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Original Article

Water, Sanitation, Hygiene (WASH) Interventions To Reduce Open Defecation Habit: A Structural Equation Modeling (SEM) Approach

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ABSTRACT

Background: Open defecation and other poor sanitation and hygienic practices create major public health problems in many developing nations. Improving community health and well-being depends on attending to these problems. Using partial least squares structural equation modeling (PLS-SEM), this study aims to investigate the links between Water, Sanitation, and Hygiene (WASH) parameters and open defecation behavior in riverbank villages.

Method: Environmental observations combined with structured questionnaires was used in a cross-sectional survey. Convenience sampling helped participants to be gathered; PLS-SEM data analysis was used to investigate the intricate connections between WASH factors and open defecation behavior.

Result: results show that there is no statistically significant relationship between open defecation practices and water (coefficient = -0.128, p = 0.355), sanitation (coefficient = -0.493, p = 0.861), income (coefficient = -0.030, p = 0.675), or education (coefficient = 0.067, p = 0.377). Furthermore, there is no significant link between open defecation practices and water (coefficient = -0.009, p = 0.911) and sanitation (coefficient = 0.058, p = 0.479) moderating effects of hygiene.

Conclusion: Effective reduction of open defecation hinges on comprehensive WASH interventions that combine improved sanitation infrastructure with hygiene promotion and community involvement. Prioritizing hygiene education and fostering community ownership are essential for sustainable public health improvements.

INTRODUCTION

Many developing countries have struggled with the problem of poor sanitation and hygiene standards, which has led to the explosion of waterborne diseases and negative consequences for public health. Particularly for communities living near riversides, Water, Sanitation and Hygiene (WASH) interventions significantly affect the welfare and health of those areas [1]. WASH measures significantly affect their welfare and health [2]. The problem of poor sanitation and hygiene standards, which has led to the explosion of waterborne diseases and negative consequences for public health. Particularly for people living near rivers, WASH interventions significantly affect the welfare and health of those areas [3]. Good health facilities and sanitation access help to greatly reduce open defecation behavior. This habit can help to reduce the prevalence of diseases caused by the surroundings [4]. Developing effective treatments and strategies to improve sanitation and hygiene habits in these communities depends on an understanding of the factors influencing the open defecation behavior [5]. Regarding access to clean water and suitable sanitation facilities, riparian communities can face a lot of challenges [6]. Lack of uncontaminated water sources and inadequate sanitation system could lead to the spread of waterborne diseases including typhoid fever, diarrhea, and cholera. Particularly for children and the elderly, these diseases seriously compromise the general well-being of the society. Furthermore common in many riverine towns is open defecation, which aggravates water source contamination and disease spread [7]. Previous studies have found several elements influencing open defecation behavior, including cultural views, poor access to sanitary facilities, and low knowledge of hygienic practices [8]. Open defecation is a deeply rooted habit in the behavioral and cultural standards of societies close to rivers. Limited access to sufficient sanitary facilities as well as conventional attitudes and ignorance have helped to sustain this habit [9]. Apart from health risks, open defecation has negative effects on the society and the surroundings [5]. Targeting these basic elements and supporting behavior changes will help WASH initiatives to bring about long-lasting gains in sanitation practices [10].

Still, understanding the complex interactions among the several components of the WASH system and the behavior of open defecation is lacking. Improving the health and welfare of populations living near rivers depends on WASH initiatives [6]. By means of clean water supplies, building of sanitation facilities, and encouragement of good hygienic behaviors, these interventions effectively lower the occurrence of waterborne diseases [11]. WASH programs also enable communities to take charge of their own health and well-being, therefore promoting higher production and economic growth [12]. Maintaining sufficient nutrition depends on the availability of hygienic, uncontaminated water since it is required for food preparation, consumption, and preserving personal cleanliness [13].

This study aims to close this information gap by means of a structural equation modeling technique to probe the complex interactions among the WASH framework's factors and the open defecation practice. Several excellent case studies offer strong proof of the major impact WASH programs have on river-side populations. Jambi, Indonesia, undertook a thorough Water, Sanitation, and Hygiene (WASH) program. Water treatment plants were built under this initiative, water distribution systems were installed, and community-led sanitation committees were established. As a result, waterborne infections dropped significantly, which generally improved the general state of the society [8]. Similar success stories from other riverfront towns around the globe show the effectiveness of targeted WASH treatments [14]. Water, Sanitation, and Hygiene (WASH) projects implemented in riverfront communities provide particular difficulties and constraints. Three major challenges are geographical restrictions, limited resources, and poor infrastructure [6]. Furthermore

impeding the acceptance and execution of improved sanitation techniques are cultural attitudes and a resistance to change [15].

Overcoming these obstacles calls for a whole approach involving government institutions, non-governmental groups, and strong community participation in order to cooperate among them. What relationship exists between the WASH framework's variables and open defecation occurrence? The aim of this study is to identify the elements causing open defecation and investigate the complex interactions among these elements and the variables inside the WASH paradigm. An original contribution to the field of WASH research is the PLS-SEM approach applied to investigate the complex interactions between WASH-related variables and the behavior of unclean feces disposal. There is a theory implying significant relationships between the WASH framework's factors and the open defecation behavior. Structural equation modeling is said to help one better understand these links.

