REKAPITULASI BUKTI REVIEW DARI JURNAL INTERNASIONAL (KEMAS)

Penulis Utama : Musfirah, S.Si., M.Kes.

No	Tanggal	Uraian Kegiatan
1	25 Januari 2021	Submit Manuskrip Via OJS
2	15 Maret 2021	Review Ke-1 Manuskrip
3	6 Mei 2021	Revisi Ke-1 Manuskrip Versi Author
4	24 Juni 2021	Review Ke-2 Manuskrip
5	9 Juli 2021	Revisi Ke-2 Manuskrip Versi Author
6	11 Agustus 2021	Review Ke-3 Manuskrip
7	16 Agustus 2021	Revisi Ke-3 Manuskrip Versi Author
8	30 Agustus 2021	Review Ke-4 Manuskrip
9	21 September 2021	Revisi Ke-4 Manuskrip Versi Author
10	27 September 2021	Review *Proofreading*
11	5 Oktober 2021	Revisi *Proofreading* Versi Author
12	9 November 2021	Pemberitahuan Administrasi Jurnal KEMAS
13	15 November 2021	*Feedback Author :* Surat bebas plagiat dan kesediaan pembayaran submit KEMAS
14	25 November 2021	Bukti Bayar Publikasi Kemas
15	2 Desember 2021	*Feedback* Pengelola Jurnal Kemas Tentang Pembayaran Publikasi
16	10 Desember 2021	Pemberitahuan Layak Muat Artikel 17.3 Januari 2022 (LoA Artikel)
17	24 Januari 2022	Artikel ilmiah dipublikasikan secara *online* oleh KEMAS

KEMAS
JURNAL KESEHATAN MASYARAKAT

#28692 Review

SUMMARY **REVIEW** EDITING

Submission

Authors	Musfirah Musfirah, Desi Nurfita, Ahmad Faizal Rangkuti
Title	Analysis of Healthy Housing and TB Prevalence in Yogyakarta City
Section	Articles
Editor	Nur Siyam, S.K.M, M.PH

Peer Review

Round 1

Review Version	28692-72843-1-RV.DOCX 2021-01-25
Initiated	—
Last modified	—
Uploaded file	None

Editor Decision

Decision	Accept Submission 2021-12-02
Notify Editor	Editor/Author Email Record 2021-05-06
Editor Version	28692-75143-1-ED.DOCX 2021-03-15 28692-75143-2-ED.DOCX 2021-06-24 28692-75143-3-ED.DOCX 2021-08-11 28692-75143-4-ED.DOCX 2021-08-30 28692-75143-5-ED.DOCX 2021-09-27
Author Version	28692-77230-1-ED.DOCX 2021-05-06 DELETE 28692-77230-2-ED.DOCX 2021-07-09 DELETE 28692-77230-3-ED.DOCX 2021-08-16 DELETE 28692-77230-4-ED.DOCX 2021-09-21 DELETE 28692-77230-5-ED.DOCX 2021-10-05 DELETE
Upload Author Version	Choose File No file chosen Upload

ISSN: 2355-3596

1. Submit Manuskrip Via OJS

Analysis of Healthy Households and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Ahmad Dahlan University, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. One of the determinants of factors that affect the degree of public health is environmental health. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on TB data in DIY in 2019, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The research method used is quantitative descriptive analysis of secondary data. The data used are data on the physical environment of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data in Yogyakarta City. The research sample comes from secondary data spread over 18 Puskesmas Kota Yogyakarta. The data processed are data on healthy houses and data on cases of BTA (+) in the study scope. The sampling technique used was total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher the percentage of unhealthy housing coverage, the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy house has a relationship with the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Households, TB

Introduction

Tuberculosis (TB) infection by the bacteria Mycrobacterium tuberculosis, whose spread is influenced by environmental factors as an infectious disease through environmental compartments by air (Muslimah and Dwi, 2019; Girsang, 2013). This environmental-based disease still reaches high rates every year and is an important public health problem in Indonesia (Sugandi, et.al., 2018). WHO estimates that in 2017 the TB morbidity rate reached 9 million people and the mortality rate was 1.6 million people, in Southeast Asia the morbidity was 56% of the total 9 million people with TB in 2015 (WHO, 2015).). The number of pulmonary TB patients in Indonesia ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). The number of deaths from suffering from TB is quite large throughout the world. A total of 1.5 million people died from TB in 2018 (including 251,000 people with HIV). TB is one of the top 10 causes of death and the leading cause of an infectious agent (above HIV / AIDS) worldwide (WHO, 2019).

Based on the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 (Yogyakarta City Health Office, 2019) TB BTA (+) cases were still found in Yogyakarta City. The number of TB BTA (+) in Yogyakarta City has increased for three consecutive months, namely 32 cases in May, 37 cases in June, and 40 cases in July 2019.

One of the factors that also affect TB cases is environmental factors which include the physical environment. Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people. This is reinforced by Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is not good in ventilation settings can facilitate the spread of TB. , The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017. The quality of the physical environment of the house is not good, will add to these risk factors. This has attracted the attention of the research team to further examine from the perspective of the quality of the households environment as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination. End TB 2030) which is in line with national programs and SDGs goals.

Method

The research method used is quantitative descriptive analysis. The data used is data on the physical environment of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The research sample comes from secondary data spread over 18 Puskesmas Kota Yogyakarta. The data processed are data on healthy houses and data on cases of BTA (+) in the study scope. The sampling technique used is the total sampling technique, so that the sample size is the same as the population, namely all secondary data and information from all health centers in the city of Yogyakarta. The data analysis used was descriptive analysis and trend / trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients found and is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There are four types of patients, including new patients, relapse patients, patients with a history of TB treatment other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019:

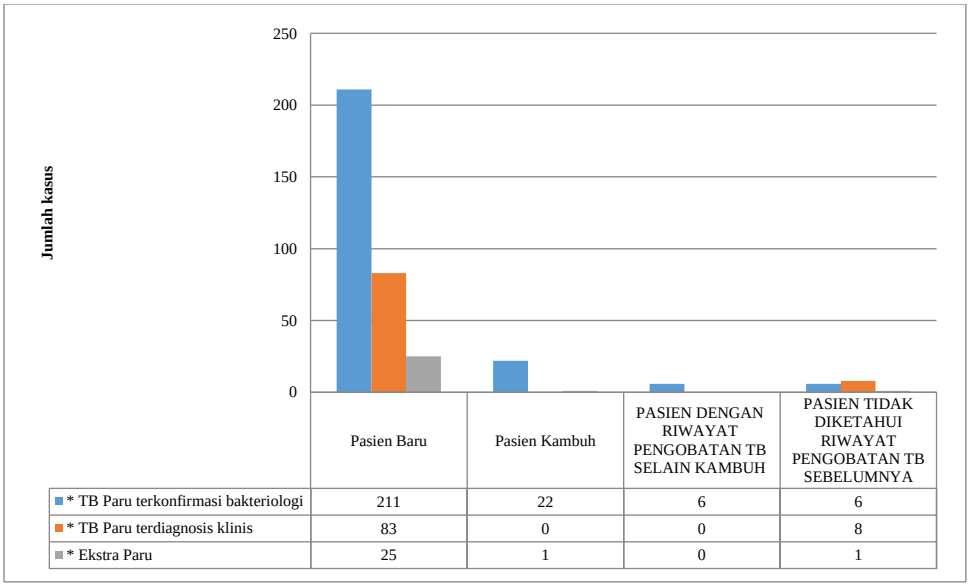


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office for the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective puskesmas. Based on 2020 data, there is a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

