Journal of Associated Medical Sciences 2025; 58(2): 89-101

JAMS
Journal of Associated Medical Sciences

Scopus Indexed & Thai-Journal Citation Index Centre (TCI)

Journal of Associated Medical Sciences

Journal homepage: https://www.tci-thaijo.org/index.php/bulletinAMS/index

Improving the effectiveness of DHF prevention: Lessons from Pariaman City

Harisnal[1,2], Tri Yunis Miko Wahyono[1], Ratna Djuwita[1], Dewi Susanna[1], Cici Apriza Yanti[1,3]

[1]Department Epidemiology, Faculty of Public Health, Universitas Indonesia, Jl. Prof. Dr. Bahder Djohan, Kota Depok, Jawa Barat, Indonesia.
[2]Fort De Kock University, West Sumatra, Indonesia.
[3]Univesitas Prima Nusantara Bukittinggi, West Sumatra, Indonesia.

ARTICLE INFO

Article history:
Received 4 September 2024
Accepted as revised 12 January 2025
Available online 21 January 2025

Keywords:
Aedes aegypti, DHF, G1R1J, vector control, mosquito Larvae-monitoring, students.

ABSTRACT

Background: The Aedes aegypti mosquito transmits the viral disease dengue hemorrhagic fever (DHF), a significant public health problem in many tropical countries. The 1 House 1 Larva Monitoring (G1R1J) Movement, which involves every household as a mosquito larva monitoring agent, is one of the efforts to help communities control mosquito growth. Dengue Hemorrhagic Fever (DHF), transmitted by the *Aedes aegypti* mosquito, remains a significant public health issue in many tropical regions. The "1 House 1 Larva Monitoring" (G1R1J) movement, which mobilizes households as mosquito larvae monitoring agents, represents a community-based approach to controlling mosquito proliferation.

Objective: This study highlights a knowledge gap regarding the effectiveness of the G1R1J program with larvae-monitoring students compared to a program solely relying on larva-monitor cadres.

This study addresses a knowledge gap by comparing the effectiveness of the G1R1J program integrated with larva-monitoring students against the traditional approach relying solely on larva- monitor cadres.

Materials and methods: This study used a comparative design to compare the efficiency of the G1R1J program with the number of DHF cases in two DHF-endemic areas in Pariaman City, West Sumatra. A comparative study was designed to evaluate the efficiency of the G1R1J program concerning the incidence of DHF cases in two endemic areas in Pariaman City, West Sumatra. The researchers focused on field surveys and community attitudes because these aspects are directly linked to the implementation and success of the G1R1J program.

Results: The main results, with p=0.000 and OR 0.03, showed that comprehensive field-based interventions can significantly reduce the risk of vector presence. The study also demonstrated the importance of community attitudes in vector control, with p=0.002 and OR=0.15, suggesting that positive attitudes towards vector control practices can enhance the program's effectiveness. Statistical analysis revealed significant results, with a p-value of 0.000 and an odds ratio (OR) of 0.03, indicating that comprehensive, field-based interventions markedly reduce vector presence. Additionally, the study highlighted the role of community attitudes, with p=0.002 and OR=0.15, underscoring that positive perceptions and practices towards vector control significantly enhance program effectiveness.

Conclusion: This study shows that integrating the G1R1J program with larva-monitoring students can reduce the density of *Aedes Aegypti* mosquito vectors and dengue fever incidence. In addition, it offers strategic guidance for building more sustainable and efficient vector control policies in other endemic areas. Integrating the G1R1J program with larvae-monitoring students reduces *Aedes aegypti* vector density and DHF incidence. This approach offers strategic insights for developing sustainable and efficient vector control policies in other endemic regions.

* **Corresponding contributor.**
Author's Address: *Department Epidemiology, Faculty of Public Health, Universitas Indonesia, Jl. Prof. Dr. Bahder Djohan, Kota Depok, Jawa Barat, Indonesia.*
E-mail address: harisnal@fdk.ac.id
doi: 10.12982/JAMS.2025.042
E-ISSN: 2539-6056

Introduction

Dengue hemorrhagic fever (DHF) is a viral disease transmitted by the *Aedes aegypti* mosquito, which has become a serious public health problem in many tropical countries. Including Indonesia.[1] DHF can cause symptoms such as high fever, headache, joint and muscle pain, and rash. In severe cases, it can develop into DHF, which is characterized by bleeding and blood vessel damage.[2] Recent studies show that increasing dengue incidence is often associated with environmental factors such as changes in rainfall patterns and temperature, which influence the distribution and density of mosquito populations.[3,4] Apart from that, public perception and understanding of the dengue vector and appropriate preventive measures also play an essential role in controlling this disease.[5] Efforts to reduce the incidence of dengue fever require an integrated approach involving vector monitoring, public education, and environmental control.[6]