METHOD

This study followed an analytical observation approach with a cross-sectional survey, therefore applying a research methodology. The approach followed environmental observation and a methodical questionnaire. The variables and their interactions inside the WASH domain were found by a methodical investigation, which also affected open defecation habit. Convenience sampling let participants be chosen from the suitable population with 100 respondent from riverside community in Muaro Jambi District, Indonesia. Inclusions criteria was Those who were 18 years of age or over, resided in the approved study area, and indicated they would be willing to participate formed the eligibility requirements. Exclusions criteria was those unable of giving informed permission, those with severe cognitive disabilities, or those too sick to participate were among the excluded groups. Skilled data collectors personally handed a well-organized questionnaire to be used for data collecting. Environmental observations also were conducted at the homes. Partial Least Squares Structural Equation Modeling (PLS-SEM) was applied in data analysis. The study got ethical approval and made sure every participant gave informed permission before the survey. This study stands out from previous studies by looking at the complex interactions between WASH-related variables and the behavior of unclean feces disposal using the PLS-SEM technique. The links between Water, Sanitation, and Hygiene (WASH) parameters and the behavior of incorrect feces disposal are investigated in this work using Partial Least Squares Structural Equation Modeling (PLS-SEM). Strong resilience, adaptability, and efficacy in both confirmatory and exploratory research define PLS-SEM as somewhat well-known. Its solutions, which give prediction and estimate top priority in order to expose causal links and predictive capacity, are well-known. Furthermore, PLS-SEM is recommended since it can effectively manage tiny sample sizes, so fitting for the study of complex models.

RESULT AND DISCUSSION

The survey findings indicated that the most prevalent age group among the respondents fell within the range of 38-47 years, with women comprising 64% of the participants. A considerable proportion of the participants exhibited low levels of education (72%) and incomes that fell below the minimum wage (66%). Diarrhea was the predominant illness over the last six months, impacting 55% of the participants. Furthermore, it was found that midwives were the healthcare providers most frequently visited, as indicated by 72% of the respondents who sought their services (as shown in Table 1).

Table 1. Respondent Characteristic

Variable	Category	Total	Percentage
Age	18-27	10	10 %
	28-37	15	15 %
	38-47	32	32 %
	48-57	25	25 %
	>58	18	18 %
Gender	Male	36	36%
	Female	64	64%
Higher education of family members	Low education	72	72%
	High education	28	28%
Income	Below minimum salary	66	66%
	Above minimum salary	44	44%
Diseases of the last 6 months	Acute Respiratory Infections	15	15%
	Dengue Hemmorage Fever	3	3%
	Malaria	1	1%
	Tuberculosis	3	3%
	Diarrhea	55	55%
	Thyfoid	2	2%
	Eksim	13	13%
	Other	29	29%
Health facilities visited	Community Health Center	28	28%
	Midwives	72	72%
	Private Health Clinics	10	10%
	Herbal	6	6%
	Other	4	4%

Source: Primer Data

The results of outer loadings for different variables in a structural equation modeling (SEM) analysis are shown in Table 2. The strength of the association between the latent variables (constructs) and the observed variables (indicators) is shown by outer loadings. "Higher education of family members" is the indicator for the Education variable, and it has a loading of 1.000, meaning that it perfectly represents the Education construct. The indicators "Monthly Income of Family" and "Open Defecation Habits" both have loadings of 1.000, and the same is true for the Income and Open Defecation Habits variables. With loadings ranging from 0.742 to 0.939, the indicators for the hygiene construct demonstrate significant to very strong connections. The indicators of the Water construct exhibit robust to extremely robust connections, with loadings varying between 0.780 and 0.928. With loadings ranging from 0.677 to 0.820, the indicators for the Sanitation construct, on the other hand, demonstrate adequate to significant correlations. Overall, these outside loadings imply that, within the parameters of this study, the indicators used are valid and trustworthy for measuring their respective constructs.

Table 2. Findings of Outer Loadings

Variable	Education	Hygiene	Water	Open Defecation Habits	Sanitation	Income
Education (Higher education of family members)	1.000					
Income (Monthly Income of Family)						1.000
Open Defecation Habits				1.000		
Hygiene						
H1 (Clean and Healthy Living Behavior)		0.920				
H2 (Smoking behavior)		0.866				
H4 (Garbage Disposal)		0.939				
H5 (Handwashing Habits)		0.742				
H6 (Self-cleaning habits)		0.865				
H7 (The habit of cleaning water reservoirs)		0.861				
Water						
W2 (Clean Water Access)			0.780			
W3 (Use of Drinking Water)			0.928			
W4 (Clean Water Storage)			0.918			
Sanitation						
S3 (Availability of Latrines)					0.677	
S4 (Latrine Condition)					0.677	
S8 (Septic Tank Conditions)					0.770	
S9 (Windows and Lighting)					0.820	

