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Cross-Cultural Adaptation and Validation of RANAS-Based Instrument for Measuring Latrine Use Behavior in Indonesia

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Abstract

Using toilets is a simple way to prevent diarrhea, yet no validated tool exists to measure this habit. This study aimed to develop and validate instruments for measuring latrine use consistency. This questionnaire was adapted from the risk, attitude, norm, ability, and self-regulation (RANAS) framework developed in India and modified for Indonesia. It was evaluated by three experts using the content validity index (CVI). The face validity index (FVI) was pilot-tested on 40 community respondents. Variables measured included behavior, habits, intentions to use toilets, knowledge, attitudes, norms, abilities, and self-regulation. Question items with relevance and clarity scores of item CVI above 0.80 were considered valid and appropriate. Item scoring 0.70–0.79 required revisions, while scores below 0.70 led to deletion. The relevance and clarity assessment results for behavioral, intention, knowledge, norm, and attitude to use toilet questions yielded a scale CVI of more than 0.80, indicating that all items were valid and reliable. However, the habits, abilities, and self-regulation variables had varying I-CVI scores, indicating a need to revise or remove certain items. A culturally adapted and validated RANAS-based instrument is reliable for measuring latrine use behavior in Indonesia.

Keywords: behavior, Content Validity, Face Validity, Instrument Development, latrine use

Introduction

Using toilets can reduce the incidence of diarrhea by protecting people from exposure to feces (excrement). It is estimated that using latrines is part of sanitation behavior and contributes to 31% of diarrheal diseases.[1] Several studies have shown that the use and access to toilet ownership significantly influence the incidence of diarrhea.[2,3] Poor sanitation practices also contribute to the incidence of cholera, worm infections, anemia, malnutrition, and long-term cognitive decline.[4–6] Improving access to better sanitation reduces diarrheal disease by 24.5% among children under the age of five.[7] Sanitation interventions can reduce diarrhea by around 15 to 26% across all age groups, with sanitation access interventions reducing diarrhea by 11 to 21% and behavior change interventions without infrastructure provision reducing diarrhea by 15 to 18%.[8]

In the sanitation ladder, toilet use behavior is associated with the existence of sanitation access: not having a toilet or open defecation (OD) behavior, having a toilet but not having a gooseneck and septic tank (unimproved), having a shared toilet with other households (improved) and having private toilet facilities (improved).[9] Several studies have also shown a correlation between ownership factors or access to toilets and their influence on toilet usage behavior.[10–12] Social norms also play a crucial role in predicting toilet use, as toilet access does not always guarantee utilization.[13] Social norms related to open defecation are still accepted in rural communities, thus hampering toilet use interventions, including efforts to increase toilet ownership that have been carried out so far.[14] Consequently, interventions involving social dynamics to change social norms are more sensitive than interventions prioritizing development or sanitation access.[15] Social norms (culture) and environmental and economic factors are also the causes of many Indonesians practicing open defecation.[16] Knowledge factors, attitudes, habits, availability of land and toilets, and social roles also contribute to open defecation in Indonesia.[17]

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Accurate measurement in identifying behavioral factors of toilet use can control open defecation levels; this measurement is better done at the individual than at the household level.[18] Accurate measurement standards to identify the causal factors of open defecation can encourage the design of appropriate interventions to reduce open defecation rates.[19] The instrument in this study was developed by adapting the questionnaire and framework from risk, attitude, norm, ability, and self-regulation (RANAS).[20–22] The RANAS questionnaire was used because it provides a comprehensive and easily adaptable framework for identifying and measuring psychosocial determinants of sanitation behavior. Based on various studies, the RANAS framework has also proven successful in encouraging changes in open defecation behavior.[20–22] Given that the adaptation of measurement instruments requires careful consideration of linguistic and cultural contexts, this study aimed to conduct cross-cultural adaptation and validate the RANAS-based instrument for measuring latrine use behavior in Indonesia.

Method

The RANAS questionnaire was previously used in India and was adjusted to the local Indonesian context and customs.[20] The RANAS questionnaire is usually used to evaluate interventions promoting toilet use behavior.[20,23] The instrument in this study was adapted from research conducted by the RANAS team with variables contained, including measurement of toilet use behavior, habits, intention to use a toilet, risk factors (knowledge of diarrhea, risk of vulnerability, and severity), norms, abilities to use a toilet, and self-regulation. RANAS was developed through collaboration between the Swiss Federal Institute of Aquatic Science and Technology (EAWAG) and the Federal Institute of Technology Zurich. This partnership has established itself as a leader in behavioral change research over the past two decades. This study adapted and adjusted the scale to Indonesia's local context. In developing this instrument, various stages were conducted, e.g., the English-Indonesian translation process to the content validity test using the Content Validity Index (CVI) format. This instrument was adapted from the RANAS questionnaire, and the stages are outlined in Figure 1.

