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The Analysis of Stigmatisation and Community Acceptance in Malang City towards Wolbachia-infected *Aedes aegypti* in Dengue Fever Vector Control

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ABSTRACT

Introduction: Dengue fever is a top ten global health threat according to the World Health Organisation (WHO). Indonesia, especially Malang City has 560 dengue haemorrhagic fever cases in 2022 with Sukun Sub-district having the highest number of 159 cases. Dengue haemorrhagic fever vector control carried out by the government is currently 3M (drain, cover, and recycle) where it is still conventional. Whereas generally now there have been many studies on dengue vector control innovations, one of which is the *Ae. aegypti* with Wolbachia. The programme has been implemented in Yogyakarta and resulted in a decrease in dengue fever cases. The purpose of this study was to analyse the stigma and acceptance of the community in Malang City towards the Wolbachia-infected *Ae. aegypti* with Wolbachia programme in controlling dengue haemorrhagic fever vector.
Methods: The method used was cross-sectional using questionnaires to 100 communities in Sukun Sub-district, Malang City with non-dense and dense populations.
Results: The results showed that 87.5% of densely populated communities were aware of the programme, while only 5% of non-densely populated communities were aware of the programme. Based on the questionnaire results, it is known that the majority of community concerns about the programme between non-dense and dense communities are the same, namely the cost and health risks. However, after distributing the comic "What is *Ae. aegypti* with Wolbachia?" the community's acceptance towards the programme was found to be majority accepting. The community also hoped that there would be a socialisation activity from the relevant government for the next step of implementation.
Conclusion: This study concluded that the community had a positive stigma and acceptance towards the Wolbachia-infected *Ae. aegypti* with Wolbachia programme if implemented in their area.

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INTRODUCTION

Dengue fever is caused by the dengue virus and transmitted by the *Ae. aegypti* mosquito is an infectious disease. Mosquitoes are the most rapidly spreading disease vector and have become a global public health problem (1). The World Health Organisation (WHO) lists dengue fever as one of the ten global health threats (2). It is a significant public health threat, particularly in tropical and subtropical countries (Southeast and South Asia), accounting for 70% of the dengue burden (1). Indonesia's tropical climate, rapid urbanisation, and lack of good sanitation contribute to the spread of this disease (3). Malang City, one of the major cities in Indonesia, also experiences the threat of DHF. The number of DHF cases in Malang City in 2022 was 560 cases. There were 159 cases of DHF in the Sukun sub-district, 119 cases in the Kedungkandang sub-district, 111 cases in the Lowokwaru sub-district, 101 cases in the Bliming sub-district, and 70 cases in the Klojen sub-district (4).

Dengue fever can cause severe symptoms such as high fever, severe joint pain, and, in extreme cases, dengue haemorrhagic fever (DHF), which can be fatal if not treated immediately (5). According to the Indonesian Ministry of Health, hundreds of thousands of cases are reported yearly, damaging the health system and the economy. In response to this, the government has intensified efforts to raise public awareness on preventive measures such as the 3M program of draining, covering, and recycling containers that can hold water to prevent mosquito breeding, along with campaigns for early detection and timely medical intervention to minimise deaths (6). The Indonesian government also relies on periodic fogging as an emergency method to reduce adult mosquito populations in areas experiencing increased dengue cases. However, the effectiveness of this method is often limited as it only kills adult mosquitoes and does not affect mosquito larvae that are still in standing water. In addition, repeated use of insecticides can lead to mosquito resistance, thus complicating vector control efforts (7).

Recently, an integrated approach involving community education, improved environmental sanitation, and better coordination between central and local governments is needed to reduce the risk of Dengue outbreaks. Research and development of more environmentally friendly technologies are also being promoted to reduce dependence on chemical insecticides and find more effective long-term solutions (1,7). One of Indonesia's latest innovations in Dengue control is the use of *Ae. aegypti* mosquitoes infected with Wolbachia bacteria. Wolbachia is a natural bacterium that does not harm humans but can inhibit the mosquito's ability to transmit Dengue virus (8).

This innovation was first implemented through the World Mosquito Programme (WMP) project in various countries, including Indonesia (8). In this effort, Wolbachia-infected mosquitoes are released into the environment, where they will mate with other mosquitoes, and the bacteria will be passed on to the next generation, thus increasing the population of Wolbachia-carrying mosquitoes (9). Studies have shown that Wolbachia-carrying mosquitoes have a high success rate in reducing dengue virus transmission because the bacteria affect virus reproduction in the mosquito. This programme has been tested in several areas in Indonesia, such as Yogyakarta, with positive results (10).

Studies in Yogyakarta showed a significant reduction in Dengue cases in areas that have implemented Wolbachia-infected *Ae. aegypti* programmes. Wolbachia-based control is considered environmentally friendly as it does not require the use of insecticides and provides long-term protective effects for the community (10). The successful implementation of this innovation opens up opportunities for a wider programme to be implemented in all high-risk areas in Indonesia. However, successful implementation depends not only on technical aspects but also on social and environmental factors. Although the technology is environmentally friendly, the community perception of Wolbachia-infected *Ae. aegypti* may vary, with some communities experiencing apprehension or uncertainty (6,11). Therefore, community engagement and a deeper understanding of their perceptions are essential to enhance the effectiveness of this programme.

