The Relationship Between Knowledge Level and Dengue Fever Incidence in Areas Exposed and Unexposed to Wolbachia in Bantul Regency Yogyakarta, Indonesia

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Abstract.
Indonesia, cases of Dengue Hemorrhagic Fever (DHF) are increasing, with the Bantul Regency having the highest number of cases in Yogyakarta. The method of controlling dengue vectors based on Wolbachia has been proven to be effective in reducing DHF cases. Public knowledge and prevention efforts are very important in reducing the disease. This study aims to compare the level of knowledge and number of dengue fever incidents between areas that have been exposed to the Wolbachia program and those that have not been exposed to it in Bantul Regency, Yogyakarta. The research used an analytical observational approach with a cross-sectional design. The study was conducted in 2023 - 2024. Data DHF incident was from 2018-2023, and knowledge data obtained from questionnaire. Data analysis was carried out using the Mann-Whitney test and the point-biserial correlation test. The knowledge of non-exposed to Wolbachia (83.77) was higher than the exposed to Wolbachia (82.49), but not significant (p=0.149). There was no significant difference in DHF incidence (2018-2023) between two areas (p=0.229). There was a significant correlation between knowledge and DHF incidence in areas exposed to Wolbachia (p=0.015; r = -0.236), and no significant correlation in non-exposed to Wolbachia (p=0.164; r = -0.136). There was no difference in the knowledge and incidence of dengue fever between groups that had not been exposed to Wolbachia and those that had been exposed. Wolbachia release programs together with increased knowledge can sharpen the decline in dengue fever incidence.

Keywords: *Dengue fever incidents; wolbachia program; knowledge and exposed area .*

I. INTRODUCTION

Dengue Hemorrhagic Fever (DHF) has increased rapidly worldwide. As many as 2.5 billion people worldwide live in dengue-endemic countries, of which 1.3 billion live in the 10 countries of the WHO Southeast Asia (SEA) region. Five countries namely Indonesia, India, Myanmar, Sri Lanka, and Thailand are among the 30 countries with the highest dengue endemic rates in the world. [1] In 2018, there were 68,391 dengue cases in Indonesia, and this number increased significantly in 2022 to 142,294 cases. [2] The Special Region of Yogyakarta (DIY) also ranks third in terms of dengue incidence rate (IR) in Indonesia, with a rate of 93.19.[3] The incidence of dengue fever in Yogyakarta Special Region (DIY) in 2021 was 1,187 cases, with the highest number of cases in Bantul Regency (410), followed by Sleman Regency (282), Kulon Progo Regency (214), Gunungkidul Regency (189), and the lowest number of cases in Yogyakarta City (93).[4]

Vector control strategies are implemented to reduce vectors directly or biologically without causing significant harm to human hosts.[5] One biological vector control method is Wolbachia-based methods. Wolbachia technology is a cost-effective method for controlling dengue fever in Indonesia. Research in Yogyakarta City showed that Wolbachia reduced dengue incidence by up to 76% in intervention areas compared to control areas.[6]

Poor public behavior in preventing dengue fever can be caused by a lack of public knowledge, which can result in high dengue fever cases and the risk of increasing the number of deaths due to dengue fever.[7,8] Previous research conducted by Rosyad, et al. (2022)[9] showed that low knowledge has a strong relationship with concerns about the possible harmful impacts of releasing mosquitoes infected with Wolbachia, so long-term community engagement efforts must be carried out to maintain public awareness and understanding of Wolbachia..

II. METHODS

This is an observational analytical study with a cross-sectional design. It was conducted from November 2023 to May 2024, involving 106 respondents in the Kasihan and Banguntapan sub-districts (areas already exposed to the Wolbachia program) and 106 respondents in the Pleret and Imogiri sub-districts (areas not yet exposed to the Wolbachia program). The sample size was determined using the Lemeshow formula using a simple random sampling technique. Subject inclusion criteria were adults aged 18 years and over, residing in the study area for at least one year, healthy, and able to read and write. Subjects who did not complete the questionnaire were excluded from the study. Data on dengue fever knowledge were obtained through a questionnaire, while data on dengue fever incidence from 2018 to 2023 were obtained from the Bantul Regency Health Office, Yogyakarta.

The questionnaire used was adapted from a research questionnaire by Wiguna (2021), which was validated using the Pearson Product Moment test and found to have 25 valid questions. The questionnaire reliability test showed a Cronbach's alpha value of 0.910, indicating reliability. Data analysis was performed using the Mann-Whitney test and point-biserial correlation test. This study has received ethical approval from the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, with registration number 061/EC-KEPK FKIK UMY/I/2024.

