Lontara
Journal of Health Science and Technology
https://jurnal.poltekmu.ac.id/index.php/lontarariset/
Vol 5, No. 2, Desember 2024, pp 154-170
p-ISSN:0000-0000 dan e-ISSN: 2721-6179
DOI:https://doi.org/10.53861/lontarariset.v5i2

Occurrences of Dengue Fever, Dengue Hemorrhagic Fever, Dengue Shock Syndrome, Severe Dengue, Dengue Warning Signs in Bandung City: A Spatial Study Based on Moran Index

Yura Witsqa Firmansyah[1,2], Adi Anggoro Parulian[1], Hedie Kristiawan[1], Bhisma Jaya Prasaja[1]
[1]Health Information and Medical Record, Santo Borromeus University, Bandung, Indonesia
[2]Environmental Science Doctoral Program, Universitas Sebelas Maret, Surakarta, Indonesia
Email: yurawf@student.uns.ac.id

Artikel info

***Artikel history*:**
Received; 06-08-2024
Revised: 30-10-2024
Accepted; 31-10-2024

Keyword:
Dengue Fever, Dengue Hemorrhagic Fever, Dengue Shock Syndrome, Dengue Warning Signs, Severe Dengue

Abstract. *Dengue cases is a tropical disease transmitted by Aedes aegypti and Aedes albopictus mosquitoes, which has become an international health issue in recent decades. The purpose of this study is to determine the autocorrelation and distribution patterns of Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), Dengue Shock Syndrome (DSS), Severe Dengue (SD), and Dengue Warning Signs (DWS) in the operational area of Hospital X. This study is classified as correlational, with a retrospective cohort design, utilizing patient medical records from January 2 to May 15, 2024. The total sample consists of 1,698 records, collected through purposive sampling, with the criteria being patient medical records diagnosed with DF, DHF, DSS, SD, and DWS during 2024. The z-score indicates that clustered distribution patterns occur in DF cases (z-score 5.07) and DHF cases (z-score 9.85). Random distribution patterns occur in DSS cases (z-score 0.86), SD cases (z-score -0.35), and DWS cases (z-score -0.15). The hypothesis that shows autocorrelation (p-value 0.000) is that the occurrence of DF in one location correlates with DF occurrences in surrounding locations, and the occurrence of DHF in one location correlates (p-value 0.000) with DHF occurrences in surrounding locations.*

Abstrak. Demam Berdarah Dengue (DBD) merupakan penyakit tropis yang ditularkan oleh nyamuk Aedes aegypti dan Aedes albopictus yang telah menjadi isu kesehatan internasional dalam beberapa dekade terakhir. Tujuan dari penelitian ini adalah untuk mengetahui autokorelasi dan pola persebaran penyakit Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), Dengue Shock Syndrome (DSS), Severe Dengue (SD), and Dengue Warning Signs (DWS) di wilayah operasional Rumah Sakit X. Penelitian ini tergolong penelitian korelasional dengan desain kohort retrospektif, menggunakan data rekam medik pasien pada periode 2 Januari hingga 15 Mei 2024. Total sampel terdiri dari 1.698 rekam medis yang dikumpulkan melalui purposive sampling, dengan kriteria rekam medis pasien yang terdiagnosis DF, DHF, DSS, SD, dan DWS selama tahun 2024. Nilai z-score menunjukkan bahwa pola distribusi

mengelompok terjadi pada kasus DF (z-score 5,07) dan DBD (z-score 9,85). Pola distribusi acak terjadi pada kasus DSS (z-score 0,86), kasus SD (z-score -0,35), dan kasus DWS (z-score -0,15). Hipotesis yang menunjukkan adanya autokorelasi (p-value 0,000) adalah kejadian DBD di suatu lokasi berkorelasi dengan kejadian DBD di lokasi sekitarnya, dan kejadian DBD di suatu lokasi berkorelasi (p-value 0,000) dengan kejadian DBD di lokasi sekitarnya.

Kata Kunci:
Demam Berdarah, Demam Berdarah Dengue, Sindrom Kejut Dengue, Tanda Peringatan Dengue, Dengue Parah

Coresponden author:
Email: yurawf@student.uns.ac.id

INTRODUCTION

Dengue hemorrhagic fever (DHF) is a tropical disease with Aedes aegypti and Aedes albopictus mosquito vectors that remains an international health problem in recent decades (Wang et al., 2020). Over the past few years, approximately 50 million cases of dengue virus infection (DHF) have occurred, with about half a million people experiencing severe dengue infection, causing significant morbidity and mortality worldwide (Wei, Shu, & Hung, 2016). In 2020, DHF continues to impact several countries, with reports of an increasing number of cases in various countries, including Indonesia (Sutriyawan, Aba, & Habibi, 2021). The reported cases of DHF in 2019 reached 138,127 cases, an increase compared to 2018 which recorded 65,602 cases (Kementerian Kesehatan Republik Indonesia, 2019). Deaths due to DHF in 2019 also increased compared to 2018, from 467 to 919 deaths (Kementerian Kesehatan Republik Indonesia, 2021). As of July 2020, the number of DHF cases reached 71,633 cases. The ten provinces that reported the highest number of cases were West Java with 10,772 cases (Kementerian Kesehatan Republik Indonesia, 2021).

Bandung City, the object of the study, was reported in 2022 to be the highest contributor of DHF cases in West Java with a total of 5,205 cases. There were two epicenters of DHF cases in Bandung City in 2022. The first epicenter is located in the southern area of the city with the most cases recorded by Buahbatu Sub-district (299 cases) and Rancasari Sub-district (288 cases). The second epicenter is located in the northern part of the city, with the most cases recorded by the Coblong sub-district (286 cases) (Somantri, 2023).

Dengue hemorrhagic fever (DHF) is a tropical disease that has remained an international health problem in recent decades (Wang et al., 2020). In recent years, approximately 50 million Dengue virus infections have occurred annually, with about half a million people experiencing severe Dengue infection, causing significant morbidity and mortality worldwide (Wei et al., 2016). In 2020, Dengue

continued to affect several countries, with reports of increasing numbers of cases in several countries, including Indonesia (Sutriyawan et al., 2021).