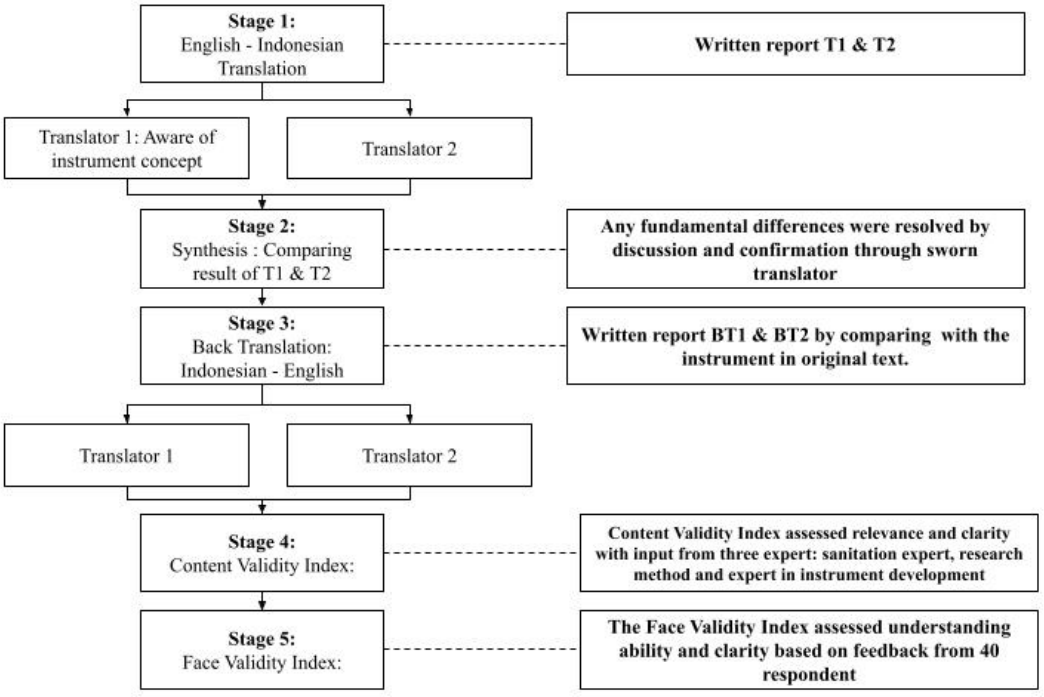

Figure 1. Stages of Cross-Cultural Adaptation and Validation Process

Notes: T1: First forward translation by a translator aware of the research concept; T2: Second forward translation by a translator without prior research knowledge; BT1 and BT2: Back translations by two independent translators who translated the synthesized Indonesian version into English.

As illustrated in Figure 1, the instrument adaptation process consisted of five stages. The first stage involved translating from English to Indonesian language by two in-house translators from a professional translation service agency. Both translators were bilingual professionals, with Indonesian as their native language, but they had different backgrounds regarding the research subject. One translator was informed about the study's purpose and latrine use concepts, while the other was not, allowing for both technical accuracy and natural language flow in the translation. In the second stage (synthesis), two independent translations were compared to the original text. This comparison ensured contextual appropriateness and terminology consistency. Any translation discrepancies were resolved through research team discussions and verified by a certified sworn translator.

The third stage involved back-translation, wherein the Indonesian version was translated back into English. This back-translated version was compared with the original English text to identify any significant discrepancies resolved through research team discussions. The fourth stage focused on content validation using the CVI to evaluate relevance and clarity. Three experts were selected based on their academic qualifications and institutional recognition: a sanitation expert, a research methodology expert, and an instrument development expert.