The results of the validity and reliability analyses utilizing Cronbach's Alpha, Rho_A, Composite Reliability (CR), and Average Variance Extracted (AVE) are shown in Table 3. All measures for the Education and Income constructs score 1.000, showing perfect measurement by their indicators. These constructs also show perfect internal consistency, reliability, and convergent validity. Rho_A and CR both rating 1.000, which show perfect reliability and composite reliability for the Open Defecation Habits design. With Cronbach's Alpha and Rho_A over 0.9, a CR of 0.948, and an AVE of 0.753, the Hygiene construct demonstrates good reliability and validity. This means that the construct accounts for more than 75% of the variance in the indicators. The Water construct has a Cronbach's Alpha of 0.860, Rho_A of 0.945, CR of 0.909, and AVE of 0.771, all of which indicate strong validity and reliability. The Sanitation construct demonstrates respectable validity and reliability, as evidenced by Cronbach's Alpha and Rho_A values of 0.725, 0.828, and 0.548, respectively.

Table 3. Findings of Validity and Reliability

Variable	Cronbach's Alpha	Rho_A	Compositer Reliability (CR)	Avarage Variance Extraced (AVE)
Education	1.000	1.000	1.000	1.000
Income	1.000	1.000	1.000	1.000
Open Defecation Habits		1.000		1.000
Hygiene	0.933	0.942	0.948	0.753
Water	0.860	0.945	0.909	0.771
Sanitation	0.725	0.725	0.828	0.548

The findings of a path analysis that looked at the connections between different variables and open defecation behaviors—with hygiene serving as a mediating variable—are shown in Table 4. The results show a strong inverse connection (coefficient = -0.536, p = 0.001) between open defecation behaviors and hygiene, suggesting that better hygiene is linked to less open defecation practices. greater water and sanitation facilities are linked to greater hygiene, as evidenced by the substantial positive relationships found between water access and hygiene (coefficient = 0.303, p = 0.007) and between sanitation and hygiene (coefficient = 0.487, p < 0.001).

On the other hand, there is no statistically significant relationship between open defecation practices and water (coefficient = -0.128, p = 0.355), sanitation (coefficient = -0.493, p = 0.861), income (coefficient = -0.030, p = 0.675), or education (coefficient = 0.067, p = 0.377). Furthermore, there is no significant link between open defecation practices and water (coefficient = -0.009, p = 0.911) and sanitation (coefficient = 0.058, p = 0.479) moderating effects of hygiene.

The analysis shows that improving cleanliness behaviors directly lowers the prevalence of open defecation. While increasing infrastructure for water and sanitation helps to enhance hygiene, these improvements alone will not significantly reduce open defecation rates unless hygiene is taken into account as a mediating element. The habits of open defecation are not significantly impacted by income or education.

Table 4. Path Coefficient Results

Variable	Sample Mean (M)	Standard Deviation (SD)	T Statistic	P Values
Hygiene → Open Defecation Habits	-0.536	0.156	3.463	0.001
Water → Open Defecation Habits	-0.128	0.144	0.926	0.355
Sanitation → Open Defecation Habits	-0.493	0.121	0.175	0.861
Income → Open Defecation Habits	-0.030	0.076	0.420	0.675
Education → Open Defecation Habits	0.067	0.074	0.892	0.377
Water → Hygiene	0.303	0.111	2.730	0.007
Sanitation → Hygiene	0.487	0.095	5.106	0.000
Moderating Water → Hygiene → Open Defecation Habits	-0.009	0.082	0.112	0.911
Moderating Sanitaiton → Hygiene → Open Defecation Habits	0.058	0.081	0.709	0.479

DISCUSSION

With cleanliness acting as a mediator, the route analysis results shown in Table 4 offer significant new perspectives on the elements affecting open defecation practices. The primary results show that better hygienic standards greatly lower open defecation practices. This is in line with earlier ideas and studies stressing the need of hygiene in advancing public health and discouraging unclean habits.

The outcomes of this research shed light on the intricate interactions among WASH-related factors and the habit of improper disposal of feces. Effective WASH programs depend mostly on encouraging behavior modification and community involvement. Challenges to ingrained cultural ideas and the encouragement of the acceptance of better sanitation methods depend mostly on awareness campaigns and

education. By means of community involvement, WASH initiatives become owned and sustainable when community members actively participate in the decision-making and execution procedures. Involving the community helps initiatives to be more successful and catered to the particular needs of riverfront regions areas.

