Environmental and Behavioral Factors Associated with the Presence of *Aedes aegypti* Larvae in the Sangurara Community Health Center Area, Palu City

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Dengue Hemorrhagic Fever (DHF) is an infectious disease caused by the *dengue virus* transmitted through the bite of the *Aedes aegypti mosquito*. The presence of mosquito larvae in the household environment is an important indicator in assessing the risk of transmission of this disease. According to *the World Health Organization* (WHO), there are approximately 390 million *dengue virus infections* worldwide each year, with approximately 96 million cases showing clinical manifestations. In Indonesia, DHF is a public health problem that continues to be monitored. In the working area of the Sangurara Community Health Center in Palu City, cases were recorded at 79 in 2022, increasing to 96 in 2023, and decreasing to 70 in 2024. This study aims to determine the relationship between temperature, humidity, and knowledge with the presence of *Aedes aegypti mosquito larvae*. This study employed a quantitative cross-sectional design using *the Fisher's Exact Test* and *the Fisher Freeman Halton Exact Tes*. The study population consisted of all household heads in the Sangurara Community Health Center working area totaling 13,591 families with a sample of 100 households. Data collection was carried out through examining larvae in all water containers in respondents' homes and interviews using questionnaires. The results showed HI values of 20%, CI 23%, BI 40%, and ABJ 80% indicating a high larval density category. Bivariate analysis showed a significant relationship between temperature (p = 0.016), humidity (p = 0.039), and knowledge (*p = 0.012) with the presence of Aedes aegypti* mosquito larvae. Knowledge was identified as the most influential factor associated with the presence of larvae. The conclusion shows that environmental factors (temperature and humidity) and knowledge are related to the presence of larvae so that it is necessary to strengthen larva surveillance and increase Mosquito Nest Eradication (PSN) practices by the community to reduce larva density and the risk of dengue transmission.

Keywords : Dengue Fever, Larvae, Temperature

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1. Introduction

Dengue Hemorrhagic Fever (DHF) is one of the major tropical infectious diseases and remains a public health problem in Indonesia. This disease is caused by the *dengue virus* and can be transmitted through the bite of the *Aedes aegypti* or Aedes *albopictus mosquito* , vectors that breed in clean water reservoirs. This disease is commonly known as dengue fever. *Hemorrhagic Fever* (Cold Dengue Fever) is One from a number of disease which is a health problem in the world, especially in developing countries.[1]

According to data from *World Health Organization* (WHO), there is around 390 million dengue virus infections worldwide each year, with around 96 million cases among them showed clinical manifestations. The incidence of dengue fever has increased 30-fold in 50 year final, placing nearly half of the world's population at risk of infection, as well as cause burden health and economy Which significant. This

estimate indicates that *dengue fever* is one of the fastest-spreading tropical diseases and poses a serious threat to global public health, particularly in tropical and subtropical regions such as Southeast Asia, including Indonesia.

The Sangurara Community Health Center's work area is one of the areas that has experienced a high rate of dengue fever in the past three years. According to data from the Sangurara Community Health Center, 32 cases of dengue fever were recorded in 2021, increasing to 79 cases in 2022**,** and increasing again to 96 cases in 2023. However, the number decreased to 70 cases in 2024.. Although there seems to be a trend decline, this number is still located in the level of absorption and requires further attention, considering the potential for an increase in cases at any time, especially during the rainy season.[2]

Based on the background description above, the researcher is interested in conducting research on the analysis of environmental factors (temperature, humidity) and behavioral factors (knowledge) on the density of *Aedes aegypti mosquito larvae* in the working area of the Sangurara Health Center, Palu City**.**