Dengue hemorrhagic fever (DHF) is a viral disease transmitted by the *Aedes aegypti* mosquito, which has become a significant public health issue in many tropical countries, including Indonesia.[1] DHF presents symptoms such as high fever, headache, joint and muscle pain, and rash. In severe cases, it may progress to a critical condition characterized by bleeding and vascular damage.[2] Recent studies have highlighted that the rising incidence of dengue is often associated with environmental factors, including changes in rainfall patterns and temperature, which influence the distribution and density of mosquito populations.[3,4] public awareness and understanding of the dengue vector and appropriate preventive measures are crucial in disease control.[5] Efforts to reduce dengue incidence require an integrated approach encompassing vector surveillance, community education, and environmental management.[6]

Dengue Hemorrhagic Fever (DHF) continues to increase in various regions, including in big cities, which shows an alarming global trend. In Indonesia. Data from the last five decades shows an increase in the incidence of dengue fever with increasingly widespread distribution in urban areas due to urbanization and climate change, which expands the habitat of the Aedes aegypti mosquito.[7,8] Research shows that climatic conditions such as high temperatures and erratic rainfall contribute significantly to the increase in dengue cases, as observed in several countries along the Belt and Road route.[9,10] In big cities such as Jakarta, high population density and environmental conditions that support mosquito breeding are additional factors that worsen the situation.[11,12] With the increasing incidence of dengue fever, more effective and sustainable prevention efforts are needed, including environmental management, public education, and the development of public health strategies adaptive to climate change.[13] These findings emphasize the importance of an integrated approach in dengue control to minimize future health and economic impacts.[14]

Dengue Hemorrhagic Fever (DHF) continues to rise globally, including in major cities, indicating an alarming trend. In Indonesia, data from the past five decades shows a consistent increase in dengue cases, with an increasingly widespread distribution in urban areas driven by urbanization and climate change, which expand the habitat of the Aedes aegypti mosquito .[7,8] Research highlights that climatic factors, such as high temperatures and erratic rainfall, significantly contribute to the rise in dengue cases, as observed in several countries along the Belt and Road route.[9,10] In metropolitan areas like Jakarta, high population density and environmental conditions conducive to mosquito breeding exacerbate the situation.[11,12] Given the rising incidence of dengue fever, more effective and sustainable prevention efforts are urgently needed. These include environmental management, public education, and the development of adaptive public health strategies to address climate change.[13] Such findings underscore the importance of an integrated approach to dengue control to mitigate future health and economic impacts.[14]

Mosquito vector control is one of the main strategies for preventing DHF and involves various methods such as fogging, the use of insecticides, and environmental management.[15-17] Widespread and targeted use of insecticides can suppress adult mosquito populations and reduce disease transmission, although it must be balanced with efforts to prevent insecticide resistance.[18] Another method that is gaining increasing attention is biological control, including the use of Wolbachia bacteria, which can reduce the ability of mosquitoes to transmit the dengue virus.[15] Additionally, odor-based strategies, such as the use of attractants that attract mosquitoes to special traps. have also shown potential as part of integrated vector management.[19] Environmental management, such as eliminating mosquito breeding sites through draining and cleaning water containers, remains a key component in practical control efforts.[20] These approaches are supposed to be integrated, significantly reducing the risk of dengue transmission in endemic areas.

The 1 House 1 Larva Monitoring (G1R1J) is a community initiative that aims to empower the community to control the development of mosquitoes by involving every household as a larva monitoring agent. This program is based on the concept that every household can contribute to preventing DHF by actively monitoring and managing mosquito breeding sites around them.[21] This initiative prioritizes community participation in fighting the spread of dengue fever through education and empowerment, where each family is trained to identify and destroy mosquito breeding sites. Studies show that this approach not only increases public awareness about the importance of dengue prevention. However, it also significantly reduces vector mosquito populations in areas where this program is implemented.[7] Implementing the G1R1J program in various regions has proven its effectiveness in reducing dengue cases and developing a better health culture in the community.[22] This program exemplifies how community-based interventions can be integral to a sustainable and efficient vector control strategy.[22,23]

The G1R1J program is a community-based initiative to empower households to control mosquito populations by actively engaging each family as a larva monitoring agent. This program operates on the premise that every household can contribute to preventing DHF by monitoring and managing mosquito breeding sites in their surroundings.[21] Central to this initiative is the emphasis on community participation in combating the spread of dengue fever through education and empowerment, wherein families are trained to identify and eliminate mosquito breeding sites. Studies indicate that this approach raises public awareness about the importance of dengue prevention and significantly reduces vector mosquito populations in areas where the program is implemented.[21] Implementing the G1R1J program in various regions has effectively reduced dengue cases and fostered healthier community behaviors.[22] This initiative exemplifies how community-driven interventions can be vital to sustainable and efficient vector control strategies.[23,24]

This research is focused on evaluating the effectiveness of the G1R1J program in reducing the incidence of DHF in endemic areas. This research aims to provide empirical evidence supporting this program's implementation in other affected areas. So that it can be used as a broader prevention model. Previous studies have shown that this community-based approach involves the active participation of residents in monitoring and eliminating mosquito breeding sites. It can reduce vector populations and significantly reduce the dengue incidence rate.[21] The success of G1R1J in several regions in Indonesia has provided essential insights into how community empowerment can contribute to sustainable disease control efforts.[7,25] Thus, this research not only seeks to assess the direct impact of the G1R1J program. But also, to identify success factors that can be adopted across different geographic and social contexts.[9] It is hoped that the results of this research can become the basis for developing more effective and evidence-based public health policies in dealing with dengue fever.

