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Community Participation in Urban Sanitation Programs at Koja, Jakarta, Indonesia

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Abstract

Urban sanitation remains a critical public health issue, with community participation recognized as a key factor in the success of sanitation programs. This study explores the multidimensional factors influencing community participation in the urban setting of Koja. Through a mixed-methods approach, including surveys, interviews, and observational studies, we investigated how socio-demographic factors such as age, gender, income, occupation, and aspects of sanitation governance, infrastructure, and educational interventions affect community engagement. The study revealed that while infrastructure and access are crucial, socioeconomic and gender-related barriers significantly impact participation. Educational level emerged as a strong predictor of engagement, indicating that awareness and knowledge play a critical role in motivating community involvement. Furthermore, sanitation governance and the quality of policies and monitoring were instrumental in shaping public attitudes towards participation. The research highlights the necessity for integrated and inclusive sanitation policies that address urban populations' local context and socioeconomic diversity. The findings underscore the importance of targeted educational campaigns and the fostering of collaborative community relationships to enhance participation in sanitation programs. This study contributes to the discourse on urban sanitation by providing a nuanced understanding of the complex factors in community-based sanitation efforts, offering insights for policymakers to improve public health outcomes.

Introduction

In the contemporary urban landscape, providing and managing sanitation services remains a critical challenge, particularly in rapidly developing regions. With its diverse and densely populated environment, Jakarta epitomizes the complexities inherent in urban sanitation management (Rosdiana and Sardjono 2020). Despite significant advancements in public health practices, disparities in access to sanitation facilities and varying levels of community engagement persist (Osborne *et al*., 2021), essential for maintaining public health standards and environmental sustainability. Historically, the development of sanitation infrastructure has been closely tied to reducing diseases and improving urban living conditions (Isunju *et al*., 2011). However, the efficacy of these infrastructural developments is often contingent upon the active participation of the community they serve (Barrios 2008). Understanding the factors that motivate or dissuade community involvement in sanitation practices is essential for designing effective public health interventions (Malima *et al*., 2022).

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In Jakarta, as in many urban areas, sanitation is not merely a technical matter but also a social one, influenced by governance, socioeconomic factors, and cultural norms (Anthonj *et al*., 2020; Rosdiana and Sardjono 2020; Daniel *et al*., 2021; Suryawan and Lee 2023). The governance of sanitation services, including policy formulation, regulation, and enforcement, plays a pivotal role in shaping public attitudes and behaviors towards sanitation practices (Mensah 2020; Mensah *et al*., 2023). Operational sanitation practices at the individual and household levels further define the sanitation landscape of a community. They are influenced by the ease of access to sanitation facilities (Kabir *et al*., 2021), the level of sanitation education provided (Ssemugabo *et al*., 2021), and the prevailing social norms regarding hygiene (Dickin *et al*., 2021). Furthermore, the infrastructure for sanitation and the collaborative efforts of communities are vital for sustaining sanitation systems and fostering a culture of sanitation (Pugel *et al*., 2022). The degree of infrastructure development can significantly impact both the feasibility of practicing good sanitation and the willingness of community members to participate in sanitation programs (Wu *et al*., 2022).

Demographic factors, including gender, age, education, occupation, and income, are also influential in determining the levels of community engagement in sanitation initiatives. Gender roles and responsibilities can affect participation, with women often facing greater barriers due to socio-cultural norms and safety concerns in accessing sanitation facilities (Akpabio *et al*., 2021; Vogel *et al*., 2022). Age-related factors may influence individuals' physical ability and willingness to engage in sanitation-related activities, while education can enhance understanding and compliance with sanitation practices (Ahmed *et al*., 2020; Dwipayanti *et al*., 2021). Occupational and income levels have been associated with differences in access to sanitation services (Omotayo *et al*., 2021; Sitotaw *et al*., 2021), where formal employment and higher income levels may be linked to greater access to resources and, consequently, higher participation in sanitation programs. Conversely, those in informal employment or with lower incomes may experience more significant challenges accessing and investing in proper sanitation (Moussié 2021).

