

RESEARCH ARTICLE

Epidemiologic Spatial Analysis of a Tuberculosis Incidence in Bandung City in 2021

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Abstract

Tuberculosis (TB) is a communicable disease that is a significant cause of ill health and one of the leading causes of death worldwide. Tuberculosis remains a major global health problem. Tuberculosis infection remains one of the biggest health problems in Indonesia, which ranked second in the world on the list of countries with a high burden of TB. This is a cross-sectional study where the research displays population data, population density, and the incidence of TB in Bandung city, which is visualized in the mapping. This research analyzed the relationship between population density and the incidence of TB. The area with the highest TB incidence was the Babakan Ciparay subdistrict, with a total of 469 people and a population density of 205 people/hectare. The study has shown a strong relationship and a positive correlation between population density and the incidence of TB in Bandung city ($p < 0.001$, $r = 0.603$). Tuberculosis cases tend to be higher in areas with high population densities. Besides population density, other factors influence the incidence of TB in an area. House technical factors such as adequacy of windows, air ventilation, and lighting influence TB transmission. Besides that, household sanitation factors and occupancy density also impact the incidence of TB. In conclusion, subdistricts with a high population density show a high incidence of TB. There is a strong and unidirectional relationship between population density and the incidence of TB.

Keywords: Density, population, spatial, tuberculosis

Introduction

Tuberculosis (TB) is a communicable disease that is a significant cause of ill health and one of the leading causes of death worldwide.¹⁻⁵ Tuberculosis remains a major global health problem.⁶ It affects approximately 10 million people worldwide and kills more than 1 million every year.⁷ Tuberculosis infection remains one of the biggest health problems in Indonesia, which ranked second in the world on the list of countries with a high burden of TB.^{8,9}

Tuberculosis is caused by the bacillus *Mycobacterium tuberculosis*, which is spread when people who are sick with TB expel bacteria into the air.¹⁰⁻¹² The disease typically affects the lungs (pulmonary TB) but can also affect other sites.¹³ Appropriate TB treatment is needed so that treatment can be completed. An unexpected condition in treating TB is the presence of

multidrug-resistant TB (MDR).^{11,14,15} In this condition, treatment becomes more complex, and costs have the potential to be greater than it should be.

Many studies have shown that there is a relationship between various factors and the incidence of TB.¹⁶⁻¹⁸ Several studies have shown that the incidence of TB is related to social factors such as population density.^{16,17,19-21} Areas with a high population density are at greater risk of transmission to the community.^{7,22,23}

This study aims to describe the distribution of population and population density and determine the relationship between population density and the incidence of TB. This research was conducted by visualizing distribution maps to make it easier to understand data distribution. Epidemiological spatial analysis makes it easier to read data by mapping according to population density and incidence of tuberculosis.

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Received: 4 August 2023; Revised: 10 February 2024; Accepted: 2 March 2024; Published: 30 April 2024

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Methods

This research is cross-sectional research where the study qualitatively displays population data, population density, and the incidence of TB in Bandung, which is visualized in the mapping. This research quantitatively analyzed the relationship between population density and the incidence of TB. This research uses secondary data from the Bandung City Health Service Office and the Bandung City Population and Civil Registry Service Office for 2021.

The data was processed using ArcGIS software and then visualized as a map of the distribution of TB incidence at the sub-district level. Statistical analysis used SPSS software with the Spearman correlation technique because the independent variable data (population, area, and population density) and the dependent variable (TB incidence) were numerical data that were not normally distributed.

The research has obtained a recommendation for a research permit from the National Unity and Politics Agency of the Bandung City Government with letter number PK.03.04.05/480-BKBP/III/2023 and the Bandung City Government Health Service Office with letter number B/PP.06.02/6272-Dinkes/III/2023.

Results

Bandung city is divided into 30 districts, which carry out administrative functions regarding public services to the community. The results showed that in all sub-districts in Bandung, there were patients diagnosed with TB. The highest incidence of TB was in the Babakan Ciparay sub-district, with 469 cases, followed by the Bojongloa Kaler sub-district, with 428 cases.

In a descriptive view, the incidence of TB in one area is also accompanied by a high population density. This condition needs to be analyzed using statistical analysis to see the relationship and the strength of the correlation between population density and the incidence of TB in an area.

The map of the population density distribution and the TB incidence map illustrates that areas with a high-density level tend to be accompanied by a high incidence of TB. Furthermore, statistical analysis using the non-Spearman correlation method was carried out to see the relationship and the strength of the correlation between the independent variables (population, area, and

population density) and the dependent variable (TB incidence). The results of the analysis shown in Table 2.

Based on the results of the analysis (Table 2), it was found that the relationship between population density and the incidence of TB can be said to have a strong relationship ($r=0.603$) with a positive correlation coefficient and a significant relationship between the two variables ($p<0.001$).