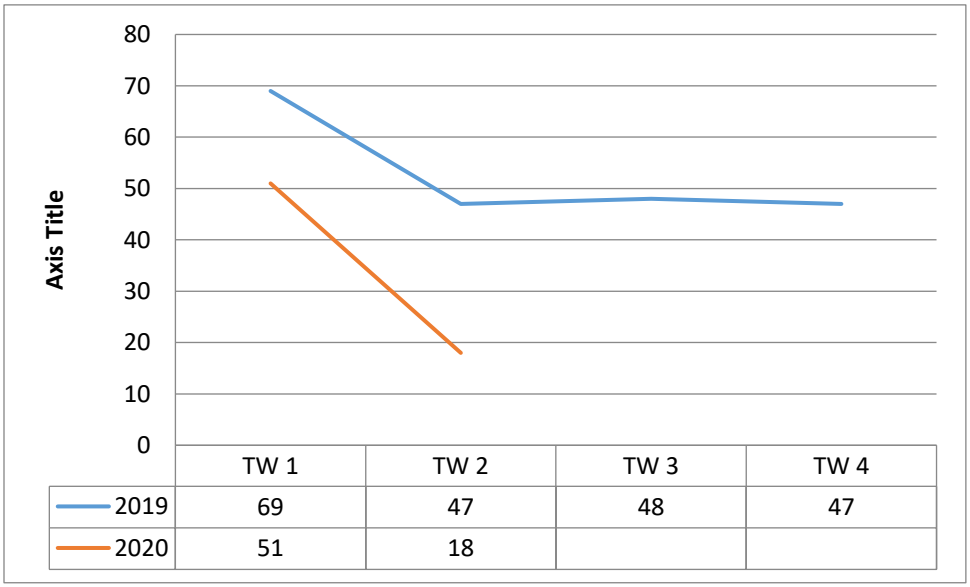


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The working area of the Yogyakarta City Health Office has 18 health centers. Each puskesmas carries out its TB surveillance function regularly. The following is a graph of new bacteriological confirmed pulmonary TB cases based on health centers in 2019:

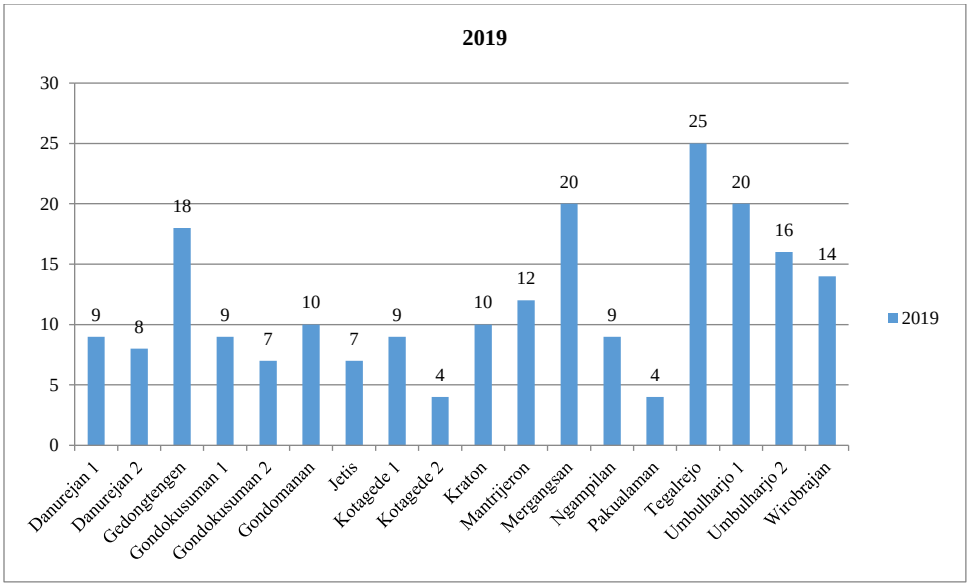


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers in 2019

TB case data in 2020 in detail are listed in table 1 below which contains data on bacteriological confirmed New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

Table 1. Data for 7 (Seven) Highest TB Cases Based on Puskesmas data for the period January to June 2020

TW	PUBLIC HEALTH CENTER	NEW PATIENT (bacteriological confirmation)	THE PATIENT RECURS	PATIENTS OF TREATMENT HISTORY	PATIENTS TAMPA HISTORY OF TREATMENT
I	Wirobrajan	4	0	0	2
II		1	0	0	0
I	Gondokusuman I	7	1	1	0
II		0	0	0	0
I	Kotagede I	6	0	2	0
II		3	0	0	0
I	Umbulharjo I	6	1	0	0
II		1	0	0	0
I	Stimulating	3	0	0	0
II		4	0	0	0
I	Gondomanan	3	1	1	0
II		0	1	0	0
I	Mantrijeron	4	0	0	0
II		0	1	0	3

Based on the data Table 1, the highest pulmonary TB cases were in the Kotagede I health center area and the lowest was found in the Gondomanan health center area. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.

The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Kemenkes RI, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited cadre network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the Puskesmas on the grounds that they feel healthy, enter the area with PSBB regulations, worry about contracting Covid-19 and personal safety when going to the Puskesmas, or restrictions from the Puskesmas examination (Kemenkes RI, 2020).

TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020).

Analysis of the Physical Environment of Households in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables that influence TB transmission. Based on Mahpudin's research, there is a relationship between the households environment and the incidence of TB. The households environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact(Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy households reached 96.29%. Following are the results of coverage of healthy households according to health centers in Yogyakarta City in 2018 in table 2 below:

Table 2. Data on the results of coverage of healthy households according to health centers in Yogyakarta City in 2018

Public health center	Total Household	A house that meets the requirements for a healthy households	
		total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Stimulating	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66

Table 2 (Continued). Data on the results of coverage of healthy households according to health centers in Yogyakarta City in 2018

Public health center	Total House	A house that meets the requirements for a healthy households	
		total	%
Look	3,422	3,392	99.12
Nails	3,028	3,027	99.97
Tegalrejo	6,271	5,860	93.45
Umbulharjo 1	10,652	10,616	99.96
Umbulharjo 2	4,516	4,514	99.96
Wirobrajan	4,381	3,891	88.82

One of the factors that also affects TB cases is environmental factors thatcovering the physical environment. Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Overcrowded housing and poor ventilation increase both the likelihood of exposure to Mycobacterium tuberculosis (MTB) and progression to disease (Srivastava, et.al., 2015).

