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RESEARCH

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Distribution and Pattern of Dengue Fever Cases in Bandung City, 2023, Indonesia: A Spatial Analysis Approach

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Abstract

Dengue haemorrhagic fever (DHF) is a significant health concern, categorised as a neglected tropical disease that requires substantial attention due to its high Case Fatality Rate (CFR) and associated mortality, especially in outbreak situations. DHF results from the dengue virus, categorised within group B of Arthropod-Borne Viruses (Arboviruses). The Bandung City Health Office reported 5,205 cases of dengue haemorrhagic fever in 2022 consisting of 2,646 (51%) male and 2,559 (49%) female patients. This study employs spatial analysis to chart the distribution of DHF cases, allowing for an assessment of potential spatial autocorrelation of DHF within the Bandung City region. This study on autocorrelation employed a retrospective cohort research design. This study focused on the incidence rates of DHF as reported by the Bandung City Health Office, with the analysis encompassing 30 sub-districts within Bandung City. The technique employed for sampling was total sampling. The independent variable in this investigation is the occurrence of DHF. The Moran I Index was employed in the spatial analysis to examine the distribution pattern of the variable. DHF incidence in 30 sub-districts of Bandung City is clustered with a Moran index value of 0.120934 in the interval $0 \leq I \leq 1$, indicating positive spatial autocorrelation. The p-value of 0.001585 is smaller than the α value (5%), indicating statistical significance. The spatial pattern of DHF incidence is clustered, and there is autocorrelation between sub-districts in Bandung City in 2023. The distribution of DHF cases in Bandung City in 2023 is clustered. Scientific studies in the form of spatial analyses are recommended to be conducted in DHF endemic areas on a regular basis because they can provide basic information to support effective prevention and control of DHF cases.

Keywords: Spatial Autocorrelation, Spatial Pattern, Moran's Index, Dengue Haemorrhagic Fever, Dengue Viruses.

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1. INTRODUCTION

Neglected tropical diseases (NTDs) constitute a category of infectious diseases endemic to tropical and subtropical regions, predominantly impacting communities with diminished socioeconomic status. Neglected tropical diseases arise from a range of pathogens, including viruses, bacteria, protozoa, and helminths (World Health Organization, 2025). These diseases are said to be neglected because they are almost missing from the global health agenda, receive minimal funding, and are associated with stigma and social exclusion (World Health Organization, 2022). Dengue haemorrhagic fever (DHF) is a type of neglected tropical disease that is one of the health problems requiring significant attention due to its high Case Fatality Rate (CFR) and associated mortality, especially in outbreak situations. Dengue Hemorrhagic Fever (DHF) is a condition resulting from the dengue virus, categorised as a group B Arthropod-Borne Virus (Arbovirus) and presently classified under the genus *Flavivirus* within the family *Flaviviridae*. The virus displays four distinct serotypes: DEN-1, DEN-2, DEN-3, and DEN-4 (Iryanto et al., 2014). The dengue virus is transmitted through the bite of infected *Aedes* mosquitoes, especially *Aedes aegypti*, classifying it as an arbovirus, a virus spread by arthropods.

DHF cases in Indonesia are still high, with 143,266 cases and 1,237 deaths in 2022 (Kementerian Kesehatan Republik Indonesia, 2023). In West Java province, DHF is a serious health problem with 36,608 cases in 2022 and 305 deaths with a CFR of 0.8% (Dinas Kesehatan Provinsi Jawa Barat, 2023). Bandung City is one of the districts/cities in Indonesia that is a DHF endemic area due to the high number of cases and deaths each year. The number of dengue patients in 2022 was 5,205 cases consisting of 2,646 (51%) male patients and 2,559 (49%) female patients (Dinas Kesehatan Provinsi Jawa Barat, 2023).

