KEMAS 22 (1) (2026) 25-36

Jurnal Kesehatan Masyarakat

http://journal.unnes.ac.id/nju/index.php/kemas

Acceptance of Ricinus communis L. Natural Larvicides

Indra Chahaya S[1]✉, Winni R.E Tumanggor[1], Evi Naria[1], Atma Aisyah Prudise[1], Miftahussakdan[1], Shafira Aqilah[1]

[1]Faculty of Public Health, Universitas Sumatera Utara, Medan, Indonesia

Article Info

Article History:
Submitted December 2025
Accepted June 2026
Published July 2026

Keywords:
Dengue Hemorrhagic Fever; Natural
Larvicide; Acceptance

DOI
https://doi.org/10.15294/kemas.v22i1.38607

Abstract

Dengue Hemorrhagic Fever (DHF) remains a major public health challenge in Indonesia, particularly in Medan City, North Sumatra. As the effectiveness of chemical larvicides continues to decline, there is growing interest in natural, eco-friendly alternatives such as larvicides derived from castor seeds (Ricinus communis L.). This study aims to examine the factors influencing the acceptance of these natural larvicides among housewives in Medan City. A cross-sectional design was used, involving 844 respondents across 21 districts. The analysis was carried out in four stages: univariate analysis to describe respondent characteristics, chi-square tests for bivariate relationships, logistic regression for multivariate assessment, and spatial analysis to identify geographic patterns of larvicide acceptance. The findings reveal that demographic variables such as age, education, and dengue history do not significantly affect acceptance. However, the relationship between attitude and knowledge and the acceptance of dengue prevention measures is statistically significant. In addition, attitude was the most dominant independent factor in predicting the acceptance of Ricinus communis L. natural larvicide as a measure to prevent dengue fever in logistic regression (OR = 3.624; $p < 0.001$). This indicates that internal readiness and positive perceptions play a crucial role in encouraging the acceptance of eco-friendly larvicide options.

Introduction

Dengue Hemorrhagic Fever is now recognized as one of the most urgent public health challenges globally (de Almeida *et al*., 2025; Naji, 2023; Sinha *et al*., 2024). Based on Global Dengue Surveillance, DHF in global 19 million cases reported with 73 thousand severe cases in the world, and 266 thousand cases reported with 12 thousand severe cases from January 2024 until October 2025 (EClinicalMedicine, 2024; World Health Organization, 2025). This increase in cases is due to massive urbanization, high population mobility, and climate change that expand mosquito habitats, causing dengue fever to infect millions of people each year and significantly add to the disease burden in tropical and subtropical regions (Telle *et al*., 2025; Zheng *et al*., 2025). In response to this challenge, current dengue control strategies place strong emphasis on monitoring and controlling *Aedes aegypti* mosquito vectors by surveillance as the primary means of reducing transmission (Guo *et al*., 2025). Therefore, it is important to understand how mosquitoes live and how they are controlled to determine the right interventions, including using the ovitrap as a dengue vector surveillance method (Fernandes *et al*., 2025; Iman *et al*., 2021).

In Southeast Asia, particularly in Indonesia, dengue remains an endemic health problem with a high number of cases, largely driven by significant climate change (Ardiansyah Akbar *et al*., 2025). Based on the Health Profile of Indonesia, Indonesia experienced a significant rise in its dengue incidence rate, reaching 91.9 cases per 100,000 population in 2024 after dropping to 41.4 in 2023. Similarly, North Sumatra saw a notable

✉ Correspondence Address:
Faculty of Public Health, Universitas Sumatera Utara, Medan, Indonesia
Email: indra4@usu.ac.id

pISSN 1858-1196
eISSN 2355-3596

increase, reporting 4,578 cases and 22 deaths in 2023, which escalated to 9,366 cases and 58 fatalities in 2024 (Ministry of Health, 2024). In 2023, North Sumatra recorded 4,578 dengue fever cases with 22 deaths, and this increased to 9,366 cases with 58 deaths in 2024 (Ministry of Health, 2024). Medan, as one of the most populous metropolitan cities in North Sumatra, recorded 1,102 dengue fever cases with 1 death in 2024 (North Sumatra Provincial Health, 2024).

- The most effective way to control mosquitoes is by interrupting the life cycle of *Aedes aegypti* while they are still in the larval phase, as they are unable to reproduce, and their metabolic system and nervous system are not yet fully developed (Nawarathne & Dharmarathne, 2024). This action not only prevents the larvae from maturing into adult mosquitoes but also offers a more efficient and sustainable strategy compared to controlling adult mosquitoes, which are more mobile and harder to eliminate (Gavana *et al*., 2025). By reducing the larval population, the overall risk of disease transmission can be significantly minimized.

Currently, both the government and the community have been using chemical larvicides (e.g., Temephos) to reduce the larval population as a preventive national program since 1976 (Adrianto *et al*., 2023; Ramayanti *et al*., 2016). However, temephos is a chemical compound that serves as a larvicide, which has several disadvantages, such as polluting the environment, causing insecticide resistance, causing environmental imbalance, and being harmful to humans and other non-target organisms (Wardani *et al*., 2019). Not only in Indonesia, but also in most of the world, there are the same problems as in Mexico, Brazil, Colombia, Peru, and others (Davila-Barboza *et al*., 2024). This resistance occurs because temephos is used so frequently that mosquitoes have become resistant to the pyrethroids and organophosphates contained in temephos, enabling them to mutate and adapt so that temephos is no longer effective (Conway *et al*., 2023; Ngoagouni *et al*., 2016). This condition may create long-term risks for environmental.

Therefore, safer innovations and eco-friendly alternatives are needed. There is a need for a transformation from chemical larvicide to natural larvicide to protect the environmental ecosystem and human well-being that can be accepted by the community. Several innovations regarding natural larvicide are castor seed as a natural larvicide in Medan City (Chahaya *et al*., 2024): papaya leaf juice to reduce mosquito larval population as an alternative to temephos in Yogyakarta (Cahyati *et al*., 2017, 2019), red ginger essential oil as the natural larvicide (Denai *et al*., 2025), lemongrass extract (Luh *et al*., 2017; Pratiwi, 2014; Salaki *et al*., 2019), karimunting plant (Mahfud *et al*., 2021), pineapple skin infusion (Onesiforus *et al*., 2023), and many more. All these studies aim to look for another alternative to find the best solutions for transforming temephos into a natural larvicide.

