

Strategic Management of Public Health Risks: Correlation Between Water Quality and *Aedes Sp.* in South Jakarta

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ABSTRACT

This study focuses on investigating the relationship between water temperature, water pH, and residual water chlorine with the presence of *Aedes sp.* larvae in the RW 06 area of North Gandaria Village, Kebayoran Baru District, South Jakarta. Utilizing an analytical cross-sectional research design, the study encompasses a population of 667 houses in RW 06, with a sample size of 92 houses determined through Proportional Simple Random Sampling. The analysis employs chi-square tests to examine the associations between the variables. The findings reveal that there is no significant relationship between water temperature and the presence of *Aedes sp.* larvae (P-value = 0.659) and no significant relationship between water pH and the presence of *Aedes sp.* larvae (P-value = 0.434). However, the research does identify a noteworthy association between residual water chlorine and the presence of *Aedes sp.* larvae (P-value = 0.000). This emphasizes the importance of water chlorine levels in influencing the presence of *Aedes sp.* larvae in the specified area. The study's outcomes contribute valuable insights to the management of water quality in the context of *Aedes sp.* larvae control.

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1. INTRODUCTION

Water is a vital need for living creatures in this world, not only important for humans but also for animals and plants. However, on the other hand, water is also a medium for disease-carrying vectors. Water can be a place for mosquitoes to live and develop as vectors that carry infectious diseases such as malaria, dengue fever, filariasis, chikungunya fever, and Japanese Encephalitis (JE). Dengue Haemorrhagic Fever (DHF) is caused by a virus dengue which is transmitted through mosquito bites *Aedes sp.*, especially *Aedes albopictus*. Mosquito *Aedes sp.* prefers clear water reservoirs protected from sunlight as its brooding place [24]. Clean water that is stored and used by residents generally comes from various sources, for example rainwater, PDAM water and groundwater. The clean water reservoir is a good medium for mosquito breeding *Aedes Sp.* Indonesia is one of the endemic countries for dengue fever and experiences epidemics every 4-5 years, especially in urban areas. Environmental factors that are susceptible to dengue hemorrhagic fever include lots of clean stagnant water which can become a place for mosquitoes to nest, high

mobility between residents, and fast transportation activities between regions which cause frequent epidemics of dengue fever [21].

According to the 2020 Indonesian Health Profile, 108,303 cases of dengue hemorrhagic fever were reported to the Ministry of Health in 2020. This number decreased compared to the previous year, reaching 138,127 in 2019. Based on the number of cases, the number of deaths due to dengue hemorrhagic fever in 2020 also decreased from 919 in 2019 it became 747. The incidence of dengue hemorrhagic fever in 2020 was 40 per 100,000 population. Compared to 2019, it was relatively low at 51.5 per 100,000. The death rate due to dengue hemorrhagic fever in Indonesia is 0.7%. A province is said to have a high Case Fatality Rate if it exceeds 1%. In 2020 there were eleven provinces with a Case Fatality Rate above 1% [12].

In the health profile of DKI Jakarta in 2020, the number of dengue hemorrhagic fever cases in 2020 was 4,744 cases, and South Jakarta was in third place with the highest number of cases with 775 cases [5]. Based on a report from the South Jakarta Health Department in 2022, data on cases Dengue Haemorrhagic Fever (DHF) in Kebayoran Baru District, South Jakarta, in 2021 there were 82 cases of dengue fever, the most cases were in Gandaria Utara Subdistrict with 17 cases of dengue fever. From data on dengue fever cases in North Gandaria Village in 2021, the most cases were in RW 06, namely 4 cases. Environmental factors that influence the presence of larvae and mosquitoes *Aedes* sp. namely the physical environment, biological environment and social environment. The physical environment that influences the presence of larvae *Aedes* sp. namely water quality, one of which is the pH level and temperature of the water, so it influences mosquito breeding [8].

Based on the results of research conducted by M. Rasyid Ridha et al in 2013, the higher the pH of the water, the more mosquito larvae there will be. Temples of the Egyptians more increasing. In another journal written by Agus Widada and Moh. Gazali, the results of his research show that the higher the chlorine concentration in the water, the higher the percentage of mosquito eggs *Aedes* sp. those that do not hatch are also lower, thereby preventing the development of mosquitoes.

2. RESEARCH METHOD

This research is an analytical study using a research design cross sectional. This research was carried out by observing and examining the relationship between independent variables, namely water quality consisting of temperature, pH and residual chlorine with the dependent variable, namely the presence of larvae *Aedes* sp., whose significance value is determined by uji Chi-Square. The population of this study was all the houses of residents of RW 06, Gandaria Utara Subdistrict, Kebayoran Baru, South Jakarta, namely 667 houses. The samples in this study were some residents houses that had clean water containers with a total sample of 92 houses. The sampling technique uses Proportional Simple Random Sampling.

3. RESULTS AND DISCUSSION

Of the 92 houses surveyed, 8 houses were found positive for the presence of larvae *Aedes* sp. The larvae free rate (ABJ) of 91.3% in the RW 06 area, North Gandaria Village, Kebayoran Baru District, South Jakarta is below the quality standard value set based on Minister of Health Regulation no. 50 of 2017 [27], which is below 95%. Egg *Aedes* sp. takes 1-2 days to become larvae [26]. Routinely draining water reservoirs every five days can break the mosquito breeding chain *Aedes* sp.