This study aimed to analyse the stigma and acceptance of the Malang City community towards the dengue fever vector control programme through the spread of Wolbachia-infected *Ae. aegypti*. This study aimed to identify factors that influence community perceptions, including concerns and support for implementing this technology. With a deeper understanding of the social and environmental factors that shape community stigma and acceptance, this research is expected to provide appropriate recommendations for stakeholders to formulate more effective and sustainable dengue control policies and ensure the programme runs with wider community support.

METHOD

Design of the Study

This study used a cross-sectional design with educational intervention to analyse stigma and community acceptance of Wolbachia-infected *Ae. aegypti* in dengue fever vector control in Malang City. The number of respondents was determined using the Slovin formula (5% margin of error) with the population being the number of household heads in RW 01, and RW 12. A total of 100 respondents (50 from densely populated areas and 50 from less populated areas) were selected using a stratified random sampling technique. The study was conducted in three phases: baseline survey, distribution of educational materials, and follow-up interviews. Respondents had to be >18 years old and lived in the area for over 6 months. This was to ensure that respondents had sufficient experience with local health campaigns.

Location of the Study

The research was conducted in two different areas in Malang City, focusing on the Sukun Sub-district, which has the most DHF cases, 159 cases. In contrast, Tanjungrejo Village has the most cases among other villages [4]. Tanjungrejo village consists of 13 RWs, and the researcher decided to conduct the study in two RWs, namely RW 01 and RW 12. RW 01 represents the type of population with high population density, while RW 12 represents the type of population with low population density. This location selection compares the stigma and community acceptance in the two areas.

Procedures of the Study

Initial Survey: In the first stage, respondents were asked to complete a questionnaire that measured their knowledge about Wolbachia and their concerns regarding the programme. The questionnaire utilised a 5-point Likert scale and open-ended questions to explore more specific concerns.

Educational Intervention: One week after the baseline survey, researchers distributed an educational comic titled "What is Wolbachia-infected *Ae. aegypti*?" to respondents. The comic contained information on the mechanism, benefits and safety of using Wolbachia-infected mosquitoes in dengue control. The design of the educational materials was informed by recent scientific literature, including the study by Martinez-Cruz et al. (2023) that addressed educational interventions (pre- and post-measures) using quantitative-qualitative techniques in a suburban town of Yucatan, Mexico (12). The validation of the materials was conducted through expert review in the fields of entomology, public health and education, ensuring content accuracy and suitability for the target audience. Furthermore, a pilot study was conducted with a small group of community members to assess the readability, visual appeal, and message comprehension of the materials. The results of this pilot test were utilised to refine and enhance the materials prior to their dissemination to respondents. This methodological approach ensured that the educational materials were not only informative but also effective in supporting changes in community perceptions of the Wolbachia programme.

Follow-up Survey: One week after the educational intervention, a follow-up survey was conducted to measure changes in community perceptions and to collect suggestions and expectations regarding the implementation of the Wolbachia programme.

Data Collection

Data were collected through structured and semi-structured questionnaires in both the baseline and follow-up surveys. The questionnaires covered demographic data, knowledge levels, concerns, and community views after the educational intervention. All interviews were conducted in person by trained enumerators to ensure consistency.

Data Analysis

Data were analysed descriptively to describe the distribution of community knowledge, concerns and acceptance of Wolbachia-infected mosquitoes. This analysis focused on identifying patterns of community perceptions based on survey results in both areas. Data from open-ended questions were analysed thematically to explore the main concerns and expectations of the community towards implementing the Wolbachia programme. The results were presented as frequencies, percentages and qualitative interpretations to describe the community's views comprehensively.

Ethical Approval

This study was approved by the Health Research Ethics Committee The State University of Malang (Approval Number: No.23.12.15/UN32.14.2.8/LT/2024). All participants, provided informed consent prior to participating in the study.

RESULTS

Based on data on the characteristics of respondents in densely populated and non-densely populated areas, there are differences in demographic distribution. In densely populated areas, the majority of respondents are female (70%) with dominant age groups of 41-50 years (38%) and >50 years (42%). The education level is dominated by high school graduates (56%), and 44% of respondents work as entrepreneurs. In contrast, in less densely populated areas, most respondents were also female (86%), with the largest age distribution at >50 years (54%). Education levels were dominated by primary school graduates (34%), and 34% worked as entrepreneurs (Table 1).

Table 1. Sociodemographic characteristics of the respondents

Criteria	Category	Densely Populated	Percentage (%)	Not Densely Populated	Percentage (%)
Sex	Male	15	30	7	14
	Female	35	70	43	86
Age	<20 years	2	4	0	0
	21-30 years	4	8	2	4
	31-40 years	4	8	5	10
	41-50 years	19	38	16	32
	>50 years	21	42	27	54
Latest Education	No Formal Education	7	14	0	0
	Elementary School	10	20	9	18
	Junior Highschool	2	4	8	16
	Highschool	28	56	18	36
	College/University	3	6	15	30
Occupation	Student	2	4	0	0
	Private Workers	2	4	1	2
	Civil Workers	4	8	2	4
	Entrepreneur	22	44	17	34
	Housewife	20	40	30	60

Source: Primary Data

Community knowledge about Wolbachia significantly varied between densely populated and non-densely populated areas. From the data obtained, 87.5% of respondents in densely populated areas had heard of Wolbachia, while only 12.5% were unaware of the programme. In contrast, in less densely populated areas, most respondents (95%) had not heard of Wolbachia, with only 5% stating that they were aware of the programme. This difference reflects the gap in access to information between the two areas (Table 2).

