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Climatic Factors and Density of *Aedes sp.* Larvae on Dengue Hemorrhagic Fever

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Abstract

Dengue Hemorrhagic Fever (DHF) remains a public health concern in endemic areas, including Labuh Baru Timur Subdistrict, Payung Sekaki District, Pekanbaru City, which is characterized by a tropical climate and high population density. This study aims to describe the influence of climatic factors and Aedes spp. larval density on the incidence of DHF in Pekanbaru City. This research employed a quantitative descriptive and observational approach with a survey design. Data on DHF incidence were obtained from the Disease Prevention and Control Division (P2PM) of the Pekanbaru City Health Office for the period January 2023 to December 2024. Climatic data, including air temperature, rainfall, and humidity, were sourced from the Meteorology, Climatology, and Geophysics Agency (BMKG) of Pekanbaru City. Measurement of Aedes spp. larval density was conducted in Labuh Baru Timur Subdistrict, Payung Sekaki District, in November 2025, involving 110 households selected using proportionate stratified random sampling. The results showed an increase in DHF cases from 291 cases in 2023 to 517 cases in 2024, with two reported deaths. The pattern of DHF incidence fluctuated, with peaks occurring in the early and mid-2024. Climatic conditions, including air temperatures ranging from 25.9–28.0°C, rainfall between 93.9–507.7 mm, and humidity levels of 79–91%, were conducive to vector breeding. Larval density indices indicated a House Index of 54.5%, Container Index of 23.5%, and Breteau Index of 91.8%. The Density Figure ranged from 6 to 7, indicating high larval density and a high risk of DHF transmission. The Larva-Free Index was recorded at 45.5%. This study underscores the need for sustainable DHF control through climate-based mosquito breeding site eradication and enhanced community participation.

Keywords: Dengue hemorrhagic fever, climatic factors; larval density ; Aedes sp.

1. Introduction

Dengue hemorrhagic fever (DHF) is an infectious disease caused by the dengue virus and transmitted through the bite of *Aedes aegypti* mosquitoes. The disease remains a major public health problem in tropical regions, including Indonesia, with an increasing incidence reported annually.[1] Globally, dengue cases have shown an upward trend, with a cumulative total exceeding 14 million cases in 2024.[2] Based on data from the Ministry of Health of the Republic of Indonesia, there were 114,720 DHF cases reported in 2023, with an incidence rate (IR) of 41.1 per 100,000 population and a case fatality rate (CFR) of 0.78%, exceeding the national targets of IR ≤10 per 100,000 population and CFR ≤0.7%.[3] Pekanbaru City recorded the highest IR in the province, reaching 78 per 100,000 population.[4] Furthermore, data from the Pekanbaru City Health Office in 2025 (week 1 to week 37) indicated that the highest number of DHF cases occurred in Payung Sekaki District, particularly in Labuh Baru Timur Subdistrict.

The high incidence of DHF is influenced by various environmental factors, particularly climatic conditions, which affect the life cycle of mosquito vectors and the potential for virus transmission[4,5] Climatic factors such as air temperature, rainfall, and humidity play a crucial role in determining mosquito activity, reproduction, and the incubation period of the dengue virus.[5-8] The optimal conditions for dengue transmission include temperatures ranging from 24–30°C, rainfall of 100–400 mm per month, and humidity above 60%, all of which increase the risk of outbreaks.[7,8] Previous studies have demonstrated that variations in climatic factors are associated with the population density of *Aedes aegypti* and the incidence of DHF, although the magnitude of their effects varies across regions depending on population density and environmental conditions[9,10,11] In Pekanbaru City, scientific publications integrating DHF data with climatic data from the Meteorological, Climatological, and Geophysical Agency (BMKG) remain limited, highlighting the importance of climate-based risk mapping for effective prevention planning.