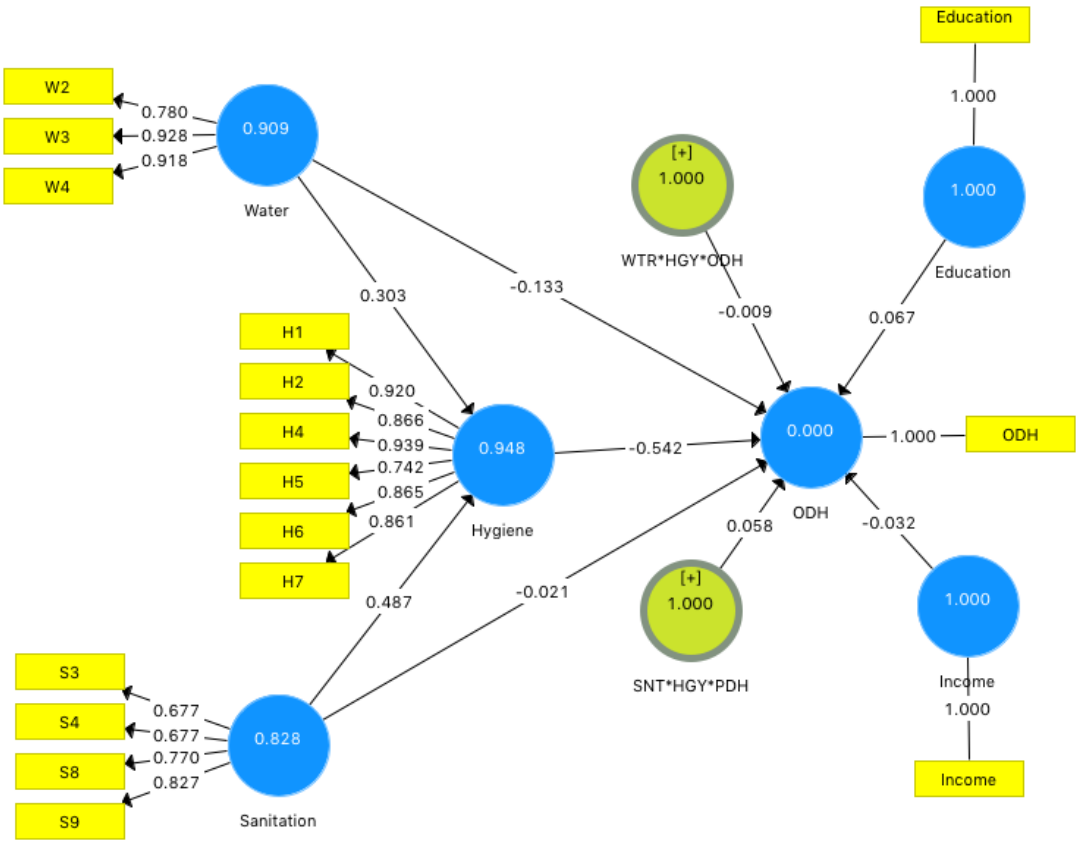

Figure 1. Final Model Diagram Path

Hygiene as a Key Factor

Programs aimed at increasing hygiene, like handwashing campaigns and the provision of clean sanitation facilities, can efficiently lower open defecation behaviors according to the substantial negative relationship between hygiene and open defecation practices (coefficient = -0.536, p = 0.001). This emphasizes the need of including sanitary infrastructure and hygienic education into policies meant to solve the open defecation issue.

A study shows the inverse link between open defecation behaviors and hygiene, which emphasizes the need of treatments meant to solve open defecation by means of enhancing hygiene practices [16]. This result fits the knowledge that insufficient sanitary facilities and poor hand hygiene help to spread diseases [17]. Furthermore, studies have revealed a clear link between inadequate waste disposal and diarrhea infections and the absence of effective hand washing facilities [18]. A study also underlines the significance of considering elements such poverty, degree of education, and rural residence as predictors of open defecation [19]. The negative coefficient emphasizes the need of funding sanitary facilities and hygiene education in order to address open defecation habits. Encouragement of handwashing with soap has been found in studies to greatly lower infection risk [20]. Furthermore, community-led initiatives have been successful in improving access to better sanitation facilities and lowering open

defecation rates [21] [22]. It is important to take social norms and community involvement under consideration while designing sanitation campaigns to effectively combat open defecation [23]. The negative correlation between open defecation practices and hygiene illustrates how well programs aimed at improving hygiene help to lower open defecation. Interventions targeting socioeconomic causes, inadequate sanitation facilities, and poor hand hygiene can help to significantly lower the prevalence of open defecation and enhance public health results..

Water and Sanitation Access

Better access to clean water and sanitation facilities helps to promote hygiene indicated by the strong positive correlations between water access and hygiene (coefficient = 0.302, p = 0.007) and between sanitation and hygiene (coefficient = 0.487, p < 0.001). On open defecation practices, however, the direct impacts of water access (coefficient = -0.128, p = 0.355) and sanitation (coefficient = -0.491, p = 0.861) are not statistically significant. This emphasizes that although water and sanitation facilities are crucial for hygiene, their direct influence on lowering open defecation practices could not be significant without changes in hygienic standards.