Table 2. Knowledge of the Wolbachia-infected Ae. aegypti Programme

Obtained Information for Wolbachia	Respondent at Densely Populated Area	Percentage (%)	Respondent at Non-Densely Populated Area	Percentage (%)
Yes	35	87.5	2	5
No	5	12.5	38	95

Source: Primary Data

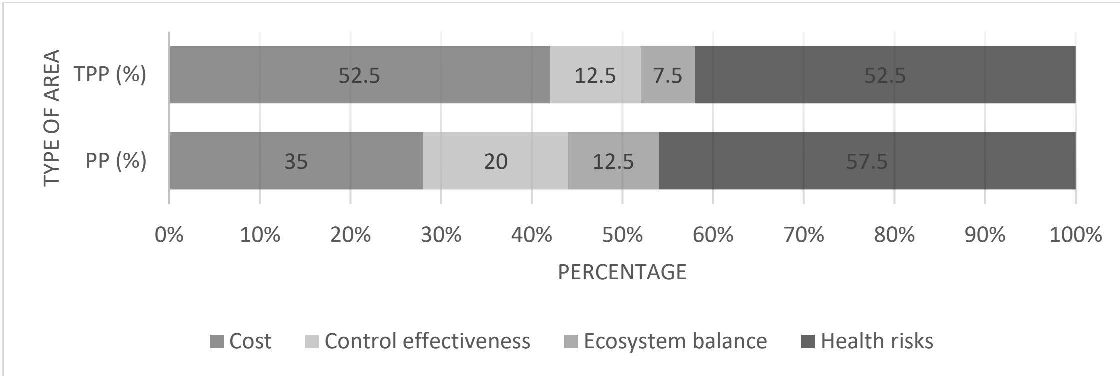

Figure 1. Community concerns over Wolbachia-infected Ae. Aegypti

Analyses of the graph above showed that community perceptions of factors influencing Wolbachia-infected mosquito implementation differed between densely populated (PP) and non-densely populated (TPP) areas. In TPP areas, cost was the most considered factor, with a percentage of 42.5%, followed by health risk at 37.5%. Meanwhile, health risks were the main concern in PP areas, at 40%, followed by costs at 27.5%. Control effectiveness and ecosystem balance were also considered but to a lesser extent in both regions.

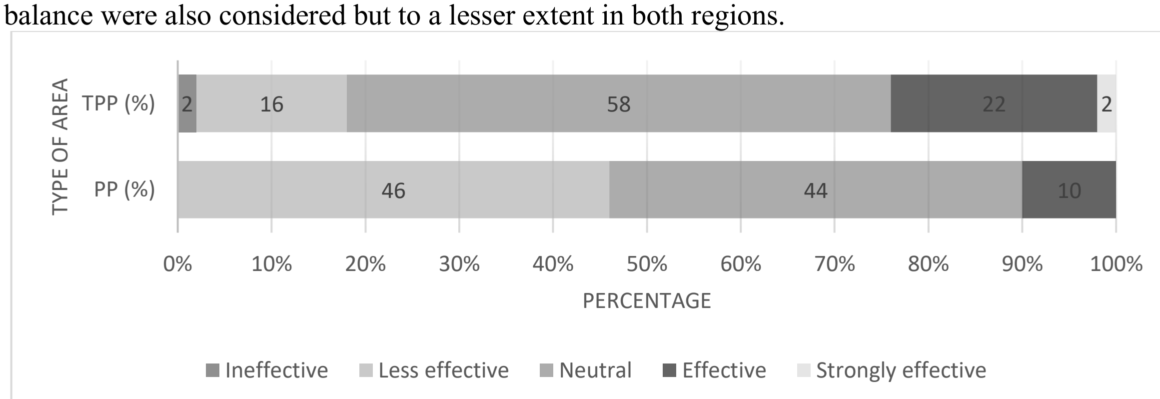

Figure 2. Opinions on the Effectiveness of Wolbachia-infected Ae. Aegypti

Data after the comic education programme showed changes in the perception of the effectiveness of Wolbachia-infected mosquitoes in the two areas. In the TPP area (non-densely populated), most respondents (60%) remained neutral about the effectiveness of Wolbachia. Still, there was an increase in positive views, with 20% of respondents rating the programme as effective. A total of 17.5% still doubted the programme's effectiveness, while only 5% considered the programme ineffective. In PP (densely populated) areas, ineffective views still dominated (45%), but there was an increase in neutral and effective ratings, with 45% and 10%, respectively. No respondents rated the programme as very effective.