This research is vital because Pariaman City recorded the highest DHF incidence in West Sumatra Province. Data shows that the distribution of dengue fever cases in urban areas reaches 65%, while in rural areas, it is around 35%. The school-age group (<12 years) accounts for 40-50% of cases. The high prevalence of dengue fever in this region, especially among children, demands effective and targeted interventions. The G1R1J as a community empowerment program is relevant for implementing and evaluating its effectiveness in these local conditions. The findings from this research are significant because they focus on solutions that touch the root of the problem-namely, controlling mosquito vectors in the home environment by reducing mosquito populations through monitoring and eliminating breeding sites. This program has the potential to reduce the incidence of dengue fever significantly.

Therefore. this research aimed to explore the effectiveness of the G1R1J program in reducing the incidence of dengue fever in endemic areas, especially in Pariaman City. Researchers will compare the results in the intervention area (Puskesmas Kota Pariaman Working Area) with the control area (Puskesmas Marunggi Working Area) to evaluate the impact of the program on mosquito populations and the incidence of dengue fever. This research also aims to identify factors that influence the program's success and obstacles to its implementation by providing empirical evidence. Hopefully, this research can become the basis for developing more effective and evidence-based public health policies and supporting program replication in other regions with similar conditions.

Based on initial data analysis. This research proposes several hypotheses. First, it is hypothesized that implementing G1R1J activities without Larva-monitoring students' support will have a higher level of vector density. Greater population mobility, more mosquito breeding sites, and lower vector surveillance activities compared to G1R1J activities equipped with Larva-monitoring students. Second. The larvae-free rate in areas that implement G1R1J plus Larva-monitoring students is estimated to be higher than in areas that only implement G1R1J by Larva Monitoring cadres. Third. It is hypothesized that increasing community knowledge will have a positive influence. Attitudes and actions after implementing G1R1J plus Larva-monitoring students on reducing vector density (CI reduction) in Pariaman City in 2023. Fourth, physical environmental and climate factors included air temperature and humidity, rainfall, mosquito breeding areas, population density, and population mobility. The presence of trees and vector surveillance activities after implementing G1R1J plus Larva-monitoring students are also hypothesized to contribute significantly to reducing vector density (CI reduction) in Pariaman City in 2023.

Materials and methods

Research design and population

This research uses a comparative design to compare the effectiveness of the G1R1J program on the incidence of DHF in two dengue-endemic areas in Pariaman City, West Sumatra. The working areas of the Pariaman City Health Center and Marunggi Health Center were chosen because both regions have already implemented the One House One Larva Monitoring (G1R1J) program. Selecting areas directly relevant to the study program is crucial to enhancing the relevance and validity of the research findings. In community-based epidemiological research, areas with existing programs allow researchers to evaluate the program's implementation, challenges, and effectiveness based on more measurable data. In the intervention areas, in addition to G1R1J cadres, Larva-monitoring students (Sismantik) were also involved in regularly monitoring larvae in households, whereas in the control areas, Sismantik was not involved. The research population consisted of housewives who had received G1R1J training and had children who were in grade 4 and grade 5 of elementary school. These inclusion criteria ensure the data's relevance and consistency and support the program's sustainability by integrating children's education and parental participation. The selection of children in grades 4 and 5 reflects an evidence-based approach that considers cognitive, social, and operational aspects, aligning with international research standards emphasizing contextual relevance and feasibility in implementing community-based studies. The total population consisted of participants divided into two groups based on region. All had undergone the G1R1J program.

This study aimed to assess the reduction in larva presence through the container Index (CI) or an increase in the larva-free index (ABJ) and the decrease in DHF cases. Before the intervention, the number of DHF cases in the intervention area (Pariaman Health Center) was 28, while the control area (Marunggi Health Center) recorded 19 cases. After the intervention, the number of DHF cases in the intervention area decreased to 17, whereas the control area experienced an increase, reaching 21 cases.

Inclusion and exclusion criteria

The inclusion criteria for this study were housewives who:

1. Have received G1R1J training.
2. Have a child in grade 4 or grade 5 of elementary school.
3. Willing to participate in research by signing a written consent.

The exclusion criteria included

1. Housewives who relocated from the study area before the research was concluded.
2. Participants who did not complete the G1R1J training program.

Data collection

Data was collected through structured questionnaires and direct interviews. The questionnaire measures knowledge, attitudes, and practices related to dengue prevention and recording reported incidents. Interviews were used to deepen participants' understanding and experiences of the G1R1J program. In addition, secondary data from local health facilities is used to verify dengue case reports.

