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Integrating self-awareness surveys and ovitrap monitoring to enhance dengue vector control: A community-based experimental study in Bulusan Village, Semarang City

Integrasi survei kesadaran diri dan pemantauan ovitrap untuk penguatan pengendalian vektor DBD: Studi eksperimen berbasis komunitas di Kelurahan Bulusan, Kota Semarang

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Abstract

Previous studies on Dengue Hemorrhagic Fever (DHF) prevention have often emphasized knowledge dissemination and community participation without directly linking these behavioral interventions to measurable entomological outcomes. There remains a gap in evidence regarding the integration of self-awareness strategies with vector surveillance indicators such as the Container Index (CI) and the Free Larvae Index (ABJ). This study aimed to evaluate the effectiveness of a community-based self-awareness survey combined with ovitrap training in controlling mosquito breeding as a preventive measure against DHF in Bulusan Village, Semarang City. This descriptive observational experimental study involved households selected through incidental sampling during routine Mosquito Nest Eradication (PSN) activities. Participants received training on installing simple ovitraps made from various household materials, which were monitored over one to two weeks. Entomological outcomes were assessed using CI and ABJ, supported by environmental observations and household interviews. The results revealed that all ovitrap types successfully detected mosquito larvae, with mineral water containers showing the highest Container Index (12.5%). This intervention led to an increase in ABJ, indicating improved mosquito control practices. The integration of behavioral self-awareness tools with low-cost entomological surveillance offers a promising model for community empowerment in DHF prevention. These findings suggest that collaborative efforts between communities and local health stakeholders can strengthen sustainable and environmentally friendly vector control strategies, particularly in endemic urban settings.

Abstrak

Penelitian sebelumnya tentang pencegahan Demam Berdarah Dengue (DBD) lebih banyak menekankan pada penyuluhan dan partisipasi masyarakat, namun belum banyak yang menghubungkan intervensi perilaku tersebut dengan indikator entomologis yang terukur. Masih terdapat kesenjangan dalam bukti ilmiah mengenai integrasi strategi kesadaran diri dengan indikator pengawasan vektor seperti Angka Bebas Jentik (ABJ) dan Container Index (CI). Studi ini bertujuan untuk mengevaluasi efektivitas survei kesadaran diri masyarakat yang dikombinasikan dengan pelatihan penggunaan ovitrap sederhana dalam mengendalikan perkembangbiakan nyamuk sebagai upaya pencegahan DBD di Kelurahan Bulusan, Kota Semarang. Penelitian ini menggunakan desain eksperimental observasional deskriptif dengan sampel rumah tangga yang diambil secara insidental saat pelaksanaan kegiatan PSN. Responden diberikan pelatihan pembuatan dan pemasangan ovitrap dari berbagai bahan rumah tangga, yang kemudian diamati selama satu hingga dua minggu. Indikator entomologis CI dan ABJ digunakan untuk menilai efektivitas intervensi, dilengkapi dengan observasi lingkungan dan wawancara rumah tangga. Hasil penelitian menunjukkan bahwa seluruh jenis ovitrap mampu mendeteksi keberadaan jentik nyamuk, dengan wadah air mineral menunjukkan Container Index tertinggi (12,5%). Intervensi ini turut meningkatkan nilai ABJ, menandakan praktik pengendalian nyamuk yang lebih baik di tingkat rumah tangga. Integrasi antara alat kesadaran diri perilaku dan pemantauan vektor berbiaya rendah ini menunjukkan potensi besar dalam pemberdayaan masyarakat untuk pencegahan DBD. Temuan ini menegaskan bahwa kolaborasi antara masyarakat dan pemangku kepentingan kesehatan lokal sangat penting dalam memperkuat strategi pengendalian vektor yang berkelanjutan dan ramah lingkungan, terutama di wilayah perkotaan yang endemis.