The existing research corpus on sanitation and public health is extensive (Anthonj *et al*., 2020; Rosdiana and Sardjono 2020; Daniel *et al*., 2021; Suryawan and Lee 2023)., yet it does not fully capture the nuanced drivers of community engagement in sanitation programs within the varied tapestry of urban settings, such as those found in Jakarta. This shortfall manifests across several critical domains. Firstly, a broader global focus often overshadows the local contextual understanding. Koja represents an urban area that is growing rapidly and evolving demographically. Such dynamics necessitate a deeper grasp of the cultural, economic, and social intricacies of designing sanitation interventions that resonate with the community's needs. Secondly, while individual factors like infrastructure and education have been the subject of much research, their integration with socio-demographic variables has not been sufficiently explored. This integration is crucial to comprehend how these variables collectively influence community participation in sanitation practices. Moreover, the impact of sanitation governance on community participation is another area neglected. There is a pressing need for studies investigating how governance quality can impact the success of sanitation programs. The community collaboration and participation domain has been acknowledged but not deeply understood. Research is needed to elucidate how such collaboration can be enhanced to improve participation rates and determine how community-based approaches can be effectively implemented to foster a sense of ownership and ensure the sustainability of sanitation programs.

This study aims to conduct an exhaustive investigation into the various factors that influence community participation in sanitation programs within the urban context of Koja. The research seeks to uncover the extent to which local cultural, economic, and social dynamics shape engagement with sanitation initiatives. It integrates multiple socio-demographic variables such as age, gender, income, and occupation, examining

their collective impact on sanitation practices. A pivotal objective is to enhance understanding of the barriers women face in participating in sanitation programs and how gender intersects with other socioeconomic factors to influence participation rates. The study also sets out to assess the role of sanitation governance and investigate how policy enforcement, regular monitoring, and community engagement contribute to the effectiveness of sanitation programs. Economic motivations and constraints across different income groups will be analyzed to understand their influence on participation in sanitation practices.

Additionally, the study aims to evaluate the efficacy of educational interventions in promoting participation in sanitation programs, especially among diverse urban populations. Finally, the research intends to explore mechanisms for fostering community collaboration, aiming to identify strategies to improve participation rates and ensure the sustainability of sanitation programs in Koja. Through these objectives, the research aspires to provide actionable insights that can aid in developing inclusive and context-sensitive sanitation policies, ultimately enhancing public health and well-being in Koja.

Method

The research was conducted in Koja, a region known for its vibrant community and urban dynamics. It is an ideal location for investigating factors influencing community participation in sanitation programs in Jakarta,

FIGURE 1. Study Location

Indonesia (Figure 1). The choice of Koja as a study site stems from its unique blend of residential, commercial, and industrial activities, which present varied sanitation challenges and opportunities for community engagement.

The study's methodological framework in Koja included a blend of survey instruments, statistical analysis software, and educational outreach materials. Survey instruments, such as structured questionnaires, were meticulously crafted to gauge residents' attitudes toward sanitation practices, their understanding of sanitation governance, and their willingness to participate in local sanitation initiatives. For the data analysis, software like SPSS played a crucial role in executing logistic regression and Exploratory Factor Analysis (EFA), which were essential in discerning the connections between the identified factors and the community's engagement with sanitation practices (Nguyen *et al*., 2023; Suryawan *et al*., 2023).

The study's approach was both quantitative and qualitative. Quantitative data were gathered via surveys distributed to a representative sample of Koja's population, including a diverse cross-section of residents, business owners, and community organization members. It helped to collect a wide range of demographic data and insights into behavioral patterns concerning sanitation. Qualitative insights were obtained through semi-structured interviews with key stakeholders such as local leaders, public health officials, and representatives from non-governmental organizations involved in sanitation efforts. These interviews aimed to uncover deeper contextual factors influencing community participation. Observational methods, including field visits and visual inspections of sanitation facilities, complemented the data collection process, providing a tangible assessment of the sanitation landscape in Koja. Figure 2 outlines the study's conceptual framework, illustrating the hypothesized relationships between various factors and the willingness to participate in community-based sanitation programs. This visual representation delineates how different elements derived from sanitation governance, practices, infrastructure, collaboration, and demographic variables are theorized to influence participation levels. Figure 2 suggests eight hypotheses (H1 through H8), each representing a predicted association:

H1: Sanitation Governance and Willingness to Participate

This hypothesis posits that effective sanitation governance, characterized by regular monitoring and consideration of aesthetic factors, positively affects the willingness of citizens to participate in sanitation programs. The hypothesis suggests that when governance is strong, with clear rules and consistent oversight, it can enhance community trust and encourage active engagement in sanitation efforts.

