1%). The presence of clean water shown a notable correlation with open defecation practices ($p = 0.001$; PR = 4.408; 95% CI: 2.105–9.231). Individuals without access to clean water were more prone to practice open defecation (57.1%) than those with sufficient clean water resources (13.0%). The involvement of health personnel shown no significant correlation with open defecation practices ($p = 0.972$; PR = 1.208; 95% CI: 0.439–3.321). The majority of respondents indicated that health staff were not actively involved in sanitation-related activities (32.9% compared to 27.3%).

3.3 Multivariate analysis of factors associated with open defecation practices

The multivariate model included three variables; including education level, access to clean water, and ownership of a sanitary latrine because of the strong link in the bivariate analysis (Table 3). The study findings indicated that only the variable pertaining to ownership of a sanitary latrine retained statistical significance ($p = 0.001$). After controlling for education level and access to clean water, owning a sanitary latrine at home was found to be the most important factor affecting open defecation behavior among people in 14 Ulu Village, with a Prevalence Ratio (PR) of 298.502 (95% CI: 30.457–2925.533).

The extremely high *Prevalence Ratio (PR)* value for the variable of sanitary latrine ownership was attributed to the fact that nearly all respondents without a sanitary latrine were still practicing open defecation (OD). Of the 31 respondents who continued to practice OD, 27 did not have a sanitary latrine at home. This condition caused a substantial increase in the

prevalence ratio within the study population. Based on this analysis, it can be concluded that respondents who did not own a sanitary latrine at home were approximately 298 times more likely to engage in open defecation compared to those who had one.

Table 3. Final multivariate model of factors associated with open defecation practices

Variables	p – value	PR	95% CI (Lower – Upper)
Education	0.365 ns	2.381	0.364–15.584
Availability of Clean Water	0.166 ns	3.756	0.557–24.460
Ownership of Sanitary latrine	0.001 *	298.502	30.457–2925.533

Note: ns = not significant ($p > 0.05$); * = significant ($p < 0.05$). PR = Prevalence Ratio showing the likelihood of open defecation behavior, and CI = 95% Confidence Interval indicating the precision of the PR estimate.

4 Result and discussion

4.1 Education level and open defecation behavior

In this study, education level showed a significant association with open defecation behaviour ($p = 0.006$; PR = 2.548), where respondents with lower educational attainment were more than twice as likely to practice open defecation compared to those with higher education. Specifically, 46.8% of respondents with low education reported open defecation, whereas this behaviour was observed in only 18.4% of respondents with higher education. This finding indicates that, in 14 Ulu Village, education plays an important role in shaping sanitation-related awareness and decision-making. The higher prevalence of open defecation among less educated respondents may be linked to limited understanding of disease transmission pathways and the long-term health risks associated with poor sanitation, particularly in riverbank settlements where open defecation has become a socially normalized practice. These local conditions reinforce behaviour patterns that persist despite ongoing sanitation programs. Respondents with lower levels of formal education were more likely to engage in open defecation compared to those who had attained higher education. This association suggests that education serves as a crucial determinant in shaping sanitation-related behaviours, particularly through its influence on knowledge, attitudes, and decision-making capacity. Individuals with limited educational attainment may possess lower awareness of the health risks associated with open defecation, as well as a reduced understanding of the benefits of proper sanitation and hygiene practices. Research consistently demonstrates a statistically significant relationship between education level and open defecation (OD) practices. Individuals with lower levels of formal education are more likely to engage in open defecation compared to those with higher educational attainment, as shown in studies from Indonesia, Ghana, Ethiopia, and Nigeria [22,23,24,25].

These results are consistent with previous studies reporting that low educational status is a key predictor of inadequate sanitation behaviour due to limited knowledge of disease transmission, environmental hygiene, and the importance of latrine use [26,27]. Education not only improves an individual's cognitive understanding of hygiene and health but also strengthens their ability to access and apply health information in daily life. Consequently, interventions targeting sanitation improvement should include education-based strategies such as

community health education, school-based sanitation programs, and behaviour change communication (BCC) initiatives that promote hygiene literacy and encourage sustained behavioural change [28,29]. In urban and rural settings alike, education remains a crucial determinant, with public health initiatives recommending increased educational outreach and health promotion to address these behavioral gaps [22,25].