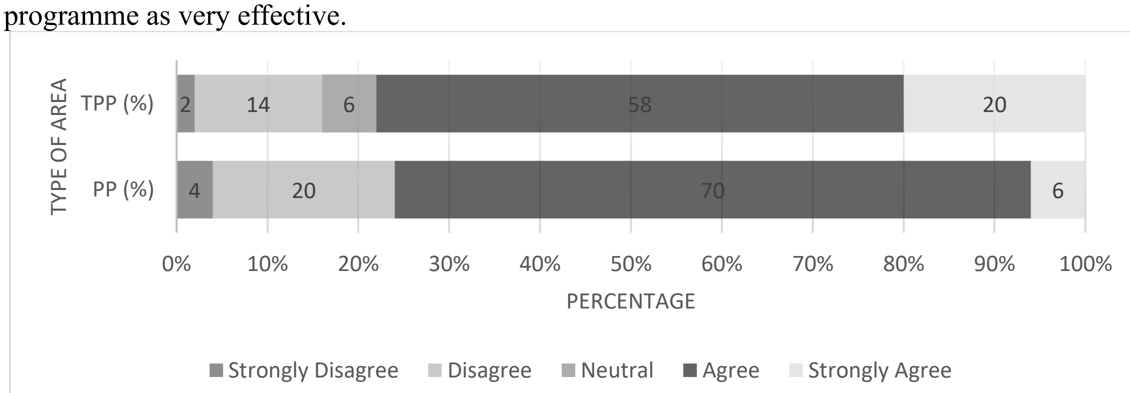

Figure 3. Community perception after a week since the distribution of the comic ‘What is Wolbachia-infected Ae. aegypti?’

Interview results related to community opinion on the Wolbachia-infected mosquito dispersal implementation plan showed significant variation between the two areas, namely densely populated (PP) and less densely populated (TPP). In the TPP area, 57.5% of respondents agreed, with 25% strongly agreeing. Meanwhile, 10% of respondents neither agreed nor disagreed. In contrast, support was stronger in PP areas, with 75% of respondents agreeing and 7.5% strongly agreeing. However, 15% of respondents disagreed. No respondents in either region strongly disagreed.

DISCUSSION

Knowledge and Concern

Our study found that there are differences in the sociodemographic composition of the two research areas. This difference in composition is an important background that shows potential variations in community responses. Densely populated areas generally have greater access to media and information and are more likely to be exposed to public health campaigns such as Wolbachia. Higher social interaction in these areas may also contribute to faster and more effective information dissemination. Research on information dissemination by the community in 2017 found that face-to-face communication was the best. Proximity and social environment factors determined respondents' ability to obtain and disseminate information in both urban and rural areas (13).

In contrast, less populated areas may have limited access to media and less exposure to educational programmes, leading to low levels of knowledge about the Wolbachia-infected *Ae. aegypti* programme among the community. Another study in Australia found that high community awareness resulted from the provision of information needed by the community about the programme directly through a health campaign programme (14). Therefore, the condition of community knowledge on the Wolbachia-infected *Ae. aegypti* programme in the two research areas showed different results. Other studies have also suggested that long-term health education programmes alone cannot optimally improve community health awareness and behaviour (15,16). The present study has been conducted on a sample of the population inhabiting the research site, and thus the validity of the results is of a qualitative nature. The qualitative validity employed is that of internal validity, which is determined by means of content analysis (17). The results of the content analysis in the two research areas have revealed some similar concerns that the Community has expressed.

Community knowledge about the Wolbachia-infected *Ae. aegypti* programme was different in each study area, resulting in community concerns. The lowest to highest concerns were ecosystem balance, control effectiveness, cost, and health risk. Although community concerns related to ecosystem balance were the lowest compared to other factors, several reasons need to be considered. The first reason expressed was the potential disruption to local insect populations. Respondents with this concern tended to be knowledgeable about the important role of insect species in the ecosystem, especially regarding food chains and biodiversity. They were concerned that the release of large numbers of Wolbachia-infected mosquitoes could alter the population dynamics of other insects, especially species that have important roles in the local ecosystem, such as natural predators of mosquitoes that may be affected by these changes. This is in line with research showing that potential environmental hazards could significantly disrupt the food chain in areas with the population of *Ae. aegypti* mosquito populations decline or are eliminated (18,19).

The second reason raised was concerns about potential unforeseen domino effects on other species. Some respondents may have heard about the ecosystem impacts of similar programmes or other synthetic biology technologies, and they fear that introducing modified mosquitoes may trigger unintended changes in the ecosystem, such as affecting birds or insects that feed on mosquitoes. This is similar to research that suggests a decline in mosquito predator insects, destabilising the ecosystem's food chain (20,21). Research in Florida also showed that 51% of respondents considered mosquitoes a nuisance, which may illustrate the variation in people's perceptions in different regions towards genetic engineering, which is an important aspect in ecological studies of vector control (22).

A further significant concern associated with the Wolbachia-infected *Ae. aegypti* release programme was the doubt on the effectiveness of mosquito control and its impact in reducing the spread of dengue fever. Respondents concerned about the effectiveness of control often had a limited understanding of the technology, particularly Wolbachia's mechanism of action in reducing mosquitoes' ability to spread the dengue virus.

The first reason that often arises is uncertainty about how Wolbachia technology works and its effectiveness in suppressing dengue transmission in the field. People unfamiliar with this technology often doubt the expected results, especially since they may not have seen any direct evidence or actual experiences from similar programmes elsewhere. In this case, they are concerned that the money spent on the programme may not be worth it and will only burden the public purse without significantly reducing the number of dengue cases. This is in line with a study in Panama, which stated that the results of releasing *Ae. aegypti* OX513A after six months showed no reduction in the density of *Ae. albopictus* species (21).