Content validity assessment is essential for ensuring the quality of adapted questionnaires, with the CVI providing a systematic approach to this evaluation.[24] This structured analysis method allowed experts to provide feedback for instrument refinement. Following recommendations from a previous study suggesting using between 3-10 experts,[25] three experts (one expert in epidemiology, one in sanitation, and one in instrument development) were selected for the CVI assessment. Each expert received the questionnaire via institutional email, along with a structured validation format that included the study's purpose, definitions of behavioral domains, and detailed instructions for completing the CVI assessment.[26]

The authors provided information on the synthesis results and back translation reports to be considered in the assessment and sent the CVI form. The final stage was the Face Validity Index (FVI), which assessed the ability to understand and clarify each question item with 40 respondents from the community. These respondents were selected based on specific characteristics that matched the target population: lived in areas where open defecation was still practiced, had limited or no access to proper sanitation facilities, and belonged to rural communities. Forty respondents were selected for the FVI pilot testing in Air Bakoman Village, Tanggamus District, Lampung Province, Indonesia, where open defecation practices remain prevalent. To ensure systematic sampling, respondents were chosen using an interval sampling method, starting from the house of the neighborhood head and then skipping one house before and after each selection within the neighborhood unit. Pilot testing was conducted in July 2024.

This instrument was adapted from previous research. Its variables included measurement of toilet use behavior, habits, intention to use a toilet, risk factors (knowledge of diarrhea, risk of vulnerability, and severity), norms, abilities to use a toilet, and self-regulation.[23] The behavior of using a toilet had 6 question items from RANAS that measured when and where they last defecated, including handling the feces of toddlers aged 0-5 years. The assessment score for this variable was 0, indicating that the respondent did not use a toilet; otherwise, it was 1 if the respondent used a toilet. The habit variable had 6 question items, with 3 in the context of open defecation habits and 3 in the context of toilet use habits.

This instrument also measured the intention to use a toilet with 3 question items. The risk factor variable was divided into 10 question items that measured the respondent's knowledge level about diarrhea, 3 question items that measured the respondent's perception of susceptibility to diarrhea, and 3 statement items that measured the risk of severity if exposed to diarrhea. The attitude variable had 17 question items that measured attitudes toward toilet use and defecating in the open. The norm variable comprised several sub-sections, such as 4 question items regarding other people's behavioral norms, 3 questions regarding personal interest norms, and 3 questions regarding other people's approval norms. The ability variable included 10 question items about processing the ability to use toilets adjusted to conditions in Indonesia and 7 question items about the ability to continue using toilets. Self-regulation variables consisted of 1 action plan question item, 3 action control question items, 3 question items on how to overcome problems using the toilet, 3 question items on remembering to use the toilet, and 3 question items on commitment to using the toilet. An overview of the variables and their assessment scales is presented in Table 1.

Table 1. Overview of Variables and Their Assessment Scales

Variable	Components	Number of Items	Scale Description
Behavior	Toilet Use	6	Binary (0 = non-use, 1 = use)
Habits	Open Defecation Habits	3	4-point scale
	Toilet Use Habits	3	4-point scale
Intention	Toilet Use Intention	3	4-point scale
Risk Factors	Knowledge about Diarrhea	10	4-point scale
	Perceived Susceptibility	3	4-point scale
	Perceived Severity	3	4-point scale
Attitude	Toilet Use and Open Defecation	17	4-point scale
Norms	Others' Behavioral Norms	4	4-point scale
	Personal Interest Norms	3	4-point scale
	Others' Approval Norms	3	4-point scale
Ability	Toilet Use Capability	10	4-point scale
	Continued Use Ability	7	4-point scale
Self-regulation	Action Planning	1	4-point scale
	Action Control	3	4-point scale
	Problem-Solving	3	4-point scale
	Memory Aids	3	4-point scale
	Commitment	3	4-point scale

These variables were assessed using the CVI format, and the CVI item-level value was calculated for each question and the overall scale of the variable level (S-CVI).[26] Each question item was evaluated for both relevance and clarity using a 4-point rating scale. In the CVI assessment, three experts independently rated each item with scores ranging from 1 to 4. For relevance, a score of 1 indicated "not relevant," while 4 indicated "very relevant." Similarly, for clarity, scores ranged from 1 (unclear) to 4 (very clear), with intermediate scores of 2 indicating "major revision" and 3 indicating "minor revision."

The item-content validity index (I-CVI) calculation process involved converting these ratings into binary scores, where ratings of 1 and 2 were converted to 0 (indicating disagreement), and ratings of 3 and 4 were converted to 1 (indicating agreement). The I-CVI for each item was calculated by dividing the number of experts who agreed (ratings of 3 or 4) by the total number of experts. For instance, if two out of three experts rated an item as either 3 or 4, the I-CVI was calculated as $2/3 = 0.67$. The S-CVI was then determined by calculating the average of all the I-CVI values across the questionnaire items.