2. Literature Review and Problem Statement

Dengue Hemorrhagic Fever (DHF) remains a major public health problem in tropical countries, including Indonesia, due to the increasing number of cases and the widespread distribution of the Aedes aegypti vector. Environmental factors such as temperature and humidity play a crucial role in supporting mosquito breeding and survival. Previous research has shown that optimal temperatures ranging from 25–30°C and humidity of 60–80% can increase larval density by accelerating mosquito metabolism and reproduction. Research conducted by Restiaty et al. (2022) and Iriani & Siwiendrayanti (2023) demonstrated a significant relationship between temperature, humidity, and Aedes aegypti larval density, thus significantly influencing the risk of dengue transmission. Furthermore, Hendrik L. Blum's theory explains that environmental factors are a key determinant of public health, particularly in vector-based diseases such as dengue.[3]

In addition to environmental factors, public knowledge also plays a crucial role in dengue fever prevention efforts. Good knowledge of mosquito breeding sites, dengue fever symptoms, and the implementation of Mosquito Nest Eradication (PSN) through the 3M Plus program can reduce the presence of mosquito larvae in the household environment. Research by Susmaneli et al. (2024) and Handayani et al. (2023) shows that communities with a good level of knowledge have a lower risk of finding mosquito larvae because they are more active in taking preventive measures. However, most previous studies have focused only on environmental or behavioral factors separately, while studies that analyze the influence of temperature, humidity, and knowledge simultaneously on the presence of larvae in endemic areas such as the Sangurara Community Health Center are still limited. This research gap is an important basis for conducting this study to examine the relationship between environmental and behavioral factors on the presence of Aedes aegypti larvae. Based on this, the formulation of the problem in this study is: "Is there a relationship between environmental factors (temperature and humidity) and public knowledge with the presence of Aedes aegypti mosquito larvae in the working area of Sangurara Health Center, Palu City?" The hypothesis of this study is that there is a significant relationship between temperature, humidity, and knowledge with the presence of Aedes aegypti larvae. [4]

3. Method

This study employed a quantitative cross-sectional design. The study was conducted in the working area of the Sangurara Community Health Center, Palu City on date 12 January to 25 January 2026. He study is all of it head family as many as 13,591 KK, with sample 100 households Which (Text illegible) use Formula Slovin and proportional random sampling techniques. Independent variables include temperature,

humidity, and knowledge, while the dependent variable is the presence of *Aedes aegypti mosquito larvae*. Data collection was carried out through direct observation of all water containers to detect larvae, temperature and humidity measurements using a DT-3 *Digital Thermo Hygrometer Outdoor digital tool, and interviews using a questionnaire to assess the level of respondents' knowledge about dengue fever and mosquito nest eradication. Larva density was calculated using the House Index* (HI), *Container Index* (CI), *Breteau Index* (BI), and Larvae Free Number (ABJ) indicators. Data were analyzed using univariate and bivariate analyses use test *Fisher's accurate test* And *Fisher-Freeman-Halton exact test* with a significance level of 95% ($\alpha = 0.05$).

4. Results and Discussion

This research was conducted in the working area of Sangurara Health Center, Palu City in the year 2026 use *cross section.* Amount sample in study This as much as 100 households. The study aims to determine the relationship between temperature, humidity and knowledge. with Price larvae Nyanya *Aedes* aegypti. Based on results research that has been conducted, the results are presented in the form of tables accompanied by narratives

Density Larvae Mosquito *Aedes aegypti*

a. *Home Index*

$$HI = \frac{\text{Number of houses positive for larvae}}{\text{Number of houses inspected}} \text{x } 100\%$$

$$HI = \frac{20}{100} \text{x } 100\%$$

HI = 20%

b. *Container Index*

$$CI = \frac{\text{Number of positive containers}}{\text{Number of containers inspected}} \text{x } 100\%$$

$$CI = \frac{40}{173} \text{x } 100\%$$

CI = 23%

c. *Breatheau Index*

$$BI = \frac{\text{Number of positive containers}}{\text{Number of houses inspected}} \text{x } 100\%$$

