(RESEARCH ARTICLE)

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Overview of Dengue Fever (DHF) incidence based on population density in Indonesia

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Abstract

Dengue fever (DHF) is an infectious disease caused by the dengue virus, with Aedes aegypti and Aedes albopictus mosquitoes as vectors. The prevalence of DHF globally has increased significantly, and the infection has become endemic in many regions including Indonesia. The purpose of this study was to determine the relationship between population density and the incidence of Dengue Hemorrhagic Fever (DHF) in Indonesia. This research uses a descriptive method with a population correlation study. Descriptive analysis in this study utilized the Health Mapper version 4.3.0.0 application while the population correlation test used the SPSS data processing application with the Spearman bivariate test. The population in this study is provinces in Indonesia. The independent variable in this study is population density in provinces in Indonesia, while the dependent variable in this study is the incidence of Dengue Fever (DHF) in Indonesia in 2020, 2021, and 2022. The results showed that DHF cases are directly proportional to the high population density in a province. The correlation test on dengue cases and Indonesia's population density in 2020 showed a correlation coefficient of 0.811. The correlation test between DHF cases and Indonesia's population density in 2021 showed a correlation coefficient of 0.766. The correlation test between dengue cases and Indonesia's population density in 2022 showed a correlation coefficient of 0.741. This study concluded that there is a very strong relationship between dengue fever cases and population density in various regions in Indonesia.

Keywords: Dengue fever; Relationship; Population density; Virus

1. Introduction

According to the Ministry of Health of the Republic of Indonesia in 2021, Dengue Hemorrhagic Fever (DHF) is an infectious disease caused by the dengue virus and since the discovery of the first case there has always been an increase in cases every year [1] . Based on the WHO statement in 2023, DHF is a disease caused by a virus and is spread through mosquitoes to humans [2]. The mosquitoes that carry the virus are the female Aedes aegypti and Aedes albopictusmosquitoes. The virus that causes DHF can cause capillary blood vessel infection and coagulation that can end in a bleeding event [3]. DHF infection has several main symptoms, namely fever with a duration exceeding two days along with other symptoms, such as headache, muscle pain, and skin rash. In addition, DHF also has other manifestations such as bleeding and low platelets in the blood [4].

The prevalence of dengue has been reported to have increased significantly globally over the past decade, from 505,430 cases in 2000 to 5.2 million in 2019. One modeling analysis noted that annually there are an estimated 390 million cases of dengue virus infection, with 96 million of them experiencing clinical symptoms. Research on the distribution of dengue also projects that around 3.9 billion people are at risk of contracting the virus. DHF infection is currently endemic in Africa, the Americas, Eastern Mediterranean, Southeast Asia, and Western Pacific regions. In this regard, the Americas, Southeast Asia, and the Western Pacific are the most predominantly affected regions. The global burden of disease is represented by Asia at about 70% [2, 5].

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In Indonesia, the number of DHF cases is still relatively high. Based on the Ministry of Health's report in 2020, there were 108,303 reported cases of DHF with 747 (0.7%) deaths [6]. While in 2021, in Indonesia there were 73,518 cases of DHF with a total of 705 (0.96%) deaths [1]. Meanwhile, in 2022, there were 143,266 cases of DHF in Indonesia with 1,237 (0.86%) deaths [7]. It can be seen that there are fluctuations in the number of DHF cases where DHF cases fell in 2021 and jumped up in 2022. Fluctuations were also found in the death rate from DHF, where there was a decrease in 2021 compared to 2020 but an increase in 2022 compared to 2021. The mortality rate in 2021, which reached 0.96%, and in 2022, which reached 0.86%, exceeded the target limit of the National Dengue Management Strategy of 0.7% [8].

The high number of DHF cases in Indonesia cannot be separated from the risk factors that can cause DHF. Based on the Ministry of Health's report in 2020, the risk factors that cause DHF include climate, environmental conditions, population mobility, population density, and community behavior [6]. This statement shows that population density is one of the factors that cause DHF in Indonesia. Population density reflects the level of population distribution in an area. Population density indicates the average number of people per 1 km^2. The higher the population density, the more people live in the area [1].

According to the Ministry of Health, Indonesia's average population density in 2020 was 202 people/ km^2 [6]. This number increased in 2021 to 202 people/ km^2 and in 2022 to 145 people/ km^2 [1, 7]. It can be seen that the population density in Indonesia continues to increase during 2020-2022. With a high population density, community interactions occur more frequently, which can lead to the rapid spread of the virus. Based on the description above, this study aims to see the relationship between population density and the incidence of Dengue Hemorrhagic Fever (DHF) in Indonesia.