Keywords :

community participation; mosquito control; ovitrap; self-awareness; severe dengue

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INTRODUCTION

The World Health Organization (WHO) has developed a global program to tackle Dengue Hemorrhagic Fever (DHF), acknowledging its serious public health impact. This initiative emphasizes integrated vector management, case management, and community engagement to curb dengue transmission, primarily spread by Aedes mosquitoes (Pimpi et al., 2022; Ristawati et al., 2023). A crucial element is the promotion of vaccination alongside vector control strategies, including the release of Wolbachia-infected mosquitoes, which have demonstrated efficacy in reducing infection rates among seropositive individuals (Prasetyo et al., 2023). This integrated approach reflects WHO's view that sustainable dengue control demands both biomedical solutions and active community involvement.

DHF presents with severe hemorrhagic symptoms and can progress to shock, posing a substantial threat in tropical and subtropical regions. WHO estimates around 390 million annual dengue infections globally (Sutriyawan et al., 2024). Effective DHF management requires strong surveillance systems and interventions targeting environmental factors that support mosquito breeding, such as poor waste disposal and inadequate water infrastructure (Pimpi et al., 2022). Ongoing research and community mobilization are essential to maintain and refine prevention efforts (Reegan et al., 2020), with entomological and environmental monitoring complementing vaccination and clinical care. DHF remains a pressing public health concern, particularly in countries like Indonesia. The global dengue burden has risen significantly, with WHO reporting approximately 40,000 annual deaths linked to severe forms such as DHF and dengue shock syndrome (Iqbal et al., 2023; Kamath et al., 2020). Indonesia alone recorded 68,614 DHF cases in 2021 (Hendriana et al., 2023), underscoring the urgency for context-specific interventions.

Environmental factors strongly influence DHF incidence. Research shows that rainfall patterns significantly affect mosquito breeding and transmission (Maretha et al., 2022; Askrening et al., 2021). With nearly 40% of the global population living in dengue-endemic areas (Inderjit et al., 2021; Baiz et al., 2024), effective intervention strategies are critical. DHF's impact on youth and healthcare systems necessitates comprehensive strategies, including public education, vector control, and enhanced case management (Rahardjo & Wardhani, 2023; Mahayanti & Suardamana, 2024). Tackling environmental determinants is vital to reduce mosquito proliferation at the source.

The dynamics of DHF transmission are shaped by environmental, demographic, and behavioral factors. Urbanization and population density increase mosquito breeding grounds, as observed in Gorontalo Regency, Indonesia, where denser populations are more vulnerable to DHF (Pakaya et al., 2022). Climate variables such as rainfall and temperature directly influence mosquito growth and virus transmission, with warmer, unpredictable weather favoring outbreaks (Gibb et al., 2023). These insights highlight the need for prevention strategies tailored to local environmental and social conditions. Human mobility also sustains dengue transmission, as travel patterns often extend beyond mosquito flight ranges, enabling virus spread across regions (Telle, 2025). Geographic Information Systems (GIS) have proven effective in mapping dengue incidence patterns, allowing targeted interventions (Nguyen et al., 2020). Overall, the interaction between infrastructure, climate change, and population dynamics illustrates the complexity of DHF and the need for both technical and socially grounded strategies (Nakase et al., 2023).

Current community-based efforts in mosquito nest eradication (PSN) to control DHF face multiple challenges. A major issue is the lack of community engagement, which hampers the success of these initiatives. For example, in Lampung Province, insufficient participation in PSN activities has been linked to broader dengue spread, highlighting the critical role of community involvement (Farich et al., 2020). Misunderstandings about disease transmission further reduce public motivation to engage in preventive actions (Kurniawan, 2023). Addressing both awareness and engagement is vital. Community indifference toward environmental hygiene, combined with urban growth, contributes to increased mosquito populations and disease risk (Lensoni et al., 2022). Weak social capital and unclear engagement strategies hinder sustainable prevention efforts (Pervaiz et al., 2022). Youth involvement in PSN activities remains low, indicating the need for targeted education to improve participation (Sulistyawati et al., 2024; Ristawati et al., 2023). To address these issues, a multifaceted strategy is needed—one that enhances awareness, encourages collaboration, and empowers communities to combat mosquito proliferation. Strengthening social capital and youth engagement are key priorities.