Analysis of the trend of the physical environment for indicators of a healthy households with TB prevalence in the city of Yogyakarta

Data on the healthy house for the "unhealthy house" category is obtained from the difference between the 100% coverage of a healthy house and the actual coverage of a healthy house. If the “unhealthy house” data is juxtaposed with the TB incidence (prevalence) data, the following graph will form:

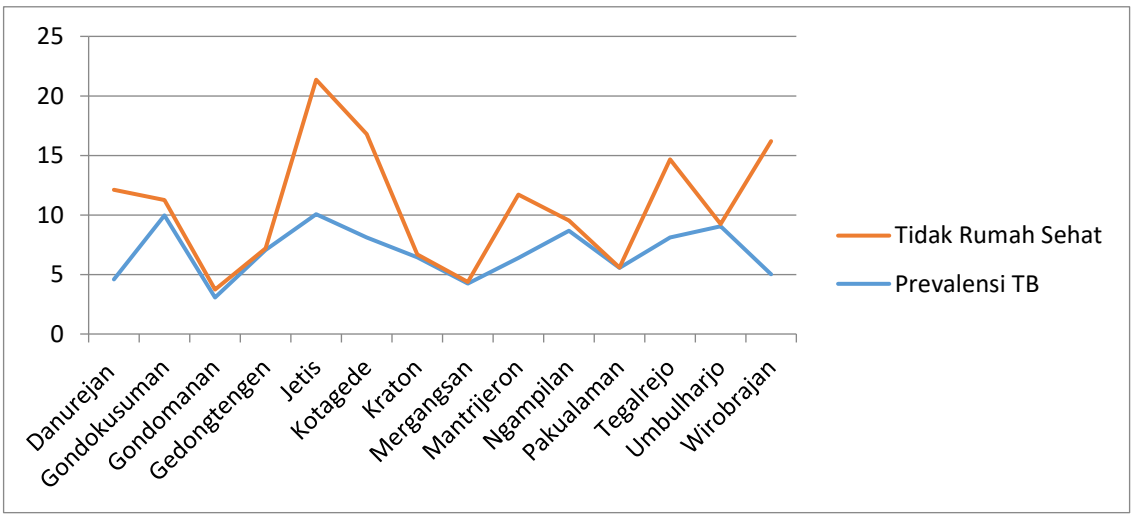


Figure 4. Graph of “unhealthy” data trends and TB prevalence based on public health centers in 2018

Based on the graph above, it can be seen that the tendency of the data is that the higher the number of unhealthy houses, the higher the TB prevalence rate. This can be seen from the trend analysis in the chart

above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa.

This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the house environment is seen from secondary data on the number of unhealthy houses, where indicators of a healthy house include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between an unhealthy house and the incidence of TB. The higher the number of unhealthy houses, the higher the TB prevalence rate. This can be seen from the trend / trend analysis chart trend carried out.

The results of this study are in line with research conducted by Sugandi et. Al., (2018) that the condition of a healthy house plays a role in the incidence of TB in Bandung as much as 73.75% of the condition of the population's house in the good category. Every family who gets a case of a child with TB due to the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB.(Harfadhilah, et.al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB(Musadad, 2006).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density. Of the four factors, it can be a factor in the incidence of TB.

This is consistent with several studies, including research by Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB in the work area of Puskesmas Perak, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven. (Muslimah and Dwi, 2019). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis. There is no relationship between floor type and the incidence of pulmonary tuberculosis(Hamidah, et.al., 2015). Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. The lighting can enter through ventilation holes, windows, or doors that are opened, otherwise it can enter through glass tiles(MOH RI, 2014).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous research that there is a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Minister of Health of the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser the occupancy in one house, the greater the interaction that occurs between residents in the one house. This facilitates the spread of disease, especially TB. Similar research results were obtained from Arifin, et. al., (2020) that the houses of respondents with households pulmonary tuberculosis have not met the requirements because the results of the assessment were that patients with pulmonary TB tended to have houses that did not meet the requirements. The physical condition of the house that does not meet the requirements has a risk of developing pulmonary TB 3 times greater than the physical condition of the house that meets the requirements.

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher the percentage of unhealthy housing coverage, the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy households is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Arifin, S., Marlinae, L., Husaini, Khairiyatie, L, Waskito, A., (2020). Implementation of the Healthy Households Development Program to Accelerate the Health Status of TB Children. *PRO SEJAHTERA (Proceedings of the National Seminar on Community Service).* Volume 2 Pages 43-51 March 2020.

MOH RI. (2014). *National TBC Countermeasures*. Jakarta: MOH RI.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Girsang M. (2013). *Mycobacterium causes tuberculosis and recognizes its growth properties in the laboratory.* Department of Health.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major*. 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Ministry of Health RI. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health of the Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J.* 2007; 1 (4): 14.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol*. 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health*. 2019; 11 (1): 26.

Pambudi, I., (2020). TB Service Protocol during the Covid Pandemic, Dit. P2PML, Directorate General of P2P, Ministry of Health of the Republic of Indonesia.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. *Dynamics of Human Health*; 2015: 2 (4). ISSN 2382-1019.

Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS*: Journal of Public Health, KEMAS 9 (1) (2013) 85-91.

WHO. (2015). *Global Tuberculosis Report 2015*. 20th ed. NASN school nurse (Print). Geneva: World Health Organization.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

World Health Organization. (2019). *Tuberculosis.* [Internet]. Available from:https://www.who.int/news-room/fact-sheets/detail/tuberculosis

Analysis of Healthy Households and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Ahmad Dahlan University, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. One of the determinants of factors that affect the degree of public health is environmental health. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on TB data in DIY in 2019, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The research method used is quantitative descriptive analysis of secondary data. The data used are data on the physical environment of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data in Yogyakarta City. The research sample comes from secondary data spread over 18 Puskesmas Kota Yogyakarta. The data processed are data on healthy houses and data on cases of BTA (+) in the study scope. The sampling technique used was total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher the percentage of unhealthy housing coverage, the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy house has a relationship with the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Households, TB

Introduction

Tuberculosis (TB) infection by the bacteria Mycrobacterium tuberculosis, whose spread is influenced by environmental factors as an infectious disease through environmental compartments by air (Muslimah and Dwi, 2019; Girsang, 2013). This environmental-based disease still reaches high rates every year and is an important public health problem in Indonesia (Sugandi, et.al., 2018). WHO estimates that in 2017 the TB morbidity rate reached 9 million people and the mortality rate was 1.6 million people, in Southeast Asia the morbidity was 56% of the total 9 million people with TB in 2015 (WHO, 2015).). The number of pulmonary TB patients in Indonesia ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). The number of deaths from suffering from TB is quite large throughout the world. A total of 1.5 million people died from TB in 2018 (including 251,000 people with HIV). TB is one of the top 10 causes of death and the leading cause of an infectious agent (above HIV / AIDS) worldwide (WHO, 2019).