$$BI = \frac{40}{100} \text{x } 100\%$$

BI = 40%

d. Larvae-Free Index (ABJ)

$$ABJ = \frac{\text{Number of houses without larvae}}{\text{Number of houses inspected}} \text{x } 100\%$$

$$ABJ = \frac{80}{100} \text{x } 100\%$$

ABJ = 80%

Based on the results Inspection larvae on 100 House respondents, 20 houses were found to be positive for larvae and 80 houses were free of them. Of the 173 containers examined, 40 were positive for larvae and 133 were free of larvae. The calculation results showed a House *Index* (HI) value of 20%. *Container Index* (CI) as big as 23%, *Breteau Index* (BI) as big as 40%, And Larvae Free Rate (ABJ) of 80%. Based on the calculation results, the research area is classified as having a high larva density, namely DF 6. The ABJ value of 80% which has not reached the standard of ≥ 95% indicates that there are still houses that have the

potential to become breeding grounds for *Aedes aegypti mosquitoes*, thus potentially increasing the risk of dengue transmission in the respondents' residential environment.

a. The relationship between temperature and the presence of *Aedes aegypti* mosquito larvae in the working area of the Sangurara Health Center, Palu City

Table 5.4 Relationship between temperature and the presence of *Aedes aegypti mosquito larvae* in the working area of the Sangurara Health Center, Palu City

Temperature	Existence						*p-value*
	There is		No		Total		
	N	%	N	%	N	%	
Optimal	9	39.1	14	60.9	23	100	0.016
No	11	14.3	66	85.7	77	100	
Total	20	53.4	80	146.6	100	100	

Source: Primary Data 2026

Table 5.4 shows the relationship between temperature and the presence of mosquito larvae in the Sangurara Community Health Center work area in Palu City. The table shows that in houses with optimal temperatures, 9 (39.1%) had larvae and 14 (60.9%) had no larvae, for a total of 23 houses (100%) . Meanwhile, in houses with suboptimal temperatures , 11 (14.3%) had larvae. in which larvae were found and 66 houses (85.7%) where no larvae were found, with a total of 77 houses (100%).

The results of the statistical test showed a *p-value* of 0.016, which means it is smaller than α = 0.05. Thus, it can be concluded that there is a significant relationship between temperature and the presence of *Aedes aegypti mosquito larvae* in the working area of the Sangurara Health Center, Palu City.

b. The relationship between humidity and the presence of *Aedes aegypti mosquito larvae* in the working area of the Sangurara Health Center, Palu City

Table 5.5 Relationship between humidity and the presence of *Aedes aegypti mosquito larvae* in the working area of the Sangurara Health Center, Palu City

humidity	Existence						*p-value*
	There is		No		Total		
	N	%	N	%	N	%	
Optimal	8	36.4	14	63.6	22	100	0.039
No	12	15.4	66	84.6	78	100	
Total	20	51.8	80	148.2	100	100	

Source: Primary Data 2026

Table 5.5 shows the relationship between humidity and the presence of mosquito larvae in the Sangurara Community Health Center working area in Palu City. Based on this table, it is known that in houses with optimal humidity, there were 8 houses (36.4%) where larvae were found and 14 houses (63.6%) where no larvae were found, with a total of 22 houses (100%). Meanwhile, in houses with suboptimal humidity, there were 12 houses (15.4%) where larvae were found and 66 houses (84.6%) where no larvae were found, with a total of 78 houses (100%) .