Self-awareness surveys offer a useful tool for behavioral change by encouraging individuals to reflect on their habits and their health consequences. Such surveys help individuals understand their motivations and make healthier choices. For example, studies have found a link between self-awareness and healthier lifestyles among university students, with self-esteem playing a mediating role (Zhang et al., 2024). These findings suggest that cognitive empowerment can promote community-level health behavior improvements. Self-awareness also fosters ethical behavior, as reflective individuals are less likely to act against their values (Chang et al., 2021). It strengthens self-efficacy, empowering people to make informed health decisions, including lifestyle choices like diet and physical activity (Conners et al., 2024). Given self-efficacy's importance in behavior change, applying self-awareness approaches to vector control could benefit households and communities. Nonetheless, challenges such as inaccurate self-reporting and low participation remain obstacles to survey effectiveness (Ardianto & Etlidawati, 2022). Despite this, integrating self-awareness assessments into public health initiatives can enhance health outcomes by equipping people with the knowledge to engage in responsible self-care (NeJhaddadgar et al., 2020; Jin et al., 2021). Applying these tools in DHF prevention could empower communities in mosquito control.

Entomological surveillance indicators are essential for monitoring and managing dengue. Among these, the larva-free rate and Container Index (CI) are particularly valuable. The larva-free rate measures the percentage of inspected containers without larvae, reflecting vector control success. Higher rates are linked to reduced transmission risks, making this a reliable evaluation tool (Leandro et al., 2022). These metrics are useful for assessing behavior-based interventions like PSN. The Container Index, which shows the proportion of containers with mosquito larvae, helps identify key breeding sites and prioritize high-risk areas for intervention (Garjito et al., 2020). Both indicators allow real-time tracking of vector control efforts, enabling timely adjustments (Leandro et al., 2022). Through these entomological tools, health officials can effectively reduce dengue risks and assess the impact of household-level interventions such as self-awareness strategies (Kosoltanapiwat et al., 2020).

Recent studies have begun exploring the potential of self-awareness and behavioral interventions in vector control. For example, Baldwin et al. (2025) implemented a self-monitoring tool in urban households, reporting improvements in monthly ovitrap maintenance and a modest reduction in Container Index. However, this study relied on short-term follow-up and lacked integration with entomological indicators such as larva-free rate. Similarly, Alarcón-Elbal et al. (2024) demonstrated that community workshops increased knowledge and attitudes toward mosquito control but did not measure actual household breeding site reduction. These findings reveal a gap between increased awareness and its impact on measurable entomological outcomes.

In this context, our study aims to address these limitations by combining self-awareness surveys with entomological surveillance metrics—specifically Container Index and larva-free rate—within Semarang City households. Unlike previous research, we integrate behavioral self-assessment with objective, field-based indicators over a sustained period, thereby directly evaluating the impact on mosquito breeding sites. Ultimately, this study seeks to fill the evidence gap between knowledge acquisition and real-world entomological outcomes, providing robust data on the efficacy of self-awareness–driven interventions. This study aims to assess the effectiveness of self-awareness surveys in reducing dengue vector breeding by measuring changes in Container Index (CI) and larva-free rate (ABJ) in households of Semarang City, Central Java. By linking behavioral insight with entomological surveillance, our research contributes novel, empirical evidence to inform scalable, community-based dengue control strategies.

METHODS

This study employed a descriptive observational experimental design with a cross-sectional approach, integrating behavioral and environmental assessments within a community-based public health intervention. The research was conducted in Bulusan Village, Semarang City, which was purposively selected based on epidemiological considerations. Bulusan Village reported a consistently high incidence of Dengue Hemorrhagic Fever (DHF) and was actively implementing the Mosquito Nest Eradication (Pemberantasan Sarang Nyamuk or PSN) program during the study period. The choice of this site allowed researchers to evaluate intervention strategies in an endemic area with active community health mobilization, ensuring ecological validity and relevance to ongoing vector control efforts. The study covered four diagnostic stages in its conceptual framework: epidemiological, behavioral-environmental, educational-organizational, and administrative-policy diagnosis.