The second reason often cited was uncertainty about the time it would take to see tangible results from the programme. Some respondents expressed concern that the programme may take years before a significant impact is felt, and this could be a source of uncertainty for communities who want to see immediate results. They were also unsure whether the programme would require ongoing monitoring and intervention over the years, raising questions about the sustainability of the funding and resources required. However, Oxitec field trial studies have successfully reduced *Ae. aegypti* populations by 80-95%, with a dengue case rate of 91%. Such studies have been conducted in Brazil, the Cayman Islands, and Malaysia (23,24).

The most common concern expressed by the community was cost, which was related to the release programme of Wolbachia-infected *Ae. aegypti* mosquitoes and who would bear the cost of implementing the programme. The community members, especially those from the middle to lower-income groups, were concerned that the programme's cost would be passed on to the residents or become a tax burden on the community. This concern is based on previous public health programmes where people were initially not charged. Still, over time, they were asked to bear maintenance costs or purchase certain items themselves. A concrete example often expressed by respondents was their experience with the Mosquito Nest Eradication Programme (PSN), where abate, previously provided free of charge by the government, now has to be purchased by the community regularly. This has led to the perception that new programs, such as the release of Wolbachia-infected mosquitoes, may follow the same pattern, where additional costs will eventually be passed on to residents, further burdening low-income families.

These cost concerns are also fuelled by uncertainty about the transparency of state budget allocations in health programmes such as these. Many respondents expressed doubts about the effectiveness of using the state budget, especially due to previous experiences where public health programmes were judged not to deliver optimal results despite their high costs. Respondents doubted whether the large amount of money spent on this programme would significantly impact dengue control or if it would end up like some other programmes where the results were not worth the expenditure. They were concerned that the high cost would not directly benefit the community, creating distrust of the effectiveness of public funds managed by the government in similar projects. The high cost was an obstacle in the 2015 release trial of sterile male mosquitoes in Semarang City, although it reduced the mosquito population (25).

A major concern expressed by respondents regarding the release programme of Wolbachia-infected *Ae. aegypti* mosquitoes were the potential health risks, especially if there is continued exposure to bites from the biologically modified mosquitoes. People were concerned that the bites of these mosquitoes might trigger allergic reactions or unexpected health effects. This concern is reasonable given that Wolbachia is a bacterium that naturally lives in many insects. Still, the technology to introduce it into mosquito populations may be perceived as unfamiliar and unusual, especially for people unfamiliar with this concept. Genetic safety evaluation, as described in the statement, is important to ensure that releasing Wolbachia-carrying mosquitoes does not lead to unforeseen health risks, such as allergic reactions or other effects that may arise from mosquito bites (20,26).

The second underlying concern is respondents' fear of genetic or synthetic biology technologies that they do not fully understand. Many of the respondents associated these biological modification technologies with interventions that were considered unnatural and had the potential to disrupt human biological systems or the environment in ways that were not fully understood. This lack of understanding often creates a perception of higher risk than is actually the case. People unfamiliar with these technologies may be more wary of potential unknown side effects, triggering resistance or apprehension towards implementing such programmes (20,26).

Lastly, public concerns about the release of Wolbachia-infected *Ae. aegypti* mosquitoes were largely driven by the lack of access to adequate information on the programme's safety, effectiveness and ecological impacts. Therefore, better communication strategies are needed, especially in disseminating trial results and empirical data from areas that have implemented the programme, so that communities in other areas can have a more comprehensive and positive understanding of the potential benefits of the Wolbachia-infected mosquito release programme in dengue control (27).

Effectivity and Availability

After the community was educated through the "What is Wolbachia-infected *Ae. aegypti*?" comic, the results of community opinion on the effectiveness and willingness of the community towards the release of Wolbachia-infected *Ae. aegypti* showed a neutral attitude that tended to be positive in its effectiveness. However, there were still variations in perceptions across the two regions, reflecting that while the education process provided a better understanding, the challenge of dealing with scepticism among some community members remains.

Different results were shown in the PP, where the majority answered neutral and less effective, where, according to them, there must first be concrete examples that support this effectiveness. This was not the case with TPP, where the majority answered neutrally and effectively due to trust in technological development. Research has shown that Wolbachia-infected *Ae. aegypti* can reduce the reproduction rate of dengue vectors, resulting in localised elimination of the disease (8). A quasi-experimental study also mentioned that the incidence of hospitalisation due to dengue haemorrhagic fever decreased by 76% in seven urban villages in Yogyakarta (28). The subsequent approach that can be adopted is a regular approach to the community, with efforts to conduct more frequent socialisation and interactive communication. The utilisation of social media, public discussion forums, and engagement with local communities can be effective methods to increase public understanding of Wolbachia-infected mosquitoes and reduce resistance to the programme.