The results of the statistical test showed a *p - value* of 0.039, which is smaller than the α value of 0.05. Thus, **it** can be concluded that there is a significant relationship between humidity and the presence of *Aedes aegypti mosquito larvae* in the working area of the Sangurara Health Center, Palu City.

c. The relationship between knowledge and the presence of *Aedes aegypti mosquito larvae* in the working area of the Sangurara Health Center, Palu City

Table 5.6 Relationship between knowledge and the presence of *Aedes aegypti mosquito larvae* in the working area of the Sangurara Health Center, Palu City

Knowledge	Existence						*p-value*
	There is		No		Total		
	N	%	N	%	N	%	
Good	8	12.3	57	87.7	65	100	
Enough	8	29.6	19	70.4	27	100	0.012
Low	4	50.0	4	50.0	8	100	
Total	20	20.0	80	80.0	100	100	

Source: Primary Data 2026

Table 5.6 shows the relationship between knowledge and the presence of mosquito larvae in the Sangurara Community Health Center work area in Palu City. Based on this table, it is known that among respondents with a good level of knowledge, there are 8 respondents (12.3%) who found larvae and 57 respondents (87.7%) who did not find larvae, with a **total** of 65 respondents (100%).

Respondents with sufficient knowledge level, there were 8 respondents (29.6%) who found larvae and 19 respondents (70.4%) who did not find larvae, with a total of 27 respondents (100%). Meanwhile, respondents with low knowledge level, there were 4 respondents (50.0%) who found larvae and 4 respondents (50.0%) who did not find larvae, with a total of 8 respondents (100%).

The results of the statistical test showed a *p-value* of 0.012, which is smaller than the α value of 0.05. Thus, it can be concluded that there is a significant relationship between knowledge and the presence of *Aedes aegypti mosquito larvae* in the working area of the Sangurara Community Health Center, Palu City.

Density Larvae Mosquito *Aedes aegypti* in Region Work Community Health Center Sangurara

The presence of larvae in this study indicates that the environment in the Sangurara Community Health Center's work area still supports the life cycle *of Aedes aegypti*. This mosquito has a high adaptability to domestic environments and prefers clean water containers inside and around homes as egg-laying locations (Ministry of Health of the Republic of Indonesia, 2024). *Aedes aegypti eggs are capable of surviving in dry conditions* during a number of month And will hatch when re-submerged in water, so that even though the container appears empty, the potential for larvae to appear remains.

Based on the larval index calculation, the highest *Density Figure* (DF) value obtained was 6. According to *the World Health Organization*, value That including on a high density scale and shows that the infestation of larvae is at a level that has the potential to increase the risk of dengue fever transmission *if* not carried out. Control in a way. In addition, all larval index values obtained in this study exceeded the threshold. maximum <0.025 Which set in Regulation Minister Health Number 2 of 2023, indicating that the area is at high risk for *dengue fever transmission*.[5] This provision emphasizes that the identified larval density is not only entomologically significant but also epidemiologically significant for increasing the potential for dengue fever cases in the community. Epidemiologically, density of larvae is at on level That depiction that A larvae develop in sufficient numbers to support the formation of a large adult mosquito population.[4] The higher the density of larvae, the greater the possibility occurrence contact between man And Nyanya infectious as a vector for *the dengue virus* (*World Health Organization*, 1973). Therefore, this situation emphasizes

the importance of strengthening larva surveillance and increasing the consistency of Mosquito Nest Eradication (PSN) and 3M Plus in reducing vector density in organizational environments. [6]

The inspection is carried out visually using a flashlight. throughout place air, Good in in Good in outside House. Larvae Which found has distinctive morphological characteristics as a marker of *the* Aedes *aegypti species*, namely an elongated body with a clear and dark head, and has a relatively short and dark siphon (breathing tube) in contrast to its lighter body color. When in the air, the larvae appear to hang vertically near the surface of the air at a certain angle of inclination to be taken oxygen through the siphon, And will actively dive to the bottomwhen exposed to disturbances. The larvae found were mostly at the instar III stage and IV, with size approximately between 4-6 mm, marked with thorns (*spinae*) on the chest that is starting to be clearly visible and the color of the head is getting darker. The bottom container Lots found larvae is tub bathe, buckets and drums, Which No closed and rarely drained.