Based on the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 (Yogyakarta City Health Office, 2019) TB BTA (+) cases were still found in Yogyakarta City. The number of TB BTA (+) in Yogyakarta City has increased for three consecutive months, namely 32 cases in May, 37 cases in June, and 40 cases in July 2019.

One of the factors that also affect TB cases is environmental factors which include the physical environment. Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people. This is reinforced by Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is not good in ventilation settings can facilitate the spread of TB. , The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017. The quality of the physical environment of the house is not good, will add to these risk factors. This has attracted the attention of the research team to further examine from the perspective of the quality of the households environment as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination. End TB 2030) which is in line with national programs and SDGs goals.

Method

The research method used is quantitative descriptive analysis. The data used is data on the physical environment of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The research sample comes from secondary data spread over 18 Puskesmas Kota Yogyakarta. The data processed are data on healthy houses and data on cases of BTA (+) in the study scope. The sampling technique used is the total sampling technique, so that the sample size is the same as the population, namely all secondary data and information from all health centers in the city of Yogyakarta. The data analysis used was descriptive analysis and trend / trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients found and is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There are four types of patients, including new patients, relapse patients, patients with a history of TB treatment other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019:

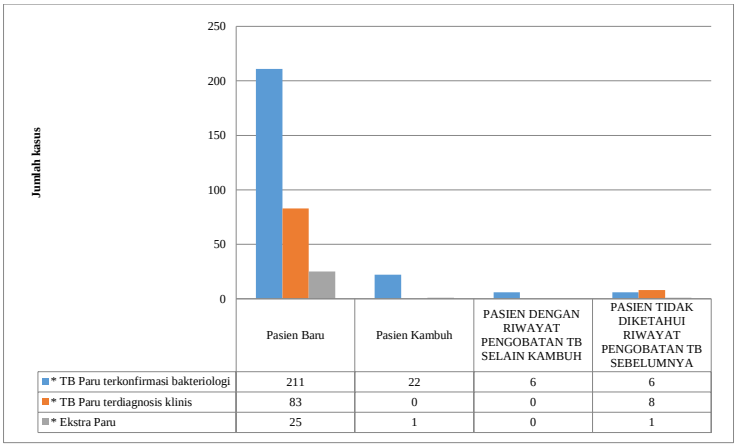


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office for the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective puskesmas. Based on 2020 data, there is a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

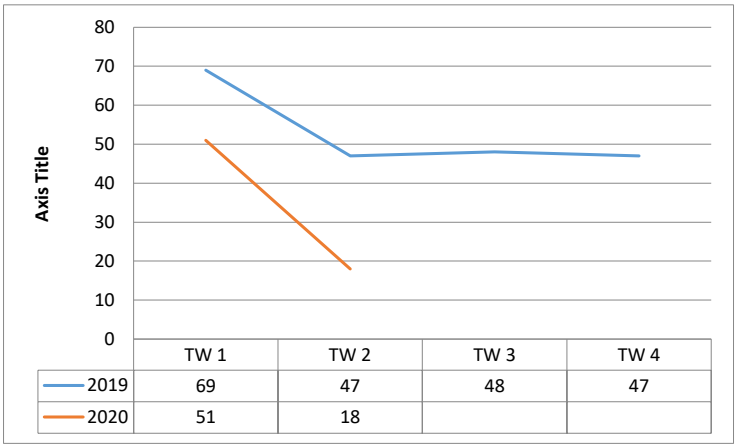


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The working area of the Yogyakarta City Health Office has 18 health centers. Each puskesmas carries out its TB surveillance function regularly. The following is a graph of new bacteriological confirmed pulmonary TB cases based on health centers in 2019:

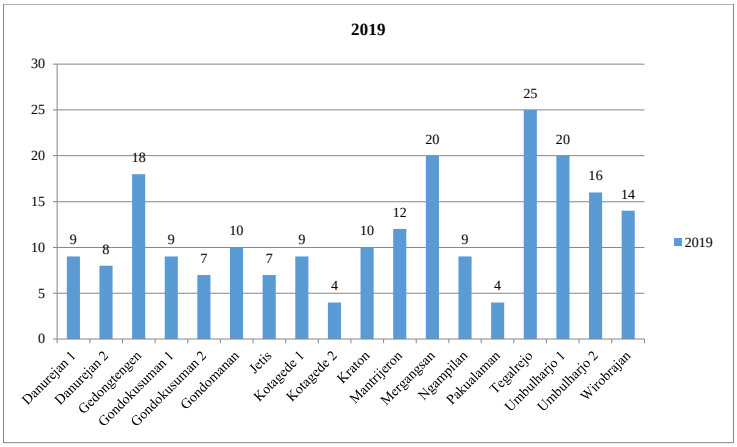


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers in 2019

TB case data in 2020 in detail are listed in table 1 below which contains data on bacteriological confirmed New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

Table 1. Data for 7 (Seven) Highest TB Cases Based on Puskesmas data for the period January to June 2020

TW	PUBLIC HEALTH CENTER	NEW PATIENT (bacteriological confirmation)	THE PATIENT RECURS	PATIENTS OF TREATMENT HISTORY	PATIENTS TAMPA HISTORY OF TREATMENT
I	Wirobrajan	4	0	0	2
II		1	0	0	0
I	Gondokusuman I	7	1	1	0
II		0	0	0	0
I	Kotagede I	6	0	2	0
II		3	0	0	0
I	Umbulharjo I	6	1	0	0
II		1	0	0	0
I	Stimulating	3	0	0	0
II		4	0	0	0
I	Gondomanan	3	1	1	0
II		0	1	0	0
I	Mantrijeron	4	0	0	0
II		0	1	0	3

Based on the data Table 1, the highest pulmonary TB cases were in the Kotagede I health center area and the lowest was found in the Gondomanan health center area. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.

The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Kemenkes RI, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited cadre network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the Puskesmas on the grounds that they feel healthy, enter the area with PSBB regulations, worry about contracting Covid-19 and personal safety when going to the Puskesmas, or restrictions from the Puskesmas examination (Kemenkes RI, 2020).

TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020).