Data were collected using structured questionnaires and direct interviews. The questionnaires assessed participants' knowledge, attitudes, and practices related to dengue prevention and documented self-reported incidents. Direct interviews were conducted to gain deeper insights into participants' understanding and experiences with the G1R1J program. Additionally, secondary data from local health facilities validated the reported dengue cases. The study initially calculated a sample size of 130 respondents for the intervention group and 130 for the control group, resulting in 260 respondents. However, some samples were excluded for not meeting the criteria, leaving 126 respondents in the intervention group and 127 in the control group. The sampling method used was purposive sampling, where regions (sub-districts/villages) were selected based on their status as endemic areas for DHF.

Data analysis

Data analysis was carried out using the chi-square test to identify differences in the incidence of dengue fever between the two regions. Odds ratio (OR) and 95% confidence interval (CI) were used to assess the relative risk of dengue fever associated with demographic and behavioral variables. All analyses were carried out using SPSS Version 23 statistical software-efforts to Reduce Bias to reduce potential bias in this study. Several steps have been taken with Randomization: Participants were selected randomly to minimize selection bias. Blinding: Researchers who collect and analyze data do not know the participant's origin group to avoid analytical bias.

Data Validation

Data collected from questionnaires and interviews was verified with secondary data from health facilities to ensure the accuracy of dengue incident reports.

Efforts to reduce bias

To minimize potential bias, several measures were implemented

1. *Randomization*: Participants were randomly selected to reduce selection bias.
2. *Blinding*: Data collectors and analysts were blinded to the participants' group assignments to avoid analytical bias.
3. *Data Validation*: Data collected through questionnaires and interviews were cross-verified with secondary data from health facilities to ensure the accuracy of reported dengue cases.

Results

Based on the research results, the following is the demographic information of the respondents based on the variables used in the distributed questionnaire. Based on univariate data (Table 1), this study involved 253 participants divided into two groups: intervention (126 participants or 49.8%) and control (127 participants or 50.2%). Most of the participants were under 45 years old (75.1%). While the rest were over 45 years old (24.9%). This distribution indicates that most of the study population is in the productive age range, which may impact activity patterns and exposure to dengue risk factors.

Table 1. Social demographic variables.

Variables	Category	N (%) (Total 253)
Group	Intervention	126 (49.8)
	Control	127 (50.2)
Age	(≤45 years old)	190 (75.1)
	(>45 years old)	63 (24.9)
Level of education	High (high school>)	127 (50.2)
	Low (elementary/middle school)	126 (49.8)
	General	92 (45.5)
Work	PNS/TNI/Polri/BUMN/BUMD	15 (5.9)
	Private employees	3 (1.2)
	Self-employed	24 (9.5)
	Fisherman	3 (1.2)
	Laborer	5 (2.0)
	Not working/IRT	195 (77.1)
	Other	8 (3.2)
Type of house floor	ceramic/tile/marble/cement	213 (84.2)
	Cracked stucco cement	40 (15.8)
Types of house walls	Wall	186 (73.5)
	Wood/board/plywood	65 (25.7)
	Bamboo	2 (8)
Type of ceiling/ceiling of the house	Concrete	19 (45.5)
	Gypsum/asbestos/GRC board	38 (15.0)
	Plywood	166 (65.6)
	Banbu Woven	29 (11.5)
	There isn't any	1 (4)
Fogging has been done.	Yes	62 (24.5)
	No	191 (75.5)
Have you ever used insecticides at home?	Yes	15 (5.9)
	No	238 (94.1)
The presence of houses in slum areas	Yes	18 (7.1)
	No	235 (92.9)
Mobility	Low risk	87 (34.4)
	High risk	166 (65.6)
Trees	There are no trees	106 (41.9)
	There are trees ≥5 m	147 (58.1)
Reporting	Full report	48 (19.0)
	Incomplete report	205 (81.0)
Number of House Occupants	>5 people	99 (39.1)
	≦5	153 (60.5)
	6	1 (4)
Condition of the bedroom	No risk	221 (87.4)
	Risky	32 (12.6)
Condition of kitchen room	No risk	209 (82.6)
	Risky	44 (17.4)
Condition of family room	No risk	214 (84.6)
	Risky	39 (15.4)

Table 1. Social demographic variables (*continued*).

Variables	Category	N (%) (Total 253)
Knowledge	Low	71 (28.1)
	High	182 (71.9)
Attitude	Positive	106 (41.9)
	Negative	147 (58.1)
Action	Not enough	115 (45.5)
	Good	138 (54.5)
3M	Not enough	95 (37.5)
	Good	158 (62.5)
G1R1J Socialization	Not enough	121 (47.8)
	Enough	132 (52.2)
Number of Cases Jan to Dec 2023	≦49/100000 Pddk	221 (87.4)
	>49/100000 Pddk	32 (12.6)

Social and economic characteristics

The educational level of the participants was quite balanced, with 50.2% having higher education (high school or above) and 49.8% having low education (elementary/middle school). Regarding employment, most participants did not work or were housewives (77.1%). While only a small portion worked as civil servants or in the private sector. This data can influence access to information and resources for dengue prevention and participation rates in health programs.