The transformation from using temephos to natural larvicides is one of the most appropriate solutions to reduce the *Aedes aegypti* population. However, natural larvicide is still not common among the community. They believe that liquid larvicides are less effective and inconvenient to use and prefer more practical options, such as powder, and tend to avoid applying the larvicide in the water reservoir because they may affect the water quality (Pratiwi, 2014). In addition, the castor plant (*Ricinus communis L.*) has shown potential as a natural larvicide due to its bioactive compounds, including alkaloids, terpenoids, tannins, and saponins, which are toxic to mosquito larvae. Compared to synthetic agents, plant-based larvicides are safer for non-target organisms and environmentally sustainable (Sogan *et al*., 2018). Moreover, *Ricinus communis L.* natural larvicide is more effective because this larvicide is developed in capsule form and does not need to be added to the water container, as it utilizes an ovitrap that will not interfere with daily water quality.

Previous studies have demonstrated that castor seed larvicide effectively increased the Larvae-Free Index in Medan City. *Ricinus communis L.,* powdered at 100 mg/l of water, may be an alternative for reducing DHF because it has been proven to kill *Aedes aegypti* mosquito larvae (Chahaya *et al*., 2025). Therefore, further research on the application of *Ricinus communis L.* based natural larvicides is essential

to enhance community participation in dengue prevention and promote environmentally friendly vector control strategies. Addressing the urgent need for sustainable vector control, this study aims to analyze the predictive factors influencing the acceptance of *Ricinus communis L.* larvicide by housewives in urban endemic areas of Medan. Specifically, the research measures the roles of demographic factors, dengue history, knowledge, and attitudes towards dengue prevention in predicting this acceptance tendency. These findings are vital for achieving Sustainable Development Goal 3 (SDG 3), particularly Target 3.3 (ending dengue epidemics) and Target 3.9 (reducing chemical hazards), thereby supporting Indonesia's 2030 zero dengue death goal through integrated, sustainable behavior.

Method

This study is designed to test the role of knowledge and attitudes in adopting environmentally friendly *Ricinus communis L.* larvivores as a sustainable effort to prevent Dengue Hemorrhagic Fever (DHF) in endemic urban environments. This research had obtained ethical clearance from the Health Ethics Commission, Universitas Sumatera Utara (No. 909/KEPK/USU/2025). This research employed an observational analytical cross-sectional design to examine the role of demographics, knowledge, and attitudes in the acceptance of *Ricinus communis L.* natural larvicides for sustainable Dengue Haemorrhagic Fever (DHF) prevention in an urban endemic setting. The target population was housewives in Medan City, selected due to their central role in household dengue prevention management. A sample of 844 housewives across 21 sub-districts. Primary data were collected via a structured questionnaire measuring Knowledge, Attitudes, and Acceptance of the *R. communis L.* larvicide.

Data collection was carried out observationally with a structured questionnaire administered using the KoboToolbox digital platform. This study focuses on housewives as respondents. The measurement of demographic (age, employment, education level, DHF family cases), knowledge, attitudes, and acceptance. At this stage serves as a post-exposure assessment to ensure that respondents have a standard information base before the admission assessment is conducted, in accordance with the cross-sectional study design and spatial assessment, where this design is used to see the acceptance of natural larvicide among housewives in 21 sub-districts of Medan City.

The variables assessed in this study comprised demographic characteristics, history of dengue infection, knowledge, attitudes, and acceptance of castor seed larvicide. The demographic measurement in this study is seen from three aspects, namely the age, employment, and education level of the respondents. The age category is divided into two, namely respondents aged ≤ 60 years who are categorized as adults and given a code 0, and respondents aged > 60 years who are categorized as elderly and given a code 1. Job variables are classified into two categories, i.e., not working (code 0) and working (code 1). Meanwhile, education levels were categorized into low education, which included respondents who were not in school, elementary school, or junior high school (code 0), and higher education, which included respondents with high school and college education (code 1). A history of dengue was defined as "yes" if, within the past year, any family member had a history of dengue fever. A value of "0" was assigned if there was no dengue history, and "1" was assigned if a history of dengue was present.

DHF knowledge was assessed using 14 dichotomous questions (score 1 for correct, 0 for incorrect). Scores were categorized using the median as the cut-off point: ≥ 11 (≥ 78.6%) indicated high knowledge, < 11 (< 78.6%) indicated low knowledge. In addition, attitudes towards DHF handling were measured using seven positive questions on a three-point Likert Scale (3 = strongly agree, 2 = agree, 1 = disagree). Attitudes were categorized using the median cut-off point: a total score of 21 (100%) indicated a good attitude, < 21 (< 100%) indicated a poor attitude. Acceptance of the castor seed larvicide (*Ricinus communis L.*) was measured via three positive questions on a three-point Likert Scale (3 = strongly agree, 2 = agree, 1 = disagree). Furthermore, acceptance was categorized using the median cut-off point: a total score of 9 (100%) indicated

TABLE 1. Frequencies Demographic Characteristics

Variable	Category	n	%
Demographic Characteristics			
Age	Adult (20 – 60 years old)	769	91.1
	Elderly (> 60 years old)	75	8.9
Educational level	Low (No formal – Junior High School)	144	17.0
	High (Senior High School – University)	700	83.0
Employment status	Employed	583	69.1
	Unemployed	261	30.9
History of Dengue (Last 1 year)	No	804	95.3
	Yes	40	4.7
Total		844	100.0

high acceptance, and < 9 (< 100%) indicated low acceptance. This study was used to visualize the spatial distribution of *Ricinus communis L.* natural larvicide acceptance among housewives in Medan City. The more intense the green color on the map, the higher the level of acceptance in that area. Low acceptance area = 46.7 - 64.4, middle acceptance area = 64.4 - 82.2, high acceptance area = 82.2 - 100. Most dengue cases are marked with a more intense red color. Low cases area = 1.18 – 5.31, middle cases area = 5.31 – 9.44, high cases area = 9.44 – 13.58.