The population in this study consisted of all households residing in Bulusan Village, with the sample comprising households that were involved in PSN activities

Table 1. Types ovitrap based on amount ovitrap installed and those that trap larvae mosquito

Type Ovitrap	∑ Ovitrap Installed	∑ Existing Ovitrap the Flick	Container index (%)
Glass Plastic	24	2	8.33
Mineral Water Glass	24	3	12.5
Used Milk Cans	24	2	8.33

during the data collection period. Sampling was conducted using an incidental sampling technique, where households that participated voluntarily during the PSN campaign were recruited. Inclusion criteria for sample selection included: households with at least one adult respondent capable of completing a self-awareness survey, willingness to install ovitraps in household environments, and consent to participate in observation and interviews. Exclusion criteria included households that were uninhabited during the study period or refused to participate after informed consent. Each participating household received training on ovitrap installation and mosquito vector control. Ovitraps were installed and monitored over a 7–14 day period to assess larval breeding activity. Simultaneously, data on household environmental conditions were gathered through structured observation and in-depth interviews with family members.

Data collection instruments included a structured questionnaire, observation checklist, and ovitrap monitoring form. The self-awareness questionnaire was designed to assess knowledge, attitudes, and behaviors regarding DHF prevention, including items on awareness of breeding sites, frequency of environmental cleaning, participation in PSN activities, and perceptions of mosquito control responsibilities. The observation checklist was used to assess physical environmental factors such as water container types, waste disposal practices, and potential mosquito breeding habitats around each household. Ovitrap effectiveness was evaluated by calculating two entomological indicators: the Container Index (CI) and Free Larvae Index (ABJ). Quantitative data from the questionnaires and ovitrap monitoring were analyzed descriptively using percentage distributions and mean scores. Spatial mapping of ABJ distribution was conducted using GIS to visualize larval density patterns across the study area. All participants provided written informed consent prior to their involvement in the study, and ethical clearance was obtained from the relevant institutional review board. Data were managed securely and presented anonymously to protect participant confidentiality. This methodological approach allowed for an integrative analysis of behavioral, environmental, and entomological dimensions of DHF control within a community-based setting.

RESULTS

The Self-Awareness Survey (Survei Mandiri Diri or SMD) serves as a community empowerment initiative aimed at enhancing public participation in Dengue Hemorrhagic Fever (DHF) prevention, particularly through Mosquito Nest Eradication (PSN) activities. One of the primary strategies promoted in this effort is the use of simple ovitraps, designed to attract and trap Aedes mosquitoes. These ovitraps function not only as a mechanical means of vector control but also as tools to raise awareness and promote behavioral change within the household setting.

The effectiveness of this intervention is assessed using two key entomological indicators: the Free Larvae Index (Angka Bebas Jentik, ABJ) and the Container Index (CI). The ABJ represents the percentage of water-holding containers free of larvae, indicating the success of vector control efforts. Meanwhile, the CI denotes the proportion of containers found to contain larvae, reflecting the presence of active breeding sites.

Based on the findings presented in Table 1, three types of ovitraps were used in equal quantities (n=24 for each type): plastic glass containers, mineral water cups, and used milk cans. The mineral water cup ovitraps showed the highest positivity rate, trapping mosquito larvae in 3 out of 24 containers, resulting in a Container Index of 12.5%. Both plastic glass containers and used milk cans each trapped larvae in 2 of 24 units, yielding a CI of 8.33%. These results suggest that all three ovitrap types are capable of attracting mosquito vectors, though mineral water cups may exhibit slightly greater efficacy in this context.

This preliminary entomological assessment indicates that simple, low-cost ovitraps are effective in detecting Aedes mosquito breeding activity. The observed CI values provide a snapshot of mosquito presence, which is crucial for targeted intervention. Moreover, these findings emphasize the potential of integrating behavioral tools like self-awareness surveys with direct environmental control