Analysis of the Physical Environment of Households in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables that influence TB transmission. Based on Mahpudin's research, there is a relationship between the households environment and the incidence of TB. The households environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact(Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy households reached 96.29%. Following are the results of coverage of healthy households according to health centers in Yogyakarta City in 2018 in table 2 below:

Table 2. Data on the results of coverage of healthy households according to health centers in Yogyakarta City in 2018

Public health center	Total Household	A house that meets the requirements for a healthy households	
		total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Stimulating	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66

Table 2 (Continued). Data on the results of coverage of healthy households according to health centers in Yogyakarta City in 2018

Public health center	Total House	A house that meets the requirements for a healthy households	
		total	%
Look	3,422	3,392	99.12
Nails	3,028	3,027	99.97
Tegalrejo	6,271	5,860	93.45
Umbulharjo 1	10,652	10,616	99.96
Umbulharjo 2	4,516	4,514	99.96
Wirobrajan	4,381	3,891	88.82

One of the factors that also affects TB cases is environmental factors thatcovering the physical environment. Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Overcrowded housing and poor ventilation increase both the likelihood of exposure to Mycobacterium tuberculosis (MTB) and progression to disease (Srivastava, et.al., 2015).

Analysis of the trend of the physical environment for indicators of a healthy households with TB prevalence in the city of Yogyakarta

Data on the healthy house for the "unhealthy house" category is obtained from the difference between the 100% coverage of a healthy house and the actual coverage of a healthy house. If the “unhealthy house” data is juxtaposed with the TB incidence (prevalence) data, the following graph will form:

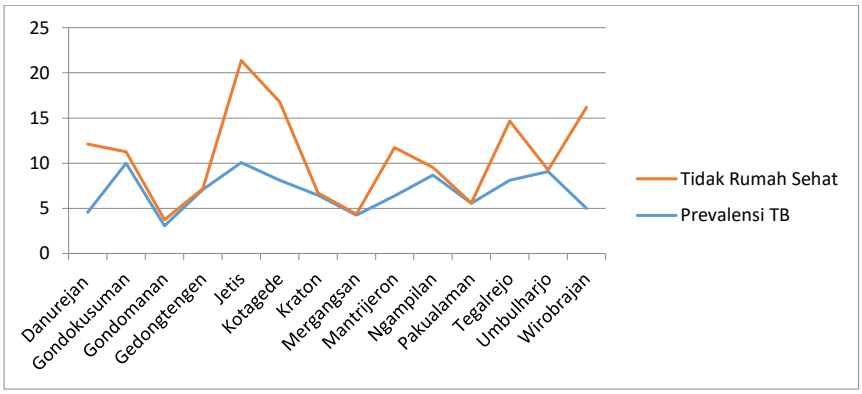


Figure 4. Graph of “unhealthy” data trends and TB prevalence based on public health centers in 2018

Based on the graph above, it can be seen that the tendency of the data is that the higher the number of unhealthy houses, the higher the TB prevalence rate. This can be seen from the trend analysis in the chart

above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa.

This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the house environment is seen from secondary data on the number of unhealthy houses, where indicators of a healthy house include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between an unhealthy house and the incidence of TB. The higher the number of unhealthy houses, the higher the TB prevalence rate. This can be seen from the trend / trend analysis chart trend carried out.

The results of this study are in line with research conducted by Sugandi et. Al., (2018) that the condition of a healthy house plays a role in the incidence of TB in Bandung as much as 73.75% of the condition of the population's house in the good category. Every family who gets a case of a child with TB due to the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB.(Harfadhilah, et.al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB(Musadad, 2006).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density. Of the four factors, it can be a factor in the incidence of TB.

This is consistent with several studies, including research by Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB in the work area of Puskesmas Perak, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven. (Muslimah and Dwi, 2019). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis. There is no relationship between floor type and the incidence of pulmonary tuberculosis(Hamidah, et.al., 2015). Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. The lighting can enter through ventilation holes, windows, or doors that are opened, otherwise it can enter through glass tiles(MOH RI, 2014).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous research that there is a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Minister of Health of the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser the occupancy in one house, the greater the interaction that occurs between residents in the one house. This facilitates the spread of disease, especially TB. Similar research results were obtained from Arifin, et. al., (2020) that the houses of respondents with households pulmonary tuberculosis have not met the requirements because the results of the assessment were that patients with pulmonary TB tended to have houses that did not meet the requirements. The physical condition of the house that does not meet the requirements has a risk of developing pulmonary TB 3 times greater than the physical condition of the house that meets the requirements.

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher the percentage of unhealthy housing coverage, the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy households is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Commented [nn1]: 80% sumber Pustaka harus dari artikel jurnal international, jumlah minimal Pustaka dari artikel jurnal internasional adalah 20 artikel.

Arifin, S., Marlinae, L., Husaini, Khairiyatie, L, Waskito, A., (2020). Implementation of the Healthy Households Development Program to Accelerate the Health Status of TB Children. *PRO SEJAHTERA (Proceedings of the National Seminar on Community Service).* Volume 2 Pages 43-51 March 2020.

MOH RI. (2014). *National TBC Countermeasures*. Jakarta: MOH RI.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Girsang M. (2013). *Mycobacterium causes tuberculosis and recognizes its growth properties in the laboratory*. Department of Health.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major*. 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Ministry of Health RI. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health of the Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J.* 2007; 1 (4): 14.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Pambudi, I., (2020). TB Service Protocol during the Covid Pandemic, Dit. P2PML, Directorate General of P2P, Ministry of Health of the Republic of Indonesia.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. *Dynamics of Human Health*; 2015: 2 (4). ISSN 2382-1019.

Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS*: Journal of Public Health, KEMAS 9 (1) (2013) 85-91.

WHO. (2015). *Global Tuberculosis Report 2015*. 20th ed. NASN school nurse (Print). Geneva: World Health Organization.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

World Health Organization. (2019). *Tuberculosis*. [Internet]. Available from:https://www.who.int/news-room/fact-sheets/detail/tuberculosis

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Ahmad Dahlan University, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. One of the determinants of factors that affect the degree of public health is environmental health. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on TB data in DIY in 2019, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Helath Center Unit or "Puskesmas" Kota Yogyakarta. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Housing, TB