This finding indicates the need for a more strategic approach in disseminating information on the Wolbachia programme, especially in areas with low population density. Community education should be strengthened by using communication methods that can reach communities in remote areas, such as through face-to-face activities, collaboration with local leaders, or using more affordable media. Thus, efforts to increase community knowledge about Wolbachia can be more evenly distributed, supporting more effective and sustainable programme implementation. In line with the study, the concerns expressed by the respondents indicate that it is important to consider alternative approaches that are more effective in conveying information on the safety and effectiveness of Wolbachia-infected mosquito release. This approach should be able to allay the community's fears through transparent and evidence-based explanations so that they can better understand the programme's overall benefits. In practice, the release of Wolbachia-infected *Ae. aegypti* mosquitoes in Yogyakarta were conducted by attaching mosquito eggs in an open container and hatching within two weeks, while in Florida and Vietnam, mosquitoes were released as adults (28,29).

Recommendation

The community had many opinions on increasing acceptance of the Wolbachia-infected *Ae. aegypti* programme. Some of the opinions expressed by the community revolved around the need for socialisation in the surrounding community, the government having confidence in the programme, suggesting a vote for approval, conducting more trials, and asking the community to maintain better hygiene. The response shown by the community is a form of concern regarding something new and unknown. Perceiving something uncertain and unclear is influenced by the state of feeling, thinking, age, personality, and the context of the risk that has an impact (30). Individual experiences related to feelings and thoughts are the main factors that underlie a person's actions. Support provided by the community for the Wolbachia-infected mosquito dissemination programme needs to consider thoughts and feelings (31). Feeling can be done by conveying unknown problems with fun activities. Meanwhile, thinking can be done by socialising. Socialisation improves understanding, ability, and behaviour towards a problem (32).

Socialisation is divided into two, namely primary socialisation (in the family) and secondary socialisation (in the community) (33). Socialisation can be done using the secondary socialisation approach directly aimed at the community. Its application also requires consideration of each individual's ability, understanding and trust (34). Therefore, the data in Table 1, where the most common age range was 41-50 years old and more than 50 years old with a high school education background, became the basis for the socialisation using the media "What is Wolbachia-infected *Ae. aegypti*?" to be conducted. The result of the comparison of opinions before and after socialisation was an increase in the willingness of the community to accept the Wolbachia-infected *Ae. aegypti* programme. Densely populated and non-densely populated areas generally had the same willingness to accept Figure 2 and Figure 3. As social creatures, individuals tend to believe in information that has been spread long and widely over time (35). Therefore, using this socialisation media, residents can review their understanding of the Wolbachia-infected mosquito. Long-lasting media also requires efforts to recall directly, which can be done by trusted people in the neighbourhood.

The subsequent phase of the programme involves the active involvement of the local community. This approach has been successfully implemented by O'Neil et al. (2019) in Townsville, a city in northern Australia, through the development of a comprehensive community engagement strategy. The results of the study demonstrated that with community engagement, the frequency of Wolbachia-infected *Ae. aegypti* has remained stable since deployment, and no local dengue transmission has been confirmed in any area of Townsville after 13 years, in the context of the epidemiological increase in imported cases (36).

CONCLUSION

The difference in community knowledge was due to the fact that densely populated areas have a faster information dissemination rate and are the target locations for health campaigns. However, the community raised concerns from densely populated and non-densely populated areas in the Wolbachia-infected *Ae. aegypti*. The *Ae. aegypti* programme was mostly about costs and health risks. They were concerned about the maintenance cost or the cost borne by the community due to the implementation of this programme. In addition, the community also had concerns about health risks affecting humans due to genetic mutation or becoming vectors for certain viruses.

After socialising the community with the comic "What is Wolbachia-infected *Ae. aegypti*?". Concerns that had previously arisen began to diminish and showed that community acceptance of the Wolbachia-infected *Ae. aegypti* programme was likely to be positive. Therefore, the community gave suggestions and expectations to the government to conduct socialisation in the community. The type of socialisation activities conducted could also be adjusted to the sociodemographic conditions.

In order to ensure the continued acceptance of the Wolbachia-infected *Ae. aegypti* programme by the community, the subsequent strategic step is the implementation of pilot programs in a variety of areas exhibiting differing sociodemographic characteristics. This will facilitate a more contextualised evaluation of the intervention's effectiveness and the adaptation of evidence-based communication strategies. Furthermore, longitudinal studies are required to assess the dynamics of changes in public perceptions of this technology over an extended period. Such studies can reveal factors that influence the level of acceptance, the effectiveness of socialisation, as well as potential challenges on a broader scale of implementation. By following this approach, Wolbachia-based vector control programmes can be more optimally supported in their role in sustainable and scientifically-based mitigation strategies for diseases transmitted by *Ae. aegypti*.

AUTHOR'S CONTRIBUTION STATEMENT

Jenvia Rista Pratiwi: Conceptualization, Methodology, Investigation, Writing - Review & Editing; **Noventia Sekar Pratiwi**: Writing, Investigation - Review & Editing; **Ridwan Muhamad Rifai**: Investigation, Interpreter - Review & Editing; **Ghea Pratiwi Santoso**: Investigation - Review & Editing; **Hanifa Salsabila**: Investigation - Review & Editing; and **Anie Yulistyorini**: Review & Editing.