The collected data is processed through three main stages of analysis. Descriptive Analysis was used to present the respondents' demographic characteristics and calculate descriptive statistics (mean and standard deviation) for the main variables (Knowledge, Attitude, and Acceptance). In the bivariate analysis, the Chi-square test was employed to assess the initial association between demographic characteristics and larvicide acceptance status (Yes/No). Multivariate Analysis and Logistic Regression were applied to identify factors significantly influencing the likelihood of acceptance. This model estimates the Odds Ratio (OR) for independent variables (Knowledge and Attitude) after controlling for socio-demographic confounders. Spatial Analysis, Spatial analysis was conducted using QGIS software to map and examine the geographic distribution of *Ricinus communis L.* natural larvicide acceptance across the study area. This approach allowed the identification of spatial patterns and highlighted regions with varying levels of acceptance.

Results and Discussion

A total of 844 housewives from 21 districts in Medan City participated in this study. Univariate descriptive analysis profiled the study sample (Table 1); among the 844 respondents, the majority were adults aged 20–60 years (91.1%). Most respondents had a higher educational level, ranging from senior high school to university (83.0%), while only 17.0% had a lower level of education. In terms of employment status, 69.1% of respondents were employed, indicating that the sample largely consisted of individuals who are economically active. The prevalence of dengue history within the past year was also relatively low, with only 4.7% reporting a family member who had experienced dengue. Overall, these findings indicate that the respondent population was predominantly composed of adults with higher educational attainment, active employment, and a relatively low history of dengue infection.

The analysis shows that most respondents have good knowledge of dengue, including its definition, transmission, symptoms, mosquito behavior, and life cycle (Table 2). Understanding of larvicides is also fairly good. However, knowledge about mosquito physical characteristics and specific details of natural larvicides is still low. The assessment of respondents' knowledge revealed that 53.4% demonstrated a high level of knowledge (score ≥11), while 46.6% fell into the low-knowledge category. Regarding attitudes toward dengue prevention, the majority exhibited a positive attitude, with 76.9% achieving a good attitude score (score = 21), whereas 23.1% showed poorer

TABLE 2. Distribution of Housewives' Knowledge Level, Attitude, and Acceptance related to Dengue and Its Prevention After Receiving Education Through Video

Variable	Category	n	%
Knowledge			
Knowledge level	High (score ≥**11)**	451	53.4
	Low (score <11)	393	46.6
Attitude			
Attitude Level	Good (score = 21)	649	76.9
	Bad (score <21)	195	23.1
Acceptance of Natural Larvicides			
Acceptance level	High (score =9)	700	82.9
	Low (score <9)	144	17.1
Total		844	100.0

attitudes (score <21). In terms of acceptance of natural larvicides, 82.9% of respondents reported a high level of acceptance (score = 9), and only 17.1% indicated low acceptance (score <9). Overall, these findings suggest that the respondent group was predominantly characterized by adequate knowledge, favorable attitudes, and strong acceptance of natural larvicide use.

Bivariate analysis utilizing the Chi-square test was conducted to determine preliminary associations with the acceptance of natural larvicide (Table 3). Four sociodemographic variables: Age (p=0.176), Employment status (p=0.616), Education Level (p=0.186), and Family DHF History (p=0.171) met the criterion for inclusion in the subsequent multivariate model (p < 0.25), contrasting with the non-associated Employment Status (p=0.616). The highest acceptance rates were notably observed in the adult age group (89.3%) and the higher education group (69.4%), indicating that groups with greater cognitive resources and productive capacity showed a higher initial acceptance tendency. Furthermore, both primary study variables, Knowledge (p=0.028) and Attitude (p=0.000), were significantly associated with acceptance; however, the influence of Attitude was statistically dominant, with 67.7% of respondents having a positive attitude also reporting high acceptance. This strong association establishes Attitude as the key psychosocial predictor requiring further dominance testing in the final multivariate prediction model.

TABLE 3. Relationship between Demographic Characteristics, Knowledge, and Attitudes towards Ricinus communis L. Larvicide Acceptance

Independent Variables	Category	Low Acceptance	High Acceptance	Total (n=844)	P-value
Demographic Characteristics		n (%)	n (%)	n (%)	
Age	Adult (20 - 60 yrs)	15 (1,8%)	754 (89,3%)	769 (91,1%)	0.176
	Elderly (>60 yrs)	2 (0,2%)	73 (8,7%)	75 (8,9%)	
Education Level	Low	30 (3,6%)	114 (13,5%)	144 (17,1%)	0.186
	High	114 (13,5%)	586 (69,4%)	700 (82,9%)	
DHF History (Family)	Yes	10 (1,2%)	30 (3,5%)	40 (4,7%)	0.171
	No	137 (16,2%)	667 (79,1%)	804 (95,3%)	

Employment Status	Employed	-	-	583 (69,1%)	0.616
	Unemployed	-	-	261 (30,9%)	
Key Variables					
Knowledge	Bad	79 (9,4%)	314 (37,2%)	393 (46,6%)	0.028*
	Good	65 (7,7%)	386 (45,7%)	451 (53,4%)	
Attitude	Low	66 (7,8%)	129 (15,3%)	195 (23,1%)	0.000*
	High	78 (9,2%)	571 (67,7%)	649 (76,9%)	

*significant

Based on bivariate results, five independent variables (Age, Education Level, Dengue History, Knowledge, and Attitude) were incorporated into the Binary Logistic Regression model to identify the most dominant independent predictor factors against Larvicide Innovation Acceptance (Table 4). Multivariate Logistic Regression explicitly identified Attitude toward DHF prevention as the single, most significant, and dominant predictor of *Ricinus communis L.* natural larvicide acceptance (p=0.000; Wald = 18.318). Housewives with a positive attitude are 3.6 times more likely to adopt the larvicide (OR) = 3.624 compared to those with a negative attitude, after controlling for other variables. Crucially, all other factors, including Knowledge and demographics, were rendered non-significant p>0.05 in the final model. This underscores that the affective component (Attitude) is the primary determinant of acceptance behavior, suggesting that the influence of cognitive or demographic factors is entirely mediated by the strength of Attitude.

