



Knowledge and Adherence to 3M Plus Dengue Prevention Practices: A Cross-Sectional Study in Rural Indonesia

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ABSTRACT

Introduction: Dengue remains a major public health challenge in tropical and subtropical regions, with persistent transmission despite ongoing vector control efforts. In Indonesia, the 3M Plus strategy constitutes the core national approach to dengue prevention and relies heavily on sustained community participation. Knowledge is considered a key determinant of preventive behavior; however, evidence examining its association with structured prevention strategies in rural settings remains limited.

Objectives: This study aimed to analyze the association between community knowledge and adherence to 3M Plus dengue prevention practices in a rural population.

Methods: A cross-sectional study was conducted among 43 respondents selected using total sampling. Data were collected through a structured questionnaire measuring dengue-related knowledge and 3M Plus practices. Knowledge and practice levels were categorized as poor and good based on predetermined scoring criteria. Data were analyzed using the Chi-square test with a significance level of $p < 0.05$.

Results: Of the respondents, 58.1% demonstrated good knowledge and 58.1% reported good 3M Plus practices. A statistically significant association was found between knowledge level and 3M Plus implementation ($\chi^2 = 7.84$; $p = 0.005$). Respondents with good knowledge were more likely to implement appropriate preventive measures compared to those with poor knowledge.

Conclusion: This study found a significant association between community knowledge and the implementation of 3M Plus dengue prevention practices in a rural population. Individuals with better knowledge were more likely to adhere to recommended preventive measures. Strengthening community-based health education and behavioral interventions is essential to improve sustainable dengue prevention efforts

Keywords: Dengue; 3M Plus; Community Knowledge; Preventive Behavior; Rural Population

INTRODUCTION

Dengue is a mosquito-borne viral infection caused by four distinct serotypes of the dengue virus and transmitted primarily by *Aedes aegypti*. Clinically, dengue infection ranges from asymptomatic or mild febrile illness to severe manifestations such as plasma leakage, hemorrhage, organ impairment, and shock, which may be life-threatening if not properly managed (1–3). The disease remains a major public health concern in tropical and subtropical regions, with increasing incidence driven by urbanization, globalization, and climate variability (4–7).

Southeast Asia remains one of the most highly endemic regions, experiencing recurrent outbreaks that contribute significantly to morbidity, mortality, and economic strain (2,4). Despite long-standing vector control initiatives, sustained dengue transmission

persists, suggesting limitations in the effectiveness of conventional control measures and highlighting the critical importance of community-level engagement (8). Vector control strategies that rely solely on centralized interventions are often insufficient without consistent behavioral participation at the household level.

Community-based preventive practices are therefore fundamental to reducing dengue transmission (9,10). In Indonesia, the Ministry of Health promotes the 3M Plus strategy—draining water containers, covering water storage facilities, disposing of unused containers, and implementing additional protective measures—as the cornerstone of national dengue prevention efforts (11). The effectiveness of this strategy depends largely on sustained community participation and adherence to recommended environmental management practices (9,12).

Health behavior theories provide a conceptual foundation for understanding why individuals adopt—or fail to adopt—preventive practices. The Health Belief Model (HBM) proposes that health-related behavior is influenced by individuals' perceptions of susceptibility, severity, benefits, and barriers (13). Similarly, the Theory of Planned Behavior (TPB) emphasizes that behavior is shaped by attitudes, subjective norms, and perceived behavioral control (14). Within these frameworks, knowledge plays a foundational cognitive role by shaping risk perception and behavioral intention, thereby influencing preventive action.

Empirical evidence from dengue-endemic regions has demonstrated positive associations between knowledge and preventive practices (15–18). Communities with higher knowledge levels are generally more likely to eliminate mosquito breeding sites, manage water storage appropriately, and engage in environmental control measures. However, inconsistencies have also been documented. Several studies report that adequate knowledge does not always translate into sustained preventive behavior, suggesting that structural and contextual factors—such as socioeconomic status, environmental infrastructure, and perceived barriers—may mediate this relationship (16,19,20).