H2: Operational Sanitation Practices and Willingness to Participate

H2 hypothesizes that the presence of operational sanitation practices, such as defecation practices and waste disposal, has a significant impact on the willingness to participate. It implies that practical, day-to-day sanitation activities if carried out effectively, can motivate individuals to participate in broader community-based sanitation initiatives.

H3: Sanitation Infrastructure and Collaboration and Willingness to Participate

The third hypothesis suggests that the availability of sanitation infrastructure and collaborative community efforts is crucial for fostering a willingness to participate. Access to facilities and cooperative socialization around treatment processes are expected to empower residents to contribute to communal sanitation programs.

H4: Gender and Willingness to Participate

H4 explores the gender dynamics within sanitation participation, proposing that females may have different levels of willingness to participate compared to males, potentially due to gender-specific barriers or motivators.

H5: Age and Willingness to Participate

This hypothesis considers age as a factor, predicting that younger individuals (under 29 years) may have different participation rates than older individuals, possibly due to generational differences in attitudes or physical ability to engage in sanitation-related activities.

H6: Education and Willingness to Participate

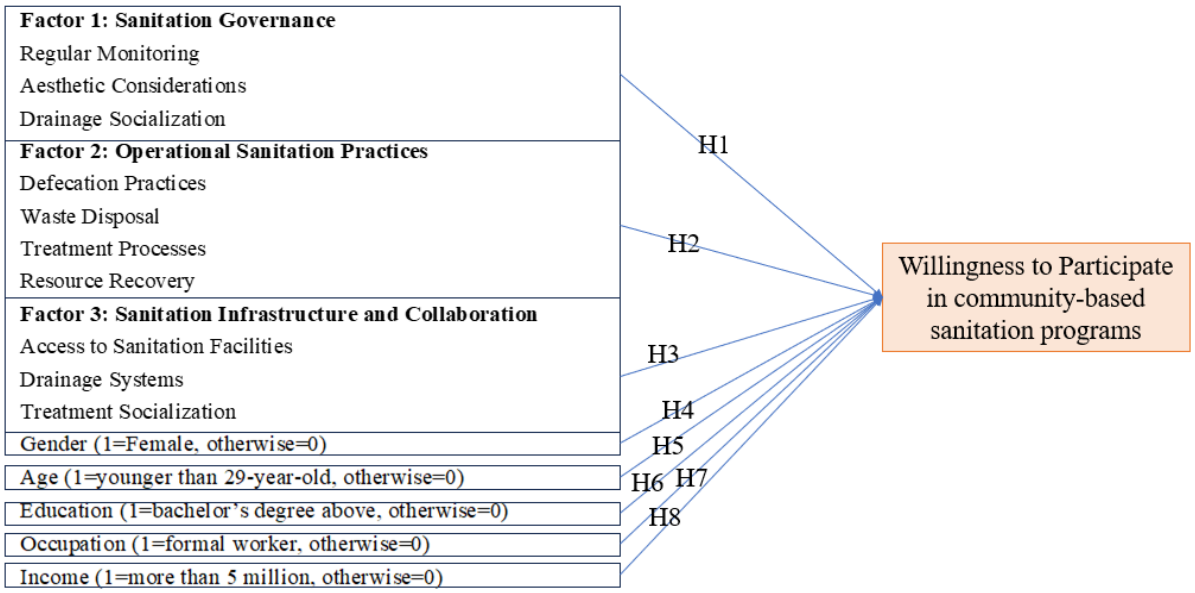

FIGURE 2. Hypothesis Developmen

H6 asserts that educational attainment, particularly at the bachelor's degree level or higher, influences the willingness to participate. It is based on the notion that education can increase awareness and understanding of the importance of sanitation, leading to higher engagement.

H7: Occupation and Willingness to Participate

The hypothesis examines the role of occupation, speculating that formal workers may exhibit different levels of willingness to participate in community-based sanitation programs compared to those in informal sectors or unemployed, possibly due to time constraints or exposure to different work environments.