The beneficial relationships between sanitation and hygiene as well as between water access and hygiene highlight the critical part clean water and sanitation facilities play in encouraging appropriate hygiene practices [24]. These results line well with the knowledge that successful Water, Sanitation, and Hygiene (WaSH) initiatives depend critically on water quality and quantity, sanitation access, and hygienic practices [24]. Furthermore underlined by the need of hand hygiene as a fundamental component of infection control in hospital environments is the great relevance of hygiene in stopping disease spread [25]. While the direct effects of water supply and sanitation on open defecation practices were not statistically significannt [24], it is still vital to recognize that hygienic behaviors are absolutely vital in lowering the open defecation rates. Interventions targeted on hygiene education, handwashing, and sanitation infrastructure have shown to dramatically lower open defecation patterns [21], [22]. Moreover, the efficiency of sanitation and hygiene practices—hand washing and toilet access—has been demonstrated to enhance health outcomes and lower diarrhea rates [26]. By means of community-led projects, access to better sanitation facilities has been effectively enhanced and open defecation rates have been lowered [21]. These projects highlight the need of taking social conventions, community participation, and the supply of suitable sanitation facilities into account in order to handle open defecation habits [23]. Furthermore, the connection between better hygiene habits and closeness to water sources emphasizes the need of easy access to water in so fostering good hygiene practices [27]. In essence, even although water and sanitation facilities are crucial for maintaining cleanliness, their direct influence on lowering open defecation practices may be limited in absence of concomitant increases in hygiene standards. Thus, properly addressing open defecation and improving public health outcomes need thorough measures including hygiene education, sanitation infrastructure development, and community involvemen.

Influence of Income and Education

The result that income (coefficient = -0.030, p = 0.675) and education (coefficient = 0.067, p = 0.377) does not show any significant direct influence on open defecation practices begs issues regarding other maybe more important determinants. Although education and affluence are usually seen as factors influencing health behaviors, our findings imply that they might have more indirect or contextual influence on altering open defecation practices. For example, changes in social conventions or more access to resources and information could

affect income and education, therefore influencing these behaviors.

As advised by Hagger et al. (2020), the minimal direct impacts of money and education on open defecation habits point to the possibility that these elements may not directly influence such practices [28]. Rather, better wealth and education levels probably have more indirect effects by improving access to resources and information, therefore influencing behaviors linked to open defecation. Furthermore, these socioeconomic elements could influence open defecation habits by means of changes in social conventions inside different societies [29]. Research emphasizes the important part social conventions, community involvement, and access to upgraded sanitation facilities play in lowering open defecation rates [30], [31]. While social pressure and peer monitoring are acknowledged tactics for encouraging toilet usage, community-led sanitation projects have been successful in promoting latrine construction and deterring open defecation [21] (Orgill-Meyer et al., 2019).

Moreover, research show how strongly habits affect behavior and underline how much they determine activities like open defecation [32], [33]. Promoting sanitary practices and lowering open defecation rates depends on an awareness of the psychological elements and causes behind personal defecation habits, including social conventions and knowledge of health advantages[34]. Furthermore, poverty has been found to be a main determinant of open defecation practices, therefore highlighting the complicated interplay between socioeconomic level and hygienic practices [35]. All things considered, even if income and education might not directly affect open defecation practices, they most certainly play significant roles indirectly by improving access to resources, changing social conventions, and funding community-based sanitation initiatives. Dealing with open defecation calls for a comprehensive strategy including community involvement, social conventions, habit development, and access to sanitary facilities to support hygienic habits and hence enhance public health results.

Moderation by Hygiene

With open defecation practices, the moderation effects of hygiene on the relationships between water (coefficient = -0.009, p = 0.911) and sanitation (coefficient = 0.058, p = 0.479) are not significant, so indicating that hygiene does not greatly strengthen or weaken the direct effects of water and sanitation. This implies that even if cleanliness is crucial, policies aiming just on improving water and sanitation access without thorough attempts to improve hygiene behaviors could not be adequately successful.

Although cleanliness is still very important, the lack of notable moderation effects of hygiene on the links between water and sanitation and open defecation behaviors implies that it does not greatly strengthen or weaken the direct benefits of water and sanitation on open defecation practices. This result suggests that open defecation may not be adequately addressed by policies emphasizing only on increasing water and sanitation access without thorough attempts to improve hygiene practices [36].

Research emphasizes the important part knowledge, attitudes, and practices (KAP) connected to Water, Sanitation, and Hygiene (WASH) in determining waterborne disease frequency in communities. Insufficient WASH education can support unsanitary behaviors and attitudes, therefore causing water pollution and disease dissemination. Furthermore noted as a contributing cause to higher open defecation rates and unclean practices is the socioeconomic level of populations, therefore contaminating water supplies with bacterial diseases [37].

Success in enhancing sanitation and hygiene habits in many contexts has come from community-led total sanitation projects including Community-Led Total Sanitation (CLTS). Reduced open defecation, more

toilet coverage, and improved community hygiene are outcomes of these projects. Moreover, better hygiene practices—such as hand washing and access to sanitary facilities—clearly help to lower diarrhea rates and thereby enhance general health outcomes [22].

By encouraging handwashing with soap, safe water treatment and storage, solid waste management, and liquid waste management, sanitation improvement activities including CLTS tactics seek to establish open defecation-free communities. These all-encompassing strategies improve sanitation and hygiene standards and attack the underlying reasons of unclean behaviors [38].

Although cleanliness might not greatly change the direct effects of water and sanitation on open defecation practices, it is important to understand how closely these elements interact to improve public health. Dealing with open defecation calls for a whole strategy including water and sanitation projects together with hygienic promotion. Comprehensive methods can effectively reduce open defecation and improve hygiene habits in communities by addressing socioeconomic settings, encouraging community involvement, using behavior modification interventions, and guaranteeing access to suitable sanitation facilities [39].