Moreover, many previous investigations have relied on generalized knowledge–attitude–practice (KAP) frameworks without specifically evaluating adherence to structured national prevention strategies (18,21). Rural populations, in particular, may face distinct contextual challenges, including reliance on water storage systems and limited waste management infrastructure, which influence both mosquito breeding dynamics and the feasibility of preventive practices (22,23). Despite these contextual differences, rural communities remain underrepresented in dengue behavioral research.

Given the continued dengue burden and the reliance on community-driven vector control strategies, examining the relationship between community knowledge and adherence to the 3M Plus prevention strategy in rural settings is essential. This study aims to analyze the association between community knowledge and implementation of 3M Plus dengue prevention practices.

METHODS

The participants in the study were adults living permanently in villages located within the service area of the Sulewana Community Health Center in Poso Regency, Indonesia. A total sampling technique was applied, as the number of eligible households was limited and manageable. All individuals who met the inclusion criteria during the study period were invited to participate. A total of 43 respondents were included in the final analysis. Inclusion criteria were: (1) aged 18 years or older; (2) residing in the study area for at least one year; (3) able to communicate effectively in Indonesian; and (4) willing to provide informed consent. Exclusion criteria included: (1) individuals with cognitive impairments that prevented questionnaire completion; and (2) incomplete questionnaire responses. Participants' demographic characteristics, including age, sex, education level, and occupation, were recorded to describe the study population and assess potential contextual influences.

The independent variable was community knowledge regarding dengue and 3M Plus prevention. Knowledge was operationally defined as the total score obtained from a structured knowledge questionnaire. Each correct answer was scored as 1 and incorrect or “do not know” responses were scored as 0. The total knowledge score ranged from 0 to 10. Scores were categorized as poor (0–3), moderate (4–7), and good (8–10). The dependent variable was implementation of 3M Plus dengue prevention practices. This variable was operationally defined as the cumulative score obtained from a structured practice questionnaire assessing routine draining of water containers, covering storage facilities, proper disposal of unused items, and additional protective measures. Responses were measured using a dichotomous scale (Yes = 1, No = 0). Total practice scores ranged from 0 to 10 and were categorized as poor (0–5) and good (6–10) implementation.

Data were collected using a structured questionnaire adapted from validated dengue Knowledge–Attitude–Practice (KAP) instruments used in previous epidemiological studies. The questionnaire consisted of three sections: Demographic characteristics (5 items), Knowledge about dengue and 3M Plus (10 items, multiple-choice), 3M Plus preventive practices (10 items, dichotomous response format). The instrument was adapted to reflect the Indonesian Ministry of Health 3M Plus guidelines. Content validity was assessed by three public health experts specializing in vector-borne disease prevention. A pilot test was conducted among 15 residents in a neighboring village to evaluate clarity and reliability. Internal consistency testing demonstrated acceptable reliability, with Cronbach's alpha values of 0.78 for the knowledge section and 0.81 for the practice section.

Prior to data collection, formal permission was obtained from the local health office and village authorities. Community leaders were informed about the study objectives and procedures. Eligible participants were approached at their households and provided with detailed information about the study. After obtaining written informed consent, trained research assistants administered the questionnaires through face-to-face interviews to minimize misunderstanding and incomplete responses. Each interview lasted approximately 20–30 minutes. Completed questionnaires were reviewed immediately to ensure completeness and accuracy. Data were coded and entered into a secure database for analysis.

Data analysis was performed using Statistical Package for the Social Sciences (SPSS) version 26.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated to summarize participant characteristics and variable distributions. The association between knowledge level and 3M Plus practice implementation was analyzed using the Chi-square test of independence. The level of statistical significance was set at $p < 0.05$ with a 95% confidence interval. Assumptions for the Chi-square test were assessed prior to analysis. When expected cell counts were less than five, Fisher's exact test was applied as appropriate.

RESULTS

A total of 43 respondents participated in this study. The socio-demographic characteristics of participants are presented in **Table 1**.