H8: Income and Willingness to Participate

H8 suggests that income level, specifically earning more than 5 million, may be associated with a greater willingness to participate. This could be because higher income provides the resources needed to engage more fully in sanitation initiatives or reflects a higher stake in maintaining community standards.

The core of the research involved the meticulous analysis of the data collected, using SPSS for logistic regression and EFA. The statistical analyses aimed to explore the intricate relationships between variables. Such as awareness of sanitation issues, the efficacy of sanitation governance, the state of infrastructure, and the willingness of the community to engage in sanitation programs. Logistic regression was instrumental in identifying key predictors that could influence participation levels, thereby informing strategic interventions to enhance community involvement (Nguyen *et al.*, 2023; Suryawan *et al.*, 2023). An integral component of the research was the implementation of educational campaigns designed to heighten the community's understanding of the importance of effective sanitation and to foster greater participation in sanitation programs. The effectiveness of these educational campaigns was also evaluated, offering insights into the most impactful methods for mobilizing community action.

Result And Discussion

Table 1 presents a detailed Exploratory Factor Analysis result that organizes various items into three distinct sanitation-related factors. The first factor is labeled "Sanitation Governance," which encompasses items such as Regular Monitoring with a substantial factor loading of 0.836, indicating a strong relationship with this factor. Aesthetic Considerations are also included under this factor with a notable loading of 0.736, followed by Drainage Socialization with a loading of 0.525. The reliability of this factor is measured

TABLE 1. EFA Analysis Result

Factors and Items	Factor Loading					% of Variance
	1	2	3			
Factor 1: Sanitation Governance				0.631	3.375	19.680
Regular Monitoring	0.836					
Aesthetic Considerations	0.760					
Drainage Socialization	0.525					
Factor 2: Operational Sanitation Practices				0.671	1.165	39.315
Defecation Practices		0.777				
Waste Disposal		0.711				
Treatment Processes		0.532				
Resource Recovery		0.518				
Factor 3: Sanitation Infrastructure and Collaboration				0.541	1.047	55.867
Access to Sanitation Facilities			0.825			
Drainage Systems			0.671			
Treatment Socialization			0.510			

by Cronbach's Alpha of 0.631, and its Eigenvalue of 3.375 suggests a significant contribution to the explained variance, which is 19.680% for this factor. The second factor, "Operational Sanitation Practices," covers practical aspects, with Defecation Practices showing a high factor loading of 0.777, Waste Disposal with 0.711, and Treatment Processes and Resource Recovery with lower loadings of 0.532 and 0.518, respectively. This factor's Cronbach's Alpha stands at 0.671, which indicates a reasonably high internal consistency. The Eigenvalue here is 1.165, and this factor accounts for a larger portion of the variance, specifically 39.315%. The third factor is "Sanitation Infrastructure and Collaboration," which seems to be the most influential, with the highest explained variance of 55.867%. This factor includes Access to Sanitation Facilities, which has the highest factor loading among all items at 0.825, suggesting a strong association with the factor. Drainage Systems also relate strongly to this factor, with a loading of 0.671. Treatment Socialization has the lowest loading in this factor at 0.510. The factor is supported by a Cronbach's Alpha of 0.541 and an Eigenvalue of 1.047.

Sanitation governance encompasses the regulatory and monitoring aspects that ensure the effective management of sanitation services. High factor loadings for regular monitoring underscore its perceived importance, suggesting that citizens recognize the need for continuous oversight to maintain sanitation standards. It aligns with the broader literature that emphasizes the role of governance in achieving sustainable sanitation outcomes, where regular monitoring is often correlated with improved service delivery and compliance with health standards (Kayser *et al.* 2013; Hutton and Chase 2016; Hollander *et al.* 2020). Operational Sanitation Practices relate to the day-to-day activities and behaviors that impact sanitation, such as defecation practices. The significant factor loadings here reflect the direct impact that individual behaviors have on public health and the environment. This factor is critical because it encapsulates the personal responsibility and habits that can either support or undermine sanitation efforts. Previous studies have highlighted the importance of improving operational sanitation practices to reduce disease transmission and promote public health (Goh *et al.* 2020; Ellwanger *et al.* 2021; Sojobi and Zayed 2022). Sanitation infrastructure and collaboration are characterized by the physical availability of sanitation facilities and the collective action within communities to manage and improve these facilities. The high percentage of variance explained by this factor suggests that citizens are acutely aware of the need for adequate infrastructure, which is supported by research demonstrating that access to sanitation facilities is a key determinant of sanitation-related

