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Determinants of Dengue Haemorrhagic Fever: Community Knowledge, Attitudes, and Practices from a Health Promotion Perspective

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ABSTRACT

***Background**: Gunungsitoli City remains a dengue-endemic area in North Sumatra Province. In 2022, Ilir Village reported the highest number of dengue hemorrhagic fever (DHF) cases within the Gunungsitoli District Primary Health Center catchment area, making it a priority for dengue prevention and control. Despite ongoing control efforts, evidence on the association between community knowledge, attitudes, and practices (KAP) and DHF occurrence in this setting remains limited, highlighting the need for context-specific evidence to inform prevention strategies. **Methods**: A surveillance-based unmatched case-control study was conducted among 99 participants, including 33 laboratory-confirmed DHF cases identified from routine dengue surveillance records at the Gunungsitoli Primary Health Center and 66 controls recruited from the same neighborhoods using a 1:2 case-control ratio. Controls originated from the same source population as the cases and had no documented history of DHF during the previous two years. Primary data on knowledge, attitudes, and preventive practices (KAP) were collected through structured interviews and household observations, while secondary data were obtained from routine dengue surveillance records. Associations between KAP and DHF were analyzed using chi-square tests and multivariable logistic regression with the Backward Likelihood Ratio (Backward LR) method. The results are presented as odds ratios (ORs), adjusted odds ratios (AORs), 95% confidence intervals (CIs), and p-values. **Results**: In the multivariable logistic regression analysis, only age and preventive practices remained independently associated with DHF. Respondents aged <15 years had significantly higher odds of DHF than those aged ≥15 years (AOR = 3.480; 95% CI: 1.122–10.793; p = 0.031). Respondents with poor preventive practices had 4.756 times higher odds of DHF than those with good preventive practices (AOR = 4.756; 95% CI: 1.854–12.204; p = 0.001), representing the strongest independent factor associated with DHF. Although age, sex, knowledge, attitudes, and preventive practices were significantly associated with DHF in the bivariate analysis, only age and preventive practices remained significant after adjustment. **Conclusions**: Poor preventive practices and younger age (<15 years) remained independently associated with DHF. Dengue prevention programs should prioritize sustained household vector control through regular elimination of mosquito breeding sites, supported by community participation and targeted health promotion for households with children in endemic areas.*

Keywords:
Dengue hemorrhagic fever, knowledge, attitudes, practices

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Introduction

Dengue hemorrhagic fever (DHF) remains one of the most significant mosquito-borne viral diseases and continues to pose a major public health challenge worldwide. Caused by the dengue virus and transmitted primarily by Aedes aegypti and Aedes albopictus, dengue has expanded rapidly over recent decades because of urbanization, population growth, climate variability, environmental changes, and increasing human mobility. In 2024, the World Health Organization (WHO) reported more than 14 million dengue cases and over 9,000 deaths globally, representing the largest dengue epidemic ever documented. Southeast Asia continues to experience a substantial disease burden, with Indonesia remaining one of the most affected endemic countries (Haider et al., 2025; Organization, 2024).

Despite the implementation of integrated dengue control programs, including epidemiological surveillance, source reduction, health promotion, and targeted vector control, dengue transmission remains persistent in many parts of Indonesia. This continuing transmission suggests that sustainable dengue prevention requires not only government-led interventions but also active and consistent community participation in vector control activities. Community engagement in eliminating mosquito breeding sites, maintaining environmental sanitation, and adopting household preventive measures has therefore become a central component of national dengue control strategies (Montenegro-Quiñonez et al., 2023; Okafor et al., 2026).

Knowledge, attitudes, and practices (KAP) are widely used behavioral indicators for understanding community participation in dengue prevention (Shafie et al., 2023). Numerous studies have reported associations between KAP and dengue-related outcomes; however, their findings remain inconsistent. While some investigations have identified significant associations between knowledge, attitudes, and preventive practices and dengue occurrence, others have reported that only preventive practices remain significantly associated after adjustment for potential confounding factors (Bibi, 2025; Jarab et al., 2026). Furthermore, studies conducted in different epidemiological settings have shown considerable variability in the magnitude and direction of these associations, suggesting that behavioral determinants may be highly context-dependent and influenced by local environmental, demographic, socioeconomic, and health system characteristics. Consequently, evidence generated in one endemic setting cannot be assumed to be directly applicable to another (Hilz et al., 2025).

