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Household intention to eliminate mosquito breeding sites following a single-session *Geplakkin* intervention

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ABSTRACT

Dengue remains an important public health problem, and household elimination of mosquito breeding sites is central to prevention. Digital technologies may strengthen dengue prevention by integrating health information with vector surveillance, but evidence regarding their relationship with household behavioral intention remains limited. This study evaluated household intention to eliminate mosquito breeding sites following a single-session intervention using the *Geplakkin* vector surveillance application. A quantitative experiment with a posttest-only control-group design was conducted in Pontianak City, West Kalimantan, Indonesia, from July to October 2025. A total of 320 purposively recruited participants were randomly allocated in a 3:1 ratio to the intervention (n = 240) or control group (n = 80) using a computer-generated sequence. Both groups received routine dengue-prevention education; the intervention group additionally received 15–30 minutes of training on *Geplakkin*, followed by immediate application use and posttest assessment. Intention was assessed using a Theory of Planned Behavior-based questionnaire. Because scores were not normally distributed, groups were compared using the Mann–Whitney U test. The intervention group had a higher mean intention score than the control group (45.43 ± 4.68 vs 36.73 ± 5.50), with a mean difference of 8.70 points ($p < 0.001$; effect size = 0.65). Thus, exposure to the single-session *Geplakkin* intervention was associated with higher immediate intention to eliminate mosquito breeding sites than routine education alone. Longitudinal studies are needed to determine whether this difference is sustained and translates into household vector-control practices.

1. Introduction

Dengue is a major vector-borne disease, particularly in tropical and subtropical regions, and nearly half of the global population is at risk of infection. Its increasing incidence has been linked to urbanization, climate change, human mobility, and the expanding habitat of Aedes aegypti [1–3]. Beyond morbidity and mortality, dengue also creates substantial healthcare costs and productivity losses [4,5].

Indonesia carries one of the highest dengue burdens in Southeast Asia, with recurrent cases despite ongoing control programmes. Pontianak City, West Kalimantan, is especially vulnerable because its tropical climate, high rainfall, and population density favour Aedes aegypti proliferation.

Entomological indicators such as the House Index, Container Index, and Breteau Index are therefore important for assessing larval infestation and guiding vector surveillance [5–7].

Vector surveillance supports early warning and targeted dengue-control planning, but conventional systems may be constrained by limited personnel, incomplete coverage, and delayed reporting. Mobile applications, geographic information systems, and web-based platforms can facilitate real-time reporting of larvae, breeding sites, and environmental risks [8,9]. By connecting surveillance with community participation, these technologies may also support household engagement in dengue prevention [9–11].

Household behavior is central to larval source management. According to the Theory of Planned Behavior, intention is a proximal determinant of behavior and is influenced by attitudes, subjective norms, and perceived behavioral control [12]. Assessing intention can therefore provide early evidence about the behavioral potential of dengue-prevention interventions, although intention does not necessarily translate into sustained practice.

The *Geplakkin* Vector Surveillance Application was developed as a community-based digital platform for reporting environmental conditions, mosquito breeding sites, and mosquito breeding-site elimination activities. Existing studies have largely examined the surveillance functions or broader community outcomes of digital and participatory dengue interventions [13]. Evidence concerning household intention to eliminate breeding sites remains limited. This study, therefore, evaluated household intentions to eliminate mosquito breeding sites following a single-session *Geplakkin* intervention. We hypothesized that intention scores would differ between participants receiving *Geplakkin* plus routine dengue-prevention education and those receiving routine education alone.

2. Method

This quantitative experimental study used a posttest-only control-group design and was conducted in Pontianak City, West Kalimantan, Indonesia, from July to October 2025. The study population comprised adult household members living in the study area who had access to a smartphone. Using purposive recruitment, 320 eligible participants were enrolled and then randomly allocated in a 3:1 ratio to the intervention group (n = 240) or the control group (n = 80) using a computer-generated sequence. The allocation sequence was generated before assignment. Eligibility criteria were age ≥18 years, ability to operate a smartphone, and willingness to participate and to complete all study procedures.

The sample-size calculation was based on a previous study of a digital dengue-surveillance intervention and used a standard deviation of 12.2, a two-sided significance level of 5%, and 80% power. The initial estimate was 72 participants; allowing for 10% attrition [$n' = n/(1-f)$] increased the minimum to 80. A predetermined 3:1 allocation resulted in a larger intervention group, yielding a final target of 240 intervention and 80 control participants (total n = 320).

Participants in the intervention group attended one standardized, practical training session on *Geplakkin* that lasted approximately 15–30 minutes. Four two-student research teams delivered the training, with each team supporting 60 participants. Training covered registration and login; participant information; the *'Lapor Nyamuk'* menu (MPI and HSS); area vulnerability and alert information; dengue-prevention recommendations; the *'Aksi'* menu for mosquito breeding-site elimination (*Pemberantasan Sarang Nyamuk/PSN*); and the feedback function. Participants then used and explored the application.