behaviors (Tumwebaze *et al*. 2013; Dreibelbis *et al*. 2015; Novotný *et al*. 2018). Moreover, collaboration emphasizes the social dimension of sanitation, where community involvement and cooperative efforts are critical for the sustainability of sanitation systems (Hollander *et al*. 2020).

The factor with the highest percentage of variance, sanitation infrastructure, and collaboration, indicates that citizens may view the presence of infrastructure as a foundational element that enables good sanitation practices. The emphasis on collaboration reflects an understanding that adequate sanitation is not solely the responsibility of individuals or governments but requires community engagement and partnership (Pugel *et al*. 2022). This recognition is pivotal, as studies have shown that community-led sanitation initiatives can improve health outcomes and community empowerment (Prabhakaran *et al*. 2016).

Table 2 shows a cluster analysis of citizen attitudes toward sanitation, examining three different factors and their association with two clusters: 'Adequate health standards citizen' and 'Public health risk areas'. Factor 1, Sanitation Governance, has a near-zero score for citizens in areas with adequate health standards and a slight negative score for those in public health risk areas, indicating a slight variance in attitude between the two clusters with an F value of 0.071 and a high significance level of 0.790, suggesting the difference is not statistically significant. Factor 2, Operational Sanitation Practices, shows a positive score in areas with adequate health standards and a more negative score in public health risk areas. The mean square for this factor is 9.266 and an F value of 9.464, which is statistically significant with a significance level of 0.002, indicating a meaningful difference in attitude between the two clusters for this factor. Finally, Factor 3, Sanitation Infrastructure and Collaboration, presents the most significant scores among the factors, with a substantially positive score for adequate health standards areas and a highly negative score for public health risk areas. The mean square for this factor is very high at 219.567, with a high F value of 493.119 and a significance level of 0.000. This indicates a significant difference in attitudes towards this factor between the two clusters, suggesting that attitudes toward sanitation infrastructure and collaboration are markedly different between citizens in areas with adequate health standards and those in public health risk areas.

The 'Adequate health standards citizens' cluster may symbolize a segment of the population with better access to sanitation facilities and services, positively influencing their attitudes and practices towards sanitation. In contrast, the 'Public health risk areas' cluster likely represents individuals in settings with less access to sanitation, possibly leading to worse or indifferent attitudes and practices due to the lack of infrastructure and resources. The significant attitudinal differences in operational sanitation practices and sanitation infrastructure and collaboration between these clusters highlight the impact of environmental and infrastructural factors on public perception and behavior. Those with adequate sanitation may exhibit more favorable attitudes due to the direct benefits they experience, such as improved health and well-being. At the same time, those in high-risk areas may feel disenfranchised or less empowered to engage in positive sanitation practices due to the lack of facilities and support.

TABLE 2. Cluster of Citizen Attitude Toward Sanitation

Factors	Cluster Adequate health standards citizen'	Public health risk areas	Mean Square	F	Sig.
Factor 1: Sanitation Governance	0.00779	-0.02307	0.071	0.071	0.790
Factor 2: Operational Sanitation Practices	0.08891	-0.26317	9.266	9.464	0.002
Factor 3: Sanitation Infrastructure and Collaboration	0.43280	-1.28110		493.119	0.000