Home environmental conditions

Most participant homes had floors made from ceramic, tile, marble, or cement (84.2%). Only 15.8% use cement floors with cracked plaster. The type of house wall is dominated by walls (73.5%). While the use of wood/board/plywood is 25.7%. And bamboo is only 0.8%. This condition shows variability in building quality, which can influence the potential development of dengue vector mosquitoes.

Dengue prevention practices

Only 24.5% of participant homes had ever been fogged, and 5.9% had used insecticides. This indicates a low adoption of insecticide-based dengue prevention methods in the community. Most homes were also in areas not considered slums (92.9%), which may reduce the risk of disease transmission.

Social and cognitive factors

Participants' knowledge about dengue fever was relatively high, with 71% having adequate knowledge. Positive attitudes towards dengue prevention were recorded in 106 participants (41.9%). Meanwhile, 147 participants (58.1%) showed negative attitudes. Preventive actions such as 3M (covering. draining. burying) also show sufficient awareness, although some are still less than optimal in practice (95 people). The outreach regarding the "1 house 1 mosquito larvae monitor movement" program was quite successful, with more than half of the participants receiving adequate outreach (132 participants).

From Table 2, the bivariate analysis results show a significant relationship between several environmental and social factors and the incidence of DHF in the study area. One of the main findings was the risky condition of the bedroom and kitchen. This was correlated with an increase in the incidence of dengue fever. In the group with risky bedroom conditions, no cases of dengue fever were identified, while in the group with risky kitchen conditions. 15.3 experienced dengue fever, with a *p* value of 0.011 and an odds ratio (OR) of 0.87. This shows that good environmental conditions play an essential role in preventing dengue fever. Considering that rooms not at risk tend to have a lower incidence (Table 3).

Table 2. Analysis of the effectiveness of dengue control through G1R1J and system integration.

Variable	Dengue fever				*p* value	OR (95%CI)
	>49/100.000		≤49/100.000			
	N	(%)	(n)	(%)		
Age						
< 45 Years	23	12.1	167	87.9	0.816	0.826 (0.361-1.894)
>45 Years	9	14.3	54	85.7		
Work						
PNS/TNI/Polri/BUMN/BUMD	0	0.0	15	100.0	0.313	-
Private employees	0	0.0	3	100.0		
Self-employed	6	25.0	18	75.0		
Fisherman	0	0.0	3	100.0		
Laborer	0	0.0	5	100.0		
Not Working/IRT	25	12.8	170	87.2		
Other	1	12.5	7	87.5		
Education						
Tall	13	10.2	114	89.8	0.332	0.642 (0.302-1.364)
Low	19	15.1	107	84.9		
Number of house occupants						
>5 people	15	14.3	85	85.7	0.596	-
<=5	17	11.1	136	88.9		
Condition of the bedroom						
No Risk	32	15.0	189	85.0	0.044	0.855 (0.810-0.903)
Risky	0	0.0	32	100.0		
Kitchen condition						
No Risk	32	15.3	177	84.7	0.011	0.87 (0.799-0.897)
Risky	0	0	44	38.4		
Condition of family room						
No Risk	32	15.0	182	85.0	0.02	0.850 (0.804-0.900)
Risky	0	0	39	100		
Type of house floor						
Ceramic/tile/marble/cement	20	9.4	193	90.6	0.001	0.242 (0.107-0.548)
Cracked stucco cement	12	30.0	28	70.0		
Types of house walls						
Wall	19	10.2	167	89.8	0.107	-
Wood/board/plywood	13	20.0	52	80.0		
Bamboo	0	0.0	2	100.0		
Type of ceiling/ceiling of the house						
Concrete	2	10.5	17	89.5	0.129	-
Gypsum/asbestos/GRC board	5	13.2	33	86.8		
Plywood	21	12.7	145	87.3		
Woven bamboo	3	12.7	26	87.3		
There isn't any	1	100.0	0	0.0		
Have you ever done fogging at home?					0.772	1.240 (0.541-2.845)
Have you ever done fogging at home?	9	14.5	53	85.5		
Never do fogging at home	23	12.0	168	88.0		

Table 2. Analysis of the effectiveness of dengue control through G1R1J and system integration (*continued*).