In Indonesia, most studies examining KAP related to dengue have been conducted in large urban centers or densely populated endemic regions. Comparatively little evidence is available from smaller island municipalities, where environmental conditions, population characteristics, healthcare accessibility, and community behaviors may differ substantially from those of mainland settings. This geographical imbalance limits understanding of whether behavioral factors associated with dengue are consistent across diverse endemic contexts and reduces the availability of locally relevant evidence to guide public

health interventions (Prayitno et al., 2025).

Gunungsitoli City, located on Nias Island in North Sumatra Province, continues to experience recurrent dengue transmission despite ongoing prevention and control programs. Routine surveillance data from the Gunungsitoli Primary Health Center recorded 284 laboratory-confirmed DHF cases in 2025, indicating sustained community transmission. Among the affected areas, Ilir Village is characterized by dense residential settlements, environmental conditions conducive to Aedes breeding, and ongoing dengue transmission, making it an appropriate setting for investigating behavioral factors associated with the disease. Examining KAP in this underrepresented island community provides an opportunity to determine whether behavioral patterns reported in other Indonesian regions are similarly observed in a distinct geographical and epidemiological setting. Such evidence is important for assessing the contextual applicability of existing behavioral findings and for informing locally appropriate dengue prevention strategies (Al Amin et al., 2021; Prayitno et al., 2025).

Accordingly, this study employed an analytical case-control design to examine the associations between community knowledge, attitudes, practices, and DHF in Ilir Village, Gunungsitoli District, Gunungsitoli City. By generating evidence from an underrepresented island endemic community, this study seeks to strengthen the understanding of behavioral factors associated with dengue and provide a scientific basis for developing more context-specific health promotion and community-based vector control programs.

Methods

Study Design, Population, and Sample Size

A surveillance-based unmatched case-control study was conducted among 99 participants, comprising 33 laboratory-confirmed dengue hemorrhagic fever (DHF) cases and 66 controls using a 1:2 case-control ratio. Cases were identified from routine dengue surveillance records maintained by the Gunungsitoli Primary Health Center, whereas controls were recruited from the same neighborhoods as the cases to ensure that they originated from the same source population. Individuals with no documented history of DHF during the previous two years were eligible for inclusion as controls.

Primary data on participants' knowledge, attitudes, and preventive practices (KAP) were collected through structured face-to-face interviews and household observations using a standardized questionnaire. Household observations were conducted to verify environmental conditions and preventive practices, thereby reducing information bias. Selecting controls from the same neighborhoods as the cases improved comparability of environmental exposures and minimized selection bias.

The sample size was calculated using the formula for comparing two proportions in unmatched case-control studies based on effect estimates reported in a previous study of dengue risk factors (Bell et al., 2014). Estimates of the proportions of exposure among controls (P_2 = 0.591, 0.727, and 0.727) and the corresponding odds ratios for knowledge, attitudes, and preventive practices (OR = 0.109, 0.083, and 0.110) reported by (Alajaimi et al., 2026) were used to determine the minimum required sample size. Based on these parameters, a minimum of 33 cases was required. To improve statistical power and increase the precision of the estimated

associations, a 1:2 case-control ratio was applied, resulting in a total sample of 99 participants (33 cases and 66 controls). All participants were household heads or adult household representatives residing in Ilir Village.

Sampling Technique, Inclusion and Exclusion Criteria, and Research Variables

The purpose of sampling was to obtain both case and control respondents. Case selection began with a review of the medical records of dengue fever patients documented at the Gunungsitoli District Health Center, specifically targeting individuals residing in Ilir Village. With the assistance of local community health workers, researchers visited the recorded addresses to recruit eligible case respondents. Control respondents were selected from neighbors living in the same immediate neighborhood as the cases. Individuals were included in the control group if they were considered at risk for dengue infection but had no history of dengue fever in the previous two years.

Predetermined inclusion and exclusion criteria guided the sampling. For the case group, inclusion criteria required respondents to have received a clinical diagnosis of dengue fever at the Gunungsitoli District Health Center within the past year, have lived in Ilir Village for at least one year, and be able to read and write independently. Inclusion criteria for the control group were living in the same neighborhood as the cases, no previous dengue diagnosis, having lived in Ilir Village for more than one year, and being able to read and write without assistance. Respondents in both groups were excluded if they were ill at the time of data collection, had lived in Ilir Village for less than one year, or were absent during home visits.