This study employs spatial analysis to chart the distribution of DHF cases, allowing for the assessment of potential spatial autocorrelation of DHF within the Bandung City region. The spatial information gathered can serve as surveillance data, forming a foundation for program planning and decision-making for policymakers in their efforts to prevent and control DHF cases (Pujianto, Raharjo, & Nurjazuli, 2020). This issue represents a significant concern for many nations, including Indonesia, highlighting the need for robust, systematic, and evidence-based systems for disease detection, reporting, and response. One effective strategy is the utilization of Geographic Information Systems (GIS) integrated with spatial autocorrelation analysis, such as Moran's I. This method is instrumental in identifying spatial patterns in disease spread. For instance, Iryanto et al. (2022) utilized this approach to examine how environmental sanitation factors influenced the incidence of childhood diarrhea in Padang City (Iryanto et al., 2022). A comparable methodology was adopted by Fikri et al. (2021) in Semarang City to assess the spatial clustering of diarrhea, typhoid, and leptospirosis cases (Fikri et al., 2021). Through the application of this methodology, analysis extends beyond mere case counts to encompass spatial distribution patterns that facilitate the identification of clusters or hotspots of disease incidence. This spatial insight is instrumental in informing more targeted and context-specific interventions, especially in densely populated areas, regions with inadequate access to health services, or locations where a substantial burden of latent or undiagnosed cases may persist. Such precision in intervention planning enhances the efficiency of public health responses and contributes to the optimal allocation of limited resources.

2. RESEARCH METHOD

This study is an autocorrelation study with a geospatial Moran index analysis method approach and uses a retrospective cohort research study design. DHF case data was sourced from the Bandung City Health Office in 2023. All DHF cases reported by health centres in 30 sub-districts in Bandung City were then totalled into a population of 1,856 cases. This study analyses all sub-districts within Bandung City. The method employed for sampling was total

sampling, where all populations were sampled (Kumar, 2018). The independent variable in this study is the occurrence of DHF, while the dependent variable is the spatial dimension.

The data will be analysed using global spatial autocorrelation with Moran's index method (Global Moran's I) using the criteria set by Pfeiffer et al (Wardana, Munibah, & Baliwati, 2023). Moran's index values span from -1 to 1. Values ranging $-1 \leq I < 0$ signify negative spatial autocorrelation, suggesting a dispersed distribution pattern. A value of $0 \leq I \leq 1$ signifies positive spatial autocorrelation, reflecting a clustered distribution pattern. A Moran index value of 0 signifies the absence of spatial autocorrelation, indicating a random distribution pattern. The z-score indicates the presence of regional spatial autocorrelation. If the z-score is below the z-value (1.64), then the H_0 is accepted and the H_a is rejected, indicating an assumption of no spatial autocorrelation between regions. If the z-score exceeds Z_α , then the H_a is accepted and the H_0 is rejected, indicating the presence of spatial autocorrelation between regions (Iryanto et al., 2022). This study has passed the ethical review by the Ethics Committee of Health Research, Santo Borromeus University, Number: 123/USTB/Etik/Has./VII/2024, on 31 July 2024.

3. RESULTS AND DISCUSSION

The spatial distribution pattern of DHF cases in Bandung City and the relationship between analysis units (subdistricts) in 2023 were spatially analysed using the Global Moran's I method. Data on DHF cases in 30 sub-districts in Bandung City in 2023 are shown in Table 1.

Table 1. Number of DHF Cases in Bandung City by Subdistrict in 2023

No	Subdistrict	DHF Case	No	Subdistrict	DHF Case
1	Andir	38	16	Cicendo	43
2	Antapani	83	17	Cidadap	40
3	Arcamanik	102	18	Cinambo	2
4	Astana Anyar	74	19	Coblong	97
5	Babakan Ciparay	119	20	Gedebage	61
6	Bandung Kidul	24	21	Kiaracondong	63
7	Bandung Kulon	34	22	Lengkong	65
8	Bandung Wetan	32	23	Mandalajati	84
9	Batununggal	65	24	Panyileukan	32
10	Bojongloa Kaler	116	25	Rancasari	76
11	Bojongloa Kidul	80	26	Regol	60
12	Buahbatu	84	27	Sukajadi	85
13	Cibeunying Kaler	50	28	Sukasari	57
14	Cibeunying Kidul	57	29	Sumur Bandung	27
15	Cibiru	72	30	Ujungberung	34
Total					1.856

The results of the distribution based on the incidence of DHF in 2023 with the unit of analysis of 30 sub-districts in Bandung City in 2023 are presented in the following spatial distribution map Figure 1.

