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# Community Reactions Towards Early Notification of Dengue Mobile Apps

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**ABSTRACT**

*Dengue is a dangerous disease caused by a virus transmitted by the Aedes mosquito. Currently, dengue vaccines are still in clinical trials; only intervention methods exist, such as fogging the affected area with insecticide, which may harm the community. Consequently, past studies have identified that rainfall significantly influences mosquito-viral transmission and increases dengue cases. Thus, it can be used as a primary indicator in the Internet of Things (IoT) early warning system, enabling the community to act by destroying Aedes mosquito breeding sites within 1 week (7 days) of at least 0.1 inches of rainfall after receiving early notification from the dengue mobile apps. But developing a dengue early warning system prototype is costly and requires confirmation of community usage. Therefore, this study surveyed 927 people's reactions towards early notification. Overall, 92% believe that dengue mobile apps are useful and good. However, those who have never had dengue fever said early notification is for the authorities. Those who had dengue fever are divided into two categories. The first category will check and clean their housing surroundings; the second will engage in community clean-up. Interestingly, different reactions were obtained, providing insights into the target users of the dengue mobile apps.*

**Keywords:** Community Response, Dengue Early Warning System, Internet of Things (IoT), Rainfall, Dengue Mobile Apps

## 1 INTRODUCTION

Dengue is a harmful disease caused by a virus commonly found in *Aedes* mosquito [1-3]. Every year, an estimated 100-400 million people are affected by dengue [4], and about 5% of cases die [5]. Presently, several dengue vaccines are available in certain countries [6-9] but not in Malaysia, which is still in clinical trials [10]. Only intervention methods exist, commonly conducted after dengue cases have occurred, such as fogging the dengue cases area with insecticide [11,12], which may cause harm to both human health and the environment.

The main human health risk associated with insecticide fogging is respiratory issues [13,14]. Inhaling insecticide particles can irritate the respiratory tract and result in coughing, wheezing, and trouble breathing, especially for people with asthma or other respiratory conditions [13,14]. In addition, coming into close contact with insecticides that have been sprayed can cause skin irritation, rashes, and allergic reactions [15]. Moreover, some insecticides are neurotoxins, which can damage the nervous system and result in symptoms like headaches, dizziness, and impaired cognitive function [16]. Insecticide exposure has also been connected to long-term health problems such as cancer [14,17], reproductive issues, and endocrine disruption [17,18].

Harmful impacts on the environment include damage to beneficial insects [19,20]. Insecticides kill beneficial insects that are essential to pollination and ecosystem balance, such as bees and butterflies [21]. Fogging can affect sources of potable water, harm aquatic life, and contaminate bodies of water [22]. Furthermore, overuse of insecticides can result in populations of mosquitoes that are resistant to the chemicals, making the issue more challenging to manage over time [23,24].

Interactions between individuals, mosquitoes, viruses, and environmental variables can cause dengue transmission [25]. Dengue virus (DENV) is transmitted to humans through infective female Aedes mosquito bites. DENV infection triggers a variety of clinical states, including mild asymptomatic dengue fever (DF), severe dengue haemorrhagic fever (DHF), and dengue shock syndrome (DSS), all of which can be fatal [26].

Dengue mapping is a crucial tool for understanding and controlling the spread of dengue in Malaysia. It involves the spatial analysis of dengue cases to identify hotspots, patterns, and potential risk factors. Several studies have been conducted in Malaysia to leverage this approach for dengue control. Masrani et al. in 2022 [27] conducted a study on the trends and spatial pattern analysis of dengue cases in Northeast Malaysia. The study revealed notable changes in the dengue's spatial pattern, indicating a shift from an urban to suburban setting and the potential impact of population movement on dengue transmission. A machine learning-based dengue epidemic prediction study conducted in Selangor, Malaysia, indicates that machine learning has a good chance of accurately forecasting dengue outbreaks [28]. A study that uses geospatial techniques to detect dengue outbreaks reveals a significant negative correlation between the maximum temperature and the minimum temperature during the outbreak in the study area and in Kuala Lumpur City Center's high-rise apartment buildings [29].

Consequently, past studies have established factors for dengue outbreak forecasting models as early warning system and showed that rainfall significantly influences mosquito-viral transmission, causing the increment of notified dengue cases [30-35]. Previous studies have found a significant association between environmental variable (rainfall) and Aedes mosquito population in determining dengue outbreaks [31-33]. A high amount of rainfall has been discovered to influence mass egg hatching, resulting in an increase in mosquito population abundance [36]. Meanwhile, Rohani et al. [31] observed that a minimum rainfall of 0.1 inches (2.54 millimetre) was sufficient to drive the number of larvae, and Rohani et al. [33] discovered that an increase in last week's rainfall would increase the number of larvae this week. As a result, the number of adult mosquitoes increased in the following weeks, which caused an increase in the number of notified dengue cases in subsequent weeks. Previous rainfall significantly influenced mosquito-viral transmission in general [30, 34] and adult mosquito lifespan [30].