The autocorrelation study conducted by Habinuddin in 2021 in Bandung City only highlighted the occurrences of DHF using the Moran's Index (Moran's I), Geary's Ratio, and Local Indicator of Spatial autocorrelation (LISA) methods (Habinuddin, 2021). This study is the basis for the research gap, with this study. This study was conducted with Moran's index-based spatial autocorrelation of the occurrences of Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), Dengue Shock Syndrome (DSS), Severe Dengue (SD), Dengue Warning Signs (DWS). DHF is the mildest form and is usually not fatal. DHF involves symptoms of bleeding and blood plasma leakage, more serious than DF. DSS is a severe form of DHF with symptoms of shock, very life-threatening. SD includes both DHF and DSS, indicating a disease with severe complications. DWS signifies a high risk of progression to a more serious form of Dengue and requires immediate treatment.

The Moran Index plays an important role in understanding the spatial patterns of diseases such as Dengue fever. Its main function in the context of prevention of these diseases is to identify spatial clusters, the Moran Index helps identify spatial distribution patterns or hotspots of Dengue cases. Clusters are areas with a higher-than-expected number of cases nearby. By identifying these clusters, public health officials can target their resources and interventions more effectively to control and prevent disease in specific geographic areas (Pujianto, Raharjo, & Nurjazuli, 2020). Early warning system, the Moran Index can be part of an early warning system for Dengue outbreaks. If the index detects significant spatial clustering of cases, it can serve as a warning, signaling the need for immediate action to control the disease in a particular area (Tay et al., 2020). Monitoring and evaluation, the Moran Index helps in monitoring the effectiveness of disease prevention programs. Public health officials can assess whether interventions reduce the spatial clustering of cases and evaluate the impact of different strategies in different geographic areas (Y. Chen, 2021). Therefore, the purpose of this study is to determine the autocorrelation and distribution patterns of Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), Dengue Shock Syndrome (DSS), Severe Dengue (SD), Dengue Warning Signs (DWS) in the working area of X Hospital.

METHOD AND MATERIALS

This type of research is classified in correlation, namely to determine the spatial autocorrelation of the occurrences of Dengue Fever (DF), Dengue Hemorrhagic Fever (DHF), Dengue Shock Syndrome (DSS), Severe Dengue (SD), Dengue Warning Signs (DWS) in the X Hospital working area with the Moran index approach. Meanwhile, the study design used was a retrospective cohort, namely data on the occurrences of DF, DHF, DSS, SD, and DWS obtained from patient medical record files in the period January 2 to May 15, 2024. The total sample amounted to 1,698 files with purposive sampling technique with the provision of patient medical record files during 2024 diagnosed with DF, DHF, DSS, SD, and DWS. There are five research hypotheses formulated below,

First hypothesis

H0: The occurrences of DF in one location is not correlated with the occurrences of DF in neighboring locations.

Ha: The occurrences of DF in one location is correlated with the occurrences of DF in neighboring locations.

Second hypothesis

H0: The occurrences of DHF in one location is not correlated with the occurrences of DHF in neighboring locations.

Ha: The occurrences of DHF in one location is correlated with the occurrences of DHF in neighboring locations.

Third hypothesis

H0: The occurrences of DSS in one location is not correlated with the occurrences of DSS in neighboring locations.

Ha: The occurrences of DSS in one location is correlated with the occurrences of DSS in neighboring locations.

Fourth hypothesis

H0: The occurrences of SD in one location is not correlated with the occurrences of SD in the surrounding locations.

Ha: The occurrences of SD in one location is correlated with the occurrences of SD in the surrounding locations.

Fifth hypothesis

H0: The occurrences of DWS in one location is not correlated with the occurrences of DWS in the surrounding locations.

Ha: DWS occurrence at one location is correlated with DWS occurrence at surrounding locations.

RESULT

Based on the results of the frequency distribution analysis of 1689 patient files, Table 1 presents the age characteristics of the patients. Table 2 describes the gender characteristics of patients. Meanwhile, Table 3 describes the characteristics of insurance used by patients. The details are presented in the table below,

Table 1. Age of Patients in Hospital Work Area X January - May 2024

Age of Patient		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Toddlers = 0 – 5 years	189	11.2	11.2	11.2
	Children = 6 – 11 years	303	17.9	17.9	29.1
	Early adolescence = 12 – 16 years	211	12.5	12.5	41.6

Age of Patient	Frequency	Percent	Valid Percent	Cumulative Percent
Late adolescence = 17 – 25 years	356	21.1	21.1	62.7
Early adulthood = 26 – 35 years	241	14.3	14.3	77.0
Late adulthood = 36 – 45 years	145	8.6	8.6	85.6
Early elderly = 46 – 55 years	107	6.3	6.3	91.9
Late elderly = 56 – 65 years	84	5.0	5.0	96.9
Seniors = 65 – upper	53	3.1	3.1	100.0
Total	1689	100.0	100.0	

Table 2. Gender of Patients in Hospital Work Area X January - May 2024

Gender		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	852	50.4	50.4	50.4
	Male	837	49.6	49.6	100.0
	Total	1689	100.0	100.0	

Table 3. Insurance of Patients in Hospital Work Area X January - May 2024

Insurance		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	National Health Insurance (JKN)	463	27,4	27,4	27,4
	Public	777	46,0	46,0	73,4
	Partnership	449	26,6	26,6	100,0
	Total	1689	100,0	100,0	

Table 1 above explains that the frequency distribution of patients in the age group of late adolescence (17 - 25 years) had the highest number of patients diagnosed with DHF, totaling 356 people (21.1%). Subsequently, the age group of children (6 - 11 years old) amounted to 303 people (17.9%). In the third category, the early adulthood age group (36 - 45 years old) had 241 people (14.3%). Table 2 describes the frequency distribution of patient gender. There were 852 female patients (50.4%). Male patients totaled 837 (49.6%).