For the FVI, the same 4-point scale structure was maintained, but "relevance" was replaced with "understanding." In this case, a score of 1 indicated that the item was "very difficult to understand," while a score of 4 indicated it was "very easy to understand." The calculation method mirrored that of CVI, maintaining consistency in the validation process. These calculations are illustrated in Table 2, which provides concrete examples of how both I-CVI and S-CVI values were determined.

Table 2. Assessment Scales for Content Validity Index and Face Validity Index

Assessment Type	Dimension	Scale	Rating Description
Content Validity Index	Relevance	1	Not relevant
		2	Somewhat relevant
		3	Quiet relevant
		4	Very relevant
	Clarity	1	Unclear
		2	Major revision
		3	Minor revision
		4	Very clear
Face Validity Index	Understanding	1	Very difficult to understand
		2	Difficult to understand
		3	Easy to understand
		4	Very easy to understand

The calculation for each question item indicated the relevance value and category for each question item. Referring to previous literature, which showed that the relevance value and CVI are in the appropriate category if the value is above 0.80; however, if it is in the range of 0.70–0.79, then the question item needs to be revised, and if it is below 0.70, both in relevance and clarity then the question item is removed.[27]

Results

The results of the CVI and FVI for the behavioral variables are described in Table 3. The Table results showed that all question items achieved perfect CVI (1) and nearly perfect FVI (0.99) scores, indicating high agreement among experts on the relevance and clarity of the items, as well as solid understanding and clarity of the 40 respondents. The assessment of toilet use consistency is seen from the suitability of the answers from E2, E3, and E4. This questionnaire also examined the consistency of toilet use for children with the question items in E5. The CVI and FVI results indicated that the instrument is suitable for assessing the consistency of toilet use, which can help understand sanitation behavior across the population.

Table 3. Consistency Latrine Use: CVI and FVI

Consistency Latrine Use	CVI (3 expert)		FVI (40 respondents)		Decision
	Relevance	Clarity	Understanding	Clarity	
E1. When was the last time you defecated?	1	1	1	1	Appropriate
E2. The last time you defecated, did you defecate in an open space (open defecation) or latrine?	1	1	0.97	0.97	Appropriate
E3. In the last five days, how often did you use the latrine to defecate?	1	1	1	1	Appropriate
E4. During the last five days, how often did you defecate indiscriminately (OD)?	1	1	1	1	Appropriate
E5. For children (children under the age of five): The last time (child's name) defecated, where did (child's name) defecate?	1	1	1	1	Appropriate
E.5.1. If a child defecates in a place other than the latrine, what should be done to dispose of the feces?	1	1	1	1	Appropriate
S-CVI/FVI	1	1	0.99	0.99	Appropriate

The results of CVI and FVI for the variable forming behavior are depicted in Table 4. Table 4 shows the CVI and FVI scores for the behavioral factor variables assessed by three experts and 40 community respondents. Overall, most variables scored high on relevance, clarity, and understanding. Only six items were revised during the CVI stage. For each variable, relevance and clarity were measured at the CVI stage, and understanding and decision-making were measured at the FVI stage. For the habit variable, which included six question items, two items were revised based on CVI feedback. Intention and risk (subdivided into knowledge, vulnerability, and severability) variables scored high in both the CVI and FVI assessments, so no revisions were made.

For the attitude variable, all 16 items were deemed appropriate, with no revisions needed. The norms variable, which was subdivided into others' behavior, personal interest, and other's approval, also scored well, so no changes were made. One item in the ability variable was revised as it scored slightly lower at the CVI stage. Finally, the self-regulation variable, which was subcategorized into action planning, action control, problem-solving, remembering, and commitment, required revision for three items based on CVI feedback, particularly in the action control and commitment categories.

The revised question item is presented in Table 5. Since 4 question items have values below 0.90, both in the relevance and clarity categories, revisions have been made. In addition to the 4 question items to be revised based on recommendations from experts, the authors also revised the sentence in the practical knowledge ability subcategory by adding the word "I am able."