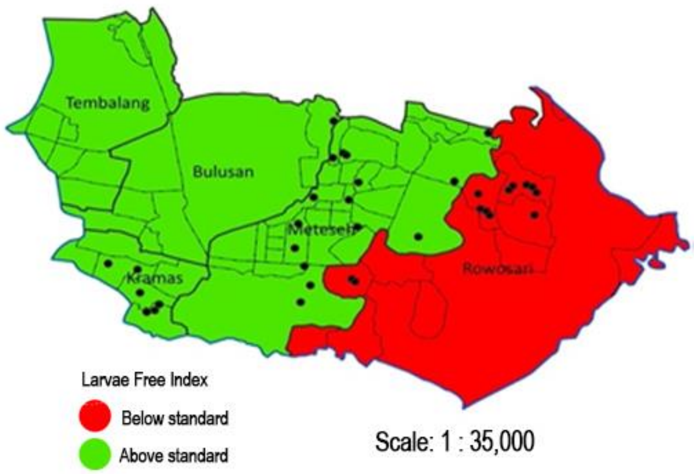

Figure 1. Map of dengue fever distribution in Rowosari Health Center working area

strategies, thus encouraging household engagement while generating measurable epidemiological data.

The spatial distribution of DHF cases in relation to ABJ values is illustrated in Figure 1. The mapping analysis provides further insight into geographic variations in larval density and DHF risk. Areas with lower ABJ percentages correspond to zones of higher disease incidence, reinforcing the importance of consistent larval control efforts across all administrative regions. This spatial correlation underlines the utility of ABJ and CI as complementary indicators for planning and monitoring community-based vector control interventions.

Collectively, the data underscore the importance of combining educational, behavioral, and environmental surveillance strategies in the fight against DHF. The integration of SMD activities with ovitrap deployment and real-time entomological monitoring offers a sustainable and participatory approach to disease control at the community level.

DISCUSSION

The findings of this study indicate that the implementation of the Self-Awareness Survey (Survei Mandiri Diri) and ovitrap training has a significant impact on community behavior regarding mosquito control and the prevention of Dengue Hemorrhagic Fever (DHF). The data showed measurable changes in entomological indicators such as the Container Index (CI) and Free Larvae Index (ABJ), with different ovitrap types showing varying effectiveness in trapping mosquito larvae. These results affirm the practical value of household-level interventions in vector surveillance, while simultaneously fostering behavioral change among residents.

The self-awareness survey has proven to be an effective instrument in promoting proactive health behaviors. By encouraging individuals to observe and assess their home environments, this intervention enhances awareness of potential mosquito breeding sites. Previous research supports this approach, showing that community engagement through self-monitoring correlates with a significant decrease in Aedes aegypti larvae populations (Nascimento et al., 2020; Vásquez-Trujillo et al., 2021). This heightened awareness cultivates a sense of responsibility and agency among participants, leading to more consistent and preventive actions, such as the routine cleaning of water containers and environmental management.

Simultaneously, ovitrap training emerged as an accessible and empowering educational tool, providing households with simple yet effective means of mosquito surveillance. Beyond its technical function, the ovitrap serves as a catalyst for public engagement. Training sessions equipped community members with knowledge on ovitrap assembly, placement, and maintenance, allowing them to become active agents in disease prevention. Studies by Silva et al. (2022) and Winter et al. (2021) highlight the high acceptance rates of ovitraps in various community settings, attributing their success to their simplicity and environmental compatibility. Consequently, this dual approach of combining behavioral self-assessment with entomological monitoring not only strengthens community capacity but also generates real-time data for public health action.

The integration of household-based strategies, such as insecticide use and educational interventions, further reinforces the efficacy of these initiatives. Empirical evidence supports the notion that household insecticide application significantly reduces mosquito populations and the risk of DHF transmission (Susanty et al., 2023). Educational outreach, especially programs that target mothers and community leaders, plays a pivotal role in increasing awareness and promoting self-efficacy (Zaini et al., 2024). Grassroots movements like "1 House 1 Larva Monitoring" (Harisnal et al., 2025) serve as powerful examples of sustainable community engagement, underscoring the value of locally driven surveillance activities.

This study also aligns with broader public health strategies that promote community-government collaboration. The success of such models depends on inclusive governance structures where community voices shape intervention strategies. As demonstrated by Mulyadi & Maulana (2021) and Guo & Li (2022), collaborative governance models enhance the legitimacy and sustainability of public health efforts. Similarly, community participation grounded in cultural understanding has been shown to address inequalities and foster health equity relevant in the context of DHF prevention, where sustained behavioral change requires trust, cooperation, and shared responsibility across sectors.