Table 3 provides the types of payments made by patients during Dengue treatment at X hospital. 777 (46.9%) patients used self-payment. 463 (27.4%) patients used JKN insurance. In addition, there were 449 (26.6%) patients who made payments with partner insurance.

The unit of analysis used in the distribution of Dengue cases is the sub-districts in Bandung City (1,116 cases). Furthermore, it is clustered in 4 levels, the first level with green color which has a range of 1-50 cases. The second level is yellow with a range of 51-100 cases. The third level is orange with a range of 101-150 cases. While level 4 is red with a range of 151-200 cases. The complete distribution of cases is presented in Figure 1, 2, 3, and 4 below,

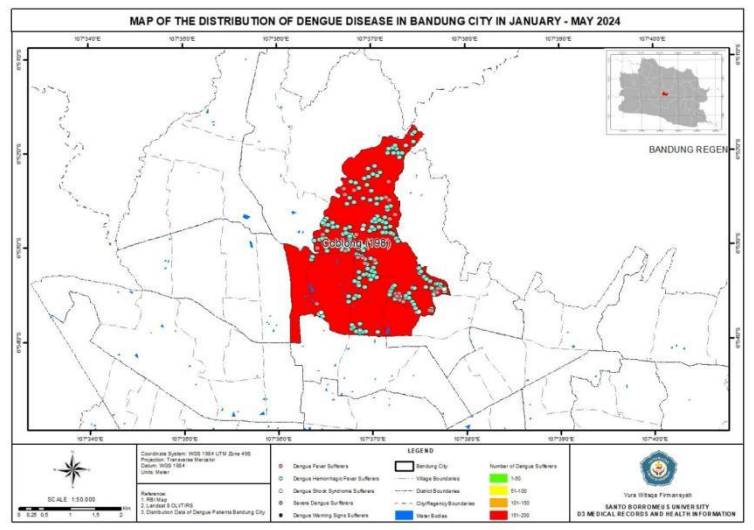

Figure 1 Distribution of Dengue Incidence Cases at Clustering Level 4 in Bandung City, January - May 2024

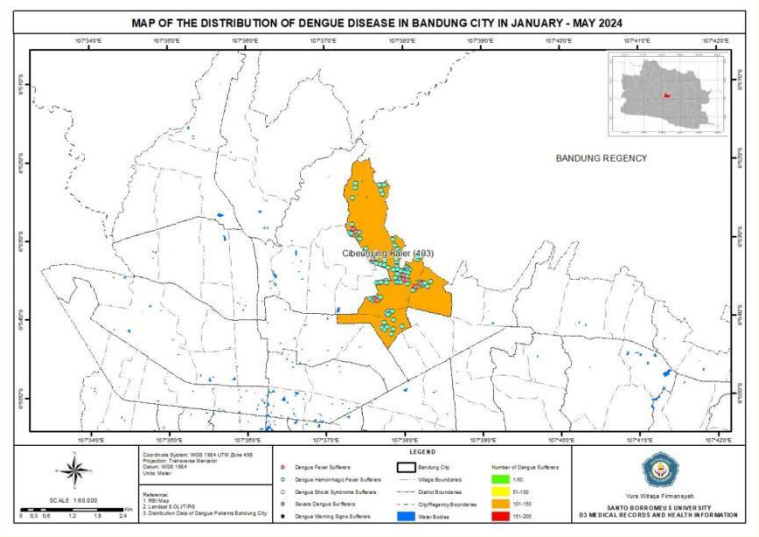

Figure 2 Distribution of Dengue Incidence Cases at Clustering Level 3 in Bandung City, January - May 2024

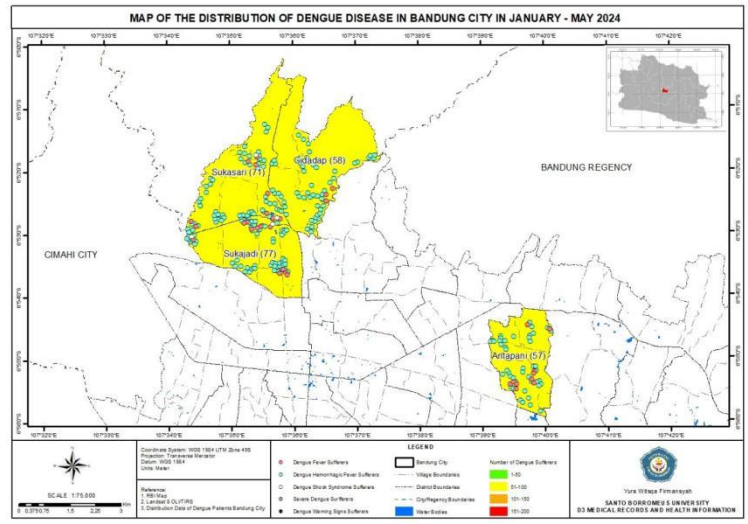

Figure 3 Distribution of Dengue Incidence Cases at Clustering Level 2 in Bandung City, January - May 2024

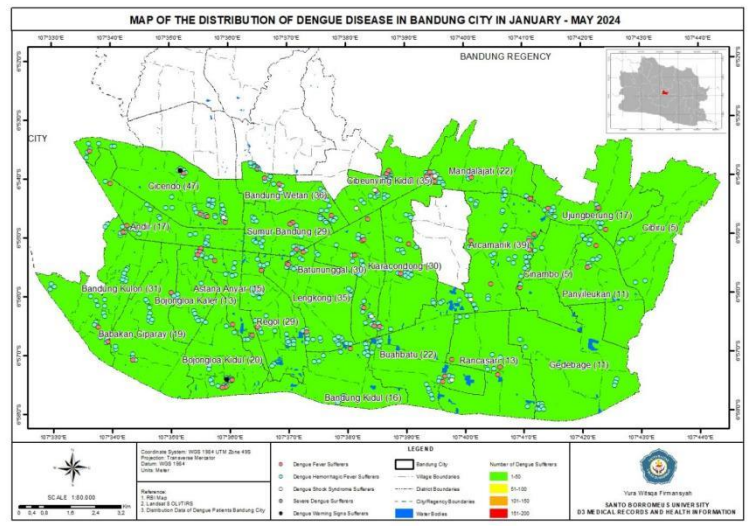

Figure 4 Distribution of Dengue Incidence Cases at Clustering Level 1 in Bandung City, January - May 2024