TABLE 3. Segmentation of Each Cluster

Variables	Adequate health standards citizen'		Public health risk areas		Pearson Chi-Square	Asymptotic significance (2-sided)
Gender					1.535	0.215
Male	124	31.31%	49	12.37%		
Female	172	43.43%	51	12.88%		
Age						
20-29	83	20.96%	17	4.29%	8.241	0.083
30-39	124	31.31%	42	10.61%		
40-49	59	14.90%	23	5.81%		
50-59	24	6.06%	13	3.28%		
>60	6	1.52%	5	1.26%		
Education					4.704	0.319
Elementary School	17	4.29%	7	1.77%		
Junior High School	13	3.28%	8	2.02%		
High School	184	46.46%	66	16.67%		
Bachelor	69	17.42%	17	4.29%		
Master	13	3.28%	2	0.51%		
Occupancy						
Formal	94	23.74%	25	6.31%	4.704	0.319
Non-formal	202	51.01%	75	18.94%		
Income					9.632	0.022
< 5 million	197	49.75%	81	20.45%		
5 - 10 million	70	17.68%	17	4.29%		
10,1 - 15 million	25	6.31%	2	0.51%		
> 15 million	4	1.01%	0	0.00%		

Table 3 provides a demographic and socioeconomic profile of two distinct clusters: 'Adequate health standards citizen' and 'Public health risk areas'. It summarizes these populations by several variables: Gender, Age, Education, Occupancy, and Income. Additionally, it reports the results of a Pearson Chi-Square test to assess the statistical significance of the differences between the clusters for each variable. For gender, the 'Adequate health standards citizen' cluster comprises more females (43.43%) than males (31.31%), while the 'Public health risk areas' cluster has a relatively balanced gender distribution with a slightly lower percentage of females (12.88%) compared to males (12.37%). In terms of Age distribution, the 'Adequate health standards citizen' cluster has its largest group in the 30-39 range (31.31%), whereas the same age group is also the largest in the 'Public health risk areas' cluster (10.61%). The least represented age group in both clusters is those over 60, with only 1.52% in the 'Adequate health standards citizen' cluster and 1.26% in the 'Public health risk areas'.

Regarding education, the majority in the 'Adequate health standards citizen' cluster have a high school education (46.46%), which is also the highest proportion in the 'Public health risk areas' cluster (16.67%). The least represented educational attainment in both clusters is a master's degree, accounting for 3.28% in the 'Adequate health standards citizen' cluster and 0.51% in the 'Public health risk

TABLE 4. Logistic Model for Citizen Willingness to Participate in Community-Based Sanitation Programs

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Factor 1: Sanitation Governance	0.087	0.138	0.394	1	0.530	1.091
Factor 2: Operational Sanitation Practices	0.103	0.141	0.526	1	0.468	1.108
Factor 3: Sanitation Infrastructure and Collaboration	0.408	0.142	8.293	1	0.004	1.503
Gender (1=Female, otherwise=0)	-0.776	0.319	5.894	1	0.015	0.460
Age (1=younger than 29-year-old, otherwise=0)	-0.424	0.301	1.991	1	0.158	0.654
Education (1=bachelor's degree above, otherwise=0)	1.229	0.551	4.982	1	0.026	3.419
Occupation (1=formal worker, otherwise=0)	-0.328	0.489	0.450	1	0.502	0.720
Income (1=more than 5 million, otherwise=0)	0.106	0.508	0.043	1	0.835	1.112
Constant	2.213	0.328	45.603	1	0.000	9.146
-2 Log likelihood	315.916					
Cox & Snell R Square	0.076					
Nagelkerke R Square	0.129					
Overall percentage	85.60%					

areas'. Occupancy types are divided into Formal and Non-formal, with non-formal being more prevalent in both clusters (51.01% in 'Adequate health standards citizen' and 18.94% in 'Public health risk areas'). Income segmentation reveals that most individuals in the 'Adequate health standards citizen' cluster earn less than 5 million (49.75%). The same income bracket is the largest in the 'Public health risk areas' cluster (20.45%). Notably, no individuals earn more than 15 million in the 'Public health risk areas' cluster.