III. RESULT AND DISCUSSION

Result

This research was conducted in two regions: those already exposed and those not yet exposed to the Wolbachia release program in Bantul Regency, Yogyakarta. Each region was represented by two villages from one sub-district in Bantul Regency. The dengue fever incidence at the study sites is reported as in Figure 1.

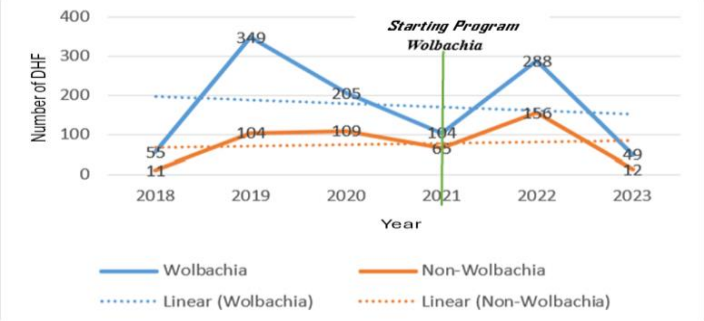

Fig. 1. Comparison of Dengue Fever Cases Based on Wolbachia Exposure in 2018-2023

Figure 1 shows that dengue fever incidence fluctuated from 2018 to 2023. The number of dengue fever cases in areas exposed to the Wolbachia program was higher than in areas not exposed to the program. In 2021, the Wolbachia release program began in Bantul Regency, particularly in exposed areas. The trendline shows a sharper decline in dengue fever cases in Wolbachia-exposed areas than in non-Wolbachia areas.

The study, which examined knowledge levels, involved 106 respondents from each region. The characteristics of respondents from both exposed and unexposed regions are presented in Table 1.

Table 1 shows that in the group not exposed to Wolbachia, all respondents were adults (100.0%), most had a high school education or equivalent (72.6%), and almost all respondents were employed (79.2%). Meanwhile, in the group of respondents who had been exposed to Wolbachia, almost all of them were adults (96.2%), most had a high school education or equivalent (74.5%), and were employed (70.8%). Furthermore, in the groups who had not been exposed to Wolbachia and those who had been exposed to Wolbachia, almost all of the respondents had been exposed to dengue fever prevention information, namely 89.6% and 92.5%, respectively.

Table 1. Characteristics of Research Respondents

Characteristics	*Wolbachia Exposure*			
	No		Yes	
	n=106	%	n=106	%
Age				
Adult (18-59 year)	106	100.0	102	96.2
Elderly (≥ 60 year)	0	0.0	4	3.8
Education level				
Not-educated	1	0.9	0	0.00
Elementery	6	5.7	2	1.9
High Junior	13	12.3	17	16.0
High School	77	72.6	79	74.5
College	9	8.5	8	7.5
Employment status				
Employee	84	79.2	75	70.8
Unemployee	22	20.8	31	29.2
Information to Dengue				
Never	11	10.4	8	7.5
Ever	95	89.6	98	92.5

The distribution of respondents based on their history of dengue fever is presented in Table 2.

Table 2. Respondent Distribution Based on Dengue Infected History and Wolbachia Exposure

Dengue Infection	*Wolbachia Exposure*			
	Never		Ever	
	n	%	n	%
No	75	70.8	78	73.6
Yes	31	29.2	28	26.4
Total	106	100.0	106	100.0

Table 2 shows that the majority of respondents had never been exposed to dengue fever, both in areas exposed to the Wolbachia program and in areas not yet exposed to it. This indirectly reflects the prevalence of dengue fever in the study area, which is 70-73%.

The questionnaires obtained data on the level of knowledge about dengue fever among the community in the two groups of areas being compared. This data is presented in Table 3.

Table 3. Comparison of Dengue Fever Knowledge between Areas Exposed and Unexposed to Wolbachia

DHF knowledge	*Wolbachia Exposure*		P *value*)*
	Never	Ever	
Average	83.77	82.49	
Standard Deviation	7.12	719	0.149
Minimum	64	64	
Maximum	100	96	

The same research questionnaire was used to measure respondents' dengue fever knowledge, with 25 questions administered to 106 respondents in each group. Based on the data in Table 2, the mean or average dengue fever knowledge score in the group not yet exposed to Wolbachia (83.7) was slightly higher (almost the same) than in the group already exposed to Wolbachia (82.4). The maximum score in the group not yet exposed to Wolbachia was 100, while the maximum score in the group already exposed to Wolbachia was 96.

The Mann-Whitney test for differences in dengue fever knowledge levels showed a p-value of 0.149 (p>0.05), indicating no significant difference in dengue fever knowledge levels between the Wolbachia-exposed and non-Wolbachia-exposed groups.

A correlation analysis using the point biserial test was conducted to determine the significance of the relationship between knowledge and dengue fever incidence. The results of this correlation test are presented in Table 4.