The results of Figure 1 show that the Coblong sub-district has the highest overall number of Dengue cases at 198 cases (11.7%) and is categorized in level 4 (red color) with a range of 151 - 200 cases. The second place is Cibeunying Kaler Sub-district (Figure 2) which has an overall number of Dengue cases of 103 (6%) cases and is categorized in level 3 (orange color) with a range of 101-150 cases. Sub-districts in level 2 (yellow color) with a range of 51-100 cases include Sukajadi (79 cases), Sukasari (71 cases), Cidadap (58 cases), and Antapani (57 cases) in Figure 3. Meanwhile, Figure 4 shows the sub-districts in Bandung City that are clustered at level 1.

In terms of specific cases of Dengue Fever (DF) clinical codification A97.9 (ICD-10 version 2019), there were 141 cases (12.6%) in Bandung City. Coblong sub-district ranked first with the highest

number of cases at 26 (18.4%). Antapani and Cibeunying Kaler sub-districts ranked second with 11 (7.8%) cases. Sukajadi sub-district ranked third with 10 (7%) cases. Sukasari sub-district ranks fourth with 9 (6.3%) cases.

The results of the Moran Index (MI) analysis of DF events using a geographic information system are presented in the Figure below. Three classifications can be generated from MI such as dispersion, random, and cluster patterns. Meanwhile, some hypotheses must be proven in these results.

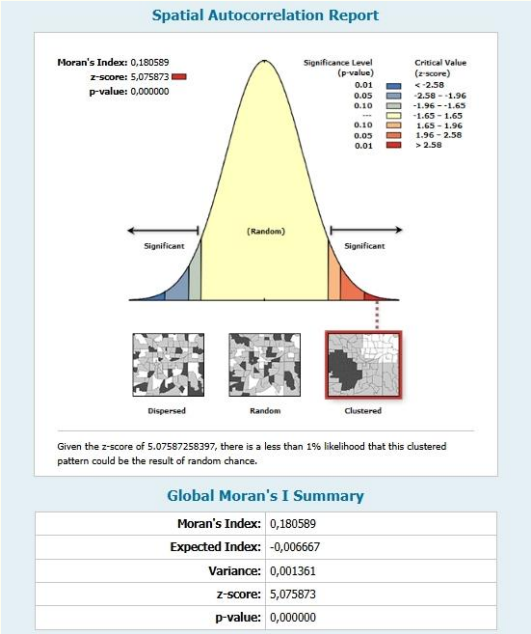

Figure 5 Moran Index Analysis Results of DF Occurrences in Bandung City January - May 2024

Based on Figure 5, the expected value is -0.006, while the MI value is 0.18, which means that the expected value is exceeded. The z-score value of 5.07 is on the cluster curve (z-score value more than 2.58) and is positive. While the p-value is 0.00 with an alpha of 5%, the null hypothesis is rejected and the alternative hypothesis is accepted, meaning that the occurrences of DF in one location is correlated with the occurrences of DF in neighboring locations.

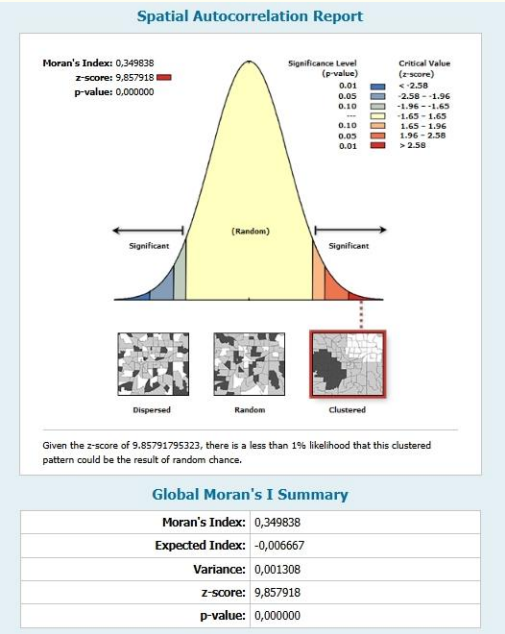

Figure 6 Moran Index Analysis Results of DHF Occurrences in Bandung City January - May 2024

Based on Figure 6, the expected value is -0.006, while the MI value is 0.34, which means that the expected value is exceeded. The z-score value of 9.85 is on the cluster curve (z-score value more than 2.58) and is positive. While the p-value is 0.00 with an alpha of 5%, the null hypothesis is rejected and the alternative hypothesis is accepted, meaning that the occurrences of DHF in one location is correlated with the occurrences of DF in neighboring locations.

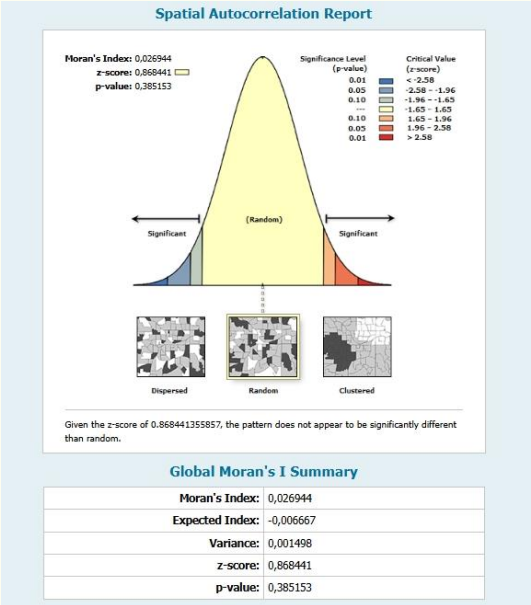

Figure 7 Moran Index Analysis Results of DSS Occurrences in Bandung City January - May 2024

Based on Figure 7, the expected value is -0.006, while the MI value is 0.02, which means that the expected value is exceeded. The z-score value of 0.86 is on the random curve (z-score value is between -1.56 to 1.56) and is positive. While the p-value is 0.38 with an alpha of 5%, the null hypothesis is accepted and the alternative hypothesis is rejected, meaning that the occurrences of DSS in one location is not correlated with the occurrences of DSS in neighboring locations.

