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ORIGINAL ARTICLE

CORRELATION BETWEEN POPULATION DENSITY, CURE RATE, MORTALITY RATE WITH TB AFB+ INCIDENCE IN SURABAYA 2018-2020

Korelasi Antara Kepadatan Penduduk, Angka Kesembuhan, Angka Kematian Dengan Kejadian TB BTA+ Di Surabaya 2018-2020

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ABSTRACT

Background: In 2020, the World Health Organization (WHO) stated that as many as 10 million people suffered from tuberculosis and 1.5 million died, making it the 13th cause of death in the world's top infectious killer number two after COVID-19. The incidence of Acid-fast bacillus (AFB)+ Tuberculosis TB in Surabaya increased from 2018 to 2020. **Purpose:** This study aimed to describe the distribution of TB AFB+ incidence in Surabaya by mapping and to analyze the relationship between population density, TB AFB+ cure rates, and death rates during TB AFB+ treatment with AFB + TB incidence in 31 sub-districts of Surabaya City from 2018 to 2020. **Methods:** This was a descriptive study with secondary data processing obtained from the Surabaya Health Profile Book 2018-2020 using the Pearson Correlation Product Moment statistical test. **Results:** There was a correlation between population density and the incidence of TB AFB+ in 2018 (0.61), 2019 (0.65), and 2020 (0.62). Then there was a correlation between TB AFB+ cure rate and TB AFB+ incidence in 2018 (0.98), 2019 (0.96), and 2020 (0.91). There was a correlation between the mortality rate during TB AFB+ treatment and the incidence of TB AFB+ in 2018 (0.31), 2019 (0.71), and 2020 (0.88). **Conclusion:** There is a relationship between population density, TB AFB + cure rate, the mortality rate during AFB + TB treatment, and the incidence of AFB + TB in Surabaya.

ABSTRAK

Latar Belakang: *Pada tahun 2020 World Health Organization (WHO) menyatakan sebanyak 10 juta orang mengalami penyakit tuberkulosis dan 1,5 juta orang meninggal menjadikannya sebagai penyebab kematian ke-*

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13 world's top infectious killer nomor dua setelah COVID-19. Angka kejadian TB BTA+ di Surabaya mengalami peningkatan pada tahun 2018-2020. ***Tujuan:*** *Penelitian ini bertujuan untuk menggambarkan persebaran kejadian TB BTA+ di Surabaya dengan bentuk pemetaan serta menganalisis hubungan antara angka kepadatan penduduk, angka kesembuhan TB BTA+, angka kematian selama pengobatan TB BTA+ dengan Kejadian TB BTA+ pada 31 kecamatan di Kota Surabaya dari tahun 2018 sampai 2020.* ***Metode:*** *Desain penelitian yang dilakukan yaitu studi deskriptifdengan pengolahan data sekunder yang diperoleh dari Buku Profil Kesehatan Surabaya tahun 2018-2020 menggunakan uji statistik Pearson Correlation Product Moment.* ***Hasil:*** *Terdapat korelasi antara kepadatan penduduk dengan kejadian TB BTA+ pada tahun 2018 (0,61), 2019 (0,65), dan 2020 (0,62), kemudian terdapat korelasi antara angka kesembuhan TB BTA+ dengan kejadian TB BTA+ pada tahun 2018 (0,98), 2019 (0,96), dan 2020 (0,91). Terdapat korelasi antara angka kematian selama pengobatan TB BTA+ dengan kejadian TB BTA+ pada tahun 2018 (0,31), 2019 (0,71), dan 2020 (0,88).****Kesimpulan:*** *Terdapat hubungan antara kepadatan penduduk, angka kesembuhan TB BTA+, angka kematian saat pengobatan TB BTA+ dengan kejadian TB BTA+ di Surabaya.*