Thus, these detailed findings by Rohani et al. [31-33] regarding rainfall can be used as the primary indicator in the Internet of Things (IoT) early warning system for the community to act by destroying Aedes mosquito breeding sites within one week (7 days) of at least 0.1 inches rainfall has occurred.

The 7 days are due to Aedes mosquitoes' life cycle, which requires 7 to 10 days from eggs to become adult mosquitoes [37]. However, developing such a prototype of a dengue early warning system is costly and, hence, firstly, requires confirmation of the community's usage. Therefore, this study surveyed community reactions towards early notification of the dengue mobile apps.

## 2 MATERIAL AND METHODS

The survey was conducted using the Situational Judgement Test (SJT) instrument to assess decision making based on specific situations [38] and one of the main questions asked as follows:

If there is a Dengue Mobile Apps to provide the following notification:

"Your area has a dengue risk potential. Please check your surroundings and destroy Aedes mosquito breeding sites within 7 days from now."

What is your action?

1. Check and clean Aedes mosquito breeding sites around my house.
2. It is not my responsibility but the authority's (e.g., district council, etc.) responsibility to eliminate Aedes mosquito breeding sites.
3. Engage in the community surrounding clean-up through "gotong-royong."

Systematic Sampling was used to randomly select respondents at Kedah, Perak, Selangor, Johor, and Terengganu, representing northern, central, southern, and eastern Peninsular Malaysia. Firstly, an observation study was conducted for 3 weeks at several large shopping malls to determine the $k$ sampling interval and calculated as follows:

$$k = \frac{\text{total number of people entering the shopping malls}}{\text{sample size of 250 for each state}} \tag{1}$$

Kedah, Perak, and Selangor, k = 3, while for Johor and Terengganu, k = 5. Then, these k intervals were used to select respondents randomly for 4 weeks. The aim was to have balanced samples across states, with 250 respondents in each state. However, only 927 respondents were obtained.

## 3 RESULTS AND DISCUSSION

Table 1 lists the respondents' demographics based on location, gender, ethnicity, age, and education level, involving 927 respondents.

Table 1 : Respondents Profile

| No | Demographic | Frequency | % |
|---|---|---|---|
| 1 | Location/State | | |
| | Kedah | 206 | 22.2 |
| | Perak | 201 | 21.7 |
| | Selangor | 189 | 20.4 |
| | Johor | 161 | 17.4 |
| | Terengganu | 170 | 18.3 |
| 2 | Gender | | |
| | Male | 441 | 47.6 |
| | Female | 486 | 52.4 |
| 3 | Ethnicity | | |
| | Malay | 596 | 64.3 |
| | Chinese | 178 | 19.2 |
| | Indian | 118 | 12.7 |
| | Others | 35 | 3.8 |
| 4 | Age | | |
| | 20-29 | 393 | 40.4 |
| | 30-39 | 225 | 24.3 |
| | 40-49 | 138 | 14.9 |
| | 50-59 | 122 | 13.2 |
| | 60 and above | 49 | 5.2 |
| 5 | Education Level | | |
| | Primary school | 16 | 1.7 |
| | PMR/PT3 | 15 | 1.6 |
| | SPM | 192 | 20.7 |
| | STPM | 51 | 5.5 |

| | | |
|---|---|---|
| Certificate | 74 | 8.0 |
| Diploma | 164 | 17.7 |
| Degree and above | 415 | 44.8 |

Figure 1 shows the status of dengue fever according to the respondents and their family members. 238 (25.7%) had experience with dengue fever, and 689 (74.3%) had never had dengue fever. However, of 689 (74.3%) who had never dengue fever, 214 (31%) of their family member had dengue fever, and 475 (69%) never had dengue fever. As for those with dengue fever (238, 25.7%), 22.3% of their family also had dengue fever, and 77.7% did not.

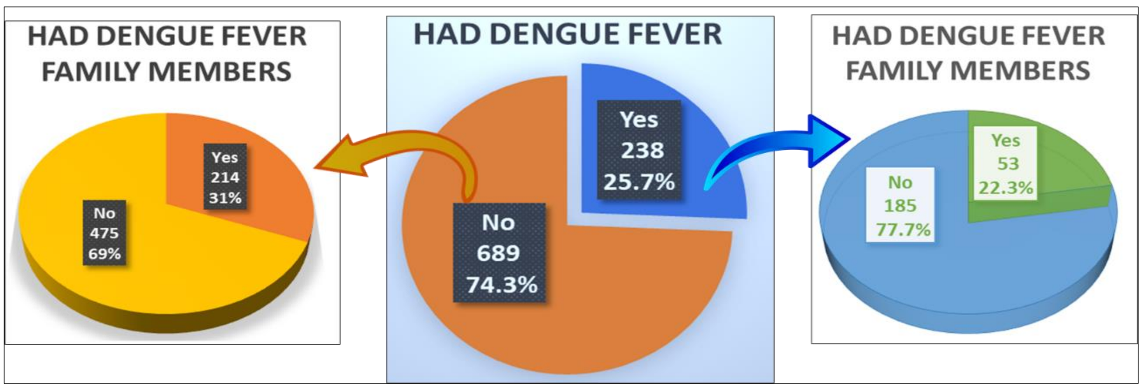


Figure 1 : Status of Dengue Fever

Figure 2 displays the status of dengue fever and action taken if dengue notification is received. The $\chi 2$ test p-value is 0.001, which is significant to indicate the association between the status of dengue fever and action taken. Most of those who have never had dengue fever stated that the early notification is not for them to react but for the authorities (70.2%). But the remainder, 29.8% which are 23.4% and 6.4% of them, will check and clean *Aedes* mosquito breeding sites, and engage in community clean up, respectively. This is because although they did not have dengue fever, their family members had it. While those who have had dengue fever are divided into two categories. The first category will check and clean their housing surroundings (82.8%); the second will engage in community clean-up through "gotong-royong" (17.2%).