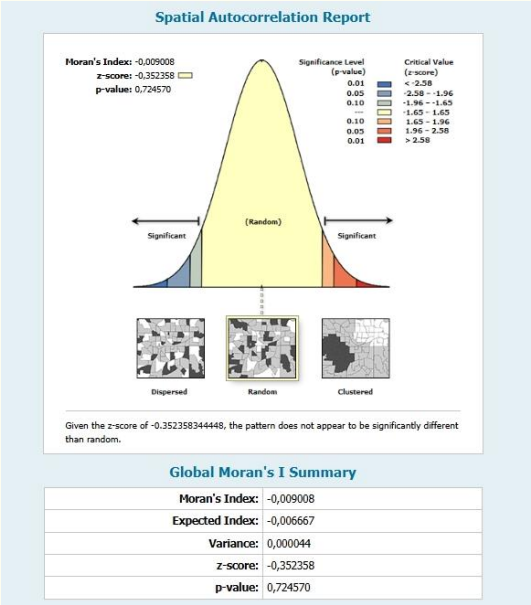

Figure 8 Moran Index Analysis Results of Severe Dengue (SD) Occurrences in Bandung City January - May 2024

Based on Figure 8, the expected value is -0.006, while the MI value is -0.009, which means that the expected value is not exceeded. The z-score value of -0.35 is on a random curve (the z-score value is between -1.56 to 1.56) and is negative. While the p-value is 0.72 with an alpha of 5%, the null hypothesis is accepted and the alternative hypothesis is rejected, meaning that the occurrences of SD in one location is not correlated with the occurrences of SD in neighboring locations.

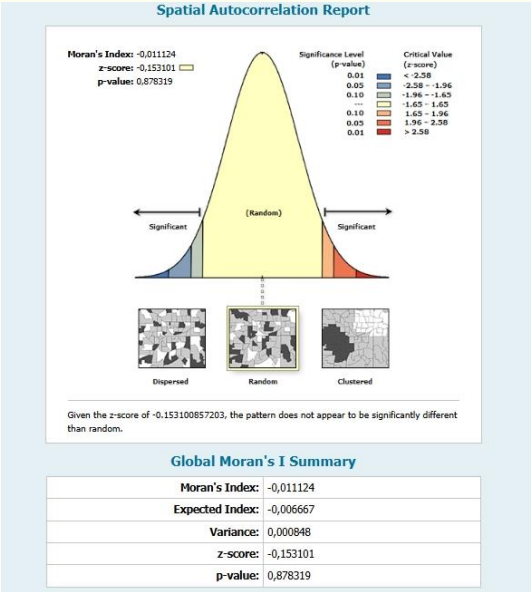

Figure 9 Moran Index Analysis Results of Dengue with Warning Signs (DWS) Occurrences in Bandung City January - May 2024

Based on Figure 9, the expected value is -0.006, while the MI value is -0.01, which means that the expected value is exceeded. The z-score value of -0.15 is on a random curve (the z-score value is between -1.56 to 1.56) and is negative. While the p-value is 0.87 with an alpha of 5%, the null hypothesis is accepted and the alternative hypothesis is rejected, meaning that the occurrences of in one location is not correlated with the occurrences of Dengue with Warning Signs in neighboring locations.

DISCUSSION

The clinical manifestations of DF are the mildest form of Dengue infection and usually do not cause serious complications. Patients with DF experience sudden high fever, severe headache, pain behind the eyes, muscle and joint pain (also called “breakbone fever”), skin rash, and nausea or vomiting (Leowattana & Leowattana, 2021). Clinical parameters for DF such as platelet count usually range between 50,000 - 100,000 cells per microliter (Hafiz et al., 2021). In milder cases, it may remain above 100,000 cells per microliter but generally falls out of the normal range. Hematocrit values can be slightly elevated due to mild plasma leakage. An increase of more than 20% from normal values (males 38.3% - 48.6% and females 35.5% - 44.9%) is indicative of more severe diseases such as DHF (Faridah et al., 2022). In primary infection, Immunoglobulin G (IgG) may not be detected in the early stages. In secondary infection, IgG will be elevated. Specific values indicating infection vary depending on the test method. Immunoglobulin M (IgM) begins to rise about 4-5 days after the onset of symptoms and peaks within 1-2 weeks (Noreka, Lardo, & Nugrohowati, 2020) (Meena, Bihari, & Meena, 2020). The specific value indicating active infection varies based on the test method, but the presence of a significant increase from the baseline value indicates acute Dengue infection. Non-structural protein 1 (NS1) antigen is detected in the blood during the early phase of infection (days 1 to 7 after symptom

onset) (Noreka et al., 2020) (Adnyana, Sudaryati, & Suardana, 2021). A positive NS1 test indicates acute Dengue infection.