INTRODUCTION

Tuberculosis (TB) is an airborne disease caused by Mycobacterium tuberculosis (MTB). Several species of Mycobacterium, including M. tuberculosis, M. africanum, M. Bovis, and M. Leprae, are known as acid-resistant bacteria. Mycobacterium tuberculosis bacteria are rod-shaped with special properties that are resistant to acid and staining because of their designation as acid-fast bacilli (AFB), with spore-free bacilli that can be eradicated by heating, sunlight, and ultraviolet light because of their ability to survive in dark and damp environments (1) Mycobacterium tuberculosis can affect the lungs (pulmonary TB), or other organs or tissues (extrapulmonary TB). TB AFB+ transmission occurs in the form of phlegm droplets spread through the air, and approximately 3000 sputum sprinklings are produced in one cough (2). Bacteriological examination and chest radiography were performed to diagnose pulmonary tuberculosis in adults. A person was declared positive if the bacteriological examination of two of the three sputum specimens taken in the morning was positive (3). In 2019, Indonesia ranked 2nd after India, with the highest number of TB sufferers worldwide (4). In 2020, there were 10 million tuberculosis patients and 1.5 million deaths, making tuberculosis the 13th leading cause of death and the world's second-leading infectious killer after COVID-19 (WHO, 2020). In 2020, Indonesia had 165,116 TB AFB+ cases, with the highest cases occurring in the provinces of West Java (28,962), East Java (20,962), and Central Java (17,829) (4). More significant and integrated efforts are needed to achieve the SDG targets in 2030, with the challenge of reducing TB prevalence (5). TB control programs effectively suppress the spread rate by identifying and curing patients (6).

Surabaya is one of the cities with 31 subdistricts in East Java Province. The incidence of TB AFB+ in Surabaya increased from 2018 to 2020. AFB + TB in 2018 was 2,086 cases (7). In 2019, the incidence of TB AFB+ increased by 7.48% in 2,242 cases (8). In 2020, there was an increase of 68.90% in 3,788 cases (8). Tuberculosis causes many deaths in developing countries due to delays in diagnosis and treatment (9). Based on data from the Surabaya Health Profile Book 2018, population density is a measure that shows the average population in 1 km²; the more significant the population density, the more people living in the area. Surabaya's population density in Surabaya increased from 2018 to 2020 because Surabaya is a metropolitan city that is the leading destination for finding work and a new place to live. The population density in 2018 was 8,841.36 people/km2, meaning that 1 km2 is inhabited by 8,842 people (10). The population density in 2019 was 8,862.01 people/km2, meaning that every 1 km2 is inhabited by 8,862 people (11). The population density in 2020 is 8,888.19 people/km2, meaning that every 1 km2 is inhabited by 8,888 people (8).

The cure rate is the percentage of TB AFB+ patients who recovered after treatment among all confirmed TB AFB+ patients. The minimum number that must be achieved was 85%. The cure rate was used to determine the results of the treatment that had been done. The number of TB AFB+ cases in 2018 was 3,003, with a total cure rate of 2,111 (70.30%) (10). Surabaya confirmed TB AFB+ in 2019 in as many as 2,998 patients, with 2,399 (80.02%) declared cured (11). The number of TB AFB+ patients in 2020 was 4,943, with 2,810 (56.85%) patients declared cured (8), which shows that the cure rate in 2018-2020 is still below the target of 85% of the total incidence of TB AFB+. The mortality rate during treatment in 2018 occurred with a total of 48 (1.71%) deaths from 2,802 deaths that occurred (10).

In 2019, the mortality rate during treatment was 190 (2.71%) in 7,007 AFB + TB cases (6). In 2020, 179 people (2.25%) died during treatment from 7,950 confirmed cases of AFB + TB (11). Providing social support to TB patients is an effort for them to feel more confident and active in treatment (12). This study was conducted based on a background that affected the incidence of TB AFB+. The purpose of this study was to map the incidence of TB AFB+ and describe its relationship with population density and the rate of cure for TB AFB+. and mortality rate during TB AFB+ treatment in 31 sub-districts in Surabaya 2018-2020.

METHODS

This research is a descriptive qualitative study conducted in 31 sub-districts of Surabaya as the unit of analysis. The data collection technique used in this research is document analysis obtained from the Internet. The incidence of TB AFB+ cases was the determining variable, while the population density, TB AFB+ cure rates, and mortality rates during TB AFB+ treatment were independent variables. The secondary data used in this study were sourced from the Surabaya City Health Profile Book 2018-2020. Retrieval of the secondary data obtained a research ethics permit with ethical number 906/HRECC. FODM/XII/2022 at the Universitas Airlagga Faculty of Dentistry Health Research Ethical Clearance Commission.