Further segmentation within each cluster, as detailed in Table 3, reveals how demographic and socioeconomic factors intersect with sanitation attitudes. The table shows that younger individuals, possibly more exposed to modern health and environmental discourses, and those with higher education levels are more willing to participate in sanitation initiatives. It could be attributed to more significant health awareness and knowledge about the benefits of sanitation, as well as a higher capacity to engage with and implement best practices (Hutton and Chase 2016; Dickin et al. 2021). Income emerges as a particularly significant factor, with the Chi-Square tests indicating a substantial economic divide in attitudes toward sanitation. Individuals with higher incomes are likely better positioned to invest in and maintain proper sanitation facilities, which can lead to more positive attitudes and behaviors regarding sanitation. This is consistent with literature suggesting that financial capacity can significantly influence one's ability to engage with sanitation services (Hollander et al. 2020; Schrecongost et al. 2020), where financial resources are a barrier to accessing sanitation infrastructure and can lead to adverse health outcomes. The relationship between socioeconomic status and sanitation attitudes may also reflect broader social inequalities. In areas where public health risks are prevalent, the lack of income can reinforce a cycle of poor sanitation practices due to the inability to afford necessary infrastructure or partake in community-led sanitation efforts.

Table 4 presents a logistic regression analysis that models the likelihood of citizens' willingness to participate in community-based sanitation programs. The analysis includes a variety of predictors, such as factors related to sanitation governance, practices, and infrastructure, along with demographic and socioeconomic variables. The model's constant, representing the log odds of willingness to participate when all other variables are zero, is 2.213 and highly significant (Sig. = 0.000). The model's fit to the data is measured by the -2 Log likelihood (315.916) and the pseudo-R-squared values: Cox & Snell (0.076) and Nagelkerke (0.129), indicating a moderate fit. Finally, the

overall percentage of 85.60% suggests that the model is quite effective at predicting whether a citizen is willing to participate in community-based sanitation programs based on the variables included.

The model includes three factors directly related to sanitation: Sanitation Governance, Operational Sanitation Practices, and Sanitation Infrastructure and Collaboration. The coefficients for these factors suggest the extent to which each is associated with the willingness to participate. Factor 1, Sanitation Governance, has a *low* positive coefficient of 0.087, but with a significance value of 0.530, it does not show a statistically significant effect on participation. Similarly, Factor 2, Operational Sanitation Practices, with a coefficient of 0.103 and a significance value of 0.468, also does not significantly impact according to the model. In contrast, Factor 3, Sanitation Infrastructure and Collaboration, has a larger positive coefficient of 0.408 and is statistically significant with a significance value of 0.004, indicating a strong positive influence on participation willingness.

The model also assesses the impact of demographic factors such as gender and age. Gender has been coded with females as 1 and males as 0, and the analysis reveals that being female is associated with a reduced likelihood of participation, as indicated by a negative coefficient of -0.776, which is statistically significant (Sig. = 0.015). Age is coded as 1 for those younger than 29 and 0 otherwise; here, the negative coefficient of -0.424 suggests a lower likelihood of participation among the younger age group, though this result is not statistically significant (Sig. = 0.158). Regarding socioeconomic factors, education is a significant variable. Individuals with at least a bachelor's degree (coded as 1) show a much higher likelihood of participation, with a coefficient of 1.229 and a significance value of 0.026. Occupation (coded as 1 for formal workers) and income (coded as 1 for those earning more than 5 million) do not appear to have a significant impact, with coefficients of -0.328 (Sig. = 0.502) and 0.106 (Sig. = 0.835) respectively.

A standout result is the positive coefficient associated with Sanitation Infrastructure and Collaboration, indicating a strong link between the quality of sanitation infrastructure, community collaborative efforts, and the likelihood of citizens participating in sanitation programs. This finding has far-reaching implications. Participation can be logistically challenging in communities where sanitation infrastructure is either poorly developed or non-existent. Without access to proper facilities, or if existing facilities are inadequate, efforts to encourage community involvement can be fundamentally undermined. It is consistent with research suggesting that investment in sanitation infrastructure can catalyze community engagement and public health improvements (Xinhui and Guoping 2021; Abramovsky *et al*. 2023). Furthermore, the collaboration component suggests that participatory approaches, where community members are actively involved in the planning and management of sanitation facilities (Willetts *et al*. 2020; Suryawan and Lee 2023), can enhance a sense of ownership and responsibility, leading to sustained use and maintenance of these facilities.

The regression analysis also reveals a negative coefficient for gender, suggesting that women are less likely than men to participate in sanitation programs. It is a significant finding, as it hints at underlying gender disparities that may affect participation rates. Cultural norms, social roles, and even the design of sanitation facilities themselves can create barriers that disproportionately affect women. For instance, the lack of gender-segregated facilities can deter women from using community sanitation resources due to privacy and safety concerns (Chaplin 2017). Additionally, women often bear the brunt of caregiving responsibilities, which can limit their availability to engage in community activities.