In terms of specific Dengue Hemorrhagic Fever (DHF) cases (clinical codification A97.2, ICD-10 version 2019), there were 956 cases (85.6%) in Bandung City. The Coblong sub-district was first with 169 cases (17.6%). Cibeunging Kaler sub-district came second with 91 cases (9.5%). Sukajadi sub-district was third with 67 (7%) cases. Sukasari sub-district was fourth with 60 (6.2%) cases. Cidadap sub-district was fifth with 55 (5.7%) cases. Antapani sub-district was sixth with 46 (4.8%) cases. DHF is an advanced clinical manifestation of DF. DHF can cause blood plasma leakage leading to a dangerous drop in blood volume (Rahat, Khanam, Iman, Ghosh, & Ghosh, 2020) (Juliansen et al., 2024). Symptoms are similar to Dengue fever, with DHF patients showing signs of bleeding, such as easy bruising, nose or gum bleeding, vomiting blood, or blood in the stool (Wang et al., 2020) (Setiawan, Wajib, Handono, & Sakti, 2023). There are also signs of plasma leakage such as fluid escaping from the blood vessels into the body space. The clinical parameters seen are platelet counts that drop dramatically, often below 100,000 cells per microliter, and in severe cases can be below 50,000 cells per microliter (Simarmata, Wija, & Ronny, 2021).

Dengue occurrence with Warning Signs (DWS) with clinical codification A97.1 (ICD-10 version 2019) in Bandung City was only found in the Cicendo Sub-district with one case and Bojongloa Kidul Sub-district with one case. While the occurrence of Severe Dengue (clinical codification A97.2, ICD-10 version 2019) there was only one case in Bandung Wetan Sub-district. DWS is life-threatening and requires immediate medical treatment to prevent death. The DWS condition is usually in patients with warning signs of Dengue who usually experience worsening symptoms after the initial fever begins to subside. Warning signs include severe abdominal pain, persistent vomiting, fluid accumulation, mucosal bleeding, lethargy or restlessness, liver enlargement, and increased hematocrit with decreased platelets (Htun, Xiong, & Pang, 2021) (V. Singh, Mishra, Agarwal, Mallikarjuna, & Raut, 2022). These symptoms indicate that the patient is at risk of developing DHF or DSS and requires immediate medical attention to prevent more serious complications. Platelet counts are usually very low, often below 50,000 cells per microliter, and can drop to below 20,000 cells per microliter in very severe cases (Huy & Toàn, 2022) (Juliansen et al., 2022). The DWS condition is usually in patients with warning signs of Dengue who usually experience worsening symptoms after the initial fever begins to subside. Warning signs include severe abdominal pain, persistent vomiting, fluid accumulation, mucosal bleeding, lethargy or restlessness, liver enlargement, and increased hematocrit with decreased platelets (H.-J. Chen, Tang, Lu, & Chien, 2020) (Tsheten et al., 2021). These symptoms indicate that the patient is at risk of developing DHF or DSS and requires immediate medical attention to prevent more serious complications. Platelet counts are usually very low, often below 50,000 cells per microliter, and can drop to below 20,000 cells per microliter in very severe cases (Yuan, Chen, Zhong, Lin, & Liu, 2022).

The overall occurrence of Dengue Shock Syndrome (DSS) amounted to 16 cases. Coblong sub-district ranked first with 3 cases (18.7%). Cibeunying Kidul, Sukasari, and Sukajadi sub-districts each had 2 cases (12.5%). DSS is the most severe form of DHF, where the patient experiences symptoms of shock such as very low blood pressure, weak and rapid pulse, cold and clammy skin, and restlessness (R. K. Singh, Tiwari, Satone, Priya, & Meshram, 2023) (Hirata et al., 2024). Platelet counts in this condition are usually very low, often below 50,000 cells per microliter, and can drop to below 20,000 cells per microliter in very severe cases (Wirajaya, Sutanegara, & Lestari, 2022).

Dengue is spread by the Aedes aegypti mosquito. These mosquitoes tend to live and breed in areas close to human habitation, so if one area is affected, there is a high chance that infected mosquitoes can move to neighboring areas and transmit the virus (al azab, Zaituon, Alghamdi, & Abd Al Galil, 2022) (Roy & Bhattacharjee, 2021). The second factor is that areas with poor sanitation conditions, such as frequent standing water, are ideal places for mosquitoes to lay eggs and breed (Sarma et al., 2022). The third factor is that areas with high population density are more susceptible to the spread of the disease as mosquitoes can easily move from one house to another. The fourth factor is that people infected with Dengue virus can carry the virus to new areas. If they are bitten by an Aedes aegypti mosquito in the new location, the mosquito can become a new vector that transmits the virus to other people in the vicinity (Gan et al., 2021). The fifth factor is that a tropical climate with high temperature and humidity is very favorable for Aedes aegypti mosquitoes (Barbosa, Moreno, Zapata, & Chua, 2020) (Mercier et al., 2022). These conditions are often uniform in adjacent areas, so disease spread tends to occur locally and clustered. The sixth factor is that some community habits, such as uncovered open water storage, can be breeding grounds for mosquitoes (Nakase, Giovanetti, Obolski, & Lourenço, 2023). If this behavior is common in a community, then the spread of disease will also be easier to occur in that community. The seventh factor is that people with low levels of education and awareness may not understand the importance of Dengue fever prevention, such as using mosquito nets or anti-mosquito lotion and keeping the environment clean (Sharp et al., 2022)

CONCLUSION AND RECOMMENDATION

Moran's index shows that cluster distribution patterns occur in cases of Dengue Hemorrhagic Fever (DHF) and Dengue Hemorrhagic Fever (DHF). Random distribution patterns occur in cases of Dengue Shock Syndrome (DSS), Severe Dengue (SD), and Dengue with Warning Signs (DWS). The hypothesis that shows autocorrelation is that the occurrence of DF in one location correlates with DF occurrences in surrounding locations, and the occurrence of DHF in one location correlates with DHF occurrences in surrounding locations. To control dengue incidence in Bandung City, prevention efforts are needed which include eradicating mosquito breeding sites, improving good residential sanitation, and increasing public literacy on dengue incidence.

REFERENCE

Adnyana, I. M. D. M., Sudaryati, N. L. G., & Suardana, A. A. K. (2021). BLOOD SMEAR PROFILE OF PATIENTS WITH DENGUE HEMORRHAGIC FEVER IN BALI ROYAL HOSPITAL. Journal of Vocational Health Studies, 5(1), 39–46. https://doi.org/10.20473/jvhs.V5.I1.2021.39-46

al azab, A., Zaituon, A., Alghamdi, K., & Abd Al Galil, F. (2022). Surveillance of Dengue Fever Vector Aedes aegypti in Different Areas in Jeddah City Saudi Arabia. Advances in Animal and Veterinary Sciences, 10, 348–353.