Table 4. CVI and FVI Scores of Behavioral Factor Variables

Variable	S-CVI (3 experts)		S-FVI (40 respondents)		Decision	Detailed Information
	Relevance	Clarity	Understanding	Clarity		
Habit: 6 question items	1	0.83	0.95	0.95	Appropriate	2 question items were revised during the CVI stages
Intention : 3 question items	1	1	0.98	0.99	Appropriate	no revised items
Risk:	**1**	**0.99**	**0.98**	**0.98**	Appropriate	no revised items
• knowledge (10 question items)	1	0.97	0.96	0.96		
• vulnerability (3 question items)						
• severability (3 question items)	1	1	0.97	0.97		
	1	1	1	1		
Attitude: 16 items question	1	1	0.98	0.98	Appropriate	no revised items
Norm:	**1**	**0.97**	**0.96**	**0.96**	Appropriate	no revised items
• other's behavior (4 question items)	1	0.91	0.93	0.92		
• personal interest (3 question items)						
• other's approval (3 question items)	1	1	1	1		
	1	1	0.96	0.97		
Ability:	**0.98**	**1**	**0.96**	**0.96**	Appropriate	1 question item was revised in the CVI stages
• practical knowledge (10 question items)	0.96	1	0.94	0.95		
• continuation of using the latrine	1	1	0.98	0.97		
Self-Regulation:	**0.97**	**0.89**	**1**	**1**	Appropriate	3 question items were revised in the CVI stages
• action planning (1 question item)	1	0.67	1	1		
• action control (3 question items)						
• problem-solving (3 question items)	1	0.89	1	1		
• remembering (3 question items)						
• commitment (3 question items)	1	1	1	1		
	0.89	0.89	1	1		
	1	1	1	1		

Table 5. List of Question Items That Need to be Revised

Questions Before Revision	Questions After Revision
F1. How automatically do you go for open defecation?	How spontaneous/automatic do you do open defecation? Such as in rivers/streams/gardens/seasides/using flying plastic
F2. How much effort do you have to make to remember to defecate in the open?	How much effort do you need to make to remember to practice open defecation? For example, in rivers, streams, gardens, or by the seaside.
O8. After 1 year of decomposing, the content of the pit can be used as fertilizer	I am able to process the contents of the septic tank after one year of decomposition to be used as fertilizer.
Q1. How do you get ready to use the latrine for defecation?	How do you prepare to use the toilet for defecation?*
R1. How much attention do you pay to yourself when using the latrine to defecate?	According to your observations, how often do you use the toilet for defecation?
T2. In the last five days, have you planned to use the latrine but then forgot?	In the past five days, have you ever planned to use the toilet for defecation but then forgot to do so?

*) The authors added an explanation about the response options ranging from "not ready" to "ready" in this survey item.

Discussion

The CVI and FVI were essential steps in evaluating the quality of an instrument because assessing how well the items represented the measured construct involved expert and respondent judgments about the clarity, relevance, and appropriateness of the language in the Indonesian context. All question items to measure the consistency of toilet use in CVI and FVI measurements showed almost perfect results, illustrating high expert agreement on the relevance and clarity of each question item as well as good respondent understanding, making the question items in this instrument suitable for describing the consistency of toilet use in all age groups. In this section, no revisions were made to the question items.

Consistent toilet use was usually measured by describing the frequency of toilet use during the past week, which was assessed by respondents's answers of "every day," "most days," "several days," and "never" in the toilet. Respondents who answered every day using the toilet were categorized as consistent, and the rest as inconsistent. The format of this question was similar to the questionnaire developed in a consistent study of latrine use in Ethiopia.[28] The results of the CVI and FVI tests for behavioral factors that form the consistency of toilet use showed good score indices for all behavioral variables measured, including habit, intention, risk, attitude, norm, ability, and self-regulation. Six question items need to be revised in the CVI phase: two for habit, one for attitude, and three for self-regulation question items.

A habit is defined as a routine that is performed repeatedly.[29] Sanitation habits in this instrument were assessed by evaluating open defecation practices and latrine use. This comprehensive approach was chosen to capture a complete picture of latrine habits and propensity to practice open defecation. By measuring both aspects, this study aimed to provide a more accurate understanding of how often and how much effort they put into continuing to use a latrine in their daily lives. There were 2 question items on the revised habit variable, which were those related to the revision of the term "automatic" to "spontaneous" since it is more relevant in the context of the habit of defecating in the open and more often heard in Indonesian society. The question item was also revised by adding the location of the intended open defecation, making it easier for respondents to understand the concept. In other revised habit question items, examples of the intended location of planned open defecation behavior were also added.