This study examined several independent variables related to the determinants of public health behavior, including knowledge, attitudes, and practices. The dependent variable was the occurrence of dengue hemorrhagic fever (DHF). Primary data were collected through structured interviews and direct observation using a questionnaire. Secondary data were obtained from official reports and registrations from the Gunungsitoli Regency Community Health Center (Puskesmas). This multi-method data collection approach ensured a comprehensive measurement of public health behavior factors associated with dengue infection.

Instrument Validity, Reliability, and Measurement Scale

Before data collection, the research instrument underwent a validity assessment using the Pearson product-moment correlation test. The calculated correlation coefficient (r_count) for each item was compared with the critical r_value in the r_table at a significance level of $\alpha = 0.05$ (Elangovan & Sundaravel, 2021). An item was considered valid if the r_count exceeded the r_table value. Instrument validity testing was previously conducted in Ujung Berung District, Bandung City, West Java, using a sample of 27 respondents. The knowledge questionnaire showed an average r_count of 0.544, with values ranging from 0.438 to 0.699, all greater than the r_table value of 0.381. Similarly, the attitude questionnaire produced an average r_count of 0.518, with values ranging from 0.382 to 0.732, also exceeding the r_table threshold of 0.381. Thus, both instruments were declared valid and suitable for use in this study. Reliability testing by the same study yielded Cronbach's Alpha values of 0.855 for the knowledge questionnaire

and 0.821 for the attitude questionnaire, both exceeding the minimum acceptable value of 0.60, indicating high internal consistency and confirming the instrument's reliability (Hidayana & Fuzi, 2025).

The occurrence of dengue fever in this study was measured using a nominal scale and behavioral factors using an ordinal scale. Dengue fever occurrence was coded as 0 for respondents diagnosed with dengue fever (cases) and 1 for those without dengue fever. The knowledge factor was coded as 0 (poor, score 0-12) and 1 (good, score 13-16). Attitudes were coded as 0 (negative < Mean (57)) and 1 (positive ≥ Mean (57)). Actions were coded as 0 (Poor (0-9)) and 1 (Good (10)). This coding procedure ensured systematic measurement and facilitated statistical analysis of behavioral factors associated with dengue fever.

Data Analysis and Ethical Considerations

Data analysis in this study was conducted in several stages. Univariate analysis was first conducted to present the frequency distribution of each independent variable, including knowledge, attitudes, and practices. Bivariate analysis was then conducted using the Chi-square test to assess the association between each independent variable and the dependent variable, with statistical significance determined at a confidence level of $\alpha = 0.05$. Odds ratios (OR) with 95% confidence intervals were calculated using a 2x2 contingency table to estimate the magnitude of the risk associated with each independent variable. In interpreting OR, a value of 1 indicates no association, a value <1 indicates a protective factor, and a value >1 indicates a risk factor. Although Relative Risk (RR) and Odds Ratio (OR) are commonly used measures of association in health research, OR is more appropriate for case-control designs, while RR is typically applied in cohort studies.

Multivariate logistic regression analysis was performed using the Backward Likelihood Ratio (Backward LR) method. Variables with a p-value <0.25 in the bivariate analysis were entered into a logistic regression model to identify factors independently associated with dengue high fever. The results are presented as adjusted odds ratios (AOR), 95% confidence intervals (95% CI), and p-values. Variables were considered significantly associated if they had a p-value <0.05.

Data processing included verifying questionnaire completeness, coding to facilitate statistical analysis, and data cleaning to ensure accuracy. All analyses were conducted using SPSS version 20 for Windows. Ethical approval for this study was obtained from the Health Research Ethics Committee of Sari Mutiara University, Indonesia (No. 2394/F/KEP/USM/III/2026). Before data collection, the researcher provided a full explanation of the study, and written consent was obtained from all participants before conducting individual sampling.