CONFLICTS OF INTEREST

There are no conflicts to declare.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors declare that they did not use Generative AI or AI-Assisted Technologies during the writing of this manuscript

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BIBLIOGRAPHY

1. Dengue and Severe Dengue Available online: https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue (accessed on 30 October 2024).
2. Ten Threats to Global Health in 2019 Available online: https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019 (accessed on 30 October 2024).
3. MEDIAKOM – Sehat Negeriku Available online: https://sehatnegeriku.kemkes.go.id/topik/mediakom/ (accessed on 30 October 2024).
4. Badan Pusat Statistik Kota Malang Available online: https://malangkota.bps.go.id/id (accessed on 30 October 2024).
5. Indra, I.M.; Mahdang, P.A.; Setyawan, D.A.; Tarnoto, K.W.; Rosyida, R.W.; Sunarto; Basri, S.; Maksum, T.S.; Sari, R.I.; Aulia, U. Epidemiologi Penyakit Menular; Indra, I.M., Mahdang, P.A., Setyawan, D.A., Tarnoto, K.W., Rosyida, R.W., Sunarto, Basri, S., Maksum, T.S., Sari, R.I., Aulia, U., Eds.; Tahta Media Group, 2022;
6. Kemenkes RI Profil Kesehatan Indonesia 2023; Sibuea, F., Ed.; Jakarta, 2024;
7. Monitoring and Managing Insecticide Resistance in Aedes Mosquito Populations. Interim Guidance for Entomologists Available online: https://www.who.int/publications/i/item/WHO-ZIKV-VC-16.1 (accessed on 30 October 2024).
8. Utarini, A.; Indriani, C.; Ahmad, R.A.; Tantowijoyo, W.; Arguni, E.; Ansari, M.R.; Supriyati, E.; Wardana, D.S.; Meitika, Y.; Ernesia, I.; et al. Efficacy of Wolbachia-Infected Mosquito Deployments for the Control of Dengue. N Engl J Med 2021, 384, 2177–2186.
9. Firdausi, R.I.; Bestari, R.S.; Dewi, L.M.; Nurhayani, N. Peran Bakteri Wolbachia Terhadap Pengendalian Vektor Demam Berdarah Dengue (DBD) Aedes Aegygpti . Prosiding University Research Colloquium 2021, 513–521.
10. Irfandi, A. Kajian Pemanfaatan Wolbachia Terhadap Pengendalian DBD (Studi Literatur Dan Studi Kasus Pemanfaatan Wolbachia Di Yogyakarta). Forum Ilmiah 2018, 15, 276–289.
11. Supriatna, A.; et al. Penerapan Wolbachia Untuk Pengendalian Demam Berdarah Di Indonesia: Sebuah Tinjauan. Jurnal Kedokteran Tropis Universitas Gadjah Mada 2020, 6, 104–111.
12. Martinez-Cruz, C.; Arenas-Monreal, L.; Gomez-Dantes, H.; Villegas-Chim, J.; Barrera-Fuentes Gloria, A.; Toledo-Romani Maria, E.; Pavia-Ruz, N.; Che-Mendoza, A.; Manrique-Saide, P. Educational Intervention for the Control of Aedes Aegypti with Wolbachia in Yucatan, Mexico. Eval Program Plann 2023, 97, doi:10.1016/j.evalprogplan.2022.102205.
13. Rumata, V.M. Perilaku Pemenuhan Dan Penyebaran Informasi Publik Bagi Masyarakat Kota Dan Desa. Jurnal Penelitian Komunikasi 2017, 20, 91–106.
14. Ryan, P.A.; Turley, A.P.; Wilson, G.; Hurst, T.P.; Retzki, K.; Brown-Kenyon, J.; Hodgson, L.; Kenny, N.; Cook, H.; Montgomery, B.L.; et al. Establishment of WMel Wolbachia in Aedes Aegypti Mosquitoes and Reduction of Local Dengue Transmission in Cairns and Surrounding Locations in Northern Queensland. Gates Open Res 2019, 1–30.
15. Sow, S.; de Vlas, S.J.; Mbaye, A.; Polman, K.; Gryseels, B. Low Awareness of Intestinal Schistosomiasis in Northern Senegal after 7 Years of Health Education as Part of Intense Control and Research Activities. Tropical Medicine and International Health 2003, 8, 744–749.
16. Dulai, J.; Salway, T.; Thomson, K.; Haag, D.; Lachowsky, N.; Grace, D.; Edward, J.; Grennan, T.; Trussler, T.; Gilbert, M. Awareness of and Intention to Use an Online Sexually Transmitted and Blood-Borne Infection Testing Service among Gay and Bisexual Men in British Columbia, Two Years after Implementation. Canadian Journal of Public Health 2021, 78–88.
17. Kuantitatif, P.; Kualitatif, P.; Kelas, T.; Rukminingsih, P.; Pd, M.; Adnan, G.; Mohammad, A.; Latief, M.A. METODE PENELITIAN PENDIDIKAN ERHAKA UTAMA YOGYAKARTA; ISBN 9786025715341.
18. Macer, D. Ethical, Legal, and Social Issues of Genetically ModifyingInsect Vectors for Public Health. Insect Biochem Mol Biol 2005, 35, 649–660.