The analysis used a mapping software application developed by the World Health Organization (WHO), namely Health Mapper version 4.3, which can be used to implement infectious disease surveillance and data presentation at the national or global level. To determine the correlation between variables in this study the Pearson correlation test was conducted to determine the correlation between variables in this study.

RESULTS

Correlation of Population Density, TB AFB+ Cure Rate, and Mortality Rate During TB AFB+ Treatment with the Incidence TB AFB+ in 2018-2020

Table 1 shows the Pearson correlation test results between Population Density, TB AFB+ Cure Rate, Death Rate During TB AFB+ Treatment with TB AFB+ Incidence 2018-2020.

Distribution and The Correlation Between Population Density with TB AFB+ Incidence 2018-2020

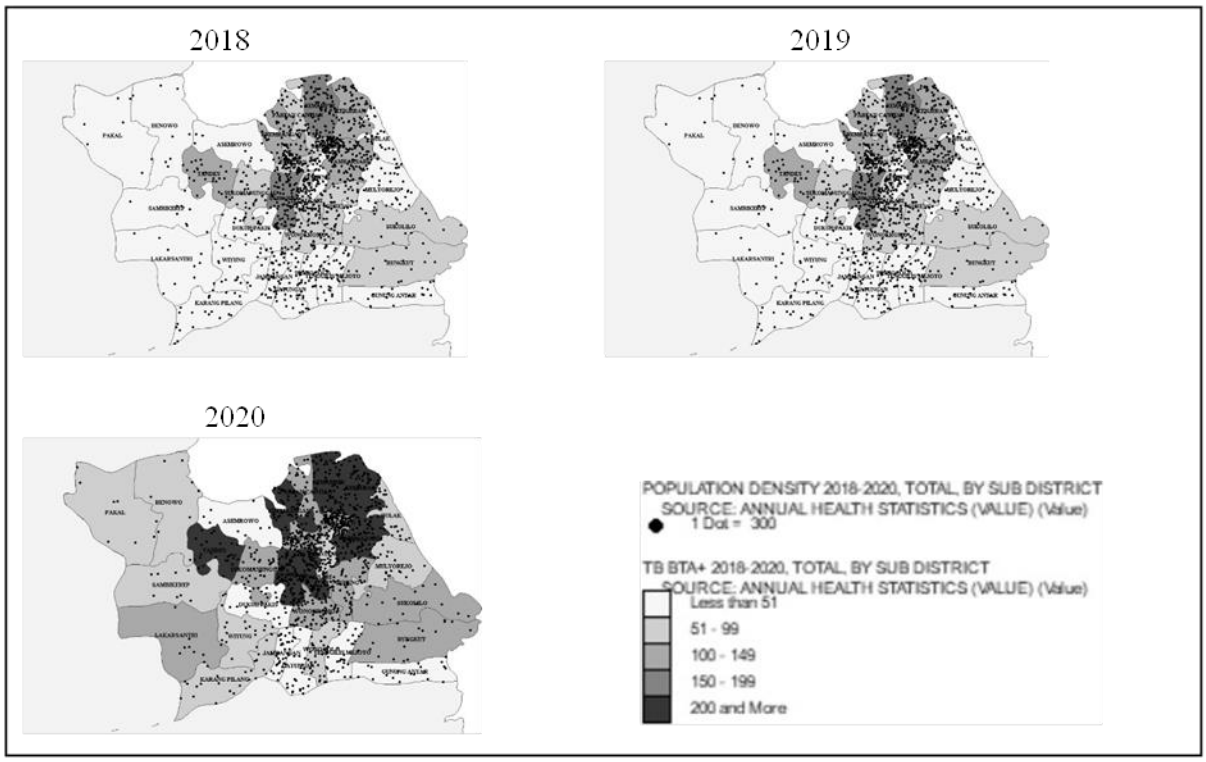
The incidence of TB AFB+ in Surabaya in 2018 reached 2086 cases with a total population density of 369064.04 people/km². Three sub-districts with the most AFB+ TB cases in 2018 were the Sawahan sub-district, Semampir sub-district, and Kenjeran sub-district, with a relatively high population density.