Barbosa, H. G., Moreno, S. M., Zapata, J. C., & Chua, J. V. (2020). Dengue Infections in Colombia: Epidemiological Trends of a Hyperendemic Country. Tropical Medicine and Infectious Disease. https://doi.org/10.3390/tropicalmed5040156

Chen, H.-J., Tang, H.-J., Lu, C.-L., & Chien, C.-C. (2020). Warning signs and severe dengue in end stage renal disease dialysis patients. Journal of Microbiology, Immunology and Infection, 53(6), 979–985. https://doi.org/10.1016/j.jmii.2019.08.005

Chen, Y. (2021). An analytical process of spatial autocorrelation functions based on Moran's index. PLOS ONE, 16(4), e0249589. https://doi.org/10.1371/journal.pone.0249589

Faridah, I. N., Dania, H., Chen, Y.-H., Supadmi, W., Purwanto, B. D., Heriyanto, M. J., … Perwitasari, D. A. (2022). Dynamic Changes of Platelet and Factors Related Dengue Haemorrhagic Fever: A Retrospective Study in Indonesian. Diagnostics, 12(4), 950. https://doi.org/10.3390/diagnostics12040950

Gan, S. J., Leong, Y. Q., bin Barhanuddin, M. F. H., Wong, S. T., Wong, S. F., Mak, J. W., & Ahmad, R. B. (2021). Dengue fever and insecticide resistance in Aedes mosquitoes in Southeast Asia: A review. Parasites & Vectors, 14(1), 315. https://doi.org/10.1186/s13071-021-04785-4

Habinuddin, E. (2021). IDENTIFIKASI AUTOKORELASI SPASIAL PADA PENYEBARAN PENYAKIT DEMAM BERDARAH DENGUE DI KOTA BANDUNG. Sigma-Mu, 13(1), 7–15. https://doi.org/10.35313/sigmamu.v13i1.3648

Hafiz, W., Alotaibi, F., Alneefia, R., Alghuraibi, E., Basha Ahmed, A., & Warsi, A. (2021). Splenic Infarction Induced by Dengue Hemorrhagic Fever: A Rare Presentation. Cureus, 13(8), e17072. https://doi.org/10.7759/cureus.17072

Hirata, K., Chiba, T., Gomi, H., Takaya, S., Kato, Y., & Shiga, T. (2024). Diagnostic challenges in a patient with dengue shock syndrome presenting with acute meningoencephalitis. IDCases, 36, e01964. https://doi.org/10.1016/j.idcr.2024.e01964

Htun, T. P., Xiong, Z., & Pang, J. (2021). Clinical signs and symptoms associated with WHO severe dengue classification: A systematic review and meta-analysis. Emerging Microbes & Infections. (world). Retrieved from https://www.tandfonline.com/doi/abs/10.1080/22221751.2021.1935327

Huy, B. V., & Toàn, N. V. (2022). Prognostic indicators associated with progresses of severe dengue. PLOS ONE, 17(1), e0262096. https://doi.org/10.1371/journal.pone.0262096

Juliansen, A., Muljono, M. P., Budiputri, C. L., Meliani, F., Heriyanto, R. S., Chandra, S., & Octavius, G. S. (2024). Clinical profile of dengue fever and dengue haemorrhagic fever in Indonesian children: A six year retrospective study. 53(2), 121. https://doi.org/10.4038/sljch.v53i2.10776

Juliansen, A., Steven Heriyanto, R., Budiputri, C., Meliani, F., Muljono, M., Chandra, S., & Octavius, G. (2022). Warning Signs in Predicting Severe Pediatric Dengue Infection. Journal of Pediatric Infectious Diseases, 17. https://doi.org/10.1055/s-0042-1745838

Kementerian Kesehatan Republik Indonesia. (2019). Profil Kesehatan Indonesia Tahun 2019. Retrieved from https://pusdatin.kemkes.go.id/resources/download/pusdatin/profil-kesehatan-indonesia/Profil-Kesehatan-indonesia-2019.pdf

Kementerian Kesehatan Republik Indonesia. (2021, January 20). Hingga Juli, Kasus DBD di Indonesia Capai 71 Ribu. Retrieved June 14, 2024, from Sehat Negeriku website: https://sehatnegeriku.kemkes.go.id/baca/umum/20200709/3134413/hingga-juli-kasus-dbd-indonesia-capai-71-ribu/

Leowattana, W., & Leowattana, T. (2021). Dengue hemorrhagic fever and the liver. World Journal of Hepatology, 13(12), 1968–1976. https://doi.org/10.4254/wjh.v13.i12.1968

Meena, V. K., Bihari, S., & Meena, S. R. (2020). Diagnostic Significance of Platelet Indices in Dengue Fever in Endemic Area. International Journal of Research and Review, 7(2), 315–319.