Table 1. Relationship between Temperature and the Presence of Larvae *Aedes* sp. At Residents Homes RW 06 area, North Gandaria Village, Kebayoran Baru District, South Jakarta

Temperature	The existence of larvae				Total		OR (95% CI)	P-value
	There is		There isn't any					
	N	%	N	%	n	%		
27 ⁰ C – 30 ⁰ C	8	8,9	82	91,1	90	100	0,911 (0,854 – 0,972)	0,659
<27 ⁰ C or >30 ⁰ C	0	0,0	2	100	2	100		
Amount	8	8,7	84	91,3	92	100		

Statistical test results were obtained P-value = 0,659 (P-value > from alpha, until H0 is accepted), So it can be concluded that there is no relationship between water temperature and the presence of larvae Aedes Sp.. From the results of the analysis, an OR value of 0.911 was obtained, which means a water reservoir with a temperature of 27°C – 30°C has a 0.9-fold chance of having larvae Aedes Sp. compared to water reservoirs with water temperatures <27°C or >30°C.

The results of research conducted by Hidayah and Rahmawati in 2019 showed that the water temperature of the brooding area was 27.6°C. This temperature is still deep range optimum temperature for larval development Aedes Sp. This is in line with the research results obtained regarding the presence of larvae Aedes Sp. only at the optimum water temperature, namely 27°C - 30°C [10]. This temperature is the ideal temperature range for the growth of Aedes sp mosquitoes [1].

The water in water reservoirs is influenced by the climate in the surrounding environment, namely air temperature and rainfall. The colder the air temperature can affect the water temperature and affect the mosquito breeding cycle Aedes Sp., and vice versa, the hotter the air temperature can affect the water temperature and mosquito breeding Aedes Sp [19].

Table 2. Relationship between pH and the Presence of Larvae Aedes sp. At Residents Homes RW 06 area, North Gandaria Village Kebayoran Baru District, South Jakarta

pH	The existence of larvae				Total		OR (95% CI)	P-value
	There is		There isn't any					
	n	%	N	%	N	%		
6,8 – 7,2	8	9,3	78	90,7	86	100	0,907 (0,848 – 0,970)	0,434
< 6.8 or >7.2	0	0,0	6	100	6	100		
Amount	8	8,7	84	91,3	92	100		

Statistical test results were obtained P-value = 0,434 (P-value > from alpha, until H0 is accepted), So it can be concluded that there is no relationship between water pH and the presence of larvae Aedes Sp..

From the results of the analysis, an OR value of 0.907 was obtained, which means that water reservoirs with a pH of 6.8 - 7.2 have a 0.9 times greater chance of containing larvae Aedes Sp. compared to water reservoirs with water pH <6.8 or >7.2.

The presence of larvae is related to the physical environment of the water reservoir. Water storage systems are a basic method of controlling mosquitoes Aedes Sp. Especially Temples of the Egyptians [20]. Health behavior also determines the level of success in carrying out activities to prevent and eradicate a source of disease in order to reduce the density of mosquito larvae [22].

Table 3. Relationship between Residual Chlorine and the Presence of Larvae Aedes sp. At Resident s Houses in RW 06, North Gandaria Village Kebayoran Baru District, South Jakarta

The existence of larvae								
Residual Chlorine	There is		There isn't any		Total		OR (95%CI)	P-Value
	n	%	N	%	n	%		
	< 0,2	5	5,7	82	94,3	87		
0,2 – 0,5	3	60	2	40	5	100	0,041 (0,005 – 0,302)	0,000
Amount	8	8,7	84	91,3	50	100		

The obtained statistical test results, with a P-value of 0.000 < Alpha, led to the rejection of H0, establishing a significant relationship between residual water chlorine and the presence of Aedes sp. larvae.

The analysis revealed OR value of 0.041, indicating that water reservoirs with residual chlorine <0.2 have a 0.041 times chance of not containing *Aedes* sp. larvae.

The selection of egg-laying locations by *Aedes* sp. is influenced by the presence of organic substances and ammonia. Ammonia compounds impact the olfactory nerves of *Aedes* sp. mosquitoes, prompting female mosquitoes to lay their eggs. The effective removal of ammonia content by chlorine in water reservoirs is a key factor, resulting in a majority of chlorine-containing water reservoirs being larva-free. Furthermore, chlorine's oxidizing properties play a crucial role in preventing mosquito eggs from hatching by destroying proteins, thereby interrupting the mosquito life cycle.

This study aligns with Sukanto's research in 2007, which identified a significant relationship (P-value 0.000) between residual chlorine and the incidence of Dengue Haemorrhagic Fever (DHF). These findings emphasize the management implications of maintaining adequate residual chlorine levels in water reservoirs to mitigate the presence of *Aedes* sp. larvae and contribute to the prevention of mosquito-borne diseases

4. CONCLUSION

1. Despite the absence of a significant relationship between water temperature and the presence of *Aedes* sp. larvae (P-value=0.659), water reservoirs within the temperature range of 27°C – 30°C exhibit a 0.9-fold chance of harboring *Aedes* sp. larvae.
2. Similarly, no significant relationship was found between water pH and the presence of *Aedes* sp. larvae (P-value=0.434). However, water reservoirs maintaining a pH between 6.8 - 7.2 have a 0.9-fold chance of containing *Aedes* sp. larvae.
3. In contrast, a significant relationship exists between residual water chlorine and the presence of *Aedes* sp. larvae (P-value=0.000).

These findings highlight the importance of targeted management strategies to mitigate the risk of dengue fever in the community. To effectively combat dengue mosquito proliferation, the community is urged to implement the 3 M strategy Mechanical, Biological, and Environmental control measures. This includes practices such as sealing water reservoirs, regular drainage of clean water reservoirs (at least once every five days), and proper disposal of used items like bottles and buckets to prevent them from becoming breeding grounds for *Aedes* sp. mosquitoes.

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