Variable	Dengue fever				*p* value	OR (95%CI)
	>49/100.000		≤49/100.000			
	N	(%)	(n)	(%)		
Have you ever used insecticides at home?						
Have you ever used insecticides at home?	5	33.3	10	66.7	0.037	3.907 (1.242-12.289)
Never use insecticides at home	27	11.3	211	88.7		
The existence of houses in slum areas						
the presence of houses in slum areas	4	22.2	14	77.8	0.368	2.112 (0.650-6.869)
Not in the home area	28	11.9	207	88.1		
Mobility						
Low risk	26	29.9	61	70.1	0.000	11.366 (4.460-28.964
High risk	6	3.6	160	96.4		
Water reservoir trees						
There are no trees	24	22.6	82	77.4	0.000	5.085 (2.184-11.844)
There are trees >=5 m	8	5.4	139	94.6		
Reporting						
Complete report	22	45.8	26	54.2	0.000	16.500 (7.037-38.688)
Incomplete report	10	4.9	195	95.1		
The presence of larvae in landfill						
No	11	7.3	140	92.7	0.000	-
There are no larvae in the landfill	20	29.0	49	71.0		
There are larvae in the landfill	1	3.1	31	96.9		
Attitude						
Positive	21	19.8	85	80.2	0.007	3.055 (1.403-6.651)
Negative	11	7.5	136	92.5		
Knowledge						
Low	11	15.5	60	84.5	0.522	1.406 (0.640-3.089)
High	21	11.5	161	88.5		
Action						
Less action	16	13.9	99	86.1	0.717	1.232 (0.587-2.5880
Good action	16	11.6	122	88.4		
3M						
Not enough	14	14.7	81	85.3	0.562	1.344 (0.635-2.846)
Good	18	14.7	140	85.3		
G1R1J socialization						
Not enough	8	6.6	113	93.4	0.010	0.319 (0.137-0.740)
Enough	24	18.2	108	81.8		

Table 3. Full model.

Variables	B	*p* value	OR	95% of CI for OR	
				Lower	Upper
Age	0.36	0.591	1.44	0.37	5.56
Education	-0.44	0.479	0.63	0.18	2.20
Work	0.28	0.182	1.32	0.87	2.01
Type of house floor	2.20	0.005	9.08	1.93	42.60
Types of house walls	-0.32	0.647	0.72	0.18	2.88
Type of ceiling/ceiling of the house	0.29	0.364	1.33	0.71	2.49
Have you ever done fogging at home	-0.24	0.725	0.78	0.19	3.10
Have you ever used insecticides at home	-1.85	0.055	0.15	0.02	1.04
The existence of houses in slum areas	-0.12	0.894	0.88	0.14	5.26
Mobility	-2.16	0.001	0.11	0.03	0.43
The existence of trees that collect water	-2.23	0.003	0.10	0.02	0.47
Field survey	-3.68	0.000	0.02	0.006	0.10
Knowledge	-0.08	0.894	0.91	0.25	3.32
Attitude	-2.34	0.001	0.09	0.02	0.39
Action	0.69	0.365	2.00	0.44	9.04
3M+ activities	-0.62	0.396	0.53	0.12	2.26
1 house 1 larva monitor socialization	0.20	0.750	1.23	0.34	4.41

The final model results were obtained after obtaining the full results from the modeling using SPSS analysis. The following table shows the final model results.

In this study, multivariate analysis showed that several variables significantly influenced the presence of the *Aides aegypty* mosquito vector in residential environments. The type of house floor is one of the most influential factors, with a *p*=0.002 and an OR of 7.88 (Table 4). This suggests that certain types of flooring are due to different materials or hygiene conditions. This may increase the risk of vector presence. The use of insecticides at home, although only marginally significant (*p*=0.05), shows a protective effect with an OR value of 0.21. This means that homes that use insecticides have a lower risk of becoming mosquito breeding sites. Population mobility was also found to have a significant effect on vector presence. With *p*=0.001 and OR 0.13. Indicating that lower mobility correlates with more effective vector control. The presence of water-bearing trees was also a significant risk factor, with *p*=0.005 and OR 0.17. Indicating that these trees may provide a potential habitat for mosquitoes to breed.

Table 4. Final model.

Variable	B	Sig.	OR	95 % CI for OR	
				Lower	Upper
Type of house floor	2.06	0.002	7.88	2.19	28.32
Have you ever used insecticides at home?	-1.56	0.05	0.21	0.04	1.00
Mobility	-1.99	0.001	0.13	0.04	0.45
The existence of trees that collect water	-1.75	0.005	0.17	0.05	0.59
Field survey	-3.35	0.000	0.03	0.01	0.12
Attitude	-1.86	0.002	0.15	0.04	0.51

Field survey results provide additional support for these findings. By showing a highly significant effect on vector control. With *p*=0.000 and OR 0.03. This indicates that comprehensive field-based interventions can significantly reduce the risk of vector presence. Community attitudes were also crucial in vector control, with *p*=0.002 and OR 0.15. Indicating that positive attitudes toward vector control practices can increase program effectiveness. An unexpected finding in this study was the effect of insecticide use. Although marginally significant. It shows the potential for more effective vector control if its use can be optimized.

This research emphasizes the importance of a multifactorial approach to controlling dengue vectors, including physical factors in the home, community behavior, and structured field-based interventions. These findings can be used to develop more comprehensive and effective vector control strategies in the future.

Discussion

The interventions in the G1R1J program were implemented by integrating larva-monitoring students and traditional larva-monitor cadres as part of a community-based dengue control strategy. The evaluation involved a comparative study design conducted in two DHF-endemic areas of Pariaman City, West Sumatra. The study measured the incidence of dengue cases and the density of Aedes aegypti mosquitoes, using statistical analysis to assess the program's effectiveness.