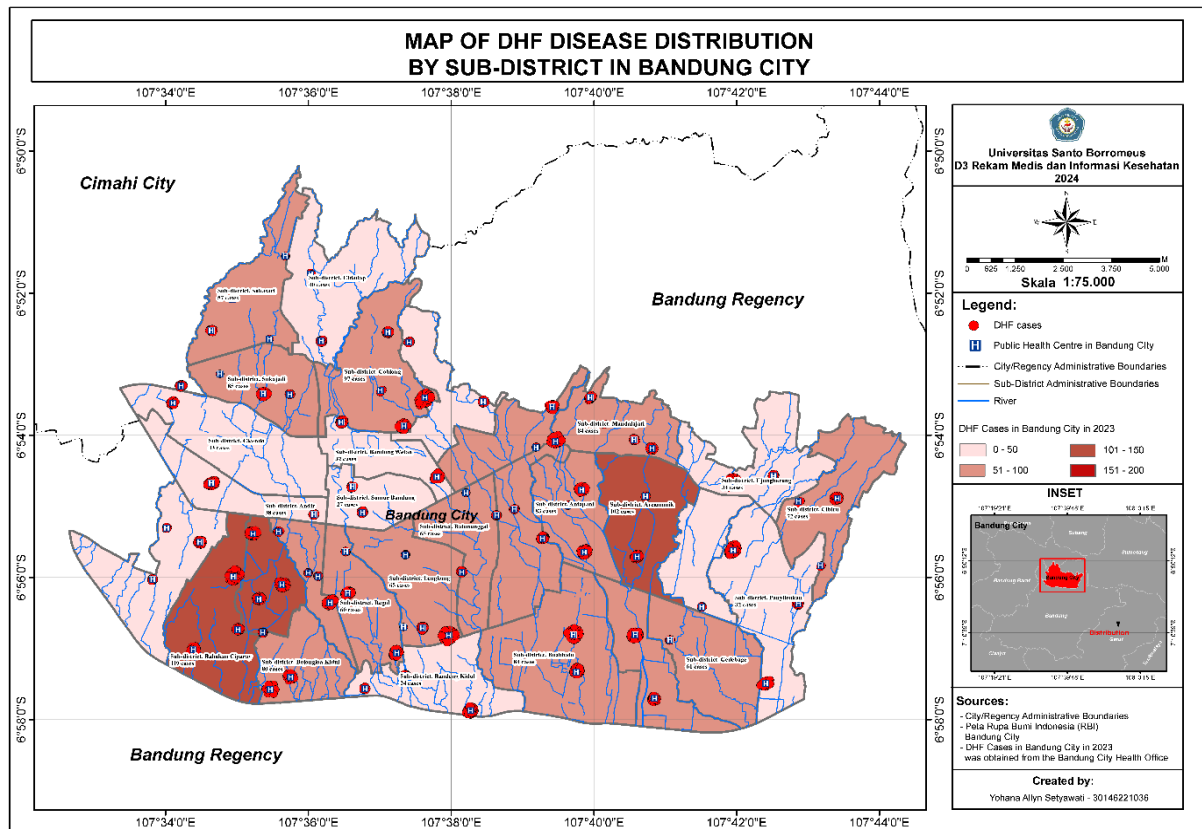


Figure 1. Distribution of DHF Cases in Bandung City based on Reporting by Community Health Centers in each Sub-District.

The results of Figure 1. show that Babakan Ciparay sub-district has the highest number of cases with 119 cases (6.41%), Bojongloa Kaler with 116 cases (6.25%), and Arcamanik with 102 cases (5.50%) categorised at level 3 with a range of 101-150. The lowest DHF cases are in the Cinambo sub-district with 2 cases (0.11%), Bandung Kidul with 24 cases (1.29%), and Sumur Bandung with 27 cases (1.45%) categorised at level 1 with a range of 0-50. The magnitude of DHF cases across sub-districts in Bandung City reveals important insights into spatial vulnerability. Babakan Ciparay, Bojongloa Kaler, and Arcamanik emerged as the top three sub-districts with the highest number of cases. These areas are characterized by high population density, dense residential settlements, and in some cases, suboptimal environmental sanitation. The high concentration of people and poor waste or water management can create ideal breeding grounds for *Aedes aegypti*, contributing to the increased transmission of DHF (Acevedo-Guerrero, 2025; Abdullah et al., 2024; Dalpadado et al., 2022).

