AMJ
ISSN: 0005-2523

ISSN: 0005-2523
Volume 62, Issue 10, December, 2022

Correlation of Population Density, Houseold Density and Larvae-Free Index With Dengue Hemorrhagic Fever Incidence Rate

Krisna Delita[1], Nurhayati Damiri[1,2*], Rico Januar Sitorus[2], Poedji Loekitowati Hariani[3]

Department of Environmental Science, Doctoral Program, Sriwijaya University[1]
Department of Plant pests and diseases, Agricultural Faculty, University of Sriwijaya, Indralaya Ogan Ilir District, South Sumatra, Indonesia[2]
Faculty of Public Health, Sriwijaya University[3]
Departement of Chemistry, Facultas of Mathematic and Natural Science, Sriwijaya University[4]

Corresponding Author: 1,2*

Keywords:
Incidence rate DHF, population density, Houseold density free larvae index

ABSTRACT

Dengue Hemorrhagic Fever is still a health problem in Indonesia, Palembang City, South Sumatra Province, Indonesia is one of the DHF endemic cities in Indonesia is a densely populated city and environmental conditions support vector development. Mosquito Aedes aegypti is the primary vector in the transmission of DHF. This study aims to analyze the relationship between population, population density, occupancy density and free larvae index on cases of fever and incidence of bleeding in Palembang City and can be used as a basis for DHF control in Palembang City. This study is an analytic epidemiological study with a cross-sectional design. The independent factors are population, population density, occupancy density and larvae free rate, while the dependent variable is dengue fever cases. The results of the study population, population density significantly and positively correlated with the incidence of dengue hemorrhagic fever. Meanwhile, the larvae free number has a significant effect and has a negative correlation. Population, population density and mosquito-free rate significantly affect the incidence of dengue fever in Palembang City. Population density, urban and settlement problems can be attributed to the high incidence of dengue fever indicating that population problems should be considered in every plan and assessment of urban and settlement development by the government and the private sector. DHF prevention and control programs will probably work efficiently if demographic issues, environmental conditions, and parameters free larvae index integrated into one system that analyzes and maps the distribution of DHF cases.

1. Introduction

Dengue hemorrhagic fever (DHF) affects many countries and even more than 100 countries including Africa, America, Eastern Mediterranean, Southeast Asia, and the West Pacific. The Americas, Southeast Asia and the Western Pacific are the worst affected regions, with Asia representing 70% of the world disease burden [1].

Dengue Hemorrhagic Fever is still a health problem in Indonesia today. Indonesia is a tropical country in Asia, these conditions are suitable for the *Aedes Aegypti* mosquito to grow and breed, especially when there are stagnant water or rainwater reservoirs which become breeding place [2], [3]. In 2020 there were 108,303 DHF cases with an incident rate of 40 per 100,000 population, in 2021 there were 73,518 DHF cases with an incident rate of 27 per 100 population. (DHF) in Indonesia shows an increasing trend throughout 2022. The cumulative number of confirmed cases of DHF from January to September 2022 is 87,501 cases with 816 deaths. In 2020 there were 108,303 DHF cases with an incident rate of 40 per 100,000 population, in 2021 there were 73,518 DHF cases with an incident rate of 27 per 100 population. (DHF) in Indonesia shows an increasing trend throughout 2022. The cumulative number of confirmed cases of DHF from January to September 2022 is 87,501 cases with 816 deaths [4].

Palembang City, South Sumatra Province, Indonesia is one of the DHF endemic cities in Indonesia. In 2018 there were 642 cases with an incident rate of 39.25 per 100,000 educators and in 2019 there was an increase of 697 cases with an incident rate of 45 per 100,000 population, in 2020 there was a slight decrease, namely as many as 435 cases with an incident rate of 30.25 per 100,000 population [5]. The population of Palembang City in 2019 was 1.843 million [6].