Urban health challenges, particularly in relation to DHF, necessitate integrated responses that include both infrastructural improvements and behavior change. The “3M Plus” strategy—draining, covering, and recycling water containers—remains a cornerstone of vector control. Community cadres and health volunteers serve as mobilizers, translating government policies into household practices (Siyam et al., 2020; Rahmah et al., 2023). However, urban risk factors such as population density and climate variability must be continually addressed through seasonal intervention campaigns and adaptive planning (Nuraeni, 2024; Fuadzy et al., 2020). Programs like "Satu Rumah Satu Jumantik" illustrate how collective vigilance within households can scale into community-level impact (Farahita et al., 2023).

To ensure sustainability, DHF prevention strategies should incorporate community-based monitoring, vaccination campaigns, and multi-sector collaboration. As noted by Shafie et al. (2024), participatory coalitions that unite health professionals, community leaders, and policymakers are essential for long-term impact. These initiatives must be bolstered by continuous education, local leadership development, and systematic evaluation to maintain their effectiveness. The introduction of Wolbachia mosquitoes and social marketing interventions may offer complementary tools for reducing vector populations and promoting preventive practices (Turner et al., 2023; Pastrana et al., 2020).

One of the strengths of this study lies in its integration of behavioral and entomological indicators, allowing for a comprehensive assessment of intervention impact. By simultaneously evaluating community awareness and mosquito breeding data, this approach offers practical insights that are both actionable and scalable. Furthermore, the study's community-based design ensures contextual relevance and enhances local ownership of DHF prevention efforts. The inclusion of GIS mapping and household-level analysis provides an added layer of spatial understanding that can inform targeted interventions.

Nevertheless, the study is not without limitations. The use of incidental sampling limits the generalizability of the findings, as participants may already possess a predisposition toward health-related behaviors. Additionally, the study's short follow-up period restricts the ability to assess long-term changes in entomological indicators or behavior sustainability. The reliance on self-reported data in the self-awareness survey may introduce bias, as participants may overestimate their engagement or understanding. Future research should consider a longitudinal design with a control group and randomized sampling to strengthen causal inferences and expand the applicability of results across diverse settings.

CONCLUSION

This study highlights the meaningful contribution of community-based interventions in controlling Dengue Hemorrhagic Fever (DHF), particularly through the integration of self-awareness surveys and ovitrap utilization. The implementation of Self-Awareness Survey (SMD) activities in Bulusan Village demonstrated a positive impact on increasing the Free Larvae Index (ABJ), reflecting improved household practices in vector surveillance and environmental hygiene. Among the three types of ovitraps tested, containers made from mineral water cups showed the highest larval detection rate, indicating their potential effectiveness and practicality in domestic settings. These findings affirm that sustainable DHF prevention cannot be achieved solely through governmental programs, but rather requires strong community involvement. The study contributes to public health efforts by showing that simple, low-cost tools like ovitraps, when paired with behavioral empowerment strategies, can lead to measurable improvements in mosquito control. This participatory model enhances local capacity, fosters responsibility, and supports environmentally friendly approaches to vector management.

Moving forward, it is recommended that community empowerment be further strengthened by involving residents not only in implementation but also in problem identification, planning, and evaluation stages of DHF control programs. For local health officers and Jumantik (larvae monitoring volunteers), continuous training and mentorship should be institutionalized, involving multi-sectoral stakeholders including the education sector, to ensure regular PSN (Mosquito Nest Eradication) practices beyond scheduled health campaigns. For future researchers, longitudinal studies with larger, randomized samples are encouraged to validate these findings and explore the long-term sustainability of behavioral and entomological impacts in diverse urban settings.

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AUTHORS' CONTRIBUTIONS

Roro Kushartanti, designed the study, formulated the concept, analyzed, wrote and revised the manuscript. Nur Gilang Fitriana enrolled participants, collected data and performed the field work.

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COMPETING INTERESTS

The authors affirm that there are no conflicts of interest related to the research, writing, or publication of this article.

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