Table 4. Results of the Point Biserial Correlation Test of Knowledge with Dengue Fever Incidence in Areas of Exposed and Unexposed to Wolbachia

Area Group	Average of knowledge score	DHF infected		P value	r score
		Yes	No		
Exposed to Wolbachia	82.4	28	78	0.015	-0.236
Non-exposed to Wolbachia	83.7	31	75	0.164	-0.136

The data in Table 4 shows that the correlation test using the point biserial test in the group exposed to Wolbachia showed a significance value of p = 0.015 (p < 0.05), indicating a significant relationship between knowledge and dengue fever incidence in areas exposed to Wolbachia. The correlation coefficient (r) value was -0.236, indicating a low correlation with a negative direction. A negative direction means that the better the knowledge on preventing dengue fever, the lower the incidence of dengue fever in areas exposed to Wolbachia.

The correlation test results in the group not exposed to Wolbachia showed a p value of 0.164 (p ≥ 0.05), indicating no significant relationship between knowledge and dengue fever incidence in areas not exposed to Wolbachia.

IV. DISCUSSION

The implementation of the method for managing the spread of dengue fever using Wolbachia-infected Aedes aegypti mosquitoes began in Bantul Regency in late 2021. Following the completion of the Wolbachia release in Bantul Regency in December 2022, a significant reduction in dengue fever cases is expected during the 2023 dengue season, as Wolbachia coverage in the Bantul region reaches 80%. [2] The results of this study indicate that despite the Wolbachia program being implemented in late 2021, dengue fever cases in the Wolbachia-exposed group continued to increase in 2022. This may be due to insufficient initial coverage or other factors influencing dengue transmission before the Wolbachia method was fully implemented. The results also indicate that after the Wolbachia program was implemented, there was a significant reduction in dengue cases in 2023. This suggests that the effects of Wolbachia implementation may take a year or more to become significant.

The results of this study align with research conducted by Irfandi (2018),[10] which explained that Wolbachia bacteria play a role in controlling dengue fever. The impact of Wolbachia on dengue cases in Yogyakarta demonstrated that Wolbachia successfully suppressed dengue virus replication in local *Aedes aegypti* mosquitoes infected with Wolbachia, which act as dengue vectors. However, because trials were limited in location, the collected data was insufficient to conduct a feasibility study on Wolbachia utilization in Yogyakarta.[10] Research in various regions of Yogyakarta indicates that Wolbachia protection against dengue fever in the community can reach >75% (77.1%).[11]

Another study consistent with this is a study conducted in the city of Niteroi, Brazil, in four Wolbachia release zones, which showed that Wolbachia deployment was associated with a 69% reduction in dengue cases.[12]

Based on the results of the questionnaire survey conducted by the researchers, the incidence of dengue fever in the group exposed to Wolbachia was 26.4% lower than in the group not exposed to Wolbachia (29.2%). Although the difference between the two groups appears small, this data provides empirical

evidence that Wolbachia has a positive effect in reducing the incidence of dengue fever. Other factors that may influence dengue fever incidence, such as population density, sanitation conditions, and community behavior, also need to be taken into account to obtain a more comprehensive picture. The researchers analyzed that the lack of a significant difference between the two groups could be due to several reasons, including the limited sample size, the distribution of Wolbachia, which may not have reached a sufficiently even or high level in all targeted areas, the short implementation period (Wolbachia implementation may not have lasted long enough to show a significant impact), as the Wolbachia program had just begun in late 2021 in this study, environmental conditions (such as climate, population density, and sanitation conditions, which may vary between areas exposed to Wolbachia and those not exposed to Wolbachia, thus significantly affecting the results), and differences in community knowledge, behavior, and awareness about dengue prevention, which may have contributed to the insignificant results (communities in Wolbachia-exposed areas may still be undereducated about dengue prevention).

This study was conducted in areas already exposed to Wolbachia (Kasihan and Banguntapan Districts) and those not exposed to Wolbachia (Pletret and Imogiri Districts) in Bantul Regency. Banguntapan and Kasihan sub-districts were the two sub-districts with the highest dengue fever cases in Bantul Regency over the past three years, 2020-2023. Furthermore, according to Fauzi and Winarni (2018),[13] Sewon, Banguntapan, and Kasihan sub-districts in Bantul Regency are endemic areas for dengue fever due to their high population density and urbanization. According to Santi et al. (2023),[14] the risk of virus transmission increases and tends to create endemic areas in densely populated areas with high mosquito densities.