Mercier, A., Obadia, T., Carraretto, D., Velo, E., Gabiane, G., Bino, S., … Failloux, A.-B. (2022). Impact of temperature on dengue and chikungunya transmission by the mosquito Aedes albopictus. Scientific Reports, 12(1), 6973. https://doi.org/10.1038/s41598-022-10977-4

Nakase, T., Giovanetti, M., Obolski, U., & Lourenço, J. (2023). Global transmission suitability maps for dengue virus transmitted by Aedes aegypti from 1981 to 2019. Scientific Data, 10(1), 275. https://doi.org/10.1038/s41597-023-02170-7

Noreka, A. H., Lardo, S., & Nugrohowati, N. (2020, February 22). Hematocrit, Thrombocyte, Body Mass Index, and Their Associations with the Severity of Dengue Hemorrhagic Fever Among Adult Patients at Esnawan Antariksa Air Force Hospital, Jakarta. 640–643. Atlantis Press. https://doi.org/10.2991/ahsr.k.200215.125

Pujianto, M., Raharjo, M., & Nurjazuli. (2020). Spatial Pattern Analysis on Dengue Hemorrhagic Fever (DHF) Disease in Tanjung Emas Port Area using Moran Index. International Journal of English Literature and Social Sciences, 5(2). Retrieved from https://ijels.com/detail/spatial-pattern-analysis-on-dengue-hemorrhagic-fever-dhf-disease-in-tanjung-emas-port-area-using-moran-index/

Rahat, F., Khanam, M., Iman, K., Ghosh, U. K., & Ghosh, N. K. (2020). Importance of Platelet Count and Hematocrit in Dengue Fever in Children. Bangladesh Journal of Child Health, 44(2), 74–77. (Bangladesh). https://doi.org/10.3329/bjch.v44i2.51129

Roy, S. K., & Bhattacharjee, S. (2021). Dengue virus: Epidemiology, biology, and disease aetiology. Canadian Journal of Microbiology, 67(10), 687–702. https://doi.org/10.1139/cjm-2020-0572

Sarma, D. K., Kumar, M., Nina, P. B., Balasubramani, K., Pramanik, M., Kutum, R., … Tiwari, R. R. (2022). An assessment of remotely sensed environmental variables on Dengue epidemiology in Central India. PLOS Neglected Tropical Diseases, 16(10), e0010859. https://doi.org/10.1371/journal.pntd.0010859

Setiawan, A. F., Wajib, Y. Y. P., Handono, K., & Sakti, S. P. (2023). Leucocytes, thrombocytes and immature platelets in patients with dengue hemorrhagic fever. Bali Medical Journal, 12(2), 2067–2069. https://doi.org/10.15562/bmj.v12i2.4613

Sharp, T. M., Anderson, K. B., Katzelnick, L. C., Clapham, H., Johansson, M. A., Morrison, A. C., … Waterman, S. H. (2022). Knowledge gaps in the epidemiology of severe dengue impede vaccine evaluation. The Lancet Infectious Diseases, 22(2), e42–e51. https://doi.org/10.1016/S1473-3099(20)30871-9

Simarmata, V. P., Wija, I. B. E. U., & Ronny. (2021). The Relationship Between Platelet Count and Severity of Dengue Hemorrhagic Fever in Pediatric Patients at UKI Cawang Hospital for the period January 2015-December 2015. Journal of Drug Delivery and Therapeutics, 11(6), 75–80. https://doi.org/10.22270/jddt.v11i6.5044

Singh, R. K., Tiwari, A., Satone, P. D., Priya, T., & Meshram, R. J. (2023). Updates in the Management of Dengue Shock Syndrome: A Comprehensive Review. Cureus, 15(10), e46713. https://doi.org/10.7759/cureus.46713

Singh, V., Mishra, S. C., Agarwal, N. A., Mallikarjuna, P. A., & Raut, B. B. (2022). Dengue infection with warning signs: The 2019 epidemic. Medical Journal Armed Forces India, 78(2), 140–146. https://doi.org/10.1016/j.mjafi.2020.06.009

Somantri, M. (2023, November). Peta Sebaran Kejadian DBD di Kota Bandung Berdasarkan Kecamatan Tahun 2022. Retrieved June 14, 2024, from Matadata website: http://data.bandung.go.id/matadata/index.php/matadata/visualisasi/kota-bandung-siaga-dbd

Sutriyawan, A., Aba, M., & Habibi, J. (2021). DETERMINAN EPIDEMIOLOGI DEMAM BERDARAH DENGUE (DBD) DI DAERAH PERKOTAAN: STUDI RETROSPEKTIF | Journal of Nursing and Public Health. Journal of Noursing and Public Health, 8(2). https://doi.org/10.37676/jnph.v8i2.1173

Tay, C. T., Hart, R. J., Hickey, M., Moran, L. J., Earnest, A., Doherty, D. A., … Joham, A. E. (2020). Updated adolescent diagnostic criteria for polycystic ovary syndrome: Impact on prevalence and longitudinal body mass index trajectories from birth to adulthood. BMC Medicine, 18(1), 389. https://doi.org/10.1186/s12916-020-01861-x

Tsheten, T., Clements, A. C. A., Gray, D. J., Adhikary, R. K., Furuya-Kanamori, L., & Wangdi, K. (2021). Clinical predictors of severe dengue: A systematic review and meta-analysis. Infectious Diseases of Poverty, 10(1), 123. https://doi.org/10.1186/s40249-021-00908-2

Wang, W.-H., Urbina, A. N., Chang, M. R., Assavalapsakul, W., Lu, P.-L., Chen, Y.-H., & Wang, S.-F. (2020). Dengue hemorrhagic fever—A systemic literature review of current perspectives on pathogenesis, prevention and control. Journal of Microbiology, Immunology, and Infection = Wei Mian Yu Gan Ran Za Zhi, 53(6), 963–978. https://doi.org/10.1016/j.jmii.2020.03.007

Wei, H.-Y., Shu, P.-Y., & Hung, M.-N. (2016). Characteristics and Risk Factors for Fatality in Patients with Dengue Hemorrhagic Fever, Taiwan, 2014. The American Journal of Tropical Medicine and Hygiene, 95(2), 322–327. https://doi.org/10.4269/ajtmh.15-0905

Wirajaya, G. B. M., Sutanegara, A. A. P. P. D., & Lestari, D. N. D. (2022). Variations of dengue shock syndrome cases and their management: Report of three cases. Intisari Sains Medis, 13(3), 625–631. https://doi.org/10.15562/ism.v13i3.1507

Yuan, K., Chen, Y., Zhong, M., Lin, Y., & Liu, L. (2022). Risk and predictive factors for severe dengue infection: A systematic review and meta-analysis. PLOS ONE, 17(4), e0267186. https://doi.org/10.1371/journal.pone.0267186