Both groups received routine dengue-prevention education, whereas only the intervention group received *Geplakkin* training and access. Because the intervention involved a single session, the study did not require repeated use, issue reminders, or monitor adherence. Immediately after the session, participants completed a Theory of Planned Behavior-based questionnaire measuring willingness and readiness to undertake household mosquito breeding-site elimination. The instrument had previously demonstrated validity and acceptable reliability (Cronbach's alpha ≥0.70) among respondents with similar characteristics.

Participant characteristics and intention scores were summarized descriptively. Normality was assessed using the Kolmogorov–Smirnov test. Because intention scores were not normally distributed, the intervention and control groups were compared using the Mann–Whitney U test, with statistical significance set at $p < 0.05$. An effect size was calculated to quantify the magnitude of the between-group difference.

This study was part of an ongoing umbrella project on the *Geplakkin* vector surveillance application and was approved by the Medical and Health Research Ethics Committee, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada (No. KE/FK/0797/EC/2022). All participants provided written informed consent, and confidentiality was maintained throughout the study.

3. Results and Discussion

3.1. Results

The analysis included 320 participants allocated to the intervention (n = 240) and control (n = 80) groups. The frequency distribution of participant characteristics is presented in Table 1.

Table 1. Characteristics of Participants in the Intervention and Control Groups

Characteristics		Intervention, n=240		Control, n=80	
		f	%	*f*	%
Education Level	Elementary School	33	13.75	12	15
	Junior High School	59	24.58	21	26.25
	Senior High School	83	34.58	33	41.25
	College/University	65	27.08	14	17.50
Occupation	Homemaker/Unemployed	85	35.41	40	50
	Civil Servant	15	6.25	2	2.50
	Private Employee	18	7.50	15	18.75
	Entrepreneur	122	50.83	23	28.75

Senior high school was the most common educational level in both groups (intervention: 34.58%; control: 41.25%). Elementary education was the least common (13.75% and 15.00%, respectively).

Entrepreneurs constituted the largest occupational category in the intervention group (50.83%), whereas homemakers or unemployed participants were most common in the control group (50.00%). Civil servants were the smallest category in both groups (6.25% and 2.50%, respectively).

Between-group comparison of intention scores

Intention scores were not normally distributed in either group (Kolmogorov–Smirnov $p < 0.001$); therefore, the groups were compared using the Mann–Whitney U test (Table 2).

Table 2. Outcomes of the Mann-Whitney U examination

Variabel	Group	Min-Max	Mean±SD	Mean Difference	Effect-Size	p-value	Distribution
Intention	Intervention	25-50	45,43±4,68	8,70	0,65	<0.001	Not Normal
	Control	23-50	36,73±5,50				Not Normal

The intervention group had a higher mean intention score than the control group (45.43 ± 4.68 vs 36.73 ± 5.50), corresponding to a mean difference of 8.70 points. The Mann–Whitney U test showed a statistically significant difference between groups ($p < 0.001$). The effect size was 0.65, indicating a moderate-to-large between-group difference in immediate intention.

Item-level intention scores show that ten intention items (I1–I10) were examined descriptively. Each item's mean was converted to a 0–100 scale; the percentages in Figure 1, therefore, represent scaled mean scores rather than proportions of participants selecting a response category.

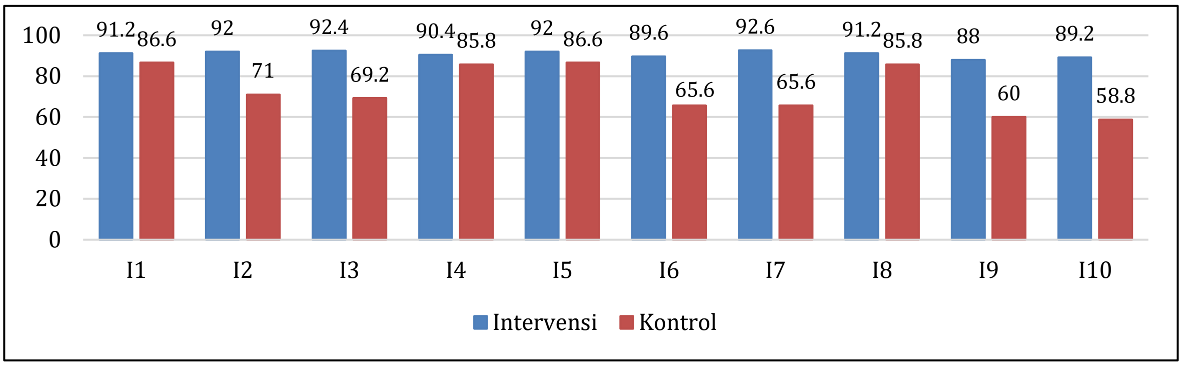

Fig. 1. Mean percentage scores of intention indicators for mosquito breeding-site control in the intervention and control groups

As illustrated in Figure 1, the intervention group had higher mean percentage scores across all ten intention indicators than the control group. The highest mean percentage score in the intervention group was observed for indicator I7 (92.6%), representing the intention to eliminate adult Aedes mosquitoes inside the house. High mean percentage scores were also observed for indicator I3 (92.4%), representing the intention to apply larvicide (Abate) to water containers, and indicators I2 and I5 (92.0%), representing intentions to clean the outdoor environment and tightly cover water storage containers, respectively. The lowest mean percentage score in the intervention group was observed for I9 (88.0%), related to the intention to routinely report the presence of mosquito larvae, followed by I10 (89.2%), related to reporting mosquito breeding-site elimination activities.