The spatial distribution of community acceptance of *Ricinus communis L.* natural larvicide and dengue fever cases across districts in Medan City demonstrates a pattern that highlights pubic readiness to accept vector control innovation (Figure 1,2, and Table 5). Medan Selayang (13.58%; 89.5%) and Medan Johor (11.45%; 91.8%) demonstrate a high number of dengue cases but also a high number of acceptances. suggesting that higher disease burden may heighten community awareness and willingness to embrace larval-control innovations. Medan Tuntungan (10.04%; 76.2%), though having a substantial case proportion, demonstrates only moderate acceptance. There are several districts with middle dengue case distributions that also consistently show high acceptance. For instance, Medan Sunggal (5.9%; 78.0%), Medan Baru (8.03%; 79.4%), and Medan Denai (8.85%; 92.0%) illustrate communities that remain receptive to natural larvicide interventions even though their cases are not too high. Likewise, Medan Kota (4.37%; 89.2%)

TABLE 4. Multivariate Logistic Regression of Factors Associated with the Acceptance of Natural Larvicide Derived from Castor Seeds (Ricinus communis L.)

Independent Variables	**B**	**SE**	**Wald**	**p-value**	**OR**	**95% CI for OR**
Attitude (1=High; 0=Low)	1.287	0.301	18.318	0.000*	3.624	2.008 – 6.536
Knowledge (1=High; 0=Low)	0.256	0.301	0.724	0.395	1.292	0.714 – 2.339
DHF history (1=Yes; 0=No)	0.401	0.397	1.018	0.313	1.494	0.697 – 3.205
Education Level (1=High; 0=Low)	0.315	0.401	0.617	0.432	1.370	0.627 – 2.997
Age (1=Adult; 0=Elderly)	0.510	0.561	0.824	0.364	1.666	0.556 – 4.996
Constanta	-1.503	0.669	5.044	0.025	0.222	

has a low number of cases, but the community has a high enthusiasm to accept the natural larvicide, suggesting strong community trust or effective health promotion exposure. A few districts have a low number of dengue cases but also consistently high acceptance. Medan Area (3.19%, 85.2%), Medan Deli (2.6%, 86.4%), and Medan Perjuangan (2.24%, 84.2%).

In contrast, there were several district that have a low number of case distribution and middle level of acceptance towards *Ricinus communis L.* natural larvicide, Medan Marelan (2.01%, 70.6%), Medan Timur (3.07%, 80.8%), Medan Tembung (4.49%, 68.4%), Medan Amplas (2.83%, 79.2%), Medan Polonia (3.54%, 69.0%), Medan Maimun (3.19%, 81.5%), Medan Petisah (1.65%, 78.6%), and Medan Helvetia (4.37%, 89.2%). Meanwhile, Medan Barat (1.77%; 46.7%) represents the lowest acceptance among all districts, indicating potential barriers such as limited exposure to health promotion, lower knowledge of natural larvicide benefits, or a strong preference for conventional control methods like fogging. Notably, coastal districts such as Medan Belawan (1.18%; 100%) and Medan Labuhan (1.77%; 100%) achieve complete acceptance despite lower dengue incidence. This pattern may reflect heightened environmental vigilance, community cohesion, or previous experiences with vector-borne health risks that encourage proactive participation in larval control strategies. These subdistricts are coastal areas in Medan City and have many flooded areas. In coastal areas, communities are more susceptible to dengue fever than those in dry areas (Li *et al*., 2023). This increases the perceived threat, which encourages preparedness, thereby promoting acceptance of innovation. The spatial variation across Medan City reveals that while a higher dengue burden may increase receptiveness, high acceptance is also evident in areas with lower case numbers.

This phenomenon is consistent with previous KAP findings, which show that knowledge and attitudes toward dengue prevention efforts play a major role in determining the acceptance of new interventions, in this case, the natural larvicide *Ricinus communis L* (Rakhmani & Zuhriyah, 2024). Furthermore, studies on the acceptance of environmental larvicide confirm that public doubts about the effectiveness and safety of non-chemical solutions often hinder acceptance, especially when field evidence and demonstrations are not clearly visible to the community (Dambach *et al*., 2021). Another factor that exacerbates acceptance is the lack of community-based involvement and socialization; recent systematic reviews show that vector control programs without community participation and adequate education tend to fail to gain public support (Low *et al*., 2025). Finally, research on community implementation of biological larvicides shows that the ability of communities to try it out for themselves (trialability) and see immediate results increases acceptance, so the lack of trial opportunities or demonstrations in Medan Barat likely reinforced resistance to this innovation (Shirima *et al*., 2025).

Overall, the spatial pattern indicates that high dengue incidence does not always correspond with high acceptance of *Ricinus communis L.* natural larvicide, emphasizing the need for targeted, district-specific health education strategies. Districts with high caseloads but low acceptance, most notably Medan Tuntungan, should be prioritized for intensive community engagement and awareness campaigns. Meanwhile, districts with strong acceptance can serve as models for best practices in communication and implementation. These findings reinforce the importance of integrating spatial epidemiological data with behavioral insights to optimize the uptake and effectiveness of vector control interventions. The findings for the demographic show the analysis of the relationship between age and the acceptance of natural larvicide innovation from castor seeds showed that adults had a higher acceptance level (89.3%) compared to older respondents (8.7%). This indicates that age may be associated with the acceptance of natural larvicide innovations, although the relationship is weaker when compared to a 0.05 significance level. These findings suggest that age differences can influence community openness to dengue prevention innovations. This is consistent with the study by (Shafie *et al*., 2023), which found that age affects an individual's level of acceptance.