Mosquito *Aedes aegypti* is the primary vector in the transmission of DHF [7]. The high DHF morbidity rate in Palembang City is driven by many factors, one of which is demographic factors and the existence of the *Aedes aegypti* mosquito vector, due to the occurrence of DHF there is an interaction between Aedes aegypti as the vector and humans as the host which causes transmission [8]. This is in line with research conducted by [9]. The results showed that the ecological factors associated with the endemicity status of DHF in Makassar City were population density ($p < 0.05$), while the rate of larva free, occupancy density was not related to the endemicity status of DHF ($p > 0.05$). Therefore, more attention needs to be paid to districts with high population densities and the need to establish trends in the spread of dengue cases based on ecological factors to determine areas prone to dengue fever and their treatment priorities.

This study aims to analyze the relationship between population, population density, occupancy density and free larvae index on cases of fever and incidence of bleeding in Palembang City and can be used as a basis for DHF control in Palembang City.

2. Methods

This study is an analytic epidemiological study with a cross-sectional design. The independent factors are population, population density, occupancy density and larvae free rate, while the dependent variable is dengue fever cases. The data used in this research is data for 2019, because in 2019, the city of Palembang experienced its highest incidence of DHF in six years. The research was conducted from September 2021 to March 2022.

2.1 Data analysis

The data were analyzed statistically to see the correlation between population size, population density, occupancy density and larvae-free rate of dengue hemorrhagic fever cases and to predict the prediction of dengue fever based on independent variables. If the data is normally stringed, Pearson correlation analysis

ISSN: 0005-2523
Volume 62, Issue 10, December, 2022

is performed and if the data is abnormally distributed, Spearman analysis is performed.

3. Result

3.1 The Incidence Rate of DHF based on Temporal Analysis and District Categories

DHF case data varies greatly each year, but there has been the same pattern for the last 6 years (Figure 1). The incidence of DHF increased in January and February and decreased in March and April, increased in May and decreased in June to August, then the incidence of DHF increased in September to December. The incidence of DHF varies between districts. The districts for the last 6 years have always had high scores, namely Sukarame, Sako, Jakabaring and Seberang Ulu II. is a high endemic district. The highest dengue fever case was in Sukarami district.(Figure 1)

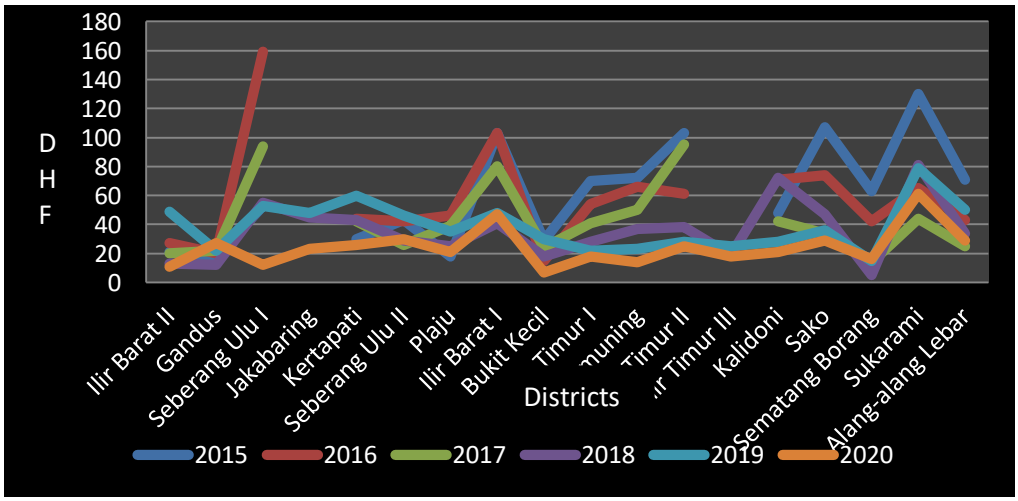

Figure 1. The DHF Cases by District in Palembang City

The high cases of dengue fever in each district are not always followed by a high incidence rate, because the incidence rate is an event per 100,000 population. High incident rates in 2019 were Bukit Kecil, Ilir Barat II, Jakabaring and Kertapati Districts (Figure 2).