As shown in Figure 1 2019, there was a decrease in the incidence of TB AFB+ in seven subdistricts). The sub-districts that experienced a decrease in the number of TB AFB+ and a decrease in population density were the Lakarsantri, Tegalsari, Bubutan, and Simokerto districts. The two sub-districts experienced a decrease in TB AFB+ but increased population density, such as in Asemworo District and Bulak District. The population density rate in Surabaya in 2019 increased in 21 sub-districts and decreased in 10 sub-districts.

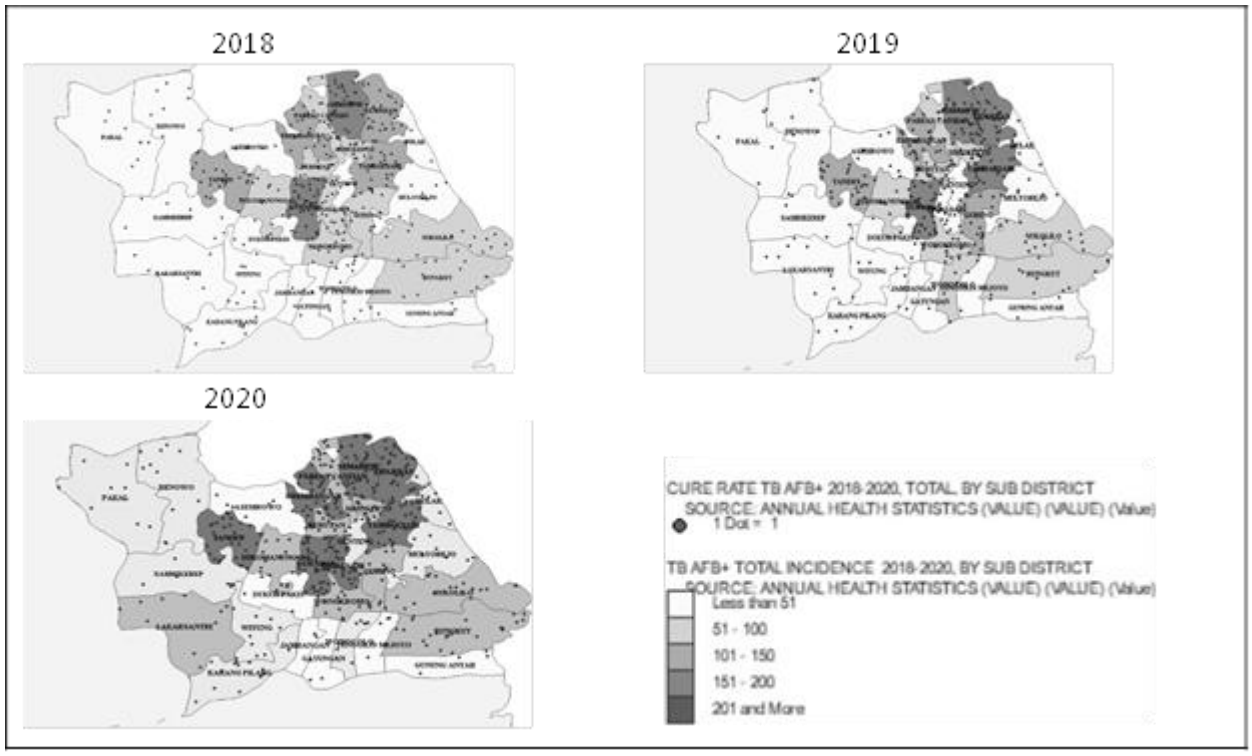
In 2020, the incidence of TB AFB+ decreased in the three sub-districts. The Dukuh Pakis Subdistrict experienced a decrease in TB AFB+ rates followed by a decrease in population density, and the Wonocolo and Jambangan subdistricts also experienced a decrease in TB AFB+ cases, accompanied by an increase in population density from the previous year.