Results

Table 1. Sociodemographic and Behavioral Characteristics of Study Participants by DHF Status (n = 99)

Variables	Cases		Controls	
	n	%	n	%
Age				
<15 years	12	36.4	7	10.6
≥15 years	21	63.6	59	89.4
Sex				
Male	19	57.6	24	36.4
Female	14	42.4	42	63.6
Employment Status				
Employed	12	36.4	28	42.4
Unempolyed	21	63.6	38	57.6
Knowledge				
Poor	20	60.6	24	36.4
Good	13	39.4	42	63.6
Attitudes				
Negative	20	60.6	22	33.3
Positive	13	39.4	44	66.7
Practices				
Poor	23	69.7	19	28.8
Good	10	30.3	47	71.2

Based on Table 1, respondents in the DHF case group were predominantly characterized by poor knowledge (20; 60.6%), whereas those in the control group were mostly characterized by good knowledge (42; 63.6%). Similarly, negative attitudes were more prevalent among respondents in the case group (20; 60.6%), while positive attitudes predominated in the control group (44; 66.7%). Regarding preventive practices, most respondents in the case group exhibited poor practices (23; 69.7%), whereas the majority of those in the control group reported good practices (47; 71.2%).

Table 2. Bivariate Analysis of Sociodemographic Characteristics, Knowledge, Attitudes, and Preventive Practices Associated with Dengue Hemorrhagic Fever (DHF)

Respondent Characteristic	Cases		Controls		*p-value*	OR (95% CI)
	n	%		%		
Age						
<15 years	12	36.4	7	10.6	0.002	4.816
≥15 years	21	63.6	59	89.4		(1.674 - 13.858)
Sex						
Male	19	57.6	24	36.4	0.045	2.375
Female	14	42.4	42	63.6		(1.012 - 5.575)

Respondent Characteristic	Cases		Controls		*p-value*	OR (95% CI)
	n	%		%		
Employement Status						
12	36.4	28	42.4	0.562	0.776	
21	63.6	38	57.6		(0.328 - 1.835)	
Employee						
Unemployee						
Knowledge						
Poor	20	60.6	24	36.4	0.022	2.692
Good	13	39.4	42	63.6		(1.140 - 6.360)
Attitudes						
Negative	20	60.6	22	33.3	0.010	3.077
Positive	13	39.4	44	66.7		(1.295 - 7.313)
Practices						
Poor	23	69.7	19	28.8	0.001	5.689
Good	10	30.3	47	71.2		(2.281 - 14.189)

Table 2 presents the bivariate associations between participants' sociodemographic characteristics, knowledge, attitudes, preventive practices, and dengue hemorrhagic fever (DHF). Age, sex, knowledge, attitudes, and preventive practices were significantly associated with DHF ($p < 0.05$), whereas employment status was not significantly associated ($p = 0.562$). Respondents aged <15 years had higher odds of DHF than those aged ≥15 years (OR = 4.816; 95% CI: 1.674–13.858; p = 0.002). Male respondents also had higher odds of DHF than female respondents (OR = 2.375; 95% CI: 1.012–5.575; p = 0.045). Compared with respondents with good knowledge, those with poor knowledge had higher odds of DHF (OR = 2.692; 95% CI: 1.140–6.360; p = 0.022). Likewise, respondents with negative attitudes had higher odds of DHF than those with positive attitudes (OR = 3.077; 95% CI: 1.295–7.313; p = 0.010). Poor preventive practices were associated with the highest odds of DHF (OR = 5.689; 95% CI: 2.281–14.189; p = 0.001). Variables with a p-value <0.25 in the bivariate analysis were subsequently included in the multivariable logistic regression model.

Table 3. Initial Multivariate Model

Model	Variables	Adjusted OR	Adjusted 95% CI	*p-value*
	Ages	3.074	0.900 - 10.499	0.073
	Sex	2.424	0.901 - 6.591	0.079
Model 1	Occupations	1.378	0.499 - 3.807	0.537
	Knowledge	0.921	0.235 - 3.605	0.906
	Attitudes	1.768	0.452 - 6.917	0.413
	Practices	4.374	1.493 - 12.815	0.007

Table 3 presents the initial multivariable logistic regression model, which included age, sex, employment status, knowledge, attitudes, and preventive practices. After adjustment for all variables entered into the model, only preventive practices remained significantly associated with DHF (AOR =

4.374; 95% CI: 1.493–12.815; p = 0.007). Participants with poor preventive practices had 4.374 times higher odds of DHF than those with good preventive practices. Age, sex, employment status, knowledge, and attitudes were not independently associated with DHF in the initial model (all p > 0.05).