4.2 Impact of the availability of clean water to open defecation behavior

The bivariate analysis demonstrated a strong association between the availability of clean water and open defecation behaviour ($p = 0.001$; $PR = 4.408$). More than half of respondents without access to clean water (57.1%) practiced open defecation, compared to only 13.0% among those with adequate water availability. This result highlights that water scarcity remains a major structural barrier to proper sanitation behaviour in 14 Ulu Village. In river-adjacent areas of the village, limited access to piped or protected water sources reduces the functionality and maintenance of household latrines, making open defecation a more practical alternative. Without sufficient water for flushing and cleaning, latrines are often underused or abandoned, reinforcing unsafe sanitation practices.

The availability of clean water was found to have a strong association with open defecation behaviour in the bivariate analysis. Respondents lacking access to reliable and sufficient sources of clean water were significantly more likely to practice open defecation than those with adequate water availability. This finding aligns with the results of several prior studies emphasizing that the accessibility and proximity of water sources are critical determinants of household sanitation practices [30,31].

Water availability plays an essential role in ensuring toilet cleanliness, maintaining functional latrine facilities, and enabling hygienic behaviours such as handwashing. In areas where water is scarce, distant, or difficult to obtain, individuals often perceive open defecation as a more practical or less burdensome alternative. This condition also hampers the maintenance of sanitary latrines, leading to their neglect or disuse [32]. For example, research in Indonesia found a significant relationship between limited clean water availability and poor toilet ownership and conditions, while studies in Timor-Leste and Ethiopia highlight that sufficient water supply is closely linked to the cleanliness and usability of toilets and overall household sanitation [32,33]. Therefore, improving access to clean water — through infrastructure development, rainwater harvesting, or community-managed water supply systems — is indispensable for sustaining proper sanitation practices. The integration of water provision with sanitation interventions is essential to achieve the goals of the “Water, Sanitation, and Hygiene” (WASH) framework and the Sustainable Development Goal (SDG) 6 on clean water and sanitation [32,34].

4.3 Ownership of sanitary latrine reduces open defecation behavior

The most striking finding of this study was the extremely strong association between sanitary latrine ownership and open defecation behaviour. Respondents who did not own a sanitary latrine were almost 298 times more likely to practice open defecation than those who owned one ($p = 0.001$; $PR = 298.502$). Among the 31 respondents who reported open defecation, 27 did not have a sanitary latrine at home, indicating a near-total dependence on open environments for defecation. This result suggests that, in 14 Ulu Village, the absence of

sanitation infrastructure is the primary and most immediate driver of open defecation, outweighing individual demographic characteristics. The magnitude of the association reflects the structural reality that without a household latrine, residents have little practical choice but to continue open defecation, particularly in densely populated riverbank areas.

The extreme value of the prevalence ratio can be attributed to the fact that nearly all respondents without latrine facilities continued to defecate in open areas. The absence of household sanitation infrastructure directly compels individuals to depend on environmentally unsafe practices, thereby elevating the risk of faecal contamination and the spread of waterborne diseases such as diarrhea, cholera, dysentery, and typhoid. Similar findings have been documented in numerous studies across Indonesia and other developing countries, which consistently identify latrine ownership as a principal predictor of improved sanitation behaviour [35,36,37]

Consequently, policy and intervention programs should prioritize the promotion of household latrine construction and the maintenance of existing facilities. These efforts must be complemented by community empowerment initiatives and behaviour change communication to ensure long-term adoption and utilization. Subsidy mechanisms, microfinance schemes, and social marketing approaches could also be leveraged to increase affordability and encourage household investment in sanitation infrastructure. Community-Led Total Sanitation (CLTS) and similar approaches have demonstrated significant increases in latrine construction when combined with behaviour change communication, community empowerment, and social marketing to address psychosocial and social determinants of sanitation behaviour [38,39].

4.4 Non-significant variables: age, occupation, and role of health workers

In contrast to the significant structural factors identified, age, occupation, and the role of health workers were not significantly associated with open defecation behavior in this study. The lack of significance for age and occupation may suggest that sanitation practices in the study area are predominantly influenced by structural and environmental factors such as infrastructure access and water availability rather than by individual demographic characteristics. This finding also reflects the possibility that open defecation is a community-wide issue rooted in collective practices and local norms, rather than being restricted to specific age or occupational groups.