Introduction

Tuberculosis (TB) become world's communicable diseases (Álvaro-Meca, et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah and Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al., 2018). WHO estimates that the TB morbidity rate in 2017 reached 9 million people and the mortality rate was 1.6 million people, and the morbidity in Southeast Asia was 56% of the total 9 million people with TB in 2015 (WHO, 2015). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). The number of deaths from suffering from TB is quite large throughout the world. A total of 1.5 million people died caused by TB in 2018 (including 251,000 people with HIV). TB is one of the top 10 causes of death

and the leading cause of an infectious agent (above HIV / AIDS) in worldwide (WHO, 2019). According to the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 TB BTA (+) cases were still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha, et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling settings can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh, et al., 2013). Household contacts become primarily risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis, et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth, et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh, et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh, et al., 2018; Shimeles, et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the households environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 “Puskesmas” Public Health Center in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment

other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

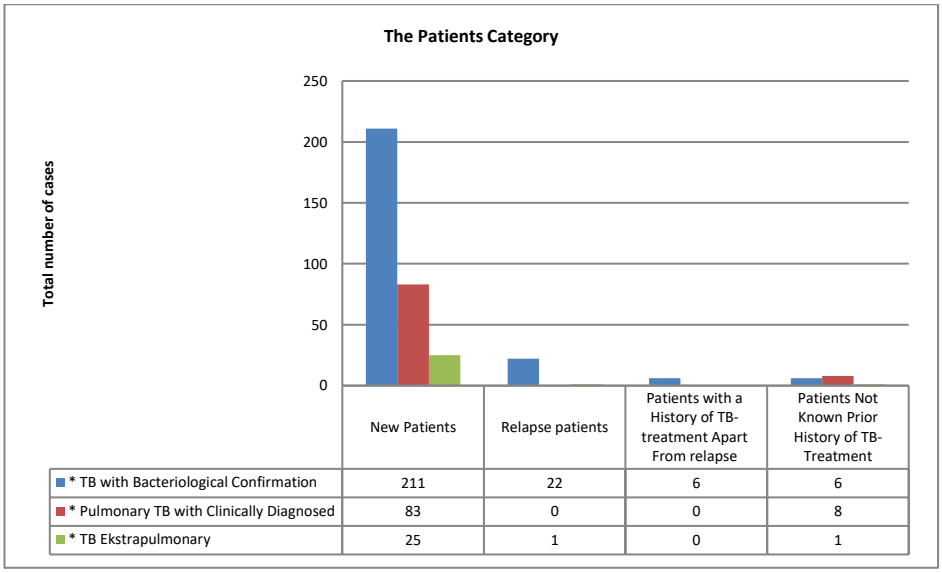


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

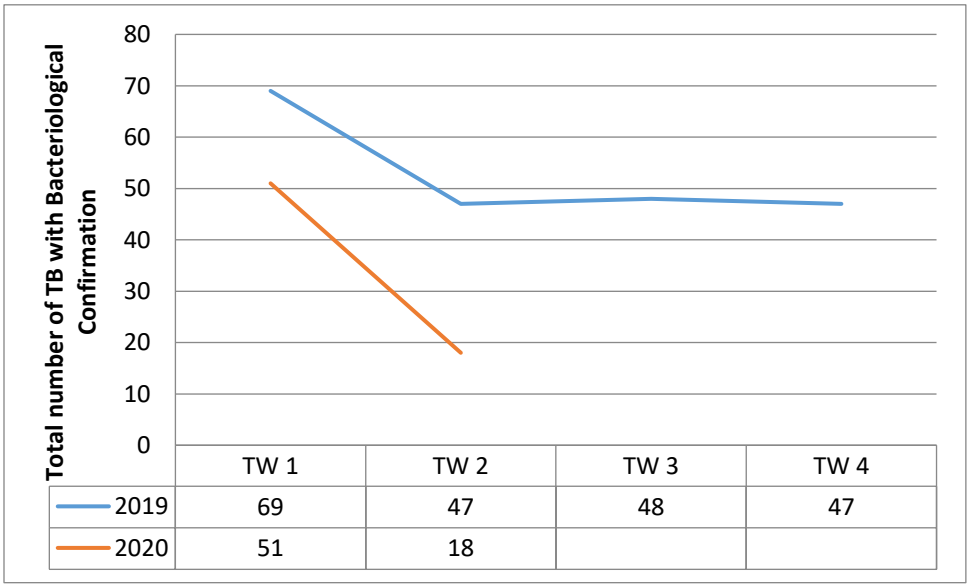


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The jurisdiction area of the Yogyakarta City Health Office has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following is a graph of new

bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

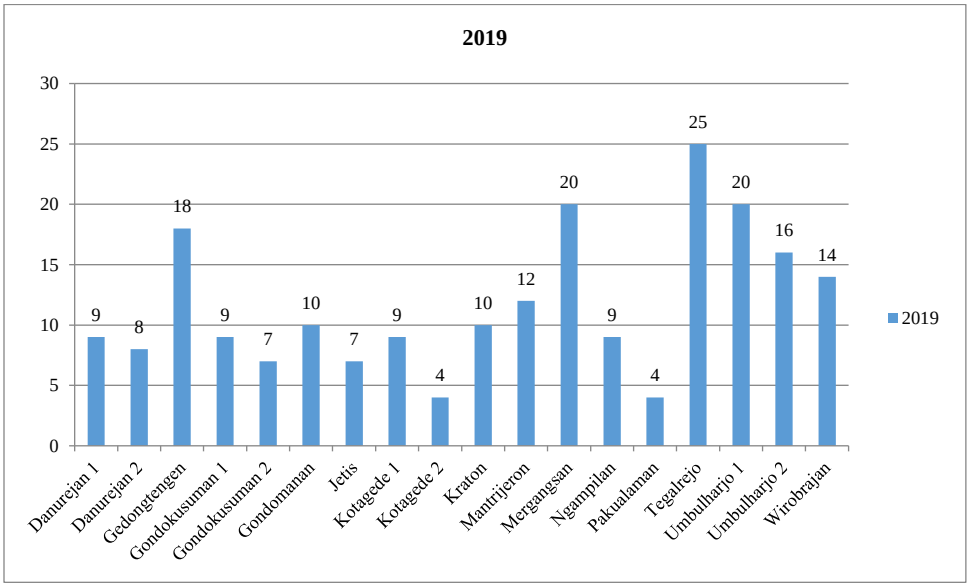


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers unit in 2019

The TB case data in 2020 were showed in Figure 3 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

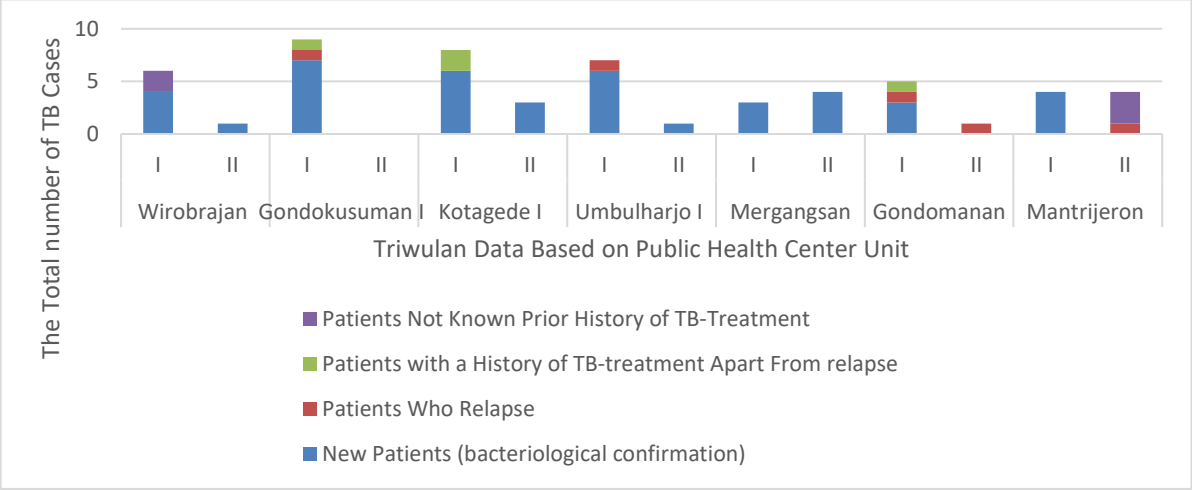


Figure 3. The Seven Highest TB Cases Data Based on Public Health Center Unit for the period January to June 2020