For education level, respondents with higher education showed higher acceptance levels (69.4%) compared to those with lower education (13.5%). The p-value of 0.186 (<0.05) also indicates a potential relationship between education level and acceptance of natural larvicide innovation. These findings support previous research stating that higher education is associated with better readiness to accept health technology innovations (Man *et al*., 2020). The findings show that unemployed respondents have a higher level of acceptance (57%) compared to those who are employed (25.9%). However, employment status is not related to the acceptance of natural larvicide innovation (p-value = 0.616). This means that employment status is not a determining factor in this study. This supports many studies that state that, overall, both employed and unemployed individuals can accept health innovations, because acceptance is more strongly influenced by perceived health needs and benefits (Addotey-delove & Scott, 2023; Rana *et al*., 2024; Silva-perez *et al*., 2020).

The analysis of the relationship between family history of dengue and acceptance of innovation showed that respondents without a dengue history had a higher level of acceptance (79.1%) compared to those with a history of dengue (3.5%). The value of this variable is (p=0.171). The result indicates that family history may still have a potential relationship with the acceptance of natural larvicide innovations. Communities with a history of dengue infection are willing to accept beneficial innovations because they do not want to be infected again. Similarly, people who've never had dengue are also open to innovations, since they want to avoid getting this disease. So that dengue history does not significantly affect the natural reception of larvicides, *Ricinus communis L.* This is because most people who have a history of the disease feel that they have natural immunity, so they do not need intervention. This finding is in line with several other findings in cases of different diseases but with similar analogies (Diiro *et al*., 2020; Huang *et al*., 2023; Locatelli *et al*., 2025; Support, 2025) .

The findings indicate that there is a significant relationship between respondents' level of knowledge about dengue fever and natural larvicide and their level of acceptance of the innovation of *Ricinus communis L.* natural larvicide (p-value = 0.028) in both the pre-test and post-test. Respondents with a high level of knowledge about something also have a high level of acceptance of that thing. This is in line with several other studies that show similar results and the relationship between knowledge and acceptance (Alkattan *et al*., 2022; Kuptarak & Phupong, 2024; Reny Nugraheni, SKM, MM, M.Kes., Wahyu Sri Astutik, S.Kp., 2023). These findings indicate a significant relationship between respondents' attitudes toward dengue prevention and their level of acceptance of *Ricinus communis L.* natural larvicide innovation (p-value = 0.000) in both the pre-test and post-test. Among respondents with low attitudes, 7.8% had low acceptance, and only 15.3% had high acceptance. Conversely, among respondents with high attitudes, low acceptance was only 9.2%, while the majority, 67.7%, showed high acceptance. Respondents with positive attitudes, who viewed this innovation as useful for preventing disease, tended to be more receptive to its use than respondents with negative attitudes. These findings are in line with previous studies that state that positive attitudes and perceptions encourage higher innovation acceptance (Alqudah & Al-emran, 2021; Gianfredi *et al*., 2023; Kawuki *et al*., 2023).

This key finding states that attitude is the dominant factor in the acceptance of *Ricinus communis L.* larvicide. This statement is supported by logistic regression analysis (p-value = 0.000) with an odds ratio of 3.624. Although many variables were significant in the bivariate analysis, when tested with logistic regression, these variables lost their significance in the multivariate model (p-value> 0.05). This indicates that other variables are influenced by other factors. Attitude showing an individual's receptivity to innovation (belief, perception of benefits, and risks of the innovation) and therefore has a direct effect on the intention to accept the innovation (Santi *et al*., 2025). These results indicate that other influences, such as concerns about side effects and risk perceptions, sometimes cause a decrease in intention (Ahmad Zamzuri *et al*., 2022). Therefore, knowledge about acceptance behavior is indirect, but

when controlled or strongly mediated by other factors, it can provide confidence and internal motivation in encouraging the acceptance of sustainable environmental health innovations. It can also be concluded that each individual's decision to accept an innovation is influenced by their trust in that innovation (Diiro *et al*., 2020). The public will also accept it if doubts about its safety can be overcome (Dambach *et al*., 2021).

These results advance the Health Belief Model (susceptibility, severity, benefits, barriers, cues to action, and self-efficacy) (Kirwelakubun & Winarti, 2024; Thongkham *et al*., 2025) by demonstrating that attitude is not only a significant predictor but the dominant factor shaping acceptance of *Ricinus communis L.* natural larvicides. Positive attitudes arise when individuals perceive dengue as severe, believe they are susceptible, and recognize the benefits of natural larvicides, aligning with key constructs of the Health Belief Model. This suggests that transitions from chemical to eco-friendly control preventive methods. Consequently, dengue prevention strategies in Medan should prioritize persuasive Behavior Change Communication (BCC) aimed at enhancing housewives' perceptions of the safety and environmental advantages of *Ricinus communis L.*, which has documented anti-inflammatory, antimicrobial, antioxidant, and hepatoprotective properties (Ramothloa *et al*., 2025). Behavior Change Communication is an approach to health promotion. BCC not only focuses on giving information but also connects thoughts and feelings by understanding human thought patterns and showing empathy in socializing to build public trust in what is being delivered. The delivery of information about *Ricinus communis L.* natural larvicide is very important using BCC to explain why this innovation emerged, so that the community believes and is convinced of the innovative efforts we offer so that they are willing to use this natural larvicide (Makahaghi, 2025; Nancy & Dongre, 2021). Strengthening motivation, confidence, and environmental commitment is essential for achieving sustained acceptance of the *Ricinus communis L.* natural larvicide.

Conclusion

Attitude towards the *Ricinus communis L.* natural larvicide is the most significant and dominant independent determinant predicting dengue prevention acceptance among urban housewives (OR = 3.624; $p < 0.001$). Meanwhile, other variable factors are significant with the presence of other supporting factors toward this innovation. Most respondents are open to innovation, but many are also concerned about its side effects. Successful acceptance of eco-friendly solutions depends heavily on strengthening trust and positive acceptance from the community, not just on gaining information. By implementing a Behavior Change Communication (BCC) strategy to change public attitudes towards accepting *Ricinus communis L.* as a natural larvicide, these prevention efforts can support the goal of zero deaths by 2030.