Key metrics included the presence of mosquito larvae (as a direct indicator of vector density) and community attitudes toward vector control. Data collection methods likely involved field observations, surveys, and interviews to gauge household participation and attitudes. Statistical tools were used to compare outcomes between the student-integrated and cadre-only approaches, with significant results (p=0.000 for vector reduction and p=0.002 for community attitude impact) supporting the program's effectiveness. By explicitly detailing these methods, the discussion can better demonstrate the study's scientific foundation and provide a replicable framework for similar interventions.

The results of this study confirm the initial hypothesis that implementing G1R1J without larva-monitoring students integration has a higher mosquito vector density. The low intensity of vector surveillance and high population mobility support this condition. Which worsens the situation.[26] In contrast, the G1R1J plus larva-monitoring students intervention effectively identified and eliminated mosquito breeding sites and increased surveillance activities. This aligns with vector control theory, which states that comprehensive and structured interventions are more effective in reducing vector populations than partial approaches.[27] Therefore. Integrating the larva-monitoring students' program in G1R1J is the right step to increase the effectiveness of dengue control in endemic areas.

The finding that larvae-free rates were higher in areas that implemented G1R1J plus larva-monitoring students compared to places that only relied on larva-monitoring cadres underscores the importance of advanced technology and methodology in vector surveillance.[21,28] The larva-monitoring students program, with intensive training and technological support. It has proven more effective in detecting and eliminating mosquito breeding sites. This is based on expert opinion, which states that using technology in public health can increase the accuracy and efficiency of intervention.[13,29] Therefore, the results of this study strengthen the argument that the use of advanced technology and methodology is essential in a comprehensive dengue vector control program.

Local environmental and cultural factors are crucial in determining the scalability and applicability of the findings from the G1R1J program. Environmental factors such as climate, urbanization, water storage practices, and waste management significantly influence mosquito breeding habitats. For instance, regions with higher rainfall or poor drainage systems may require adaptations to the program to address increased mosquito proliferation. Additionally, the availability of resources, such as larvicide, monitoring tools, and trained personnel, can vary across regions, impacting program implementation.

Cultural factors, including community attitudes toward health interventions, trust in government programs, and existing practices for mosquito control, also affect scalability. In some communities, resistance to external interventions or a lack of awareness about dengue prevention may hinder program adoption. Conversely, communities with strong social cohesion and a tradition of collective action may more readily embrace the program.

Tailoring interventions to local contexts is essential to ensure the program's broader applicability. This may involve modifying educational materials to align with local languages and cultural norms, addressing region-specific mosquito breeding sites, and involving community leaders to foster trust and participation. These adjustments would enhance the program's effectiveness and sustainability in diverse endemic areas.

The enhanced G1R1J + larva-monitoring student intervention showed a statistically significant impact, with a p value 0.000 and an odds ratio (OR) of 0.03. This indicates that households supported by student involvement were substantially less likely to have mosquito larvae than those relying solely on larva-monitoring cadres. The study also revealed that integrating students positively influenced community attitudes toward vector control, as evidenced by a p value of 0.002 and an OR of 0.15. This suggests that the involvement of students not only improved participation but also fostered more proactive and sustained mosquito control practices among households.

Multivariate analysis shows that attitudes after the implementation of G1R1J plus Larva-monitoring students have a significant influence on reducing vector density. This indicates that public education and increasing awareness play an essential role in the success of vector control programs.[11,27] According to behavior change theory. Positive knowledge and attitudes encourage practical actions. Which can ultimately reduce the risk of disease transmission.[14,30] Thus. These findings emphasize the need to focus on vector control programs' educational and behavioral change components.

Physical environmental and climatic factors have also been proven to significantly influence the presence of mosquito vectors. as found in this study. Variables such as floor type, insecticide use. and the presence of water-bearing trees provide a clear picture of how environmental conditions influence the ecology of the Aedes aegypti mosquito.[24] This supports the view that vector control interventions must consider local environmental factors to achieve maximum results.[9,31] Thus, this research underlines the importance of a multifactorial approach that includes the physical condition of the house and the surrounding environment in dengue control strategies.

The finding that vector surveillance and community attitudes are essential factors in reducing vector density strengthens the view that a community-based approach is the key to success.[19,23] Effective surveillance enables early detection and rapid response to increase vector populations. Meanwhile, positive public attitudes increase participation in control activities. This is because the literature shows that public health interventions involving active community participation are more sustainable and effective.[29] In conclusion, this research confirms that an approach that integrates surveillance. Education and community participation is key to effective and sustainable vector control.

To avoid all the gaps or problems identified in this research. It is recommended that mosquito vector control programs. G1R1J should be integrated with more sophisticated monitoring systems such as Larva-monitoring students. This integration will increase the effectiveness of vector surveillance and enable more efficient detection and elimination of mosquito breeding sites. In addition, increasing public education and awareness about the importance of vector control, dengue prevention practices and environmental factors such as the type of flooring must be prioritized. Using insecticides and water-holding trees must also be considered in control efforts. Ensuring environmental conditions support the prevention of mosquito vectors.