In addition to climatic factors, the density of *Aedes sp*. larvae is an important indicator of DHF transmission risk. The female *Aedes aegypti* mosquito is the primary vector, while *Aedes albopictus* serves as a potential secondary vector.[12] Larval surveys using indicators such as the House Index (HI), Container Index (CI), Breteau Index (BI), and Larva-Free Index (LFI) are essential for assessing mosquito population density and evaluating the effectiveness of vector control strategies.[13,14,15] Previous studies conducted in Labuh Baru Timur Subdistrict reported varying larval densities, ranging from moderate (HI 32.06%, CI 8.32%, BI 37%, LFI 67.94%) to high (HI 56%, CI 22.4%, BI 61%, LFI 44%).16,17 These findings indicate that the risk of DHF transmission remains high and that vector control efforts have not been optimal. Therefore, updated data are needed as a basis for evaluating and improving vector control programs.

Based on the background described, this study aimed to assess the density of *Aedes sp*. larvae and the influence of climatic factors (temperature, rainfall, and humidity) in dengue hemorrhagic fever (DHF) endemic areas of Pekanbaru City. The findings are expected to support the planning of DHF control strategies, mosquito breeding site eradication, risk communication to the community, and the evaluation of vector control program effectiveness..

2. Materials and Methods

This study employed a quantitative descriptive and observational approach conducted in a continuous manner. Data on DHF incidence and climatic factors were collected using secondary data from January 2023 to December 2024, obtained from the Pekanbaru City Health Office and the Meteorology, Climatology, and Geophysics Agency (BMKG) of Pekanbaru. A survey of *Aedes* spp. larval density was conducted in November 2025 in Labuh Baru Timur Subdistrict, Payung Sekaki District, an endemic area of DHF in Pekanbaru City, using an observation checklist.

The population for DHF incidence and climatic factors included all recorded DHF cases in Pekanbaru City and all monthly climatic data from BMKG during the study period. A total population sampling approach was used, covering monthly DHF cases and monthly air temperature, rainfall, and humidity data. For the larval density survey, the population consisted of all households in Labuh Baru Timur Subdistrict. The sample size was calculated using Slovin's formula with a 10% margin of error, plus an additional 10% to account for potential non-response, resulting in 110 households. Proportionate stratified random sampling was applied based on household density at the neighborhood (RW) level, followed by random sampling at the community unit (RT) level. The study variables included DHF incidence, climatic factors (air temperature, rainfall, and humidity), *Aedes sp.* larval density indicators (House Index [HI], Container Index [CI], Breteau Index [BI], and Density Figure [DF]), and the Larva-Free Index.

3. Results

Monthly Distribution of DHF Cases in 2023–2024

The distribution of dengue hemorrhagic fever (DHF) cases in Pekanbaru City during 2023–2024 showed monthly variations. Based on weekly data obtained from the Pekanbaru City Health Office, the number of DHF cases per month is presented in Table 1.

Table 1. Monthly Distribution of DHF Cases in 2023–2024 Month

	2023 (Case)	2024 (Case)
January	**46**	67
February	31	**84**
March	27	48
April	30	25
May	16	33
June	19	36
July	27	51
August	9	36
September	13	31
October	30	41
November	18	45
December	25	20
Total	291	517

Source: Pekanbaru City Health Office

The number of dengue hemorrhagic fever (DHF) cases in 2024 was higher than in 2023 for almost every month. The most notable increase occurred in January and February 2024, with 67 and 84 cases, respectively, representing the peak incidence over the two-year period. In 2023, the highest number of cases was observed in January with 46 cases, followed by a gradual decline until mid-year.

After reaching the peak in early 2024, the number of cases decreased from March to May and then rose again in July. This pattern indicates two distinct periods of increased DHF incidence: early and mid-year. In contrast, the pattern in 2023 was relatively stable, with minor fluctuations, although case numbers increased again in October and December. These fluctuations suggest that DHF transmission in Pekanbaru City occurs year-round, with peaks that do not necessarily follow the same period each year. This underscores the need for continuous prevention and control efforts to reduce DHF transmission throughout the year.

Climatic Factors in Pekanbaru City, 2023–2024

Based on data from the Meteorological, Climatological, and Geophysical Agency (BMKG), Pekanbaru Station, the average air temperature, rainfall, and humidity in Pekanbaru City during 2023–2024 are presented in Tables 2 and 3.