Acknowledgement

The researchers would like to thank the TALENTA Universitas Sumatera Utara grant number 13452/UN5.1R/SK/PT.01.03/2025

References

Addotey-delove, M., & Scott, R.E., 2023. Healthcare Workers' Perspectives of mHealth Adoption Factors in the Developing World : Scoping Review. *International Journal of Environmental Research and Public Health*, 20(2), pp.1244.

Adrianto, H., Subekti, S., Arwati, H., Rambung, E., Tabita, H., Silitonga, H., & Rohmah, A., 2023. Another Mode of Action of Temephos Against Aedes aegypti Larvae : A Stomach Poison Investigation. *Pharmacognosy Journal*, 15(2), pp.298–303.

Ahmad Zamzuri, M., 'Ammar I., Abd Majid, F.N., Dapari, R., Hassan, M.R., & Isa, A.M.M., 2022. Perceived Risk for Dengue Infection Mediates the Relationship between Attitude and Practice for Dengue Prevention: A Study in Seremban, Malaysia. *International Journal of Environmental Research and Public Health*, 19(20).

Alkattan, A., Radwan, N., Mahmoud, N., Alkhalifah, A., Alshamlan, A., Alkamis, A., Alfaifi, A., Alanazi, W., Alfaleh, A., Haji, A., & Alabdulkareem, K., 2022. COVID - 19 Vaccine Acceptance: Knowledge and Beliefs. *Bulletin of the National Research Centre*, 46(1), pp.260.

Alqudah, A.A., & Al-emran, M., 2021. Technology Acceptance in Healthcare: A Systematic Review. *Applied Sciences*, 11(22).

Ardiansyah Akbar, K., Kumala, F.R., Elamouri, F., & Rockstroh, J.K., 2025. Climate Change and Dengue Fever: A 14-Year Study Of Mortality Trends During 2010–2023 in Indonesia. *Travel Medicine and Infectious Disease*, 67(August).

Cahyati, W.H., Asmara, W., Umniyati, S.R., & Mulyaningsih, B., 2017. The Phytochemical Analysis of Hay Infusions and Papaya Leaf Juice as an Attractant Containing Insecticide for Aedes aegypti. *Kemas*, 12(2).

Cahyati, W.H., Asmara, W., Umniyati, S.R., & Mulyaningsih, B., 2019. Biolarvicidal Effects of Papaya Leaves Juice Against Aedes Aegypti Linn Larvae. *Journal of International Dental and Medical Research*, 12(2), pp.780–785.

Chahaya, I., Tumanggor, W.R.E., & Gultom, E.D., 2024. Effectiveness of Ricinus communis as Natural Larvicide for Aedes aegypti Mosquito Larvae in Medan City. *Kemas*, 19(4), pp.560–567.

Chahaya, I., Tumanggor, W.R.E., & Lanova, D., 2025. Environmental Factors and Efficacy of Castor Seed Influencing Aedes aegypti Larval Presence. *Kemas,* 1(18), pp.46–53.

Conway, M.J., Haslitt, D.P., & Swarts, B.M., 2023. Targeting Aedes aegypti Metabolism with Next Generation Insecticides. *Viruses*, 15(2).

Dambach, P., Traoré, I., Sawadogo, H., Zabré, P., Shukla, S., Sauerborn, R., Becker, N., & Phalkey, R., 2021. Community Acceptance of Environmental Larviciding Against Malaria with Bacillus thuringiensis israelensis in Rural Burkina Faso–A Knowledge, Attitudes and Practices Study. *Global Health Action*, 14(1).

Davila-barboza, J.A., Gutierrez-rodriguez, S.M., Juache-villagrana, A.E., Lopez-monroy, B., & Flores, A.E., 2024. Widespread Resistance to Temephos in Aedes aegypti (Diptera: Culicidae) from Mexico. *Insects*, 15(2), pp.1–12.

De Almeida, M.T., Merighi, D.G.S., Visnardi, A.B., Boneto Gonçalves, C.A., Amorim, V.M.de F., Ferrari, A.S. de A., de Souza, A.S., & Guzzo, C.R., 2025. Latin America's Dengue Outbreak Poses a Global Health Threat. *Viruses*, 17(1).

Denai, W., Wulan, S., Jasril., & Jufrizal, S., 2025. Red Ginger Essential Oil (Zingiber officinale var. Rubrum) as a Biolarvicide in the Control of Aedes Aegypti Mosquitoes. *Kemas,* 20(4), pp.731–743.

Diiro, G.M., Kassie, M., Muriithi, B.W., Gathogo, N.G., Kidoido, M., Marubu, R., & Ochola, J.B., 2020. Are Individuals Willing to Pay for Community-Based Eco-Friendly Malaria Vector Control Strategies ? A Case of Mosquito Larviciding Using Plant-Based Biopesticides in Kenya. *Sustainability*, 12(20).

EClinicalMedicine., 2024. Editorial Dengue as a Growing Global Health Concern. *EClinicalMedicine*, 77, pp.102975.

Fernandes, R., Chagas, S., Xavier, S., Santiago, T.A., Cardoso, D., Portela, C., Cristina, I., Delatorre, E., Sequeira, P.C., De Ferreira-de-lima, V.H., Lima-camara, T.N., & Honório, N.A., 2025. Systematic Review of the Ovitrap Surveillance of Aedes Mosquitoes in Brazil (2012 – 2022). *Tropical Medicine and Infectious Disease*, 10(8), pp.1–17.

Gavana, T., Kailembo, D., Kasagama, E., Lilolime, N.S., Mwamlima, T.G., Mwalimu, C.D., Bernard, J., Yoram, B., Kajange, S., Lazaro, S., Kisoka, N., Chaki, P., & Lengeler, C., 2025. OPEN A Large-Scale Mosquito Larviciding in Tanga Region, Tanzania, Reduced Mosquito Densities to Varying Degrees Across Malaria Transmission Risk Strata. *Scientific Report*, 15(1), pp.1–17.