Based on the data Figure 3, the highest pulmonary TB cases were in the Kotagede I public health center unit and the lowest was found in the Gondomanan public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the

pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Ministry of Health The Republic of Indonesia, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the "Puskesmas" or public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the "Puskesmas" or public health center unit, or restrictions from the examination over there (Ministry of Health The Republic of Indonesia, 2020).

TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients who have a high risk of becoming a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021).

Analysis of the Physical Environment of Healthy Housing in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables that influence TB transmission. Based on Mahpudin's study, there was a relationship between the households environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015).

Factors affecting the incidence of tuberculosis is related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that coinfection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The healthy housing coverages data according to public health centers unit in Yogyakarta City in 2018

Public health center unit	Total Household	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the “non-healthy housing” data is compared with the TB incidence (prevalence) data, the following graph will showed (Figure 4):

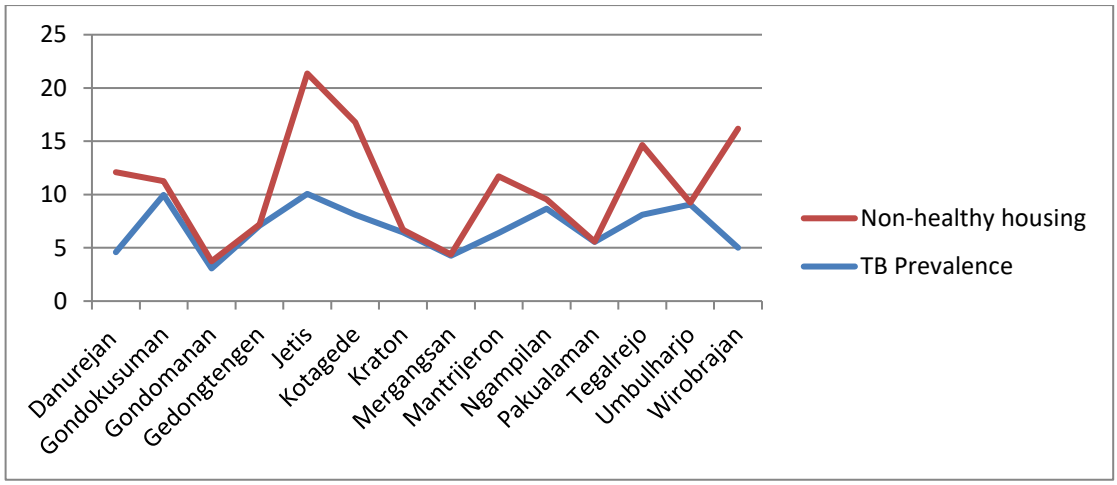


Figure 4. Graph of “non-healthy housing” and TB prevalence-based data trends on public health centers in 2018

Based on the chart above, it can be seen that the trend of the data the higher the number the house is not healthy, it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household filogenik related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density, it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. The lighting can enter through ventilation holes, windows, or doors that are opened, otherwise it can enter through glass tiles (Ministry of The Health Republic of Indonesia, 2014). In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru, et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous research that there is a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Ministry of Health the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser the occupancy in one house, the greater the interaction that occurs between residents in the one house. This facilitates the spread of disease, especially TB. Similar research results were obtained from Arifin, et. al., (2020) that the houses of respondents with households pulmonary tuberculosis have not met the requirements because the results of the assessment were that patients with pulmonary TB tended to have houses that did not meet the requirements. The physical condition of the house that does not meet the requirements has a risk of developing pulmonary TB 3 times greater than the physical condition of the house that meets the requirements.

Environmental condition and host information related risk factors were very important to control the spread of infection and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. Al., 2021). The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multisectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd, et al. 2018). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Aditama, W., Sitepu, F. Y., & Saputra, R. (2019). Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res,* 4(1) : 227-231.

Álvaro-Meca A, Díaz A, de Miguel Díez J, Resino R, Resino S. (2016). Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. PLoS One. 2016 Nov 3;11(11).

Arifin, S., Marlinae, L., Husaini, Khairiyatie, L, Waskito, A., (2020). Implementation of the Healthy Households Development Program to Accelerate the Health Status of TB Children. *PRO SEJAHTERA (Proceedings of the National Seminar on Community Service).* Volume 2 Pages 43-51 March 2020.

Cardoso, B. A., Fonseca, F. D. O., Moraes Neto, A. H. A. D., Martins, A. C. G. S., Oliveira, N. V. D. S., Lima, L. N. G. C., ... & Saad, M. H. F. (2017). Environmental aspects related to tuberculosis and intestinal parasites in a low-income community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo*, 59.

Chen, Y., Peng, W. H., Lai, S. F., Luo, F., Luo, D., & Wang, B. G. (2021). Association of gene polymorphisms and environmental factors in tuberculosis patients and their household contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(1) : 20-29.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Duru, C. B., Iwu, A. C., Uwakwe, K. A., Diwe, K. C. & Merenu, I. A. Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State , Nigeria. *Int. J. Sci. Healthc. Res.* 1 : 57–69.

Floyd K, Glaziou P, Zumla A, Raviglione M. (2018). The global tuberculosis epidemic and progress in care, prevention, and research: an overview in year 3 of the End TB era. *Lancet Respir Med.* ;6(4):299-314.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major.* 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Health Official Department of Republic Indonesia. (2014). *National Poverty Reduction of TBC*. Jakarta.

Khaliq A, Khan IH, Akhtar MW, Chaudhry MN (2015) Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)* 5:201. doi:10.4172/2161-1165.1000201.

Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57–72.

Lo¨nnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. (2010). Tuberculosis control and elimination 2010–50: cure, care, and social development. *Lancet.* 2010; 375: 1814–1829.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J*. 2007; 1 (4): 14.

Ministry of Health The Republic of Indonesia. (2014). *National TBC Countermeasures*. Jakarta

Ministry of Health The Republic of Indonesia. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health The Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Narasimhan P, Wood J, MacIntyre CR, Mathai D. (2013). Risk factors for tuberculosis. *Pulm Med.* 2013:1–11

Pambudi, I., (2020). *TB Service Protocol during the Covid Pandemic*, Dit. P2PML, Directorate General of P2P, Ministry of Health The Republic of Indonesia.