Table 2. Average Air Temperature, Humidity, and Rainfall in Pekanbaru City, 2023

Month	Air Temperature (°C)	Humidity (%)	Rainfall (mm)
January	25,9	88,1	183,8
February	26,3	85	269,4
March	26,3	87	260,7
April	27,3	86	176,1
May	28	84,1	193,1
June	27,7	81,8	202,8
July	27,5	79,4	93,9
August	27,1	83,1	183,5
September	27,6	81,7	205,2
October	27,3	86	158,4
November	27	88,3	385,3
December	26,5	91	507,7

Source: Riau Climatology Station

In 2023, the air temperature in Pekanbaru City ranged from 25.9°C to 28.0°C, with an average of approximately 27.1°C. The highest temperature was recorded in May, while the lowest occurred in January. In 2024, temperatures ranged from 26.4°C to 28.0°C, with an average of 27.6°C. The highest temperature was observed in October, and the lowest in January.

Rainfall in 2023 varied from 93.9 mm to 507.7 mm, peaking in November and December. In 2024, the highest rainfall occurred in January and November, while the lowest was recorded in July. These patterns indicate that the rainy season in Pekanbaru typically occurs at the beginning and end of the year, whereas the mid-year months are dominated by the dry season.

Humidity in 2023 ranged from 79.4% to 91%, with the highest value in December. In 2024, the highest humidity was observed in January, decreasing in mid-year and increasing again toward the end of the year. Overall, the climatic patterns in Pekanbaru City indicate relatively stable temperatures, high humidity, and seasonal increases in rainfall. These conditions are consistent with a tropical wet climate and provide a favorable environment for the life cycle and activity of the *Aedes aegypti* vector.

***Aedes sp.* Larval Density**

Examination of 110 households revealed that 60 houses were positive for larvae, while 50 houses were negative. A total of 429 containers were inspected, of which 101 were positive for larvae and 328 were negative. Positive households were distributed across all selected neighborhood units (RW), with variations in the number of positive houses among community units (RT).

Regarding container types, buckets were the most frequently inspected and also had the highest number of positive larvae findings. Containers such as aquatic plant vases did not contain any larvae. In terms of container location, most containers were located indoors, and the majority of positive containers were also found inside the households.

House Index, Container Index, Breteau Index, and Larva Free-Index

The House Index (HI) was 54.5%, the Container Index (CI) was 23.5%, the Breteau Index (BI) was 91.8%, and the Larva-Free Index was 45.5%. Based on the HI, CI, and BI values, the Density Figure (DF) ranged from 6 to 7, indicating a high larval density and a high risk of dengue hemorrhagic fever (DHF) transmission.

Discussion

Air Temperature, Rainfall, and Humidity on DHF Incidence

The incidence of dengue hemorrhagic fever (DHF) in Pekanbaru City is influenced by the interaction among air temperature, rainfall, and humidity, which together create an ideal environment for the survival of *Aedes aegypti* vectors. Air temperature within the optimal range accelerates mosquito development and shortens the dengue virus incubation period, thereby increasing transmission potential. However, because temperatures in tropical regions are relatively stable, temperature variation does not always serve as the main differentiating factor in case fluctuations; instead, it functions as a basic supporting factor for transmission.[6]

Rainfall plays a crucial role in providing breeding sites through the formation of water collections in various containers. Its impact on case increases is indirect and exhibits a lag effect related to the mosquito life cycle and virus incubation period. Water remaining after rainfall continues to sustain vector populations, leading to an elevated risk of transmission in subsequent periods.9

Air humidity supports mosquito survival by reducing body fluid loss and maintaining the stability of egg and larval habitats. High humidity prolongs mosquito lifespan and increases the likelihood of human contact. However, because humidity variation is relatively minor, its influence on case number fluctuations tends to be indirect and primarily serves as an environmental maintenance factor for the vectors.[7] Overall, DHF dynamics reflect the synergistic effects of climatic factors, combined with environmental and community behavior influences. Integrated climate monitoring and strengthened environmental control are essential strategies to mitigate the risk of DHF case increases.[4]