Study This - with study Which done by Anindita & Sudrajat (2022) shows HI (59%), CI (31%), and BI (62%). *Density Figure analysis* shows that Village Karangsatria Subdistrict Fat North, Bekasi is at at high risk of dengue fever transmission. Similar research by Pongu, R. (2025) showed a *House Index value* of 7.98%, *Receptacle Index* of 8.15%, and *Breteau Index* as big as 8.34% with *a density figure* in the high category.

Connection Temperature with Existence Larvae Mosquito *Aedes aegypti*

Environmental temperature is a factor that greatly influences the life cycle. Nyanya *Aedes aegypti*. Temperature For various process biology start From egg hatching, larval development, pupae, to adult mosquito development. Optimal temperature For development *Aedes aegypti* is at on range 25–27°C. On temperature range In this case, the larval metabolic process takes place maximum, development time becomes shorter, and the human survival rate becomes higher so that A larvae in Container air can per with fast. On the other hand, at temperatures below 25°C, larval growth slows down because metabolic activity is disrupted.

Temperature is one of the physical factors that influence the continuity of *the Aedes aegypti life cycle*. Temperature measurements in this study were conducted once in each respondent's home, namely at 08.00-12.00 WITA and continued at 15.00-17.00 WITA. The selection of this time period takes into account the social conditions of the community, where most respondents carry out work activities in the morning, so data collection in the afternoon is considered more effective and does not disrupt household activities. In addition, this period represents daily temperature conditions when the intensity of solar radiation increases and reflects the characteristics of the environmental temperature at the time of field observations.

Research results show that environmental temperature is related to the presence of *Aedes aegypti mosquito larvae*. Temperatures within the optimal range (25–27°C) support the development of mosquito eggs, larvae, and pupae. At this temperature, the mosquito's metabolic rate increases, accelerating the life cycle and increasing the larvae's chances of survival. [7]

Study This - with research Izhar, M. D. (2022) a data analysis with test *Chi-Square* . Results analysis show There is between temperature air *p-value* : 0.041 with the presence of Larvae. Similar research was conducted by Mulyani *et al.,* (2022). Results study This push that There is connection temperature air (*p value* = 0.017) with Existence larvae. [8]

Connection humidity with Existence Larvae Mosquito *Aedes aegypti*

Air humidity is an environmental factor that plays a crucial role in supporting the survival of the *Aedes aegypti mosquito*, both in the larval and adult stages. Certain humidity levels affect mosquito survival, egg-

laying frequency, and the sustainability of vector populations in residential areas. The optimal humidity level for *Aedes aegypti* development is between 60 and 80%. Under these conditions, the environment becomes more stable and does not cause evaporation air Which fast on container, so that larvae can survive longer in aquatic environments. High humidity also supports adult mosquitoes' search for egg-laying sites.

Humidity measurements in this study were conducted simultaneously with temperature measurements in each respondent's home between 8:00 and 12:00 WITA and 3:00 and 5:00 PM WITA to represent the condition of the home during field observations. Methodologically, more representative humidity measurements are generally conducted in the morning, specifically before 10:00 WITA, when atmospheric conditions are relatively stable and have not yet experienced a maximum temperature increase due to exposure to solar radiation. During the midday to evening period, the increase in ambient temperature tends to decrease, causing relative humidity, which in some conditions can be below 60%. Therefore, variations in measurement time have the potential to affect the humidity values obtained during observations.