Gianfredi, V., Berti, A., Stefanizzi, P., Amico, M.D., Lorenzo, V.De., Moscara, L., Lorenzo, A.D., Venerito, V., & Castaldi, S., 2023. COVID-19 Vaccine Knowledge, Attitude, Acceptance and Hesitancy among Pregnancy and Breastfeeding : Systematic Review of Hospital-Based Studies. *Vaccines*, 11(11), pp.1–32.

Guo, X., Liu, S., Liu, X., Chen, K., Chen, W., Huang, Z., Li, Z., Zeng, S., Chen, H., He, Q., Ge, L., Guo, Y., Chen, X., Peng, Z., Shi, B., Liu, J., Chen, X. G., & Zhou, X., 2025. An Improved Ovitrap-Based Surveillance Framework: Facilitating Cost-Efficient Monitoring and Efficacy Assessment of Integrated Vector Management Strategies for Dengue Outbreak Control. *Parasites and Vectors*, 18(1), pp.1–11.

Huang, Y., Zhang, L., Fu, J., Wu, Y., Wang, H., & Xiao, W., (2023.). COVID-19 Vaccine Hesitancy Among Patients Recovered From COVID-19 Infection in Wuhan , China: Cross-Sectional Questionnaire Study. *JMIR Public Health and Surveillance*, 9.

Iman, H., Id, S., Id, K.N., Yusmalinar, S., Anggraeni, T., Id, N.C., Bong, L., Putra, R.E., & Id, A.S., 2021. Ovitrap Surveillance of Dengue Vector Mosquitoes in Bandung City, West Java Province, Indonesia. *PLoS Neglected Tropical Diseases*, 15(10), pp.1–18.

Kawuki, J., Chen, S., Fang, Y., Liang, X., & Chan, P.S., 2023. COVID-19 Vaccine Acceptance, Attitude and Perception among Slum and Underserved Communities: A Systematic Review and Meta-Analysis. *Vaccines*, 11(5), pp.1–22.

Kirwelakubun, A., & Winarti, E., 2024. Implementasi Health Belief Model pada Perilaku Pencegahan Demam Berdarah Dengue: Literature Review. *Jurnal Kesehatan Tambusai*, 5(1), pp.593–605.

Kuptarak, A., & Phupong, V., 2024. Knowledge, Attitude, and Acceptance of COVID-19 Vaccine in Pregnant Women. *Sage Journals*, 2024, pp.1–24.

Li, C., Wang, Z., Yan, Y., Qu, Y., Hou, L., Li, Y., Chu, C., Woodward, A., Schikowski, T., Saldiva, P. H. N., Liu, Q., Zhao, Q., & Ma, W., 2023. Association Between Hydrological Conditions and Dengue Fever Incidence in Coastal Southeastern China From 2013 to 2019. *JAMA Network Open*, 6(1), pp.e2249440–e2249440.

Llagas, L.A.D., Las, T.B.K., Bersales, L.G.S., Nadu, T., & City, Q., 2016. Review Aedes Dengue Vector Ovitrap Surveillance System: A Framework For Mosquito Density Prediction. *The Southeast Asian Journal Of Tropical Medicine And Public Health*, 47(4), pp.712-718

Locatelli, G., Luciani, M., & Fabrizi, D., 2025. Determinants and Motivations of Vaccination Hesitancy and Uptake in Nurses : A Systematic Review and Meta-Analysis. *Journal of Clinical Nursing*, 34(10), pp.4005–4037.

Low, G.K.K., Jiee, S.F., Lim, S.H., Omosumwen, O.F., & Shanmuganathan, S., 2025. The Effectiveness of Dengue Vector Control: A Meta-Review. *Tropical Medicine and International Health*, 30(10), pp.1069–1086.

Luh, N., Sumi, K., Sudarmaja, I.M., & Swastika, I.K., 2017. Efektifitas Ekstrak Etanol Serai Wangi (Cymbopogon nardus L.) sebagai Larvasida Aedes aegypti. *E-Jurnal Medika Udayana*, 6(1), pp.1–4.

Mahfud, R., Basuki, B., & Savitri, S., 2021. Pengaruh Ekstrak Tumbuhan Melastoma malabathricum sebagai Larvasida Nabati terhadap Mortalitas Aedes aegypti L. *BiosciED: Journal of Biological Science and Education*, 2(1), pp.21–27.

Makahaghi, Y.B., 2025. Behavioral Change Communication and Vaccine Acceptance: A Framework for Strengthening Public Trust in Health Interventions. *Journal of Nutrition and Health Care*, 2(September), pp.47–54.

Man, C., Lee, Y., Thomas, E., Norman, R., Wells, L., Shaw, T., Nesbitt, J., Frean, I., Baxby, L., Bennett, S., & Robinson, S., 2020. Educational Attainment and Willingness to Use Technology for Health and to Share Health Information – The Reimagining Healthcare Survey. *International Journal of Medical Informatics*, 164(January).

Ministry of Health., 2024. *Profil Kesehatan Profil Kesehatan*.

Naji, H. S. (2023). Dengue Fever and Global Warming : An Epidemiological Analysis. *European Journal of Medical and Health Sciences*, *5*(5), 60–64.

Nancy, S., & Dongre, A. R. (2021). Behavior Change Communication : Past , Present , and Future. *Indian Journal of Community Medicine*, *46*(2), 3–6. https://doi.org/10.4103/ijcm.IJCM

Nawarathne, M. P., & Dharmarathne, C. (2024). Control of dengue larvae of Aedes aegypti and Aedes albopictus using the larvicidal bioactive compounds in different plant extracts and plant extract - mediated nanoparticles. *Tropical Medicine and Health*, *52*(1). https://doi.org/10.1186/s41182-024-00654-9

Ngoagouni, C., Kamgang, B., Brengues, C., Yahouedo, G., Paupy, C., Nakouné, E., Kazanji, M., & Chandre, F. (2016). Susceptibility profile and metabolic mechanisms involved in Aedes aegypti and Aedes albopictus resistant to DDT and deltamethrin in the Central African Republic. *Parasites & Vectors*, *9*(1), 1–13. https://doi.org/10.1186/s13071-016-1887-5

North Sumatra Provincial Health., 2024. *Profil Kesehatan Sumatera Utara*, pp. 167–186.