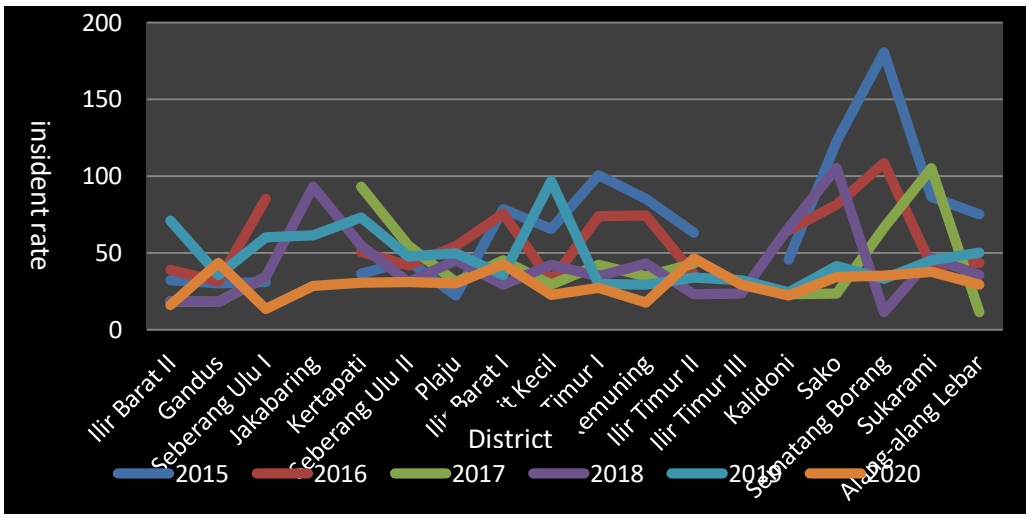

Figure 2. The Incidence Rate of DHF by District in Palembang City

3.2 The Incidence Rate of DHF Based on Population Factors and Larvae Free Index

Over six years, 4.779 cases of DHF have been reported. Over six years, 4,377 cases of DHF have been reported. Every year, the distribution of dengue cases follows a cyclical pattern. Total population, population density, relationship density and larvae-free rate show a separate pattern in each district (Figure 3).

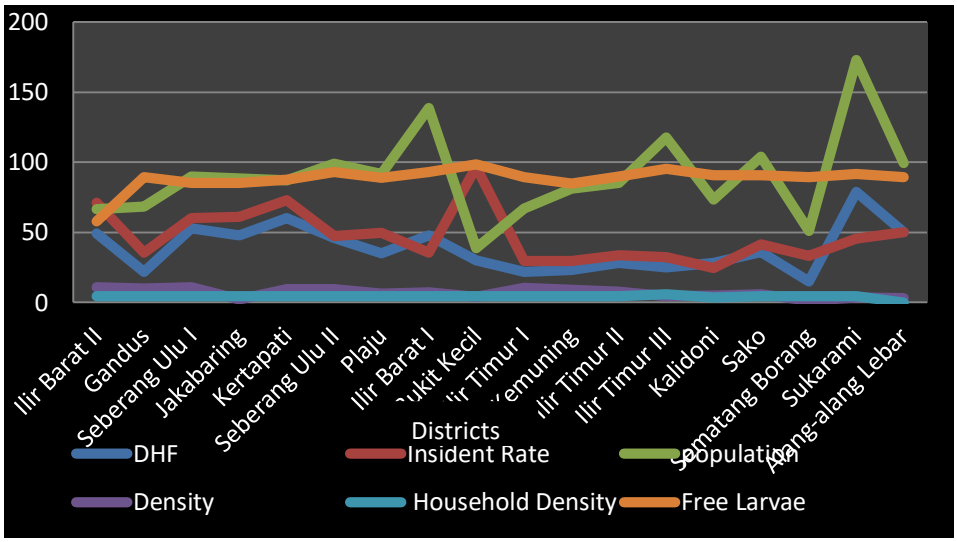

Figure 3. The Incidence Rate of DHF by District in Palembang City.