19. Romadhona, H.A.; Qushayyi, M.F.; Sari, R.Y.; Rohmah, S.A. Rekayasa Genetik Pada Nyamuk Penyebab Malaria: Kajian Literatur. Jurnal PIPA: Pendidikan Ilmu Pengetahuan Alam 2024, 5, 7–17.
20. National Academies of Science, E. and M. Gene Drives on the Horizon: Advancing Science, Navigating Uncertainty, and Aligning Research with Public Values; The National Academies Press: Washington, DC, 2016;
21. Achee, N.L.; Grieco, J.P.; Vatandoost, H.; Seixas, G.; Pinto, J.; Ching-NG, L.; Martins, A.J.; Juntarajumnong, W.; Corbel, V.; Gouagna, C.; et al. Alternative Strategies for Mosquito-Borne Arbovirus Control. PLoS Negl Trop Dis 2019, 13, 1–22.
22. Adalja, A.; Sell, T.K.; McGinty, M.; Boddie, C. Genetically Modified (GM) Mosquuito Use to Reduce Mosquito-Transmitted Disease in the US: A Community Opinion Survey. PLoS: Currents Outbreaks 2016.
23. Carvalho, D.O.; McKemey, A.R.; Garziera, L.; Lacroix, R.; Donnelly, C.A.; Alphey, L.; Malavasi, A.; Capurro, M.L. Supression of a Field Population of Aedes Aegypti in Brazil by Sustained Release of Transgenic Male Mosquitoes. PLoS: Neglected Tropical Disease 2015, 9.
24. Dengue Fever Cases Drop 91% in Neighbourhood of Piracicaba, Brazil, Where Oxitec's FriendlyTM Aedes Were Released Available online: https://www.prnewswire.com/news-releases/dengue-fever-cases-drop-91-in-neighbourhood-of-piracicaba-brazil-where-oxitecs-friendly-aedes-were-released-586796981.html (accessed on 31 October 2024).
25. Setiyaningsih, R.; Agustini, M.; Rahayu, A. Pengaruh Pelepasan Nyamuk Jantan Mandul Terhadap Fertilitas Dan Perubahan Morfologi Telur Aedes Aegypti. Vektora: Jurnal Vektor dan Reservoir Penyakit 2015, 7, 71–78.
26. McNaughton, D.; Duong, T.T.H. Designing a Community Engagement Framework for a New Dengue Control Method: A Case Study from Central Vietnam. PLoS Negl Trop Dis 2014, 8.
27. Rosyad, H.R.; Geater, A.F.; Indriani, C.; Ahmad, R.A. Awareness and Preception of Wolbachia-Infected Aedes Aegypti as a Dengue Control Method among Residents of Yogyakarta Municipality. Journal of Public Health and Development 2022, 20, 54–71.
28. Indriani, C.; Tantowijoyo, W.; Rances, E.; Andari, B.; Prabowo, E.; Yusdi, D.; Ansari, M.R.; Wardana, D.S.; Supriyati, E.; Nurhayati, I.; et al. Reduced Dengue Incidence Following Deployments of Wolbachia-Infected Aedes Aegypti in Yogyakarta, Indonesia: A Quasi-Experimental Trial Using Controlled Interrupted Time Series Analysis. Gate Open Research 2020, 50.
29. Anders, K.L.; Indriani, C.; Ahmad, R.A.; Tantowijoyo, W.; Arguni, E.; Andari, B.; Jewell, N.P.; Rances, E.; O'Neill, S.L.; Simmons, C.P.; et al. The AWED Trial (Applying Wolbachia to Eliminate Dengue) to Assess the Efficiacy of Wolbachia-Infected Mosquito Deployments to Reduce Dengue Incidence in Yogyakarta, Indonesia: Study Protocol for a Cluster Randomised Controlled Trial. Trials 2018, 302.
30. Siegrist, M.; Arvai, J. Risk Perception: Reflections on 40 Years of Research. Risk analysis 2020, 40, 2191–2206.
31. Zhou, Z.; Liu, J.; Zeng, H.; Zhang, T.; Chen, X. How Does Soil Pollution Risk Perception Affect Farmers' pro-Enviromental Behavior? The Role of Income Level. Journal of Enviromental Management 2020, 270.
32. Darmon, M. Socialization; John Wiley & Sons, 2023;
33. Trültzsch-Wijnen, C.W. Media Literacy and the Effect of Socialization; Springer International Publishing, 2020;
34. López-Torres, V.G.; Jiménez-Terrazas, C.P. Adaptability, Knowledge, Resilience: Effects on Socialization in a Post COVID-19 Context–Empirical Study. Revista de Gestão Social e Ambiental 2024, 18.
35. Gil-Marti, B.; Isidro-Mézcua, J.; Poza-Rodriguez, A.; Tello, G.S.A.; Treves, G.; Turiégano, E.; Beckwith, E.J.; Martin, F.A. Socialization Causes Long-Lasting Behavioral Changes. Sci Rep 2024, 14.
36. O'Neill, S.L.; Ryan, P.A.; Turley, A.P.; Wilson, G.; Retzki, K.; Iturba-Ormaetxe, I.; Dong, Y.; Kenny, N.; Paton, C.J.; Ritchie, S.A.; et al. Scaled Deployment of Wolbachia to Protect the Community from Dengue and Other Aedes Transmitted Arboviruses. Gates open researcg 2019, 236.