2. Material and methods

This research uses a descriptive method with a population correlation study design. The population in this study are provinces in Indonesia. The independent variable in this study is population density in provinces in Indonesia, while the dependent variable in this study is the incidence of Dengue Fever (DHF) in Indonesia in 2020, 2021, and 2022. The data in this study used secondary data, which was adopted from the Indonesian Health Profile in 2020, 2021, and 2022. The data analysis technique used in this research is descriptive analysis by utilizing the Health Mapper application version 4.3.0.0 and product version 4.03. This application is the result of development by WHO which is designed to create maps and display information related to the health status of a country or region. The data will be presented in the form of a Dengue Fever (DHF) incidence map by covering provinces with high population density using an area distribution map. In addition, this research also involves population correlation tests using the SPSS data processing application. The data analysis process involved a normality test using the Kolmogorov-Smirnov test and it was found that the data was not normally distributed. Therefore, the population correlation test used is the Spearman bivariate correlation test to see if there is a significant relationship between two variables, namely the independent variable and the dependent variable.

3. Results

The number of Dengue Fever (DHF) cases in Indonesia nationally in 2020, 2021, and 2022 has decreased consecutively. The distribution and trend of DHF incidence in Indonesia in 2020, 2021, and 2022 by province can be seen in the following table:

Table 1 Distribution of DHF Cases in Indonesia in 2020, 2021, and 2022

Province	2020		2021		2022	
	Total	Description	Total	Description	Total	Description
Aceh	891	-	366	Decrease	2079	Increase
Bali	11.964	-	2.673	Decrease	5761	Increase
Banten	2.910	-	2.136	Decrease	5283	Increase
Bengkulu	1.276	-	628	Decrease	1339	Increase
DIY	3.618	-	1.186	Decrease	2164	Increase
DKI Jakarta	4.745	-	3.092	Decrease	8138	Increase

Province	2020		2021		2022	
	Total	Description	Total	Description	Total	Description
Gorontalo	951	-	557	Decrease	580	Increase
Jambi	2.049	-	357	Decrease	1378	Increase
West Java	22.613	-	23.959	Increase	36608	Increase
Central Java	5.683	-	4.468	Decrease	12476	Increase
East Java	8.567	-	6.760	Decrease	13235	Increase
West Kalimantan	784	-	664	Decrease	1384	Increase
South Kalimantan	1.768	-	176	Decrease	1014	Increase
Central Kalimantan	669	-	189	Decrease	890	Increase
East Kalimantan	2.299	-	2.898	Increase	5887	Increase
North Kalimantan	515	-	172	Decrease	1331	Increase
Bangka Belitung Islands	1.144	-	864	Increase	1887	Increase
Riau Islands	1.753	-	1.925	Increase	2235	Increase
Lampung	6.372	-	2.271	Increase	4662	Increase
Maluku	77	-	169	Increase	96	Decrease
North Maluku	425	-	318	Decrease	623	Increase
West Nusa Tenggara	4.720	-	2.697	Decrease	3260	Increase
East Nusa Tenggara	5.968	-	2.538	Decrease	3096	Increase
Papua	163	-	147	Decrease	533	Increase
West Papua	172	-	98	Decrease	293	Increase
Riau	2.948	-	1.038	Decrease	2370	Increase
West Sulawesi	630	-	339	Decrease	676	Increase
South Sulawesi	2.714	-	3.585	Increase	3562	Decrease
Central Sulawesi	1.190	-	671	Decrease	1883	Increase
Southeast Sulawesi	905	-	674	Decrease	918	Increase
North Sulawesi	1.219	-	1.196	Decrease	2206	Increase
West Sumatera	1.117	-	654	Decrease	4024	Increase
South Sumatera	2.359	-	1.135	Decrease	2854	Increase
North Sumatera	3.125	-	2.918	Decrease	8541	Increase
Total	108.303	-	73.518	Decrease	143.266	Increase

Based on Table 1, it can be seen that the number of DHF cases in each province in Indonesia tends to fluctuate. However, there are provinces that experience a constant increase in cases, namely Riau Islands Province, East Kalimantan, and West Java. Riau Islands Province in 2020 had a total of 1,753 DHF cases, increased in 2021 to 1,925 cases, and increased again in 2022 to 2,235 cases. Meanwhile, East Kalimantan Province in 2020 had a total of 2,299 DHF cases, increased in 2021 to 2,898 cases, and increased again in 2022 to 5,887 cases. West Java Province also experienced a constant increase, from 22,613 in 2020, to 23,959 in 2021, and to 36,608 cases in 2022. In this case, West Java Province was the largest contributor of DHF cases for three consecutive years.