***Aedes sp.* Larval Density**

The high values of the House Index (HI), Container Index (CI), and Breteau Index (BI) indicate that residential areas have a high larval density, resulting in a significant risk of dengue hemorrhagic fever (DHF) transmission. Dense housing and close proximity between houses facilitate the movement of mosquitoes from one house to another.[18] Furthermore, the greater the number of containers in a house or surrounding environment, the higher the potential breeding sites for *Aedes aegypti* mosquitoes.[19]

The predominance of positive containers indoors suggests that community practices in managing water storage and implementing mosquito breeding site control are still suboptimal. Low frequencies of container cleaning, covering, and monitoring increase the likelihood of larval development.17 During the rainy season, outdoor containers also contribute as potential habitats when rainwater accumulates and is not promptly removed.

The Density Figure (DF) in the high category reinforces that the study area has a substantial risk of DHF transmission.20 This reflects the accumulation of environmental and behavioral factors that allow vector populations to proliferate. The low Larva-Free Index indicates that household-level vector control has not been fully effective vector control through the reinforcement of the 3M Plus practices and increased role of community larval inspectors.21 Overall, larval density is an important indicator for predicting DHF transmission potential.

4. Conclusion

This study concludes that the incidence of dengue hemorrhagic fever (DHF) in Pekanbaru City during 2023–2024 showed an increasing trend, with a more pronounced rise in 2024. Climatic conditions, including air temperature, rainfall, and humidity, were generally within ranges that support the survival and development of *Aedes aegypti* vectors, thereby creating a conducive environment for dengue transmission. The interaction among climatic factors influenced the dynamics of DHF incidence, particularly following periods of high rainfall accompanied by stable humidity.

In addition to climatic factors, the high larval density and low Larva-Free Index (LFI) indicate that residential environments still provide abundant potential breeding sites for mosquitoes. Housing density, the presence of water-holding containers, and community practices in environmental management contribute to the persistence of vector populations. These conditions reinforce the ongoing risk of DHF transmission at the community level. Overall, DHF incidence is influenced by climatic factors and high vector density in residential environments. Integrated control efforts are necessary, including utilizing climatic information as a basis for early warning systems, strengthening environmental management, and increasing community participation in sustainable mosquito breeding site eradication.

Recommendations from this study include enhancing climate and DHF surveillance systems to support timely preparedness and targeted interventions, improving cross-sectoral coordination for environmental control, and strengthening public education on proper management of water-holding containers and environmental hygiene, particularly during high-risk periods. Health facilities are encouraged to conduct regular larval density monitoring and reinforce community-based vector control programs. Future research is recommended to develop spatial and temporal analyses to provide a more detailed risk assessment and support more effective DHF control planning.

Reference

1. Kemenkes. Demam berdarah dengue [Internet]. 2022 [cited 2025 May 29]. Available from: https://ayosehat.kemkes.go.id/topik/demam-berdarah-dengue
2. Haider N, Hasan MN, Onyango J, Billah M, Khan S, Papakonstantinou D, et al. Global Dengue Epidemic Worsens With Record 14 Million Cases And 9000 Deaths Reported In 2024. Int J Infect Dis. 2025;158.
3 .Kementrian Kesehatan. Strategi Nasional Penanggulangan Dengue 2021-2025. In 2021.
4. BMKG. PPID BMKG Kuansing.
5. Morin CW, Comrie AC, Ernst K. Climate and dengue transmission: Evidence and implications. Environ Health Perspect. 2013;121(11–12):1264–72.
6. Ali K, Addin Rizaldi M, Bangun Sugiharto S, Yuniarno S, Fitria Widiyanto A, Suratman S, et al. The correlation between temperature and dengue haemorrhagic fever in Malang Regency –