In contrast, Cinambo, Bandung Kidul, and Sumur Bandung recorded the lowest DHF cases in 2023. These sub-districts typically feature either lower population densities, better-managed housing layouts, or improved drainage infrastructure, potentially disrupting mosquito breeding cycles. For instance, Cinambo, while being an industrial area, may have limited residential zones, thereby reducing exposure to domestic mosquito breeding sites (Bayona-Valderrama et al., 2021; Kampango et al., 2023). The findings of the spatial autocorrelation analysis on dengue fever incidence in Bandung City for 2023 are illustrated in Figure 2. below.

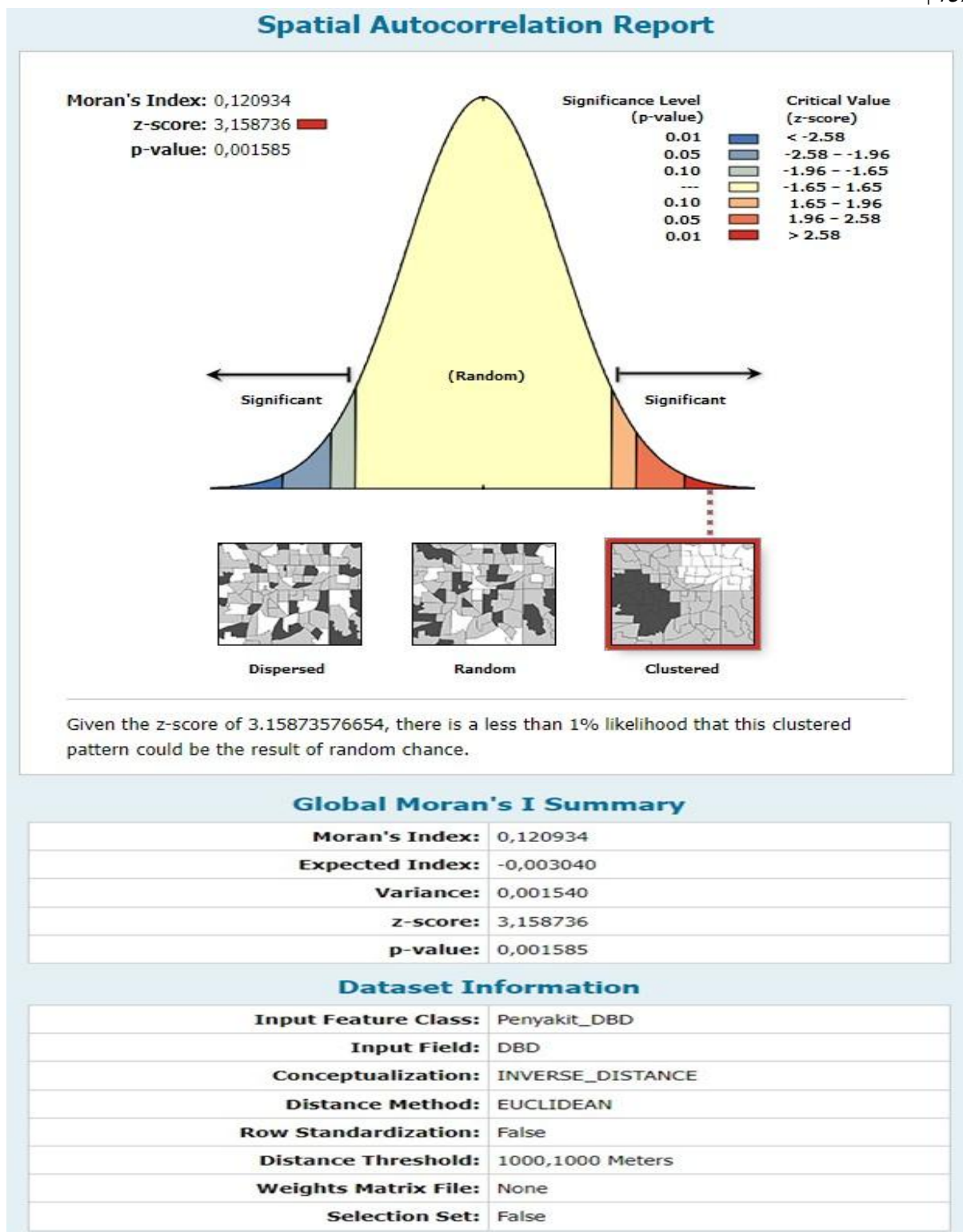


Figure 2. Result of Spatial Autocorrelation Analysis on DHF Cases in 2023.