Discussion

The study showed a strong relationship and a positive correlation between population density and the incidence of TB in Bandung city. Several studies have shown the same result that there is a relationship between population density and the high incidence of TB.^{24–28}

The area with the highest TB incidence was the Babakan Ciparay sub-district, with 469 people and a population density of 205 people/hectare. The area with the second highest incidence is Bojongloa Kaler, with a total of 428 people and a population density of 405 people/hectare. There are very different densities between the sub-districts of Babakan Ciparay and Bojongloa Kaler, even though the incidence of TB is in the high group.

High population density increases the risk of transmission of infectious disease cases. Tuberculosis cases tend to be higher in areas with high population densities. Besides population density, other factors influence the incidence of TB in an area. House technical factors such as adequacy of windows, air ventilation, and lighting influence TB transmission. Besides that, household sanitation factors and occupancy density also influence the incidence of TB.²⁹

Efforts to detect early detection of new cases of TB have an important role in a strategic step in eliminating TB cases. New TB cases must be handled immediately and thoroughly and seek to break the chain of transmission of TB to others. The primary health service intervention that may be carried out to reduce the risk of TB infection developing into active TB is to carry out preventive measures. Preventive interventions that can be carried out are preventing and controlling TB infection and vaccinating the bacille Calmette-Guerin (BCG) vaccine.

Disturbances in the detection and treatment of TB have an impact on those who already have TB disease. People who remain undiagnosed and

Table 1 Characteristics of Bandung Sub-districts

No.	Sub-districts	Area (ha)	Population (n)	Population Density (n/ha)	TB Case (n)
1	Andir	455.09	99,319	218	256
2	Antapani	423.05	80,375	190	169
3	Arcamanik	733.52	79,731	109	127
4	Astana Anyar	264.18	73,614	279	266
5	Babakan Ciparay	699.31	143,066	205	469
6	Bandung Kidul	510.27	61,250	120	150
7	Bandung Kulon	688.53	136,607	198	291
8	Bandung Wetan	340.99	29,042	85	64
9	Batununggal	479.14	121,639	254	341
10	Bojongloa Kaler	307.24	124,309	405	428
11	Bojongloa Kidul	482.69	87,916	182	255
12	Buahbatu	734.11	104,102	142	216
13	Cibeunying Kaler	459.64	70,808	154	151
14	Cibeunying Kidul	410.38	113,568	277	223
15	Cibiru	666.56	75,777	114	153
16	Cicendo	723.59	96,544	133	205
17	Cidadap	768.28	54,616	71	133
18	Cinambo	429.98	25,586	60	61
19	Coblong	719.22	115,256	160	337
20	Gedebage	978.30	41,738	43	75
21	Kiaracondong	568.28	131,612	232	326
22	Lengkong	579.56	71,261	123	169
23	Mandalajati	472.66	73,532	156	153
24	Panyileukan	520.45	40,584	78	66
25	Rancasari	684.33	86,465	126	147
26	Regol	475.85	80,808	170	213
27	Sukajadi	520.72	102,987	198	259
28	Sukasari	626.73	77,815	124	133
29	Sumur Bandung	344.50	37,921	110	89
30	Ujungberung	613.72	90,006	147	169

untreated have a higher risk of death compared to those who start treatment. Most people infected through increasing community transmission are at risk of becoming a source of infection. Transmission times vary greatly, ranging from weeks to decades. Therefore, disruption to diagnosis and treatment has a more rapid impact on TB mortality and a slower effect on TB incidence.

Several strategies and programs must be carried out effectively to eliminate TB. Conducting advocacy efforts to gain political support is a strategic step. The executive and legislative parties must carry out this advocacy to accelerate efforts from a regulatory perspective. Besides that, it is necessary to strengthen the

decentralization of TB services to the primary service level. Exceptional funding support in the treatment of TB is also needed so that programs can run effectively. A cross-sectoral collaboration, including government, academia, business,

Table 2 Relationship of Population, Area, and Population Density to TB Incidence

Variables	p	r
Population (n) ^s	<0.001*	0.866
Area (ha) ^s	0.244	0.095
Population density (n/ha) ^s	<0.001*	0.603