Based on the results of the analysis of the relationship between the population and cases of dengue fever and the incidence rate in 2019 in Palembang City, it shows that the population has a relationship with a p value of 0.003 for dengue fever and the incidence of dengue fever and has a very strong positive correlation with the value of r = 0.604, while the relationship between the cases DHF and the incidence rate has no significant relationship and is positively correlated with weak strength with a value of r = 0.258. The total population can predict 42.28% cases of dengue fever (Table 1 and Figure 4).

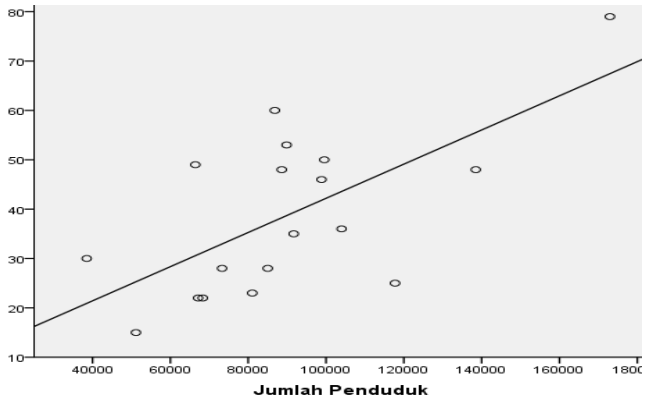

Figure 4. Correlation between Total Population and DHF Cases

The results of the analysis of the relationship between population density and the cases of dengue fever and the incidence rate in 2019 in Palembang City, it shows that there is a significant (close) relationship with a p value > 0.05, namely 0.041 with a value of r = 0.466 and a positive correlation for dengue fever and moderate strength value of r = 0.466 and positively correlated. Whereas the relationship between population density and incidence rate has a relationship with a value of 0.046 with medium and positive strength with a value of r = 0.402. Population density can predict 46.6% of cases of dengue fever (Table 1-2 and Figure 5).

AMJ
ISSN: 0005-2523
ISSN: 0005-2523
Volume 62, Issue 10, December, 2022

Table 1. Relationship of population, population density, houseold density and larvae free rate for DHF cases

Variabel	Dengue case		
	Koefisie Korelasi	R_{Squard}	Sig. (p 0.05)
Total population	0.654	0.4228	0.003
Population density	0.466	0,217	0.041
Houseold Density	0.135	0,018	0.593

There is no significant relationship and a weak correlation between the incidence of dengue fever and the incidence rate with houseold density. Based on the results of the analysis of the relationship between occupancy density and the incidence of dengue fever and the incidence rate, there is no significant relationship with a p *value* > 0.05, which is 0.593 and has a positive correlation with weak strength with a value of r = 0.135 and a relationship between occupancy density and incidence rate with p value 0.800 and value r = 0.064 (Table 1 and 2).

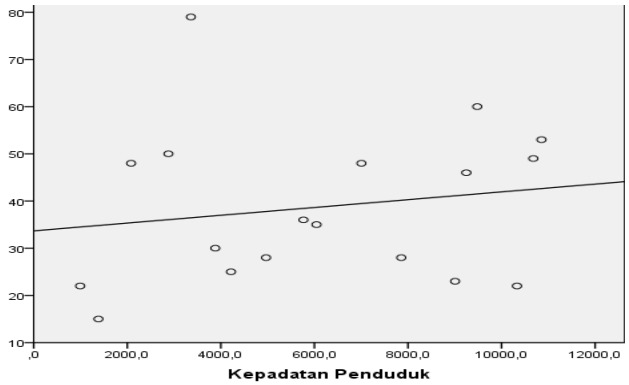

Figure 5. Correlation between Population Density and DHF Cases

Based on the results of the analysis of the relationship between larva-free index and the incidence rate, it shows a real (close) relationship with a value of v hammer > 0.05, namely 0.003 with a value of r = - 0.758 based on a value of r, it shows a very strong relationship and a negative correlation Larvae free index can predict cases of dengue fever by 57.4% (Table 2 and figure 6).