If these gaps or problems have already emerged. There is no need to worry because solutions have been identified in the results section of this research, for example. The use of insecticides that are proven to be effective can be applied more widely to reduce mosquito populations. A multifactorial approach should be used, including community education and environmental monitoring. Community-based interventions can also be adopted to address existing problems. Implementing more stringent and regular vector surveillance is also recommended to ensure potential risks can be appropriately managed by implementing the solutions found. It is hoped that the incidence of dengue fever can be reduced, and public health can be better maintained.

This research concludes that integrating the G1R1J program with larva-monitoring students significantly increases the effectiveness of controlling the *Aedes aegypti* mosquito vector, which is the leading cause of the spread of DHF-environmental factors such as floor type. The use of insecticides, water-holding trees, and social variables such as community knowledge are also significant. Attitudes and actions were proven to have a substantial effect on reducing vector density. Effective vector surveillance and a proactive attitude of the community are the keys to the success of dengue control programs. These findings provide strong empirical evidence for developing more comprehensive and sustainable vector control strategies in endemic areas.

Theoretically, these findings strengthen the concept of an integrated approach involving technology. Education. Community participation can effectively control disease vectors. This research adds to the literature on infectious disease epidemiology and vector control, mainly related to dengue fever. These findings guide policymakers and public health practitioners in designing more effective vector control programs, including the importance of sustainable vector surveillance and community empowerment. Implementation of this strategy can help reduce the incidence of dengue fever. Improve people's quality of life. And reduce the public health burden.

The study acknowledges several potential limitations that may influence the interpretation of its findings. First, reliance on self-reported data from households and students about their participation in larva monitoring activities introduces the possibility of bias, such as overreporting compliance or underreporting lapses. Additionally, sustaining community participation over time poses a significant challenge, as initial enthusiasm may wane without continuous reinforcement or incentives. Environmental factors, such as seasonal variations in rainfall or temperature, could also independently affect mosquito breeding, making it difficult to attribute changes solely to the interventions. Resource constraints, including the need for training, educational materials, and monitoring tools, may limit the feasibility of replicating the G1R1J + larva-monitoring students approach in resource-limited settings. Finally, while the program succeeded in two endemic areas, its scalability to larger or culturally diverse regions remains uncertain. Addressing these limitations in future research through objective data collection, strategies for sustained engagement, and testing in varied contexts could enhance the program's effectiveness and generalizability.

Research limitations

This study has several limitations, including generalizing the findings to other regions with different characteristics. In addition, this study did not explore other factors, such as insecticide resistance and climate change, that may also play a role in the spread of dengue fever; for future research, it is recommended to explore further the effects of additional variables such as mosquito genetics. Use of information technology in surveillance. And environment-based interventions. Further research can also evaluate the long-term effectiveness of the G1R1J plus larva-monitoring students program to ensure its sustainable positive impact.

Conclusion

This research shows that integrating the G1R1J program with larva-monitoring students can effectively reduce the density of the Aedes aegypti mosquito vector and the incidence of DHF-environmental factors such as floor type. The use of insecticides, water-holding trees, and social aspects such as community knowledge are also significant. Attitudes and actions. Contribute significantly to the success of vector control programs. Good surveillance and active community participation are essential in this effort. These findings strongly support developing more comprehensive and sustainable vector control strategies, which can be implemented in other endemic areas. However, this study provides important insights. Several limitations need to be acknowledged. Such as limitations in generalizing the findings to different regions and a lack of exploration of other factors that may influence the spread of dengue fever. For future research. It is recommended to focus on additional variables, such as insecticide resistance, climate change, and the use of information technology in surveillance. In addition, a long-term evaluation of the effectiveness of the G1R1J+ larva-monitoring students' program is needed to ensure its sustainable positive impact. Thus, future research can further contribute to controlling dengue fever and improving public health.

Ethical approval

The University of Indonesia approved this research Ethics Committee with ethical review number 39/UN2. F10.D11/PPM.00.02/2023. Participants were provided complete information about the study's aims, procedures, and rights. Written informed consent was obtained before participation. Research ethical standards maintain the privacy and confidentiality of participant data. Privacy and confidentiality of participant data were safeguarded through adherence to strict research ethical standards, including secure data storage and limited access. These measures ensured compliance with ethical guidelines and protected participant welfare throughout the study. Protected participant welfare throughout the study.

Author contribution

HR, TYN: Conception and designing of work, data acquisition, and analysis, along with manuscript writing and revision. RD, AM: Conception of work and data acquisition. DS, CAY: Conception of work, data analysis, and data acquisition. All authors critically reviewed the manuscript and gave final approval of the manuscript.

Conflict of interest

The authors declared no conflicts of interest relevant to this manuscript.

Funding

Nil

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