The population density figures in Indonesia in 2020, 2021, and 2022 by province are presented in the following table:

Table 2 Population Density Distribution in Indonesia in 2020, 2021, and 2022

Province	2020		2021		2022	
	Total	Description	Total	Description	Total	Description
Aceh	94	-	94	Constant	94	Constant
Bali	758	-	765	Increase	765	Constant
Banten	1.362	-	1.286	Decrease	1.286	Constant
Bengkulu	101	-	101	Constant	101	Constant
DIY	1.239	-	1.159	Decrease	1.159	Constant
DKI Jakarta	16.031	-	17.031	Increase	17.031	Constant
Gorontalo	108	-	100	Decrease	100	Constant
Jambi	74	-	74	Constant	74	Constant
West Java	1.412	-	1.302	Decrease	1.302	Constant
Central Java	1.065	-	1.087	Increase	1.087	Constant
East Java	834	-	855	Increase	855	Constant
West Kalimantan	35	-	37	Increase	37	Constant
South Kalimantan	111	-	111	Constant	111	Constant
Central Kalimantan	18	-	17	Decrease	17	Constant
East Kalimantan	29	-	30	Increase	30	Constant
North Kalimantan	10	-	10	Constant	10	Constant
Bangka Belitung Islands	92	-	88	Decrease	88	Constant
Riau Islands	273	-	252	Decrease	252	Constant
Lampung	246	-	265	Increase	265	Constant
Maluku	39	-	41	Increase	41	Constant
North Maluku	40	-	40	Constant	40	Constant
West Nusa Tenggara	276	-	276	Constant	276	Constant
East Nusa Tenggara	114	-	118	Increase	118	Constant
Papua	10	-	12	Increase	14	Increase
West Papua	11	-	14	Increase	12	Decrease
Riau	82	-	73	Decrease	73	Constant
West Sulawesi	84	-	87	Increase	87	Constant
South Sulawesi	191	-	202	Increase	202	Constant
Central Sulawesi	50	-	50	Constant	50	Constant
Southeast Sulawesi	72	-	74	Increase	74	Constant
North Sulawesi	182	-	183	Increase	183	Constant
West Sumatera	131	-	133	Increase	133	Constant
South Sumatera	94	-	99	Increase	99	Constant
North Sumatera	202	-	210	Increase	210	Constant

Province	2020		2021		2022	
	Total	Description	Total	Description	Total	Description
Total	25.471	-	26.276	Increase	26.276	Constant

Based on Table 2, it can be seen that the population density rate in Indonesia tends to fluctuate during 2020, 2021, and 2022. In 2020, DKI Jakarta Province has a population density of 16,031 people/km^2 and the DHF cases that occurred were quite high, namely 4,745 cases. The highest number of cases occurred in West Java Province with 22,613 cases and a population density of 1,412 people/km^2. Fewer cases were reported in Maluku Province, with 77 cases and a population density of 39 people/km^2. In 2021, there was an increase in population density. East Kalimantan Province experienced an increase in population density (29 people/km^2 to 30 people/km^2) along with an increase in DHF cases (2,299 cases to 2,898 cases). Maluku Province also experienced an increase in population density (39 people/km^2 to 41 people/km^2) and an increase in DHF cases (77 cases to 169 cases). Another province that experienced an increase in population density was South Sulawesi Province (191 people/km^2 to 202 people/km^2) and DHF cases also increased (2,714 cases to 3,585 cases). In 2022, population density remained constant nationally with an increase in DHF cases. The only province that experienced an increase in population density was Papua Province (12 people/km^2 to 14 people/km^2) accompanied by an increase in DHF cases (146 cases to 533 cases).

Table 3 Correlation between Dengue Fever Cases and Population Density in Indonesia

	Population Density in 2020			Population Density in 2021			Population Density in 2022		
	N	P-Value	r	N	P-Value	r	N	P-Value	r
DHF Cases	34	0.000	0.811	34	0.000	0.766	34	0.000	0.741