The results of the attitude index were good at the CVI stage. However, there was input from experts regarding revising all question items on the ability variable changed to the initial word "I am able." The revision of "I am able" was done to emphasize the ability and readiness of respondents to be involved and is more following the Indonesian cultural context, which tends to require direct and personal statements. This revision clarified subject (I) and described the specific actions respondents must take. In several studies conducted in Indonesia, affirmation of the subject in the questionnaire, like "I am able," is often used to measure the ability variable.[30,31] In the attitude variable, one question item with I-CVI attitude required revision related to the sentence "content of the pit" to "content of the septic tank." The term septic tank is a term that is familiar to Indonesians.

Three question items on the self-regulation variable were modified based on the CVI stage. The first modification related to respondents' readiness to use the toilet. An explanation was added for the options "not ready" to "ready." This revised item was intended to help respondents understand the scale of readiness to use the toilet in question. Second, the question items were revised to include more specific questions on the frequency of toilet use to enhance respondent comprehension. Finally, the question item in the self-regulation variable was modified by adding specifications regarding toilet use for defecation. Toilets in Indonesia are typically used for multiple purposes, such as bathing and washing clothes; thus, specifying the defecation function was deemed more appropriate for the Indonesian context.[32]

The FVI results indicated a good index with no question items requiring revision from the 40 respondents. However, based on notes and input from the questionnaire trial study, a modification was recommended regarding the terminology. The term "diarrhea" was supplemented with *"mencret"* (a colloquial Indonesian term commonly used in the study area to describe diarrhea) since this local term was more familiar and better understood by the Indonesians than the formal term "diarrhea." Subsequently, the term *"mencret"* was added alongside each question item containing the word diarrhea, particularly in the knowledge variable section.

This study had several limitations that should be considered. First, while the instrument demonstrated good content and face validity, other psychometric properties, such as construct validity and reliability, were not assessed. Second, face validity testing was limited to one rural village in the Tanggamus District, which may not fully represent the diverse cultural and linguistic variations across different regions of Indonesia. Third, the adaptation process focused primarily on linguistic and cultural aspects without extensive testing of the theoretical construct validity of the RANAS framework in the Indonesian context. Fourth, although adequate for initial validation, the sample size of 40 respondents for FVI may benefit from larger-scale testing across different geographical areas.

This study's findings have several important implications for research and practice. Regarding research implications, this validated instrument provides a foundation for future studies examining latrine use behavior in Indonesia, particularly in rural areas where open defecation remains prevalent. The successful adaptation of the RANAS framework demonstrates its potential applicability in Indonesia, although further psychometric testing is recommended. For practical implications, this instrument can be utilized by public health practitioners and policymakers to assess latrine use behavior and its determinants more accurately. Incorporating culturally appropriate terminology and context-specific

modifications enhances its utility in community-based assessments. The validated instrument can help design more targeted interventions by identifying specific behavioral factors influencing latrine use in Indonesian communities.

Conclusion

This study demonstrates the successful adaptation of a theoretically grounded instrument to measure latrine use behavior in Indonesia through systematic content and face validation processes. The adaptation process revealed the importance of incorporating cultural nuances and the local context when developing behavioral assessment tools, particularly in sanitation-related research. Beyond mere translation, the validation process highlighted the importance of cultural understanding, local terminology, and contextual modifications for creating effective measurement instruments for public health. This validated instrument represents a significant step forward in sanitation behavior research in Indonesia, providing researchers and practitioners with a reliable tool for understanding and addressing open defecation practices. The successful integration of the RANAS framework into the Indonesian context suggests that theoretical frameworks can be effectively adapted across cultures when proper validation procedures are followed, paving the way for evidence-based sanitation interventions that are both theoretically sound and culturally appropriate.

Abbreviations

RANAS: risk, attitude, norm, ability, and self-regulation; CVI: Content Validity Index; FVI: Face Validity Index; S-CVI: scale-content validity index; I-CVI: item-content validity index.

Ethics Approval and Consent to Participate

This study involved humans and has obtained ethical approval from the Medical and Health Research Ethics Committee (MHREC), Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, with number KE/FK/0383/EC/2024. All participants were explained the purpose of the study and informed consent to participate in the study before taking part.

Competing Interest

There are no conflicts of interest in this study.

Availability of Data and Materials

The data can be accessed upon a reasonable request.

Authors' Contribution

VY was the first author to conceptualize, collect data, and draft the manuscript. FSTD provided supervision, methodology, and manuscript revision. I assisted in conducting instrument assessments and revising the instruments.

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