Note: ^snon-parametric Spearman correlation, *significance

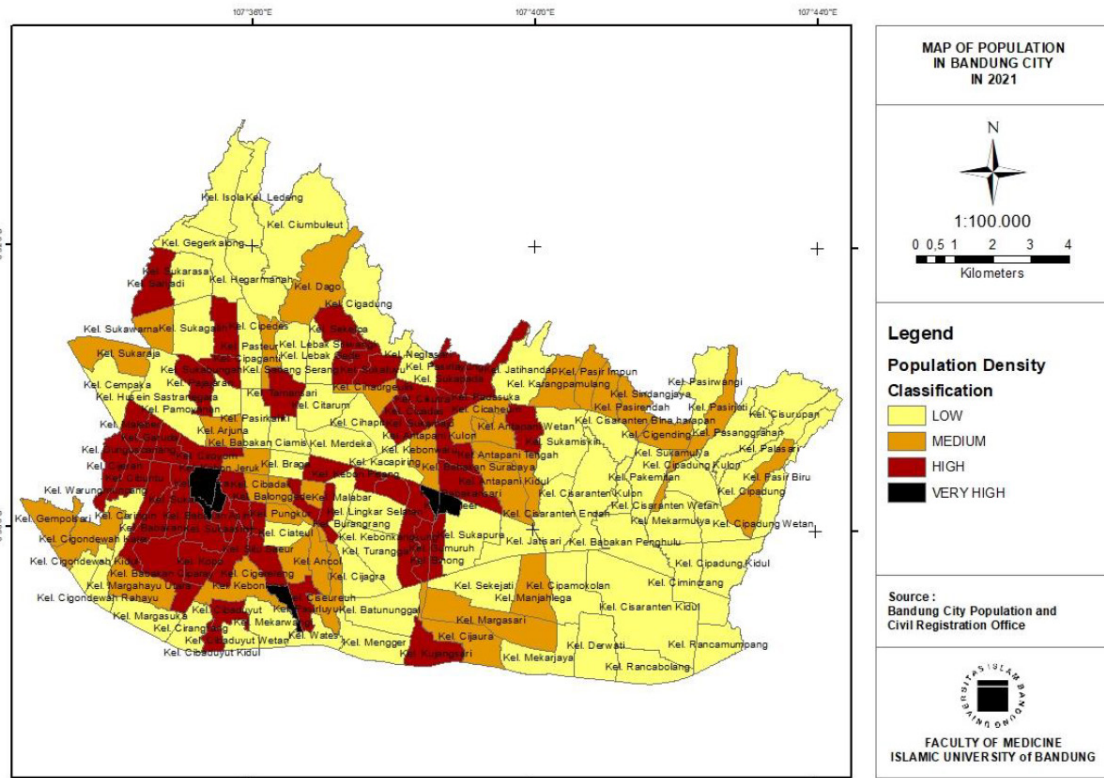


Figure 1 Map of Population Density in Bandung City Year 2021

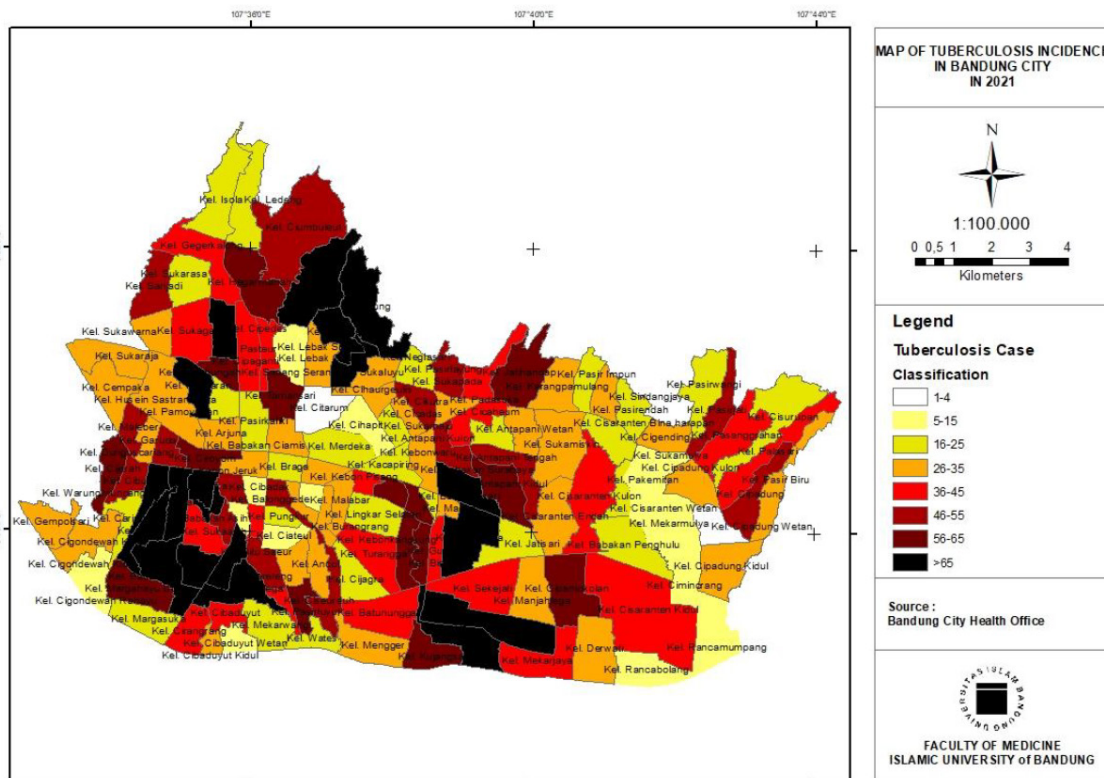


Figure 2 Map of Tuberculosis Incidence in Bandung City Year 2021

society, and the media, is required to build an effective TB control system.

Conclusion

Sub-districts with a high population density show a high incidence of TB. There is a strong and unidirectional relationship between population density and the incidence of TB.

Conflict of Interest

There is no conflict of interest in this research.

Acknowledgment

Thanks were conveyed to the Bandung City Government Health Service and the National Unity and Politics Agency.

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