Table 2. Relationship of population, population density, houseold density and larvae-free rate on the Incidence Rate of DHF

Variabel	Incidence Rate of DHF		
	Koefisie Korelasi	R_{Squard}	Sig. (p (0.05)
Total population	0.258	0,056	0.303
Population density	0.402	0,162	0.046
Houseold Density	0.064	0.004	0.800
free Larvae index	- 0.758	0,574	0.003

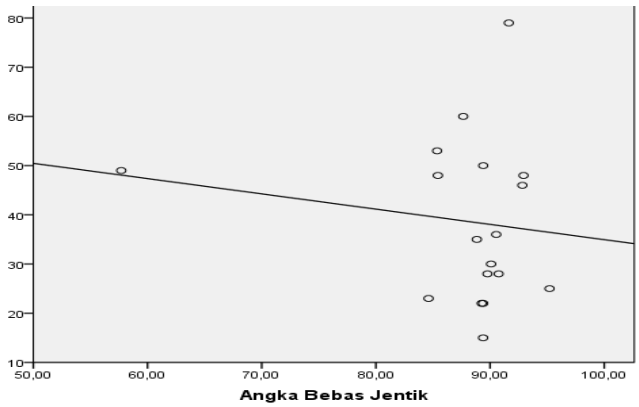

Figure 6. Correlation between Free larvae Index and DHF Cases

4. Discussion

Dengue fever and population, population density and free larvae spread according to the pattern. This is in line with research conducted by Sragen [10], the results showed that the spatial distribution of DHF was spread randomly in all districts in Sragen. The average incidence rate (IR) of DHF during the last 3 years in Sragen was > 50 / 100,000 population. Spatial description showed that 58 villages out of 208 villages in Sragen were DFH endemic areas and generally all subdistricts in Sragen were endemic areas of DHF. Conclusion: Spatial description of DHF in Sragen showed that all subdistricts in Sragen were endemic areas for DHF

Based on the results of research and data analysis, it shows that the more the population, the higher the incidence of dengue hemorrhagic fever with a stronger correlation. This can be seen in endemic areas in Sukarame District, the highest incidence of dengue fever. The results of this study are in line with the results of research conducted in Jambi, there is a relationship between population density and the incidence of DHF [11]. Population projections provide key missing evidence for the changing global threat of vector-borne diseases and will help decision-makers worldwide to better prepare for and respond to future changes in dengue risk [12].

There is a significant (close) relationship between population density and the incidence of dengue hemorrhagic fever and the incidence rate is moderate and has a positive correlation, meaning that the denser the population, the higher the incidence of dengue fever. This is in line with research conducted in Palu, where population density has a significant relationship with the incidence of dengue hemorrhagic fever [13]. And the results of a study conducted in Bandung showed a relationship between the incidence of dengue fever and population density [14]. This pattern emerges from the combined effect of herd immunity and seasonal transmission, and is strongly driven by variation in population density at sub-kilometer scales. It is apparent only when the landscape is stratified by population density and not by spatial proximity ashas been common practice. Models that exploit this emergent simplicity should afford improved predictions of the local size of successive epidemic waves [15]. Rural areas may contribute at least as much to the dissemination of dengue fever as cities. Improving water supply and vector control in areas with a human population density critical for dengue transmission could increase the efficiency of control efforts [16]. Population density affects the incidence rate of DHF. population density affects about 24.3% ($r = 0.245$) but does not affect the incidence of DHF ($r = 0.133$) [17]. These results differ from those carried out by [18], The results showed that the correlation between elevation and DHF ($p = 0.014$, $r = 0.339$) and th correlation between population density and DHF ($p = 0.186$). It can be concluded that there is significant correlation with positive direction between elevation and the DHF, and there is no significant correlation between