Table 1
Pearson Correlation Test Results between Population Density, TB AFB+ Cure Rate, Death Rate During TB AFB+ Treatment with TB AFB+ Incidence 2018-2020

Factors	Correlation	Coefficient
2018		
Population Density	0.61	Strong
TB AFB+ Cure Rate	0.98	Very Strong
TB AFB+ Mortality Rate During Treatment	0.31	Weak
2019		
Population Density	0.65	Strong
TB AFB+ Cure Rate	0.96	Very Strong
TB AFB+ Mortality Rate During Treatment	0.71	Strong
2020		
Population Density	0.62	Strong
TB AFB+ Cure Rate	0.91	Very Strong
TB AFB+ Mortality Rate During Treatment	0.88	Very Strong

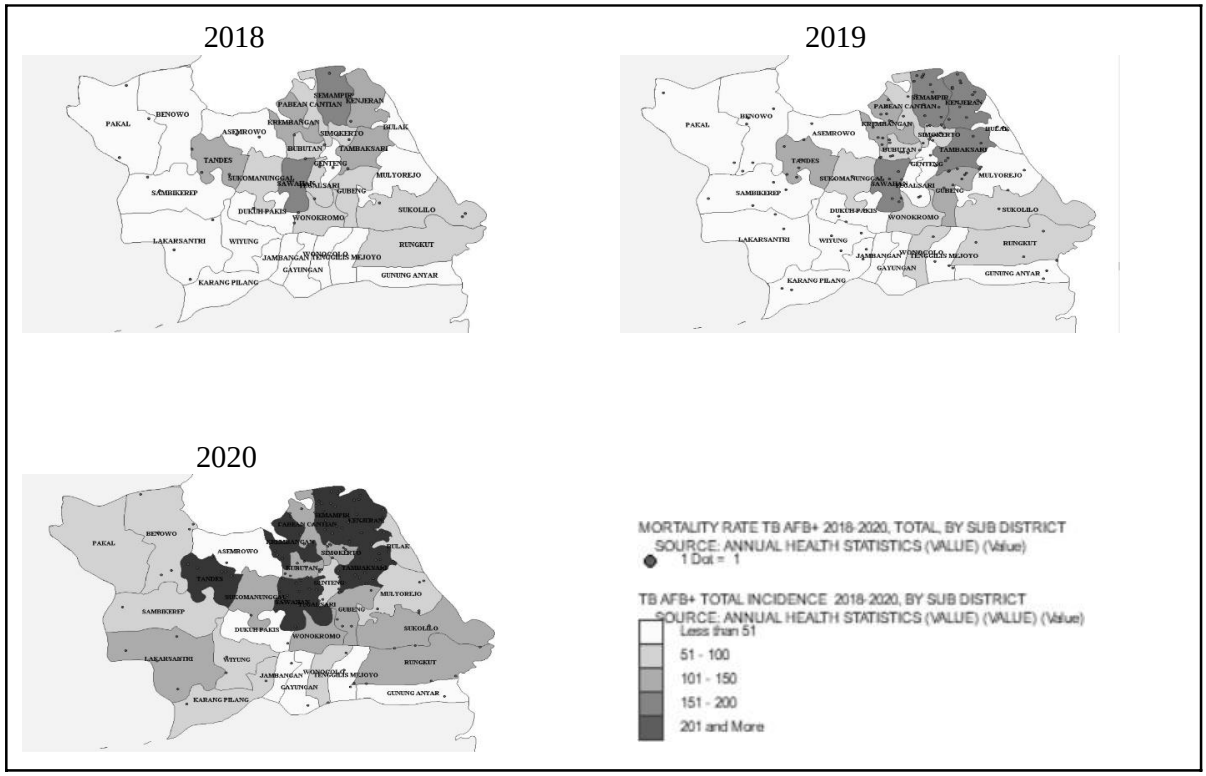


Source: Surabaya Health Profile Book, 2018-2020
Figure 1. TB AFB+ Incidence Distribution Map and Population Density Level in 2018-2020



Source: Surabaya Health Profile Book, 2018-2020

Figure 2. TB AFB+ Incidence Distribution Map and TB AFB+ Cure Rate in 2018-2020



Source: Surabaya Health Profile Book, 2018-2020

Figure 3. TB AFB+ Incidence Distribution Map and Mortality Rate During Treatment in 2018-2020