Indonesia: A spatial – temporal analysis. BIO Web Conf. 2025;155.
7. Linda EP, Febiyanti P, Muhtar A, Kurniawan R. Klasifikasi dan Prediksi Kelembapan Udara Optimal Perkembangbiakan Nyamuk Aedes aegypti. 2024;2024(Senada):125–39.
8. Xu H yan, Fu X, Kim L, Lee H, Ma S, Goh KT, et al. Statistical Modeling Reveals the Effect of Absolute Humidity on Dengue in Singapore. 2014;8(5).
9. Olivia DN, Jaksa S, Sekarputri AL. Pengaruh Faktor Cuaca (Curah Hujan , Kelembapan , dan Suhu) Terhadap Kejadian DBD. 2025;(3):1–16.
10. Prasti Widyorini, Kintan Arifa Shafrin, Nur Endah Wahyuningsih, Retno Murwani S. Dengue hemorrhagic fever (DHF) cases in semarang city are related to air temperature, humidity, and rainfall. Adv Sci Lett. 2017;23(4).
11. Fitriani S, Binti N, Suhaimi A. Factors Affecting Cases of Dengue Hemorrhagic Fever in Riau Province. 2024;2(1):37–43.
12. Ogunlade ST, Meehan MT, Adekunle AI, Rojas DP, Adegboye OA, McBryde ES. A Review: Aedes-Borne Arboviral Infections, Controls And Wolbachia-Based Strategies. Vaccines. 2021;9(1):1–23.
13. Daramusseng A, Hanif Abdi Rahman D. The Vector Entomology Index of Dengue Hemorrhagic Fever (DHF) was conducted in the Working Area of the Temindung Health Center. J Kesehat Lingkung J dan Apl Tek Kesehat Lingkung. 2023;20(2):209–16.
14. Wijayanti SPM, Sunaryo S, Suprihatin S, McFarlane M, Rainey SM, Dietrich I, et al. Correction: Dengue in Java, Indonesia: Relevance of Mosquito Indices as Risk Predictors. PLoS Negl Trop Dis. 2016 Apr 26;10(4):e0004683.
15. Tomia A. Karakteristik Habitat dan Keberadaaan Larva Aedes spp. di Kelurahan Gambesi Kecamatan Ternate Selatan. JUSTE (Journal Sci Technol. 2022;2(2):112–22.
16. Maryanti E, Lesmana SD, Triguna D, Plymoth M, Harmas W, Delly D, et al. Maya Index dan Kepadatan Larva Aedes aegypti di Daerah Endemis Demam Berdarah Dengue Kelurahan Labuh Baru Timur Kecamatan Payung Sekaki Kota Pekanbaru. J Ilmu Kedokt (Journal Med Sci. 2019 Apr 4;12(1):19.
17. Susmaneli H, Hidayati U, Agnesia Y. Faktor-Faktor Yang Berhubungan Dengan Keberadaan Jentik Nyamuk Aedes Aegypti. Media Penelit dan Pengemb Kesehat. 2024;34(2):356–67.
18. Baskoro T, Satoto T, Diptyanusa A, Setiawan YD, Alvira N. Environmental Factors Of The Home Affect The Density Of Aedes aegypti (Diptera: Culicidae). 2017;25(1):41–51.
19. Anindita R, Sudrajat NAD. Kepadatan Populasi Jentik Aedes sp. di Desa Karangsatria, Kecamatan Tambun Utara, Bekasi. ASPIRATOR - J Vector Borne Dis Stud. 2023;14(2):79–88.
20. Marina R, Hermawati E, Kesehatan B. Tingkat Penularan Kasus Dengue Berdasarkan Karakteristik Habitat Larva Aedes sp . Di Kecamatan Mustikajaya , Kota Bekasi Level Of Dengue Transmission Based On Habitat Characteristic Of Aedes Sp . Larvae In Mustikajaya District , Bekasi City Demam Berdarah. 2018;105–13.
21. Priyatna BS, Rudiansyah R, Rossanti L. Hubungan Perilaku Pemberantasan Sarang Nyamuk Dengan Keberadaan Jentik Nyamuk Aedes Sp (Studi Pada Ibu Rumah Tangga Di Desa Pabean Udik Kabupaten Indramayu Tahun 2023). 2023;12(Juni 2024):35–9.