Based on Table 3, the correlation test for DHF cases and Indonesia's population density in 2020 shows a correlation coefficient = 0.811, which means there is a very strong relationship between DHF cases and Indonesia's population density in 2020. Meanwhile, the correlation test between dengue cases and Indonesia's population density in 2021 shows a correlation coefficient = 0.788 which means there is a very strong relationship between dengue cases and Indonesia's population density in 2021. Finally, the correlation test on dengue cases and Indonesia's population density in 2022 also showed a correlation coefficient = 0.741 which means there is a very strong relationship between dengue cases and Indonesia's population density in 2022.
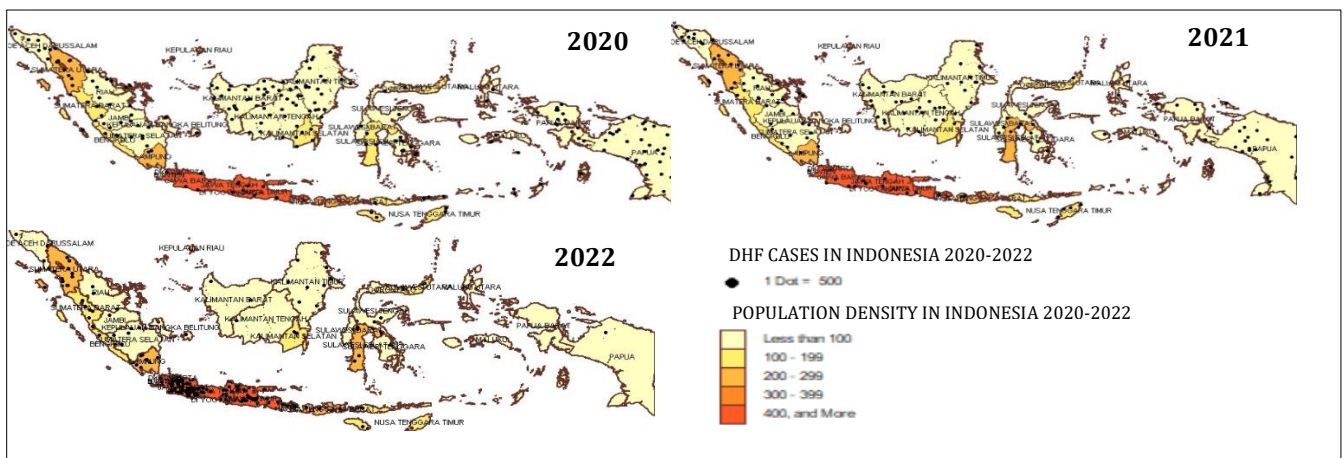

Figure 1 Distribution of DHF Cases by Population Density in Indonesia in 2020, 2021, and 2022

Figure 1 shows that as the population density in a province increases, so does the number of DHF cases. The amount of population density is shown with different colors on the map of each province following the high population density, the higher the level of population density, the darker the color of the map. While the number of DHF cases is shown by dots on the map where 1 dot represents 500 DHF cases.

4. Discussion

The results showed that DHF cases were strongly associated with high population density in a province. This is in accordance with the statement in the Indonesian Health Profile in 2022 that one of the factors affecting the process of spreading DHF disease is the level of population density. The higher the level of population density, the faster the process of dengue virus transmission by the Aedes aegypti mosquito vector [7, 9].

Dense environments provide more opportunities for water storage containers for daily needs. In addition, the impact of population density also generates a number of used items that are potentially ideal places for mosquitoes to breed. These discarded items have the potential to become new containers to hold water, and if they are not covered, it will make it easier for mosquitoes to lay eggs as part of their reproductive cycle [10] . Densely populated environments and their association with dengue cases are also related to the flying ability of Aedes aegypti mosquitoes as vectors, which can reach distances of less than 50 meters. This phenomenon may increase the risk of spreading DHF in densely populated environments [11].

The results of research in Blitar in 2013-2017 showed that there was a strong relationship between DHF cases and population density as indicated by the correlation coefficient value of 0.619 [11]. The study also used the same method, namely using descriptive tests using graphs and maps and analytical tests using the Spearman bivariate test. The study illustrated that the population density in Blitar has been constantly increasing for five years. Meanwhile, the level of DHF cases in Blitar fluctuated and had increased in 2015.

Another similar study was conducted in South Jakarta from 2016-2020. This study analyzed quite a number of variables, one of which was population density with DHF cases in South Jakarta. In addition, this study also examined the relationship between population density and the Flick Free Rate (FFR), which is also one of the risks of dengue cases. In this study, it was found that the FFR value had a significant relationship with DHF cases. In addition, a high FFR value indicates low population density and other vectors. It can be concluded that the level of population density has a significant relationship with DHF cases in South Jakarta [12].