In the control group, I1 (maintaining household environmental cleanliness) and I5 (covering water-storage containers) had the highest mean scores (both 86.6%). I10 (reporting breeding-site elimination activities; 58.8%) and I9 (reporting larvae; 60.0%) had the lowest. The largest descriptive between-group differences were observed for I10 (30.4 percentage points), I9 (28.0), I7 (27.0), and I6 (24.0). Because item-level inferential tests were not conducted, these differences should not be interpreted as statistically significant effects.

3.2. Discussion

Participants who received the single-session *Geplakkin* intervention reported higher immediate intention to eliminate mosquito breeding sites than those who received routine dengue-prevention education alone (45.43 ± 4.68 vs 36.73 ± 5.50; $p < 0.001$; effect size = 0.65). This finding is consistent with the Theory of Planned Behavior, which positions intention as a proximal determinant of behavior [12]. However, the study measured neither the underlying TPB constructs attitudes, subjective norms, and perceived behavioral control nor subsequent behavior; consequently, it cannot identify the mechanism responsible for the difference or establish behavioral change.

The result also aligns with evidence that mobile applications and other digital technologies can combine surveillance, spatial risk information, health communication, and community-oriented prevention [14,15]. *Geplakkin* integrates dengue-prevention information, mosquito reporting, area vulnerability and alert information, recommendations, and recording of breeding-site elimination activities. This combination may make relevant information and surveillance functions more accessible, although the contribution of each feature was not assessed separately. A similar Indonesian experience with the Android-based Tunggal Dara application indicates the potential of digital surveillance while also highlighting implementation challenges related to interoperability, data quality, user characteristics, and stakeholder participation.

Item-level findings suggest that *Geplakkin* may be particularly relevant to both direct control and reporting intentions. The highest intervention-group score was for eliminating adult Aedes mosquitoes inside the home (I7; 92.6%), while the largest descriptive differences concerned reporting breeding-site elimination (I10), reporting larvae (I9), and eliminating adult mosquitoes (I7). These patterns are pertinent because household participation in elimination, surveillance, and reporting is central to dengue control [10,16]. Nevertheless, without item-level inferential testing, these differences remain descriptive [10].

The participant profile provides context but does not explain the observed outcome. Senior high school graduates were the largest educational category in both groups, while occupational distributions differed: entrepreneurs were most common in the intervention group, and homemakers or unemployed participants were most common in the control group. Although education and occupation may be related to dengue knowledge and practices [17,18], they were not analyzed as predictors or effect modifiers. The findings should therefore be interpreted with caution, particularly because the posttest-only design does not provide baseline intention scores to assess pre-intervention equivalence.

From a public health perspective, *Geplakkin* may complement household dengue-prevention programs by linking education with participatory surveillance [14,19,20]. Translation of immediate intention into sustained practice, however, is likely to depend on continued engagement, user acceptability, implementation support, and integration with local surveillance systems [21,22]. Future evaluations should examine these implementation factors and include longer follow-up periods, actual application use data, household practices, and entomological outcomes [10,23–25]. However, because the present study measured intention immediately after the intervention rather than observed community participation or actual PSN activities, the findings should not be interpreted as evidence that *Geplakkin* increased community participation or sustained vector-control behavior. suggests that communication strategies are more likely to be sustainable when supported by community engagement, appropriate implementation processes, and sustained public health support [26].

This study has several limitations. First, intention was measured immediately after a single-session intervention; actual behavior, sustained intention, application adherence, and entomological outcomes were not assessed. Second, the posttest-only design precluded comparison of baseline intention and therefore limits certainty that the groups were equivalent before the intervention, despite random allocation. Third, the study was conducted in one city using purposive recruitment, which may limit generalisability. Fourth, self-reported responses may be affected by social desirability or response bias. Finally, the unequal 3:1 allocation and unadjusted analysis of sociodemographic differences should be considered when interpreting the findings. Future studies should use baseline and repeated follow-up assessments, monitor application use, adjust for relevant covariates, and evaluate behavioral and entomological outcomes.

4. Conclusion

The single-session *Geplakkin* intervention was associated with greater immediate intention to eliminate mosquito breeding sites than routine dengue-prevention education alone. This finding suggests that *Geplakkin* may serve as a useful digital complement to household dengue-prevention initiatives. However, because intention was assessed immediately after the intervention, the findings do not demonstrate sustained intention or actual behavioral change. Local health authorities may consider further piloting *Geplakkin*, with appropriate user support and integration into existing dengue surveillance activities. Future studies should include baseline and longer-term follow-up assessments, monitor application use and household practices, and evaluate acceptability, behavioral change, and entomological outcomes before wider implementation.

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Conflict of Interest

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