Distribution and The Correlation of TB AFB+ Cure Rate with TB AFB+ Incidence 2018-2020

In 2018, the incidence of TB AFB+ reached 2,086 cases with 1,705 cure rates. A total of 29 sub-districts in Surabaya achieved a cure rate of > 50%. The Tenggilis District achieved a 100% cure rate because the total cure rate was the same as the number of AFB+ TB cases. There was one sub-district with 15 (36.11%) TB AFB+ cure rates in the Genteng sub-district. The highest cure rate was 181 (89.12%) in the Sawahan sub-district, but the incidence of TB AFB+ was also the highest in Surabaya, with 198 cases of TB AFB+.

The total cure rate in 2019 was 1,972, which showed an increase in the TB AFB + cure rate in Surabaya compared to the previous year, but was followed by an increase in the incidence of TB AFB+ in Surabaya. Seven sub-districts experienced a decrease in the cure rate and a decrease in the incidence of TB AFB+. A total of 29 sub-districts in Surabaya achieved a cure rate of >50%. The Pabean Cantikan sub-district reached a cure rate of 100 % %because the number of cures was the same as the number of TB AFB+ cases. The Tegalsari sub-district had a cure rate of 106.90%, and the incidence of TB AFB+ in the sub-district decreased in 2019.

The total cure rate for TB AFB+ in 2020 has increased compared to 2019. An increase in the incidence of TB AFB+ in Surabaya accompanied this increase. Six sub-districts experienced a decrease in cure rate, two of which also experienced a decrease in the incidence of TB AFB+. Five of the six sub-districts experienced a decrease in the cure rate and reached a cure rate above 50%, but there was still one sub-district with a cure rate of 24.57%. An increase in the cure rate for TB AFB+ was found in 24 sub-districts, whereas the incidence of TB AFB+ also increased in 22 sub-districts.

Distribution and The Correlation Between TB AFB+ Mortality Rate During Treatment with TB AFB+ Incidence 2018-2020

TB is a global concern, seen from the number of targets for sustainable development and the reduction in the incidence of TB (13). The number of TB AFB+ cases 2018 was 2,086, and the mortality rate during TB AFB+ treatment reached 32 deaths in Surabaya. Fourteen sub-districts were found to have no death cases during TB AFB+ treatment. The highest mortality rate during TB AFB+ treatment was observed in the five sub-districts. An increase in mortality occurred in 2019, with a total death rate of 146 deaths during TB AFB+ treatment in Surabaya. The increase in the mortality rate during TB AFB+ treatment occurred in 25 sub-districts, with 18 sub-districts, followed by an increase in the incidence of TB AFB+. There were no deaths during TB AFB+ treatment in the Gayungan and Wonocolo subdistricts. There was an increase in the mortality rate during treatment in 14 sub-districts with 13 sub-districts, followed by an increase in TB AFB+ rates in 2020.

DISCUSSION

The distribution and size of the population determine the population density in an area. Areas with high population density tend to have crowded living areas, slums, poor sanitation, and nutrition; therefore, exposure to TB will be easily transmitted from one human to another in an area with a high population density (14). TB AFB+ can quickly spread if there is intensive contact with victims in the same house (15). Based on research conducted by Sasmita et al (16) , 95 cases of TB AFB+ were found in 2013-2015 98% of cases occurred in areas with high population density, and 2% occurred in areas with moderately dense population density.The results of this study are in line with research conducted by Daniel et al (17), , who stated that there was a significant relationship between population density and new cases of pulmonary TB AFB+ in Nigeria, which has a positive pattern and an increase in population density in new cases of pulmonary TB AFB+.

The results of this study are also in line with the research conducted by Srisantyorini et al (18), and the results of the correlation and regression analysis of population density in 2017-2019 with new cases of pulmonary TB AFB+ in 2017-2019 showed a strong correlation (r = 0.70) and a positive value. However, the findings of this study contradict those of Tabilantang et al (19), who conducted a correlation test between population density and the number of TB AFB+ cases in Manado City between 2015 and 2017. Every year, the population density in each sub-district does not change, but the incidence of TB AFB+ does change. There was no significant difference between areas with high and low population densities for positive smear-positive PTB cases. Population density affects indoor air circulation; this condition can potentially increase the risk and intensity of infection, facilitating disease transmission (20).