CONCLUSION

Ultimately, the results highlight the important part hygiene plays in determining open defecation practices and serve as a major mediator between public health results, water, and sanitation. Effective reduction of open defecation practices has been demonstrated by better hygienic habits including handwashing and access to sanitary facilities. The study also emphasizes, though, that although access to water and sanitation is crucial for hygiene, their direct influence on lowering open defecation practices may be restricted in absence of concomitant changes in hygiene practices.

Furthermore underlined in the study is the need of thorough WASH treatments combining efforts to improve water and sanitation infrastructure with hygienic promotion. Successful in encouraging behavior change and raising community cleanliness standards, community-led projects including Community-Led Total Sanitation (CLTS) These initiatives challenge cultural standards and advance environmentally friendly sanitation methods by means of community involvement and education.

Dealing with open defecation going ahead calls for comprehensive strategies including socioeconomic issues, community involvement, and the supply of sufficient sanitary facilities. Comprehensive methods can efficiently reduce open defecation and enhance general public health outcomes by giving hygiene education top priority, sanitation infrastructure development, and encouragement of community ownership of WASH projects top importance.

REFERENCES

1. *Wandera EA, Muriithi B, Kathiiko C, Mutunga F, Wachira M, Mumo M, et al. Impact of integrated water, sanitation, hygiene, health and nutritional interventions on diarrhoea disease epidemiology and microbial quality of water in a resource-constrained setting in Kenya: A controlled intervention study. Tropical Medicine and International Health [Internet]. 2022;27(8):669–77. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85133076289&doi=10.1111%2Ftmi.13793&partnerID=40&md5=d1c3b9ee30417d311f046d4aa8bba463*
2. *Demartoto A, Zunariyah S, Pujihartati SH. The optimization of public toilet maintenance in Covid-19 pandemic era. In: AIP Conference Proceedings [Internet]. 2023. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-*

85160829557&doi=10.1063%2F5.0144912&partnerID=40&md5=807067667a14fb73a31a5d8741c0b074

3. *Adjibolosoo S V, Ofori BD, Adongo PB, Afranie S, Yirenya-Tawiah DR. The influence of culture on open defaecation in some basic schools in selected districts in Ghana: A preliminary study. PLoS One [Internet]. 2020;15(10 October). Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85092636238&doi=10.1371%2Fjournal.pone.0239491&partnerID=40&md5=2e0d323b8ff21f553d85c8c1a0fb48c2*
4. *Patil SR, Arnold BF, Salvatore AL, Briceno B, Ganguly S, Colford JM, et al. The effect of India's total sanitation campaign on defecation behaviors and child health in rural Madhya Pradesh: A cluster randomized controlled trial. PLoS Med [Internet]. 2015;11(8). Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84936086523&doi=10.1371%2Fjournal.pmed.1001709&partnerID=40&md5=a673d5cdc385cd5427f823e14d7c49b3*
5. *Herawati C, Abdurakhman RN, Neneng S. The Effect of Stop Open Defecation (BABS) Triggering Method on Open Defecation Behavior. In: Journal of Physics: Conference Series [Internet]. 2020. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85084183527&doi=10.1088%2F1742-6596%2F1477%2F6%2F062021&partnerID=40&md5=0ef56220eab989973a7fa4ff8a3c38d4*
6. *Gonçalves RM, Domingos IM. Riverside population in Amazonas and inequality in access to health. Revista de Estudos Constitucionais, Hermeneutica e Teoria do Direito [Internet]. 2019;11(1):99–108. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85071274774&doi=10.4013%2Frechtd.2019.111.06&partnerID=40&md5=c9a172992fb8f9af205c8e35eaf0d5b2*
7. *Salou Bachirou Z, Mignanwande ZF, Bokossa H, Degnonvi H, Djossou P, Hondjrebo F, et al. WASH and NTDs: Outcomes and lessons learned from the implementation of a formative research study in NTD skin co-endemic communities in Benin. Front Med (Lausanne) [Internet]. 2023;10. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85150185089&doi=10.3389%2Ffmed.2023.1022314&partnerID=40&md5=7e4a65ab9080947d22edfffe015956f8*
8. *Kurniatillah N, Hayat F, Masyruroh A. Factors related to open defecation behavior: A cross-sectional study in Serang City, Banten, Indonesia. Public Health of Indonesia [Internet]. 2023;9(2):57–65. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85167909600&doi=10.36685%2Fphi.v9i2.682&partnerID=40&md5=d016ec8ae6bf019deba25950d5ae2fc1*
9. *Elhanur AH, Ramadhani PN, Azizah R. THE ROLE OF SANITARIAN AND SOCIAL-CULTURAL FACTORS IN PROMOTING THE OPEN DEFECATION-FREE (ODF) VILLAGE. Jurnal Kesehatan Lingkungan [Internet]. 2021;13(1):17–23. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85175091159&doi=10.20473%2Fjkl.v13i1.2021.17-23&partnerID=40&md5=2c7282d879cdda27283128392fa271fe*
10. *Niedfeldt HJ, Beckstead E, Chahalis E, Jensen M, Reher B, Torres S, et al. Use of Technology to Access Health Information/Services and Subsequent Association With WASH (Water Access, Sanitation, and Hygiene) Knowledge and Behaviors Among Women With Children Under 2 Years of Age in Indonesia: Cross-sectional Study. JMIR Public Health Surveill. 2021 Jan;7(1):e19349.*
11. *Wolf J, Hubbard S, Brauer M, Ambelu A, Arnold BF, Bain R, et al. Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on risk of diarrhoeal disease in children in low-income and middle-income settings: a systematic review and meta-analysis. The Lancet [Internet]. 2022;400(10345):48–59. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85133293490&doi=10.1016%2FS0140-6736%2822%2900937-0&partnerID=40&md5=7e0e421f0a68ea3ec99243ab324b0e3d*
12. *Delea MG, Snyder JS, Belew M, Caruso BA, Garn J V, Sclar GD, et al. Design of a parallel cluster-randomized trial assessing the impact of a demand-side sanitation and hygiene intervention on sustained behavior change and mental well-being in rural and peri-urban Amhara, Ethiopia: Andilaye study protocol. BMC Public Health. 2019 Jun;19(1):801.*
13. *Humphrey JH, Mbuya MNN, Ntozini R, Moulton LH, Stoltzfus RJ, Tavengwa N V, et al. Independent and combined effects of improved water, sanitation, and hygiene, and improved*