Table 1. Socio-Demographic Characteristics of Respondents (n = 43)

	Variabel	n	%
Age			
1	18–35 years	9	20.9
2	36–45 years	12	27.9
3	46–60 years	17	39.5
4	>60 years	5	11.6
Gender			
1	Male	24	55.8
2	Female	19	44.2
Education Level			
1	Primary School	18	41.9
2	Junior High School	14	32.6
3	Senior High School	9	20.9
4	Higher Education	2	4.6
Occupation			
1	Farmer	29	67.4
2	Private Worker	6	14.0
3	Self-employed	5	11.6
4	Others	3	7.0

Source: Primary Data

The majority of respondents were aged 46–60 years (39.5%), male (55.8%), had primary-level education (41.9%), and worked as farmers (67.4%).

Table 2. Distribution of Community Knowledge (n = 43)

	Variabel	n	%
Knowledge Level			
1	Poor Knowledge	18	41.9
2	Good Knowledge	25	58.1
Total		43	100

Source: Primary Data

More than half of the respondents (58.1%) demonstrated good knowledge about dengue transmission and 3M Plus preventive measures, while 41.9% were classified as having poor knowledge.

Table 3. Distribution of 3M Plus Dengue Prevention Practices (n = 43)

	Variabel	n	%
3M Plus Practice			
1	Poor Practice	18	41.9
2	Good Practice	25	58.1
Total		43	100

Source: Primary Data

A total of 58.1% of respondents reported good adherence to 3M Plus practices, whereas 41.9% demonstrated poor implementation.

Table 4. Association Between Knowledge Level and 3M Plus Implementation (n = 43)

Knowledge Level	Good Practice n (%)	Poor Practice n (%)	Total	P Value
Poor Knowledge	6 (33.3%)	12 (66.7%)	18	0,005
Good Knowledge	19 (76.0%)	6 (24.0%)	25	
Total	25	18	43	

Source: Primary Data

The Chi-square analysis revealed a statistically significant association between community knowledge and the implementation of 3M Plus dengue prevention practices ($p = 0.005$). Respondents with good knowledge were more than twice as likely to report good preventive practices (76.0%) compared to those with poor knowledge (33.3%). Conversely, inadequate implementation was predominantly observed among respondents with poor knowledge (66.7%).

These findings indicate that knowledge level is significantly associated with adherence to structured 3M Plus dengue prevention strategies in the rural community studied, supporting the hypothesis that improved knowledge contributes to better preventive behavior.

DISCUSSION

This study examined the association between community knowledge and adherence to the 3M Plus dengue prevention strategy in a rural population. The findings demonstrated a statistically significant relationship between knowledge level and preventive behavior, indicating that respondents with higher knowledge were more likely to implement appropriate 3M Plus measures. These results reinforce the central role of cognitive determinants in shaping community-based vector control practices.

From a theoretical standpoint, the findings are consistent with the Health Belief Model (HBM) proposed by Rosenstock (13) and the Theory of Planned Behavior (TPB) developed by Ajzen (14). The HBM posits that individuals are more likely to engage in preventive behavior when they understand disease transmission, perceive susceptibility and severity, and recognize the benefits of action. Similarly, the TPB emphasizes that behavioral performance is influenced by attitudes, subjective norms, and perceived behavioral control. In the context of dengue prevention, knowledge functions as a foundational cognitive component that shapes risk perception and behavioral intention, thereby facilitating the adoption of preventive practices.

The present findings are also supported by empirical evidence from dengue-endemic settings. Studies conducted in Indonesia and other Southeast Asian countries have consistently demonstrated positive associations between knowledge and dengue preventive behaviors (15–18). For instance, community-based surveys have shown that households with higher knowledge scores are more likely to eliminate standing water, manage waste appropriately, and adopt larval control measures (15,16). These findings suggest that knowledge enhances individuals’ awareness of mosquito breeding sites and reinforces perceived benefits of environmental management practices.