Distribution of TB AFB+ Incidence and TB AFB+ Cure Rate

The cure rate for TB AFB+ shows the percentage of treatment for TB patients who have their calculations; patients with TB AFB+ who receive treatment with TB AFB+ with retreatment have different categories. TB can be prevented or cured. Patients with TB AFB+ recovered when they had completed all treatments and had at least two negative sputum examinations in a row at the end of treatment or one month before the treatment period and after passing the intensive stage. Approximately 85% of people with TB can be successfully treated with a drug regimen within six months, and treatment can help limit the transmission of TB infection. TB treatment has prevented >60 million deaths, although access and coverage are still lacking (21).

The increase in the incidence of TB AFB+ in Surabaya in 2018-2020 was followed by an increase in the cure rate for TB AFB+, which the high treatment coverage for patients with confirmed TB AFB+ could influence. Previous studies have shown that medication adherence and the presence of medication supervisors significantly influence the recovery of TB patients (22). Patient compliance in taking the medication regularly during the implementation of treatment and the role of health workers and family members are critical in maximizing efforts to increase the TB AFB + cure rate (23).

Distribution of TB AFB+ Incidence and TB AFB+ Mortality Rate During Treatment

Delays in the diagnosis of TB are a problem in both developed and developing countries, starting from patients complaining of symptoms to administering treatment. Early diagnosis is needed to reduce TB mortality through bacteriological examination, which can determine the number and ability of bacteria to transmit TB germs (3). In 2018 the success rate of treatment for TB patients worldwide was 59% (24). Deaths due to tuberculosis have increased to 1.2 million cases, plus 0.25 million deaths occurred in individuals with HIV; the high mortality rate due to tuberculosis has made TB one of the top 10 infectious diseases that cause death worldwide. In 2020, the tuberculosis mortality rate in Indonesia reached 34 cases per 100,000 people (21). Efforts to detect and treat TB must be carried out because the transition to TB AFB+ can be extended. Patients who are irregular or drop out of treatment will be resistant to TB germs, so that treatment costs will be higher, and healing time will be relatively long (25). Individuals with TB AFB+ infection are still separated from the community through treatment efforts in hospitals and other health services to reduce the mortality rate and incidence of TB AFB+ (26). In South Africa, there has been a reduction in the death rate during TB treatment, and further interventions are being implemented to address specific risk factors for death from TB (27). The correlation between the increase in the mortality rate during TB AFB+ treatment and the incidence of TB AFB+ can be seen in the Surabaya health profile data, which contain an increase in the incidence of TB AFB+, followed by the mortality rate during TB AFB+ treatment.

Research Limitation

Data analysis based on the incidence of TB AFB+, population density, the cure rate for AFB + TB, and mortality rates during TB AFB+ treatment in Surabaya from 2018 to 2020 were secondary data sourced from the Surabaya Health Profile Report 2018, 2019, and 2020. The secondary data gathered in the health profile report corresponded to the actual situation, directly collected and entered by workers. As secondary data were used as the primary source, direct data were not collected.

CONCLUSION

There was a strong correlation between the population density and TB AFB+ in 2018, 2019, and 2020. The correlation between the TB AFB and the cure rate was solid in 2018, 2019, and 2020. The correlation between the mortality rate during TB AFB+ treatment and the incidence of TB AFB+ was weak in 2018, firm in 2019, and very strong in 2020.

The public needs education about screening as early as possible if TB symptoms are experienced, both AFB+ and AFB-. It is an effort to increase the cure rate because treatment can be carried out as soon as possible and can reduce the mortality rate of TB AFB+ due to late detection and treatment. Improvements in the cure rate for BTA+ TB should be pursued, especially in areas with a high population density.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this study.

AUTHOR CONTRIBUTIONS

All authors contributed to the completion of this research from beginning to end. LN: Collecting and analyzing data with software, making maps, writing, and improving articles. LY: Provides direction during the drafting, reviewing, editing, and revising.

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