complementary feeding, on child stunting and anaemia in rural Zimbabwe: a cluster-randomised trial. Lancet Glob Health [Internet]. 2019;7(1):e132–47. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85058717792&doi=10.1016%2FS2214-109X%2818%2930374-7&partnerID=40&md5=0f441da4f0cfb030bea222a61b6149ed

14. *Majid Sadeghi K, Tam W, Kharaghani S, Loáiciga H. Green Stormwater Infrastructure (GSI) Hydrologic Modeling: Albion Riverside Park Project in Los Angeles, California. In: World Environmental and Water Resources Congress 2020: Water, Wastewater, and Stormwater and Water Desalination and Reuse - Selected Papers from the Proceedings of the World Environmental and Water Resources Congress 2020 [Internet]. 2020. p. 258–71. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85085565494&doi=10.1061%2F9780784482988.025&partnerID=40&md5=1f8302362efc46c18db62102e9426a7c*
15. *Chandra F, Restila R, Restuastuti T. Defecation Behavior in Elementary School Age Children Who Live Along the Kampar River Riau Province. Jurnal Kesehatan Lingkungan [Internet]. 2020;12(2):87–96. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85175069825&doi=10.20473%2Fjkl.v12i2.2020.87-96&partnerID=40&md5=30c2ce220c903c58c686ae4be061aae3*
16. *Tegen D, Damtie D, Hailegebriel T. Prevalence and Associated Risk Factors of Human Intestinal Protozoan Parasitic Infections in Ethiopia: A Systematic Review and Meta-Analysis. J Parasitol Res. 2020;2020:1–15. doi: https://doi.org/10.1155/2020/8884064*
17. *Sun S, Han J. Open Defecation and Squat Toilets, an Overlooked Risk of Fecal Transmission of COVID-19 and Other Pathogens in Developing Communities. Environ Chem Lett. 2020;19(2):787–95. doi: https://doi.org/10.1007/s10311-020-01143-1*
18. *Tafere Y, Abate BA, Enyew HD, Mekonnen AB. Diarrheal Diseases in Under-Five Children and Associated Factors Among Farta District Rural Community, Amhara Regional State, North Central Ethiopia: A Comparative Cross-Sectional Study. J Environ Public Health. 2020;2020:1–7. https://doi.org/10.1155/2020/6027079*
19. *Njuguna J. Progress in Sanitation Among Poor Households in Kenya: Evidence From Demographic and Health Surveys. BMC Public Health. 2019;19(1). https://doi.org/10.1186/s12889-019-6459-0*
20. *Dessie A, Gebrehiwot TG, Kiros B, Wami SD, Chercos DH. Intestinal Parasitic Infections and Determinant Factors Among School-Age Children in Ethiopia: A Cross-Sectional Study. BMC Res Notes. 2019;12(1). https://doi.org/10.1186/s13104-019-4759-1*
21. *Orgill-Meyer J, Pattanayak SK, Chindarkar N, Dickinson KL, Panda U, Rai S, et al. Long-Term Impact of a Community-Led Sanitation Campaign in India, 2005–2016. Bull World Health Organ. 2019;97(8):523-533A. https://doi.org/10.2471/BLT.18.221572*
22. *Yeboah-Antwi K, MacLeod WB, Biemba G, Sijenyi P, Höhne A, Verstraete L, et al. Improving Sanitation and Hygiene Through Community-Led Total Sanitation: The Zambian Experience. American Journal of Tropical Medicine and Hygiene. 2019;100(4):1005–12. https://doi.org/10.4269/ajtmh.18-0632*
23. *Harter M, Contzen N, Inauen J. The Role of Social Identification for Achieving an Open-Defecation Free Environment: A Cluster-Randomized, Controlled Trial of Community-Led Total Sanitation in Ghana. J Environ Psychol. 2019;66:101360. https://doi.org/10.1016/j.jenvp.2019.101360*
24. *Ross AG, Rahman M, Alam M, Zaman K, Qadri F. Can We 'WaSH' Infectious Diseases Out of Slums? International Journal of Infectious Diseases. 2020;92:130–2. https://doi.org/10.1016/j.ijid.2020.01.014*
25. *Roshan R, Feroz AS, Rafique Z, Virani N. Rigorous Hand Hygiene Practices Among Health Care Workers Reduce Hospital-Associated Infections During the COVID-19 Pandemic. J Prim Care Community Health. 2020;11:215013272094333. https://doi.org/10.1177/2150132720943331*
26. *Mshida HA, Malima G, Machunda RL, Muzuka ANN, Banzi J, Gautam OP, et al. Sanitation and Hygiene Practices in Small Towns in Tanzania: The Case of Babati District, Manyara Region. American Journal of Tropical Medicine and Hygiene. 2020;103(4):1726–34. https://doi.org/10.4269/ajtmh.19-0551*
27. *Torres-Slimming PA, Wright C, Cárcamo C, García PJ, Harper SL. Achieving the Sustainable Development Goals: A Mixed Methods Study of Health-Related Water, Sanitation, and Hygiene (WASH) for Indigenous Shawi in the Peruvian Amazon. Int J Environ Res Public Health. 2019;16(13):2429. https://doi.org/10.3390/ijerph16132429*