Similarly, research was conducted in West Java in 2017-2021. This study analyzed the relationship between population density and dengue cases in West Java. In this study, a p-value = 0.008 <0.05 was obtained, indicating that there is a significant relationship between population density and dengue cases in West Java. This study also showed that districts or cities with a population density of more than 1792.40 had an 8.75 times greater chance of DHF cases than districts or cities with a lower population density [13].

5. Conclusion

This study concluded that there is a strong correlation between dengue fever cases and population density in various regions in Indonesia. The high number of DHF cases is strongly associated with an increase in population density because it increases the potential for an increase in water storage containers and used goods as a breeding ground for the Aedes aegypti mosquito, which is the vector of DHF disease.

Compliance with ethical standards

Disclosure of conflict of interest

The author(s) declared no conflict of interest.

References

[1] Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia 2021. Jakarta: Kementerian Kesehatan Republik Indonesia; 2021. 538 p.

[2] World Health Organization. Dengue and severe dengue [Internet]. World Health Organization Newsroom. 2023 [cited 2023 Nov 13]. Available from: https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue

[3] Akbar H, Syaputra EM. Faktor Risiko Kejadian Demam Berdarah Dengue (DBD) di Kabupaten Indramayu. Media Publikasi Promosi Kesehatan Indonesia (MPPKI). 2019 Sep 28;2(3):159–64.

[4]   Canggra M, Kurnain D, Handayanti L, Surjadi T. LAPORAN KEGIATAN DIAGNOSA KOMUNITAS DALAM UPAYA PENURUNAN INSIDEN DEMAM BERDARAH DENGUE DI WILAYAH KERJA PUSKESMAS KRONJO, KECAMATAN KRONJO, KABUPATEN TANGERANG, PROVINSI BANTEN PERIODE 20 SEPTEMBER – 15 OKTOBER 2022 | Indonesian Nursing Journal of Education and Clinic. INDONESIAN NURSING JOURNAL OF EDUCATION AND CLINIC. 2023 Mar 27;3(3):66–89.

[5]   Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia 2019. Jakarta: Kementerian Kesehatan Republik Indonesia; 2019. 487 p.

[6]   Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia 2020. Jakarta: Kementerian Kesehatan Republik Indonesia; 2020. 480 p.

[7]   Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia 2022. Jakarta: Kementerian Kesehatan Republik Indonesia; 2023 p. 550.

[8]   Kementerian Kesehatan Republik Indonesia. STRATEGI NASIONAL PENANGGULANGAN DENGUE 2021-2025 [Internet]. Jakarta: Kementerian Kesehatan Republik Indonesia; 2021 [cited 2023 Nov 19]. 94 p. Available from: https://p2pm.kemkes.go.id/storage/publikasi/media/file_1631494745.pdf

[9]   Fadlirahman RA, Alfianti F, Dewi AFL, Estasya BN, Iriana NI, Rahma DM, et al. PENGARUH FAKTOR IKLIM DAN KEPADATAN PENDUDUK TERHADAP KEJADIAN DEMAM BERDARAH DENGUE DI KOTA ADMINISTRASI JAKARTA TAHUN 2018-2020. JURNAL MEDIA KESEHATAN. 2022 Dec 28;15(2):164–80.

[10]   Auritha Biis N, Wahyuni Sukesi T. HUBUNGAN ANTARA CURAH HUJAN DAN KEPADATAN PENDUDUK DENGAN KEJADIAN DEMAM BERDARAH DENGUE (DBD) DI WILAYAH KERJA PUSKESMAS GAMPING I (DESA BALECATUR) KABUPATEN SLEMAN TAHUN 2015-2017 [Internet] [bachelor]. Universitas Ahmad Dahlan; 2019 [cited 2024 Feb 16]. Available from: https://eprints.uad.ac.id/15000/

[11]   Nuranisa R, Maryanto YB, Isfandiari MA. CORRELATION OF FREE LARVAE INDEX AND POPULATION DENSITY WITH DENGUE FEVER INCIDENCE RATE. ijph. 2022 Nov 4;17(3):477–87.

[12]   Amelinda YS, Wulandari RA, Asyary A. The effects of climate factors, population density, and vector density on the incidence of dengue hemorrhagic fever in South Jakarta Administrative City 2016-2020: an ecological study. Acta Biomed. 2022;93(6):e2022323.

[13]   Juariah, Samiran, Fuadzy H. Population density and rainfall increase the incidence of Dengue Haemorrhagic Fever in West Java, Indonesia: a secondary data analysis from 2017 to 2021. IOP Conf Ser: Earth Environ Sci. 2023 Sep 1;1239(1):012023.