Table 4. Final Multivariate Analysis Model

Model	Variables	Adjusted OR	Adjusted 95% CI	*p-value*
	Ages	3.480	1.122 – 10.793	0.031
Model 6	Practices	4.756	1.854 – 12.204	0.001

The final multivariable logistic regression model, presented in Table 4, identified two variables that remained independently associated with DHF: age and preventive practices. After adjustment for preventive practices, respondents aged <15 years had 3.48 times higher odds of having DHF than those aged ≥15 years (AOR = 3.480; 95% CI: 1.122–10.793; p = 0.031). Similarly, after adjustment for age, respondents with poor preventive practices had 4.76 times higher odds of having DHF than those with good preventive practices (AOR = 4.756; 95% CI: 1.854–12.204; p = 0.001). Preventive practices had the highest adjusted odds ratio among the variables retained in the final model; however, this finding should be interpreted with caution because the confidence interval indicates limited precision in the estimated effect.

Discussion

This study investigated the association between community knowledge, attitudes, and practices (KAP) and the occurrence of dengue hemorrhagic fever (DHF) in Ilir Village, Gunungsitoli District, Indonesia, using a community-based case-control design. The findings demonstrated that younger age, poorer knowledge, negative attitudes, and inadequate preventive practices were significantly associated with DHF in the bivariate analysis. However, after adjustment for potential confounders, only younger age and preventive practices remained independently associated with DHF, with poor preventive practices emerging as the strongest predictor. These findings indicate that the consistent implementation of preventive behaviors is substantially more important for reducing DHF risk than knowledge or favorable attitudes alone.

Children younger than 15 years were significantly more likely to develop DHF than older individuals. This finding is consistent with the epidemiology of dengue in many endemic countries, where children remain disproportionately affected because of limited acquired immunity, greater susceptibility to severe infection, and frequent exposure to Aedes mosquitoes during daytime activities at home and school (Cohee et al., 2021; Deng et al., 2024; Nunez et al., 2026). Dependence on caregivers for environmental sanitation and personal protection may further increase their vulnerability. Similar associations between younger age and dengue infection have been consistently reported across Southeast Asia, including Indonesia (Vicco et al., 2024; Weng et al., 2025).

Male sex was associated with DHF in the bivariate analysis but not after

multivariable adjustment, suggesting that the apparent difference was explained by behavioral and environmental exposures rather than biological sex itself. Previous studies have similarly reported inconsistent associations between sex and dengue infection, with differences largely attributable to variations in outdoor activities, occupational exposure, and household environments rather than inherent biological susceptibility (Kumar et al.; Mponzi et al., 2022). Likewise, employment status was not associated with DHF, indicating that occupational classification alone does not adequately reflect dengue exposure in endemic communities where transmission predominantly occurs within or around households. This finding reinforces evidence that residential environmental conditions and household vector control are more influential than occupational characteristics in determining dengue risk (Baitharu et al., 2020; Fesce et al., 2026).

Knowledge and attitudes were significantly associated with DHF in the unadjusted analysis but lost statistical significance after adjustment for preventive practices. These findings suggest that although knowledge and positive attitudes provide an essential foundation for dengue prevention, they do not independently reduce disease risk unless translated into sustained preventive behavior. Health behavior theories similarly propose that knowledge increases awareness of disease transmission and prevention, whereas actual behavioral change depends on additional motivational, environmental, and social determinants (Campos & Fernandes, 2020; Wang et al., 2025). Comparable findings have been reported in several KAP studies, where individuals demonstrated adequate knowledge yet failed to routinely implement mosquito control measures because of competing priorities, limited community support, insufficient environmental resources, or weak risk perception (Alajaimi et al., 2026; Kumaran et al., 2018).

The strongest finding of this study was the independent association between poor preventive practices and DHF. Respondents reporting inadequate preventive behaviors had almost fivefold greater odds of developing DHF after adjustment for demographic factors. Preventive practices evaluated included elimination of mosquito breeding sites, appropriate management of household water storage, environmental sanitation, and other routine vector control measures. Failure to consistently perform these activities creates favorable breeding habitats for Aedes mosquitoes, thereby increasing mosquito density and opportunities for human-vector contact (Montenegro-Quiñonez et al., 2023). This observation aligns with growing evidence that community participation in routine source reduction remains the cornerstone of sustainable dengue prevention (Alok et al., 2025; Dambach et al., 2024).