However, the relationship between knowledge and behavior is not uniformly linear. Several studies have reported inconsistencies between adequate knowledge and actual preventive practices (16,19,20). Structural constraints, including socioeconomic limitations, water storage dependency, inadequate waste management systems, and environmental conditions, may hinder the translation of knowledge into sustained action (16,17,24). This contextual explanation may account for the subset of respondents in the present study who demonstrated good knowledge yet suboptimal 3M Plus implementation. Thus, while knowledge is a significant determinant, it operates within broader environmental and structural contexts.

A key contribution of this study lies in its focus on adherence to a structured national strategy—3M Plus—rather than generalized mosquito control behaviors. Previous studies have frequently assessed broad knowledge–attitude–practice constructs without explicitly evaluating compliance with standardized program components (18,19). By operationalizing preventive behavior according to defined 3M Plus indicators, the present study provides program-specific evidence that may inform evaluation of national dengue control policies.

From a public health perspective, the findings underscore the importance of strengthening behavior change communication and community engagement initiatives. Systematic reviews and regional analyses emphasize that educational interventions are most effective when integrated with participatory community mobilization and sustained local involvement (20,21,24). Educational campaigns alone may increase knowledge, but long-term behavioral adherence requires supportive environmental conditions and community empowerment mechanisms. Integrating routine larval surveillance, community-based monitoring, and locally tailored health promotion strategies may enhance the sustainability of dengue prevention efforts (22,24).

This study has several strengths. It focuses on a rural population, which remains comparatively underrepresented in dengue behavioral research (23). Rural communities often face unique infrastructural and environmental challenges that influence vector breeding and preventive practices. Furthermore, the use of inferential statistical analysis strengthens the evidence regarding the association between knowledge and 3M Plus adherence.

Nevertheless, several limitations warrant consideration. The cross-sectional design precludes causal inference, as temporal relationships between knowledge acquisition and behavioral adoption cannot be established. The relatively small sample size may

limit generalizability beyond the study setting. Additionally, reliance on self-reported preventive practices introduces the possibility of recall bias and social desirability bias (25). These limitations should be considered when interpreting the findings.

Future research should employ longitudinal or quasi-experimental designs to clarify causal pathways between knowledge and preventive behavior. Multivariate analyses incorporating socioeconomic status, environmental infrastructure, and perceived risk variables would provide a more comprehensive understanding of determinants influencing 3M Plus implementation. Qualitative investigations may further elucidate contextual and cultural factors shaping dengue prevention behaviors in rural communities.

CONCLUSION

This study demonstrates a significant association between community knowledge and the implementation of 3M Plus dengue prevention practices in a rural population. Respondents with higher levels of knowledge were more likely to adhere to recommended preventive measures, highlighting the critical role of cognitive factors in shaping community-based vector control behaviors. These findings contribute empirical evidence to the knowledge–behavior framework within dengue prevention and provide context-specific insights relevant to rural settings. Practically, the results underscore the importance of strengthening health education programs alongside community engagement strategies to enhance sustainable dengue control efforts. Future research should explore additional behavioral and structural determinants using larger and longitudinal designs to better understand causal pathways and optimize intervention effectiveness.

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AUTHORS’ CONTRIBUTIONS

EL was responsible for the study conceptualization, research design, data collection coordination, and drafting of the manuscript. VMK contributed to the development of the research methodology, statistical analysis, and interpretation of the data. R provided supervision, critical revision of the manuscript for important intellectual content, and final approval of the version to be published. All authors reviewed and approved the final manuscript and agree to be accountable for all aspects of the work, ensuring the accuracy and integrity of the study.

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2. Use of Artificial Intelligence (AI)

Artificial intelligence tools were used solely to assist with language editing and structural refinement of the manuscript. The authors take full responsibility for the study design, data collection, data analysis, interpretation of the results, and the final content of the manuscript.

3. Conflict of Interest

The authors declare that there are no financial, professional, or personal conflicts of interest that could have influenced the conduct or outcomes of this study.

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