Theoretically, relative humidity is associated with the survival and distribution of Aedes aegypti mosquitoes. specifically on region tropical Which have a relatively high humidity level. Recent research has shown that relative humidity contributes to vector population dynamics by increasing *the survival rate* of adult mosquitoes, although its effects often interact with temperature and other environmental conditions.[9] Air humidity also indicates connection with Existence larvae Nyanya *Aedes aegypti*. Which relatively tall Build Environment Which support day stand life adult mosquitoes and the continuation of the larval life cycle. Humid air can extend the lifespan of mosquitoes, thereby increasing the chance of egg-laying and increasing the larval population.[3]

This research is in line with research that conducted by Rasjid et al., (2023) The results of *the Chi Square test* regarding the relationship between humidity and the presence of *Aedes Aegypti* larvae with a 95% confidence level obtained a *p-value of* 0.019, meaning there is a significant relationship between humidity with the existence *Aedes aegypti* larvae. Similar research conducted by Jannah et al., (2021) also showed a significant relationship with the presence of *Aedes sp* . larvae (*p value* 0.001).[10]

The Relationship Between Public Knowledge and the Presence of *Aedes aegypti Mosquito Larvae*

Dengue Hemorrhagic Fever (DHF) and Mosquito Nest Eradication (PSN) is one of the behavioral factors that people have. role important in Control vector *Aedes aegypti* . Knowledge Good public health is reflected in respondents' understanding of the characteristics of the *Aedes aegypti mosquito* , the mosquito life cycle, potential breeding sites for larvae, and preventive measures through 3M Plus activities, namely draining, covering, and reusing used items that have the potential to collect air. Theoretically, the community Which own level Knowledge Which Good expected able to recognize risk factors for the presence of larvae in their home environment and take preventive measures independently. [11]

However, the knowledge held by the community is not always followed by optimal practices in the field. Research results revealed that various air containers inside and outside homes were still uncovered and rarely cleaned. This situation indicates that some communities still lack understanding. Which limited about Importance management place shelter water as part from effort prevention Dengue fever. Lack of implementation Knowledge In real action, it causes air containers to remain a medium that really supports the development of *Aedes aegypti mosquito larvae* .

This research aligns with research conducted by Rau and Nurhayati (2021) in the Sangurara Community Health Center work area, which showed a significant relationship between community knowledge and the presence of *Aedes aegypti larvae* ($p = 0.000$).[12] This is also in line with research by Nahren (2023) which

showed a significant relationship between the level of knowledge and the presence of *Aedes aegypti larvae* (p = 0.008). [2]

5. Conclusion

This study has several limitations that should be acknowledged. First, the cross-sectional design only identifies associations between variables and does not establish causal relationships. Second, temperature and humidity measurements were conducted only once during the observation period, which may not fully represent daily environmental variations. Third, this study focused only on temperature, humidity, and knowledge, while other factors such as rainfall, water container characteristics, sanitation conditions, and community practices were not examined. Therefore, future studies are recommended to employ longitudinal or cohort designs, include additional environmental and behavioral variables, and involve larger sample sizes from broader endemic areas to improve the generalizability of the findings.

Based on the larval index calculation, the HI value was 20%, CI 23%, and BI 40% shows that the Sangurara Community Health Center area is at *Density Figure* (DF) 6 which is included in the high mosquito larvae density category, because the determination of DF is based on mark highest from third index the. Besides That, mark ABJ as big as 80% Which not yet fulfilled standard ≥ 95% indicates that many houses were still positive for larvae Which found positive mosquito larvae, and shows that the research area still has a risk of *Dengue* Hemorrhagic Fever (DHF) transmission so that sustainable vector control efforts are needed. Based on the results of statistical tests, there is a significant relationship between temperature and the presence of *Aedes aegypti mosquito larvae* in the Sangurara Health Center work area of Palu City with a *p-value = 0.016. There is a significant relationship between humidity and the presence of Aedes aegypti* mosquito larvae in the Sangurara Health Center work area of Palu City with a *p-value* = 0.039. There is a significant relationship between the level of respondent's knowledge and the presence of *Aedes aegypti mosquito larvae* in the Sangurara Health Center work area of Palu City with a *p-value* = 0.012. Suggestions for the community are expected to increase their active role in DHF prevention efforts by implementing the 3M Plus PSN behavior routinely and continuously, as well as paying attention to the condition of the home environment that has the potential to become a mosquito breeding ground .

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