Education emerges as another significant predictor of participation. The positive coefficient for individuals with a bachelor's degree or higher suggests that educational attainment is correlated with increased willingness to participate in sanitation initiatives. Education likely equips individuals with a better understanding of the health implications of poor sanitation and the benefits of improved sanitation practices, thus

fostering a more proactive attitude toward participation. It also empowers individuals with the knowledge and skills required to contribute to community sanitation efforts effectively (Anderson *et al*. 2021; Dickin *et al*. 2021; Malolo *et al*. 2021). It underscores the need for educational interventions that raise awareness about the importance of sanitation and equip individuals with practical knowledge on maintaining hygiene standards and manage sanitation facilities.

Although not found to be a significant predictor in the logistic model, income level is, nonetheless, a vital factor to consider in the broader context of sanitation participation. The lack of significance in the model may be attributed to the complex ways income interacts with other socioeconomic and cultural factors. However, the literature suggests that lower-income individuals may face financial barriers that limit their access to sanitation facilities and resources, affecting their ability to participate in sanitation programs (Malima *et al*. 2022; Cavoli *et al*. 2023; Vicario *et al*. 2023). Hence, policies aimed at improving sanitation should consider economic incentives or support mechanisms that enable the participation of lower-income groups.

The logistic model's high predictive accuracy (85.60%) reinforces the importance of these variables as reliable indicators of willingness to participate in sanitation programs. This level of predictability provides a strong foundation for policymakers and public health officials to design and implement targeted interventions that address the specific needs and barriers identified by the model. By prioritizing infrastructure development, gender inclusivity, and educational outreach, sanitation programs can be tailored to effectively mobilize community participation and achieve sustainable improvements in public health (Pouramin *et al*. 2020; Assefa *et al*. 2021). The synthesis of findings from the EFA, cluster analysis, and logistic regression paints a complex picture of the dynamics influencing sanitation participation. It highlights the interplay between personal beliefs, community infrastructure, social norms, educational background, and economic conditions. Addressing the multifaceted nature of these dynamics is essential for successfully implementing community-based sanitation programs. The evidence calls for integrated strategies that not only build and maintain physical sanitation infrastructure but also foster community solidarity, empower women, and elevate the role of education as a tool for promoting public health and hygiene practices.

Conclusion

The conclusion of this research encapsulates the multifaceted nature of citizen participation in community-based sanitation programs, as revealed through Exploratory Factor Analysis (EFA), cluster analysis, and logistic regression modeling. The investigation has provided valuable insights into the factors influencing an individual's decision to engage in sanitation initiatives, illuminating the complexities of public health behaviors. The EFA has elucidated three critical factors: sanitation governance, operational sanitation practices, infrastructure, and collaboration, which underpin sanitation concerns. These factors represent the perceptual dimensions through which citizens evaluate and engage with sanitation issues. The importance of robust sanitation governance and effective operational practices has been underscored, highlighting the need for consistent and structured approaches to sanitation management.

Through cluster analysis, we have identified distinct groups within the population, categorized by their attitudes toward sanitation, termed 'Adequate health standards citizens' and 'Public health risk areas'. This segmentation is pivotal, as it reflects the disparity in sanitation attitudes and suggests that contextual factors such as location and access to infrastructure significantly shape public sentiment and behavior towards sanitation. As indicated by further analysis, the demographic and socioeconomic segmentation within these clusters, have revealed that factors such as age, education, and income play significant roles in shaping attitudes towards sanitation. Younger and more educated individuals have demonstrated a greater willingness to participate in sanitation initiatives, pointing to the potential of these demographics as catalysts for change and advocates for improved sanitation

practices. The logistic regression model has been instrumental in quantifying the impact of these factors on the willingness to participate. The significant positive influence of sanitation infrastructure and collaboration suggests that enhancing physical sanitation facilities and promoting collaborative community efforts will likely increase engagement. Conversely, the negative coefficient for gender indicates potential barriers to female participation, necessitating gender-sensitive approaches to program design and implementation.

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