The present findings also highlight the persistent gap between knowledge and behavior. Although many community members understand dengue transmission and prevention, this knowledge does not always translate into regular preventive action. Behavioral implementation is influenced by multiple contextual factors, including perceived susceptibility, household priorities, community engagement, social norms, available resources, and reinforcement from health workers (Abassi et al., 2026). Consequently, educational interventions alone are unlikely to substantially reduce dengue transmission unless accompanied by community empowerment, environmental management, regular household monitoring, and active

participation of local leaders and community health volunteers (Salam, 2026).

These findings have important implications for dengue prevention programs. Current control efforts in many endemic settings continue to emphasize reactive measures such as insecticide fogging during outbreaks. Although fogging temporarily reduces adult mosquito populations, it does not eliminate larval habitats or prevent the re-establishment of breeding sites (Nejadghaderi et al., 2026). Long-term dengue control therefore requires sustained community engagement, routine source reduction, proper waste management, environmental sanitation, and regular inspection of water-holding containers. Integrating these activities into existing community health programs, schools, and neighborhood organizations may improve long-term adherence to preventive behaviors and strengthen integrated vector management (Arxer, 2025; Montiel et al., 2025).

This study has several strengths. The case-control design enabled efficient identification of behavioral determinants of DHF using laboratory-confirmed surveillance data, while selecting cases and controls from the same community minimized differences in environmental exposure and healthcare accessibility. In addition, multivariable logistic regression allowed adjustment for potential confounding factors, providing more robust estimates of independent associations. These methodological approaches are widely recommended for investigating behavioral and environmental determinants of dengue in endemic settings (Dambach et al., 2024; Kenneson et al., 2017).

Several limitations should be acknowledged. First, the retrospective case-control design precludes causal inference because exposure and outcome were assessed after disease occurrence. Second, KAP variables were measured using self-reported questionnaires and may therefore be affected by recall and social desirability bias, although household observations were performed to validate selected preventive practices. Third, the study was conducted in a single village with a relatively modest sample size, limiting generalizability to other settings. Finally, important determinants such as household income, housing quality, mosquito density, climatic conditions, previous dengue infection, population mobility, and community participation in vector control programs were not evaluated. Future multicenter longitudinal studies incorporating these environmental and socioeconomic factors would provide a more comprehensive understanding of dengue transmission dynamics (Coulibaly et al., 2023; Haider et al., 2025; Waskito et al., 2025).

Overall, this study demonstrates that younger age and inadequate preventive practices are the principal factors independently associated with DHF in Ilir Village. The findings reinforce previous evidence that sustained household vector control and community participation are more effective for reducing dengue transmission than reliance on knowledge improvement or emergency insecticide-based interventions alone (Dambach et al., 2024; Montenegro-Quiñonez et al., 2023; Samsudin et al., 2024). Although knowledge and positive attitudes remain important components of health promotion, their protective effects appear to depend on successful translation into routine preventive practices. Accordingly, future dengue control strategies should prioritize behavior-focused, community-based interventions that strengthen

environmental management, encourage continuous source reduction, and promote collective responsibility for vector control. Such integrated approaches are likely to provide more sustainable reductions in dengue transmission in endemic communities.

Conclusion

This study identified younger age and poor preventive practices as the factors independently associated with dengue hemorrhagic fever (DHF) in Ilir Village, Gunungsitoli District, Indonesia. Although knowledge and attitudes were associated with DHF in the bivariate analysis, their effects were no longer significant after adjustment for preventive practices and demographic characteristics, indicating that knowledge and positive attitudes alone are insufficient to reduce dengue risk unless they are translated into consistent preventive behaviors. Poor preventive practices emerged as the strongest determinant of DHF, underscoring the critical role of routine household and community-based vector control in preventing dengue transmission.

These findings suggest that dengue prevention programs should move beyond information dissemination and reactive outbreak responses toward sustained behavior-focused interventions that promote regular source reduction, environmental sanitation, and active community participation. Strengthening collaboration among public health authorities, local governments, schools, community organizations, and community health volunteers will be essential to improve long-term adherence to preventive practices. Future longitudinal and multicenter studies incorporating environmental, entomological, climatic, and socioeconomic factors are recommended to further clarify the complex determinants of dengue transmission and to inform more effective, context-specific prevention strategies.

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Conflict of interest

The authors declare that there are no conflicts of interest

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