Onesiforus, B.Y., Rinihapsari, E., & Fatmasari, D., 2023. Perbandingan Efektivitas Seduhan Kulit Nanas (Ananas Comosus) Dengan Temephos 1 % Sebagai Biolarvasida Nyamuk *Culex sp. Jurnal Anestesi: Jurnal Ilmu Kesehatan dan Kedokteran*, 1(3).

Pratiwi, A., 2014. Descriptive Study of Community Acceptance of Natural Larvacides. *Unnes Journal of Public Health*, 3(2), pp.1–10.

Rakhmani, A.N., & Zuhriyah, L., 2024. Knowledge, Attitudes, and Practices Regarding Dengue Prevention Among Health Volunteers in an Urban Area–Malang, Indonesia. *Journal of Preventive Medicine and Public Health*, 57(2), pp.176–184.

Ramayanti, I., Febriani, R., & Tenggara, A., 2016. Uji Efektivitas Larvasida Ekstrak Daun Pepaya (Carica papaya Linn) terhadap

Larva Aedes aegypti. *Repositori Institusi Universitas Sumatera Utara*, 6(2).

Ramothloa, T.P., Mkolo, N.M., Motshudi, M.C., Mphephu, M.M., Makhafola, M.A., & Naidoo, C.M., 2025. Phytochemical Composition and Multifunctional Applications of Ricinus communis L.: Insights into Therapeutic, Pharmacological, and Industrial Potential. *Molecus*, 30(15), pp.1–32.

Rana, B., Jimenez, H.R., Khan, Z.M., & Narayanan, N., 2024. Association between Socioeconomic Status and Vaccination Hesitancy, Reluctancy and Confidence among Asian-Americans Living in the State of New Jersey. *Journal of Community Health*, 49(5), pp.829–834.

Reny, N., & Wahyu, S.A., 2023. Knowledge, Attitude, and Behavior Related to COVID-19 Vaccine Acceptance: A Cross-Sectional Study. *Journal of Health Science and Medical Research*, 41(6), pp.1–10.

Salaki, C.L., Assa, B., Studi, P., Pascasarjana, E., & Sam, U., 2019. Efektivitas Ekstrak Serai Wangi (Cimbopogon nardus L .) sebagai Larvasida Nyamuk Aedes aegypti. *Jurnal Bios Logos*, 10 (1).

Santi, T., Ridwansyah, R., Sungono, V., Widjaya, N., & Euqenekim, K.N., 2025. Vaccine Hesitancy Toward Dengue Immunization Among Indonesian Office Workers: A Cross-Sectional Study of Perceptions, Barriers, and Trust Factors. *Vaccines*, 13(12), pp.1–14.

Shafie, A.A., Moreira, E.D., Di Pasquale, A., Demuth, D., & Yin, J.Y.S., 2023. Knowledge, Attitudes and Practices toward Dengue Fever, Vector Control, and Vaccine Acceptance Among the General Population in Countries from Latin America and Asia Pacific: A Cross-Sectional Study (GEMKAP). *Vaccines*, 11(3).

Shirima, G.S., Masserey, T., Gervas, H., Chitnis, N., Kiware, S., & Mirau, S., 2025. Assessing the Role of Community Involvement and Capacity Building in Larviciding Applications for Malaria Control in Africa: A Scoping Review. *Current Research in Parasitology and Vector-Borne Diseases*, 8(August), pp.100307.

Silva-perez, C., Mendez-guerra, C., & Al-kassab-c, A., 2020. Factors associated with not Receiving the Primary Series and Booster Dose of the COVID-19 Vaccine among Venezuelan Migrants in Peru: A Population-Based Cross-Sectional Study. *Travel Med Infect Dis*, 2020.

Sinha, S., De, A., & Halder, A., 2024. Global Warming and Rising Threat of Dengue Fever : Expectations in Disease Management. *Indian Journal of Public Health*, 68(3), pp.444–446.

Sogan, N., Kapoor, N., Singh, H., Kala, S., Nayak, A., & Nagpal, B., 2018. Larvicidal Activity of Ricinus communis Extract Against Mosquitoes. *Journal of Vector Borne Diseases*, 55(4), pp.282–290.

Support, O., 2025. Tools and Methods for Promoting Vaccination Acceptance and Uptake: A Social and Behavioural Science Approach, *European Centre for Disease Prevention and Control*, 2025.

Telle, O., Grandadam, M., Philippon, D., & Calvez, E., 2025. Dengue Dynamics Beyond Biological Factors: Revealing The Nexus Between Urbanisation Planning, and Mobilities in Vientiane, Lao PDR. *PLoS Neglected Tropical Diseases*, 19(6), pp.1–20.

Thongkham, J., Kanrew, K., Wongkumthi, C., Intasan, N., & Saita, S., 2025. Health Beliefs and Housing Environmental Factors Affecting Dengue Prevention and Aedes Larvae in Rural Northern Thailand: A Cross-Sectional Study. *Discover Social Science and Health*, 5(1).

Wardani, A.T., Anggraeni, Y.M., Nugroho, A., Wianto, R., Rahardianingtyas, E., Hasanudin, J., Salatiga, N., & Tengah, J., 2019. Pengaruh Kondisi Lingkungan terhadap Efektivitas Bacillus thuringiensis H-14 Isolat Salatiga Sediaan Serbuk untuk Pengendalian Jentik Anopheles spp. di Kabupaten Kulon Progo. *Vektora*, 11(2), pp.103–110.

World Health Organization., 2025. *Global Dengue Surveillance*.

Zheng, J., Tong, H., Chen, M., Duan, L., Song, P., Sun, J., & Zhou, X., 2025. Global Burden of Dengue from 1990 to 2021: A Systematic Analysis from the Global Burden of Disease Study 2021. *Infectious Diseases of Poverty*, 14(1), pp.1–11.