Spatial autocorrelation analysis of dengue cases in 2023 in the sub-districts located in the working area of the Bandung City Health Office based on the dengue incidence rate obtained a Moran index of 0.120934 while the expected value is -0.003040 so the expected value is exceeded, the positive Moran index value indicates the distribution pattern of dengue cases in the study area is clustered. The z-score value of 3.158736 (clustered distribution pattern) and the p-value of 0.001585 is smaller than the α value (5%) indicating statistical

significance. In proving the hypothesis, the result is H_0 is rejected and H_a is accepted so it can be concluded that there is spatial autocorrelation between regions on the incidence of dengue hemorrhagic fever in 2023 in the working area of the Bandung City Health Office.

This study analyses the incidence of DHF using data reported to the Bandung City Health Office by hospitals and community health centres. The data will subsequently be organised by the community health centres to identify DHF cases in hospitals that fall within their designated work areas. The spatial distribution of DHF is measured globally using Moran's index method (Global Moran's I), which shows a positive Moran's index value in 2023 so that the surrounding neighbourhood patterns are uniform with each other. Clustered distribution patterns indicate a concentration of vector habitats, which can potentially lead to local transmission. This aligns with a study carried out in Padang City in 2020, which found that the distribution of DHF follows a clustered pattern, suggesting a concentration of vector habitats and consequently a higher potential for case transmission in the local area (Yuliana et al., 2022).

In general, the clustered type of DHF distribution tends to be directly proportional to the level of population density. The denser the area, the higher the intensity of the spread. This is in line with research conducted in 2019 in the working area of Puskesmas Oesapa, Kupang City which found that the distribution of cases throughout the working area of Puskesmas Oesapa was at a high population density level (Ximenes, Manurung, & Riwu, 2019). Another study conducted by Amelinda et al. also argued that areas with high population density are more vulnerable to the spread of disease because mosquitoes can easily move from one house to another (Amelinda, Wulandari, & Asyary, 2022). Bandung City is also one of the areas with high population density (Kusnandar, 2022). This research is also in line with research conducted in the Tanjung Emas Port area found that there is a positive spatial autocorrelation and shows statistical significance, so the distribution pattern formed is clustered (Pujianto et al., 2020). This distribution pattern also occurs in Bandung City in research conducted by Habinuddin in 2021 and the results of the analysis using Moran's I show a clustered distribution pattern (Habinuddin, 2021). Another study along the same lines was conducted by Firmansyah et al., 2024, which found that cluster distribution patterns occurred in dengue fever and dengue hemorrhagic fever, while random distribution patterns were observed in dengue shock syndrome (DSS), severe dengue (SD), and dengue warning signs (DWS), based on an analysis of 1,698 medical records from January 2 to May 15, 2024 (Firmansyah et al., 2024).

Environmental and behavioural factors also contribute significantly to the increase in the number of vector-borne disease cases (Alqassim, 2024; Ma et al., 2022; Molina-Guzmán et al., 2022; Wu and Huang, 2022). Investigations carried out in Pringsewu District revealed a significant correlation between water reservoirs harbouring larvae and the practice of using mosquito repellent with the incidence of DHF. The existence of mosquito breeding sites, the quantity of these sites, free larvae count, CI, and HI were linked to the incidence of DHF (Yuanita et al., 2019). Another study stated 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 presence of several major rivers in Bandung City, including the Citarum River, Cikapundung River, and their tributaries. Areas around dirty rivers and stagnant water can be an ideal habitat for breeding *Aedes aegypti* mosquitoes. Efforts to prevent dengue fever can be carried out through various interventions, community empowerment programs conducted by Cahyanti et al., and the production of peppermint emulgel as an insect repellent at Kartini Bhakti Mandiri tertiary school (Cahyanti et al., 2024). In addition, efforts to increase knowledge were carried out through lectures (44.23%) and discussions (11.38%) (Firmansyah et al., 2024; Tian et al., 2025).

4. CONCLUSION

The distribution of DHF cases in Bandung City in 2023 is clustered where the neighbourhood patterns are similar to each other so that an increase in cases will affect the

incidence of DHF in the surrounding area. Scientific studies in the form of spatial analyses are recommended to be conducted in DHF endemic areas on a regular basis because they can provide basic information to support effective prevention and control of DHF cases.

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