28. *Hagger MS, Smith SR, Keech JJ, Moyers SA, Hamilton K. Predicting Social Distancing Intention and Behavior During the COVID-19 Pandemic: An Integrated Social Cognition Model. Annals of Behavioral Medicine. 2020;54(10):713–27. https://doi.org/10.1093/abm/kaaa073*
29. *Gauri V, Rahman T, Sen I. Shifting Social Norms to Reduce Open Defecation in Rural India. Behavioural Public Policy. 2020;7(2):266–90. File URL: https://www.cambridge.org/core/product/identifier/S2398063X20000469/type/journal_article*
30. *Osumanu IK, Kosoe EA, Ategeeng FN. Determinants of Open Defecation in the Wa Municipality of Ghana: Empirical Findings Highlighting Sociocultural and Economic Dynamics Among Households. J Environ Public Health. 2019;2019:1–10. https://doi.org/10.1155/2019/3075840*
31. *Truelove Y, O'Reilly K. Making India's Cleanest City: Sanitation, Intersectionality, and Infrastructural Violence. Environ Plan E Nat Space. 2020;4(3):718–35. https://doi.org/10.1177/2514848620941521*
32. *Badawy SM, Shah RB, Beg U, Heneghan M. Habit Strength, Medication Adherence, and Habit-Based Mobile Health Interventions Across Chronic Medical Conditions: Systematic Review. J Med Internet Res. 2020;22(4):e17883. https://doi.org/10.2196/17883*
33. *Moksness L, Olsen SO, Tuu HH. Exploring the Effects of Habit Strength on Scholarly Publishing. Journal of Documentation. 2020;76(6):1393–411. https://doi.org/10.1108/JD-11-2019-0220*
34. *Lopez VK, Berrocal VJ, Angulo BC, Ram PK, Trostle J, Eisenberg JNS. Determinants of Latrine Use Behavior: The Psychosocial Proxies of Individual-Level Defecation Practices in Rural Coastal Ecuador. American Journal of Tropical Medicine and Hygiene. 2019;100(3):733–41. https://doi.org/10.4269/ajtmh.18-0144*
35. *Busienei PJ, Ogendi GM, Mokua MA. Open Defecation Practices in Lodwar, Kenya: A Mixed-Methods Research. Environ Health Insights. 2019;13:117863021982837. https://doi.org/10.1177/1178630219828370*
36. *Kuang J, Ashraf S, Shpenev A, Delea MG, Das U, Bicchieri C. Women Are More Likely to Expect Social Sanctions for Open Defecation: Evidence From Tamil Nadu India. PLoS One. 2020;15(10):e0240477. https://doi.org/10.1371/journal.pone.0240477*
37. *Alemu F, Kumie A, Medhin G, Gebre T, Godfrey P. A socio-ecological analysis of barriers to the adoption, sustainablity and consistent use of sanitation facilities in rural Ethiopia. BMC Public Health [Internet]. 2017;17(1). Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85029367040&doi=10.1186%2Fs12889-017-4717-6&partnerID=40&md5=ce00ee9240aaea2af6898baec828003c*
38. *Headey D, Palloni G. Water, Sanitation, and Child Health: Evidence From Subnational Panel Data in 59 Countries. Demography [Internet]. 2019;56(2):729–52. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85062600032&doi=10.1007%2Fs13524-019-00760-y&partnerID=40&md5=7a040d815bd03e307852acb08c892c19*
39. *Nique MR, Smertnik H. The role of mobile in delivering sanitation services. In: Broken Pumps and Promises: Incentivizing Impact in Environmental Health [Internet]. 2016. p. 179–94. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.084978215465&doi=10.1007%2F978-3-319-28643-3_12&partnerID=40&md5=04f54d02c6630d62078f019a3efffadf*