This study shows that the implementation of the Wolbachia method in Bantul Regency has had a significant positive impact on reducing the number of dengue cases. While initial challenges may exist, with sufficient coverage and sufficient time, this method could be a long-term strategy for dengue control in the region. Further analysis and monitoring are needed to ensure the long-term sustainability and effectiveness of this Wolbachia program intervention.

Knowledge of dengue fever between areas that have been exposed and not exposed to Wolbachia

The lack of significant differences between dengue fever knowledge scores in the two groups is supported by the characteristics of respondents in both groups, which showed similar results, including majority adult age, high school education level, employment status, and exposure to dengue information.

Furthermore, the results of this study revealed that the mean or average dengue fever knowledge score in the group not yet exposed to Wolbachia (20.9) was higher than that of those exposed to Wolbachia (20.6). This suggests that public health education related to dengue fever should be conducted more frequently, especially in areas already exposed to Wolbachia, to more effectively reduce dengue cases.

Knowledge is a crucial factor influencing how a person perceives stimuli and is a crucial element in dengue prevention.[15] Respondents with a good understanding of dengue fever are supported by the characteristics of respondents, namely, the majority having a high school education. This study's results align with the findings of Mahardika (2023),[16] who showed that most respondents have good knowledge, driven by the characteristic of the majority of respondents being high school graduates. People with low levels of education are generally less effective in preventing the spread of the disease compared to those with higher education, who generally have better attitudes and understanding of dengue fever prevention.[17] According to Nursalam (2014) in Mahardika (2023),[16] the higher a person's education, the better their ability to absorb information.

Knowledge can also be influenced by informal education not obtained through formal schooling. Even with low levels of education, personal experiences such as dengue fever, the experiences of others, and the environment can broaden one's understanding and develop their knowledge.[18] Dengue fever education is needed to improve public understanding of this disease.[17]

Respondents with a good understanding of dengue fever are also supported by the majority of respondents who are employed, particularly in the Wolbachia-exposed (70.8%) and unexposed (79.2%) groups. New information about dengue health and prevention is more readily received by employed respondents through their work networks, social relationships, and residential environments. Through work,

individuals can interact with others and exchange information, which can contribute to increased knowledge.[18]

A person's knowledge is also influenced by exposure to information. Nearly all respondents had been exposed to information on dengue fever prevention: 89.6% (not yet exposed) and 92.5% (exposed to Wolbachia), respectively. This indicates that respondents' information sources were not limited to public education provided by health workers, but also from various sources, including print and electronic media, family, neighbors, and friends. It is hoped that with easily accessible information, positive attitudes will increase and behaviors will change.[19]

Correlation between knowledge and dengue fever incidence in areas that have and have not been exposed to the Wolbachia program

The results of the point biserial correlation test showed that in areas already exposed to Wolbachia, there was a significant relationship between knowledge and dengue fever incidence ($p=0.015$; $p<0.05$) with a correlation coefficient (r) of -0.236, indicating a low and negative relationship. A negative relationship between the two variables means that the better the knowledge on dengue prevention, the lower the incidence of dengue fever in areas exposed to Wolbachia. These results align with those of Aldiyan et al. (2023),[15] which showed a significant relationship between knowledge and dengue fever incidence ($p=0.039$; $p<0.05$).

Meanwhile, in areas not yet exposed to Wolbachia, there was no significant relationship ($p=0.164$; $p\geq0.05$), but still showed a negative direction ($r=-0.136$). This is in line with the research of Baitanu (2022),[20] which showed no significant relationship between knowledge and dengue fever incidence (p-value = 0.604; $p\geq0.05$) in …….

A person's knowledge significantly influences their behavior and can motivate specific actions.[21] When people have a good understanding of dengue fever, they are more likely to behave positively and participate in dengue prevention efforts.[8] Research conducted by Wirna et al. (2023)[22] showed that knowledge is significantly related to dengue prevention measures ($p = 0.000$). Communities with poor knowledge and attitudes toward dengue fever may neglect their role in preventing infection. This can put them at a higher risk of dengue outbreaks due to a lack of cooperation in managing environmental hygiene.[23]

The success of mosquito vector control in a community context is influenced by several factors, including public awareness and literacy regarding mosquito population distribution and the rate of virus transmission in their respective areas.[24] In addition, the role of health workers is very important in efforts to prevent the spread of dengue fever and regular monitoring with Jumantik officers can have a significant impact on reducing dengue fever cases.[22]

V. CONCLUSION

This study demonstrates a significant correlation between knowledge and dengue fever incidence in areas already exposed to Wolbachia, albeit with a low, negative correlation. This means that the higher the level of knowledge, the lower the incidence of dengue fever. However, in areas not yet exposed to Wolbachia, there was no significant correlation between knowledge and dengue fever incidence. Wolbachia release programs, combined with awareness-raising programs, can significantly reduce dengue fever incidence.

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