ISSN: 0005-2523
Volume 62, Issue 10, December, 2022

population density and DHF incidence in Kendari City in 2014–2018)

Houseold density is not associated with cases of dengue fever and has a weak correlation. This is in line with research conducted by [9], the results showed that the ecological factors associated with the endemicity status of DHF in Makassar City were population density ($p < 0.05$), while the rate of larva free, occupancy density was not related to the endemicity status of DHF ($p > 0.05$). Therefore, more attention needs to be paid to districts with high population densities and the need to establish trends in the spread of dengue cases based on ecological factors to determine areas prone to dengue fever and their treatment priorities. The results of the analysis provide information that the statistical value of the p-value shows the number 0.017 in the healthy house variable. Conclusion: That there is an influence very real between healthy home variables and the presence of DHF cases in Batam City. This shows that the house is healthy Includes sanitation, adequate ventilation, good lighting, good management of air access and other causes that do not the existence of a space that is used as a nesting place for Ae. aegypti. Suggestion: Factors that influence presence DHF, among others, that need to be considered are altitude, ecology and bionomics, eggs, larvae and pupae, adult mosquitoes, perch habits, flight range, life span and virus transmission (transovarial transmission) [19].

The results of the analysis of the larva free number (ABJ) are significantly (closely) related to the incidence rate, showing a strong negative correlation, meaning that the higher the larva free number (ABJ), the lower the Dengue Incidence Rate (IR) of DHF. This shows that the presence of the Aedes aegypti mosquito DHF vector can increase the incidence rate. Controlling the existence of mosquito larvae, especially the Aedes aegypti mosquito as a vector of dengue fever is very important, especially prevention by removing cointaners as mosquito breeding grounds and physical, chemical and biological control. This is in line with a study conducted in Denpasar, where there was a decrease in the incidence of dengue fever with a decrease in vector density and an increase in the free number of larvae [20]. Index shows a low incidence of dengue fever, and high density indicates a high incidence of dengue, low levels of education indicate Larva Free Index are at risk, and population density high shows that Larva Free Index are not at risk. The only variable according to the DHF theory is population density, and the variable according to the Larva Free Index theory is only the level of education [21].

5. Conclusion

Population, population density and mosquito-free rate significantly affect the incidence of dengue fever in Palembang City. Population density, urban and settlement problems can be attributed to the high incidence of dengue fever indicating that population problems should be considered in every plan and assessment of urban and settlement development by the government and the private sector. DHF prevention and control programs will probably work efficiently if demographic issues, environmental conditions, and parameters free larvae index integrated into one system that analyzes and maps the distribution of DHF cases like a spatial-temporal system

Acknowledgements
This research was funded by the Doctoral Dissertation Research Program (PDD), State University Operational Assistance (BOPTN), Ministry of Education and Culture Research and Technology with contract number 016603/UN9/SB.3LP2MPT/2021.

6. Reference

[1] WHO, 2020. Dengue and Severe Dengue.World Health Organization. URL

[2] Hasan, S., Jamdar, S.F., Alalowi, M., 2016. Dengue Virus: A Global Human Threat: Review of Literature, 6 (10): 1- 6.

[3] T. A. Garjito et al., 2020. "Stegomyia Indices and Risk of Dengue Transmission: A Lack of Correlation," Front. Public Heal.,. 8, no. July: 1 -13, 2020, doi: 10.3389/fpubh.2020.00328.

[4] Ministry of Health of the Republic of Indonesia. 2022. Indonesian Health Profile.

[5] Palembang City Health Office, 2021. Palembang City Health Profile 2021.

[6] Central Bureau of Statistics for Palembang City in 2020. Palembang in Figures for 2020.

[7] Wagner, C.E. et al., 2020. "Climatological, virological and sociological drivers of current and projected dengue fever outbreak dynamics in Sri Lanka," J. R. Soc. Interface, 17 (167). doi: 10.1098/rsif.2020.0075.