Furthermore, the absence of a significant relationship between the role of health workers and sanitation behaviour may be explained by limited engagement of health personnel in active sanitation promotion. As reported by many respondents, routine counselling or community health activities focusing on sanitation have not been consistently implemented. This implies that the current outreach of sanitation education through local health cadres or health posts remains suboptimal. Strengthening the involvement of health workers in participatory and community-driven sanitation programs - such as the Participatory Hygiene and Sanitation Transformation (PHAST) approach or Community-Led Total Sanitation (CLTS) could enhance behavioural outcomes and facilitate more effective dissemination of hygiene messages [38,40]. Integrating sanitation advocacy into regular public health services and cross-sectoral collaboration is also recommended to increase coverage and sustainability. Research suggests that the minimal influence of health workers on sanitation behaviour may result from deficiencies in their engagement and the irregular execution of sanitation-oriented outreach initiatives. A study conducted in rural Tanzania revealed that fewer than half of

community health workers (CHWs) exhibited sufficient knowledge of household sanitation and hygiene, and merely one-third reported adherence to good practices [40]. Many CHWs lacked recent training and encountered inadequate community cooperation and support in their roles [38,40].

4.5 Study limitations, recommendations, and future prospects

This study provides important insights into the determinants of open defecation (OD) practices among residents of 14 Ulu Village; however, several limitations need to be acknowledged. The first limitation lies in the cross-sectional design used in this study, which restricts the ability to establish causal relationships between the studied variables and open defecation behaviour. The observed associations reflect relationships at a single point in time and may not capture temporal or seasonal variations in sanitation practices. Another limitation is the reliance on self-reported data collected through interviews and questionnaires, which may be influenced by recall bias or social desirability bias, especially when discussing sensitive issues such as sanitation habits. In addition, the relatively small sample size of 96 respondents, limited to one urban village, may constrain the generalizability of the findings to other settings with different socioeconomic or environmental characteristics.

Despite these limitations, the findings of this study remain valuable for informing local sanitation policies and intervention strategies. Based on the results, several recommendations can be proposed. Efforts should be made to strengthen access to basic sanitation infrastructure by promoting affordable household latrine construction programs supported by local government or community-based financing initiatives. Furthermore, sanitation education and awareness should be enhanced, particularly among populations with lower educational attainment, through participatory and culturally sensitive health promotion strategies [29,32,33,40]. Improving access to clean water sources is also essential to ensure that the use and maintenance of sanitary latrines are sustainable in the long term. Moreover, the role of health workers should be reinforced by integrating sanitation promotion activities into regular community health programs and home visits.

For future research, longitudinal or mixed-method studies are recommended to explore behavioural determinants and community perceptions in greater depth, as well as to evaluate the long-term impact of sanitation interventions. Comparative studies across different regions would also provide broader insights into the contextual factors that influence open defecation practices in Indonesia. Overall, while this study demonstrates that the ownership of a sanitary latrine is the most dominant factor influencing open defecation behaviour, future efforts should adopt a multidimensional and sustainable approach that combines infrastructure provision, health education, and active community participation to achieve total sanitation in both urban and rural settlements.

5 Conclusion

This study aimed to analyze the association between sanitary latrine ownership and the availability of clean water with open defecation practices in 14 Ulu Village, Palembang City. The findings clearly demonstrate that both factors were significantly associated with open defecation behaviour. Households without access to clean water and those with lower

educational attainment were more likely to practice open defecation. However, the ownership of a sanitary latrine emerged as the most dominant determinant of open defecation behaviour. Respondents who did not own a sanitary latrine were almost 298 times more likely to practice open defecation compared to those who had one. In contrast, age, occupation, and the role of health workers were not significantly associated with open defecation practices. These results indicate that improving household access to sanitary latrines, supported by adequate clean water provision, is essential to reduce open defecation and accelerate the achievement of Open Defecation Free (ODF) status. Strengthening sanitation infrastructure should therefore be prioritized alongside community education to support sustainable sanitation behaviour change.

6 Conflict of interest

The author declares that there is no conflict of interest concerning the content of this paper.

7 Author contribution

Yuanita Windusari: Conceptualization, supervision, research funding, project administration and review draft; Yadi Oktariansyah: Data curation, formal analysis, original draft, and review draft; Tega Indah Suryani: Data collection, formal analysis, and review draft; Dwi Septiawati: Data curation, formal analysis, and review draft.

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