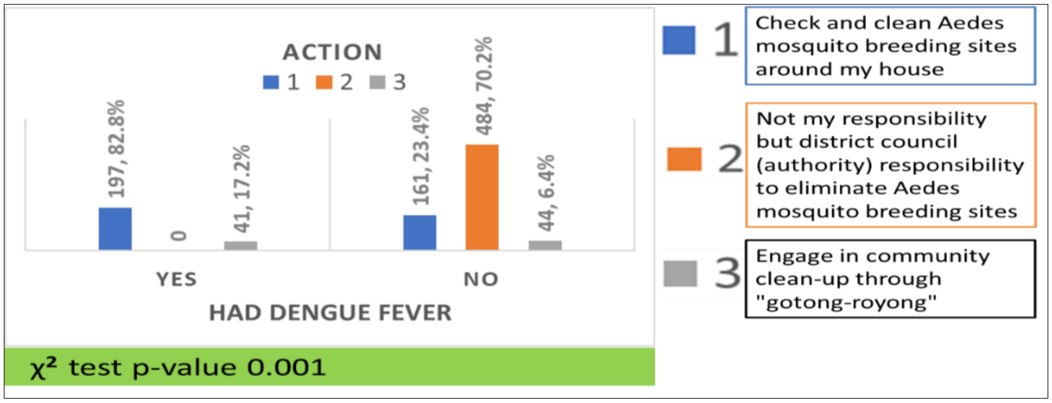


Figure 2 : Status of dengue fever and action taken if receive dengue notification

Figure 3 presents respondents' perceptions towards dengue mobile apps on a scale of 1 to 10, where the median is 10, and 92% chose a scale of 8 and above. This indicated that overall, they believe the apps are useful and good at providing early warning dengue notifications.

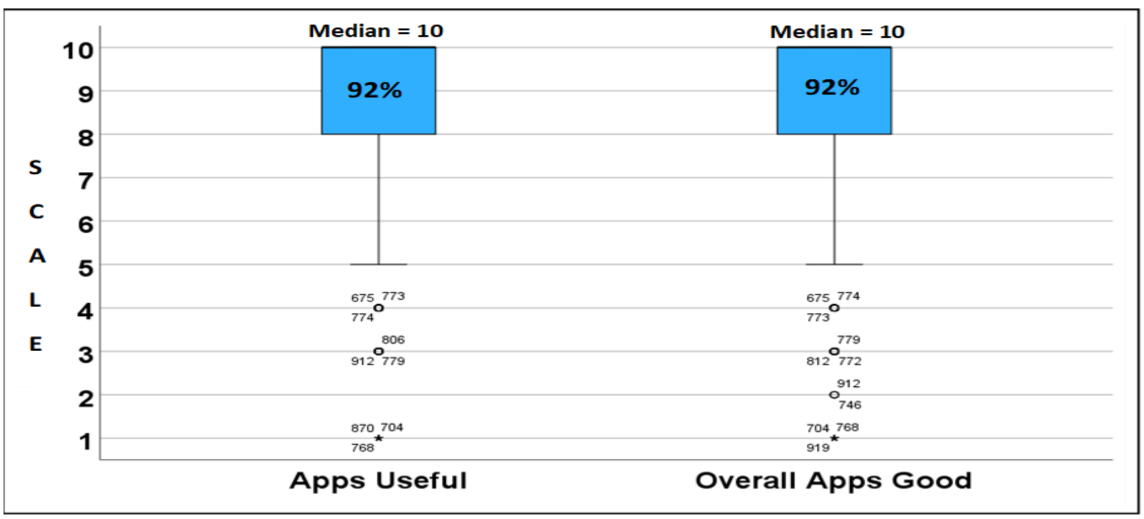


Figure 3 : Perceptions towards dengue mobile apps

## 4 CONCLUSION

Overall, 92% of the respondents believe that dengue mobile apps are useful and good. However, those who have never had dengue fever stated that the early notification is not for them to react but for the authorities (70.2%). While those who have had dengue, fever are divided into two categories. The first category will check and clean their housing surroundings (82.8%); the second will engage in community clean-up through "gotong-royong" (17.2%). Interestingly, different reactions were obtained, providing information regarding the target users for the dengue mobile apps. Perhaps dengue mobile apps are more suitable for authority and community task forces such as COMBI

(Communication for Behavioural Impact) as prevention measures for destroying Aedes mosquito breeding sites.

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