[8] Nuranisa,R. maryanto, y.b. and isfandiari, M.A. (2022). Correlation of Free Larvae index and Population Density With Dengue Fever Incidence Rate. The Indonesian Journal of Public Health, 17 (3): 477-487.

[9] Ilham Salam,I., Arsina, AA. And Wahyu, A., et al., 2019. Eco-Epidemiological Analysis of Dengue Hemorrhagic Fever (DHF) in Makassar City. Indian Journal of Public Health Research & Development, 10(12): 1248 – 1250. DOI :10.37506/v10/i12/2019/ijphrd/192217.

[10] Setyawan, D.A. and Setyaningsih, 2021. W. Spatial Distribution of Dengue Hemorrhagic Fever (DHF) Cases in Sragen. Disease Prevention and Public Health Journal ,15(1):, 42 - 49. ISSN: 2720-9997.

[11] Suparmi,S.2017. Demam Berdarah Dengue Berdasarkan Kepadatan Penduduk dan Curah Hujan. Jurnal Bahana Kesehatan Masyarakat Vol.1 No.1.

[12] Jane P. Messina J.P., Oliver J. Brady, O.J. Golding, N., et al., 2019. The current and future global distribution and population at risk of dengue. Nature Microbiology, 4: 1508–1515. www.nature.com/naturemicrobiology.

[13] Rahmi, A.R.,dan Puspita, S. 2017. Relationship between the population density andthe occurrence of dengue hemorrhagic fever in Palu at 2010-2014. Medika Tadulako, Jurnal Ilmiah Kedokteran, 4 (1).

[14] Afriyandika, D.,Yulianto, F.A. dan Feriandi,Y.2014. Hubungan Kepadatan Penduduk Dengan Kejadian Demam Berdarah Di Kota Bandung.Prosiding Pendidikan Dokter.Universitas Islam Bandung.

[15] Aznar, V.R., , Freitas , L.P., Oswaldo Gonçalves Cruz, O.G. Aaron A. King , A.A. and Pascual, M. 2022. Fine-scale heterogeneity in population density predicts wave dynamics in dengue epidemics Nature Communications 13:996. doi.org/10.1038/s41467-022-28231-w www.nature.com/naturecommunications.

[16] Schmidt ,W.P. m Motoi Suzuki , W. And Thiem, V.D. 2011. Population Density, Water Supply, and the Risk of Dengue Fever in Vietnam: Cohort Study and Spatial Analysis. PLoS Medicine, 8 (8). www.plosmedicine.org.

ISSN: 0005-2523
Volume 62, Issue 10, December, 2022

[17] Chandra, E. And Kalsum, U. 2016. Effect of Rainfall, Humadity and Population Density on The Occurrence of Dengue Hemorrhagic Fever (Dhf) in Jambi. The 1'st International Conference on Green Development. Pp. 10 – 12.

[18] Istiqamah, SNA. , Arsin, A. A., Salmah, A.U. Mallongi, A., 2020. Open Access Maced J Med Sci. 03; 8(T2):63-66. doi.org/10.3889/oamjms.2020.5187.

[19] Kinansi,R.R. and Martiningsih, I. 2015. The Effect of Environmental Health Indicators Against Dengue Under 5 Years Old Cases Based on Sub District of Batam City in 2009. Buletin Penelitian Sistem Kesehatan, 18 (3): 311–319.

[20] Rubianti, I., Wirawan, D.N. dan A.Sawitri.2018. Incidence of dengue fever, climate and vector density in Denpasar. Public Health and Preventive Medicine Archive 6(2):114. DOI:10.15562/phpma.v6i2.135.

[21] Fakhriadi, R.A. Setyaningrum , Musafaah , and Rosadi, D. 2021. The Overview of Dengue Hemorrhagic Fever Based on Larva Free Index, Education Level, and Population Density. Jurnal Berkala Kesehatan, 7 (2) : 78-84. DOI: 10.20527/jbk.v7i2.9666.