Putri, A. S. E., Tari Amanda, R., & Ilham, R. (2019). Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah A, Mallhi TH, Khan YH, Iqbal MS, Alotaibi NH, Alzarea AI, Rasheed M. 2021. Evaluation of risk factors associated with the development of MDR- and XDR-TB in a tertiary care hospital: a retrospective cohort study. *PeerJ 9*:e10826. DOI 10.7717/peerj.10826.

Schmidt C. W. (2008). Linking TB and the environment: an overlooked mitigation strategy. *Environmental health perspectives*, 116(11), A478–A485.

Shimeles, E. et al. (2019) 'Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia', *PLoS ONE*, 14(4), pp. 1–19. doi: 10.1371/journal.pone.0214235.

Singh J, Sankar MM, Kumar S, Gopinath K, Singh N, Mani K, et al. (2013). Incidence and prevalence of tuberculosis among household contacts of pulmonary tuberculosis patients in a Peri-urban population of South Delhi, India. *PLoS One.*, 8(7):1–11.

Singh, S. K., Kashyap, G. C. and Puri, P. (2018) 'Potential effect of household environment on prevalence of tuberculosis in India: Evidence from the recent round of a cross-sectional survey', BMC Pulmonary Medicine. *BMC Pulmonary Medicine*, 18(1), pp. 1–10.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. Dynamics of Human Health; 2015: 2 (4). ISSN 2382-1019.Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS: Journal of Public Health*, 9 (1) : 85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2014). Tuberculosis: epidemiology and control. *Mediterranean journal of hematology and infectious diseases*, 6(1),Taha M, Deribew A, Tessema F, Assegid S, Duchateau L. (2011). Risk factors of active tuberculosis in people living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci.* 2011;21:131–139. e2014070. https://doi.org/10.4084/MJHID.2014.070.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F. (2015). Environmental and host-related determinants of tuberculosis in Metema district, north-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, 87.

WHO. (2015). *Global Tuberculosis Report 2015. 20th ed. NASN school nurse* (Print). Geneva: World Health Organization.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

World Health Organization. (2019). *Tuberculosis.* [Internet]. Available from:https://www.who.int/news-room/fact-sheets/detail/tuberculosis.

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Ahmad Dahlan University, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. One of the determinants of factors that affect the degree of public health is environmental health. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on TB data in DIY in 2019, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Helath Center Unit or "Puskesmas" Kota Yogyakarta. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Housing, TB

Introduction

Tuberculosis (TB) become world's communicable diseases (Álvaro-Meca, et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah and Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al., 2018). WHO estimates that the TB morbidity rate in 2017 reached 9 million people and the mortality rate was 1.6 million people, and the morbidity in Southeast Asia was 56% of the total 9 million people with TB in 2015 (WHO, 2015). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). The number of deaths from suffering from TB is quite large throughout the world. A total of 1.5 million people died caused by TB in 2018 (including 251,000 people with HIV). TB is one of the top 10 causes of death

and the leading cause of an infectious agent (above HIV / AIDS) in worldwide (WHO, 2019). According to the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 TB BTA (+) cases were still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha, et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling settings can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh, et al., 2013). Household contacts become primarily risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis, et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth, et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh, et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh, et al., 2018; Shimeles, et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the households environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 “Puskesmas” Public Health Center in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment

other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

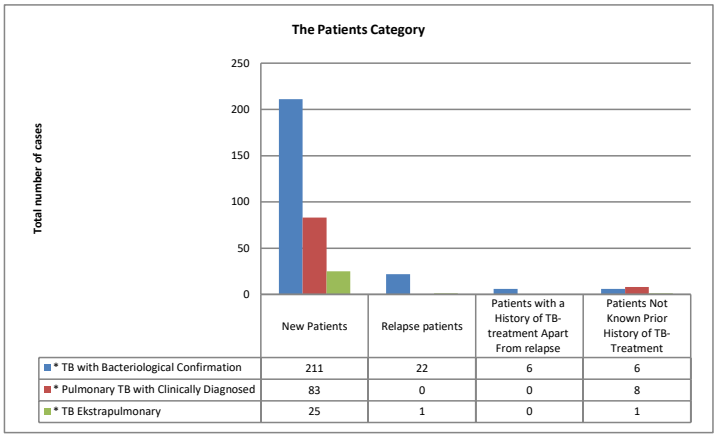


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

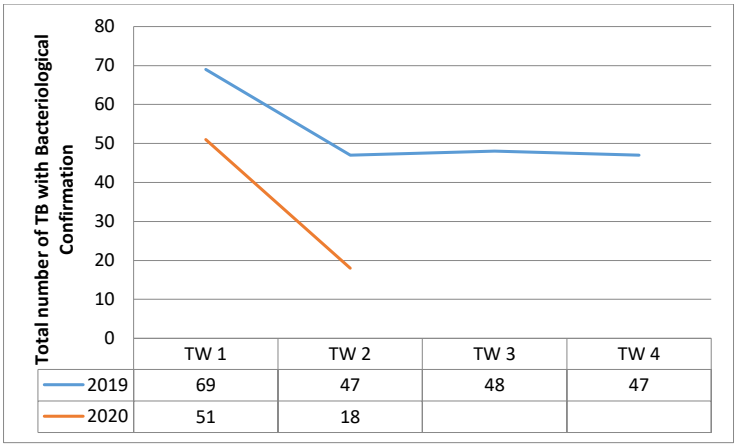


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The jurisdiction area of the Yogyakarta City Health Office has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following is a graph of new

bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

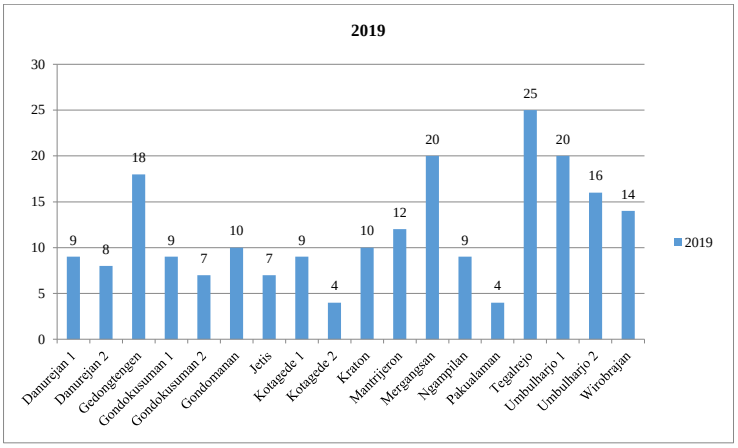


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers unit in 2019

The TB case data in 2020 were showed in Figure 3 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

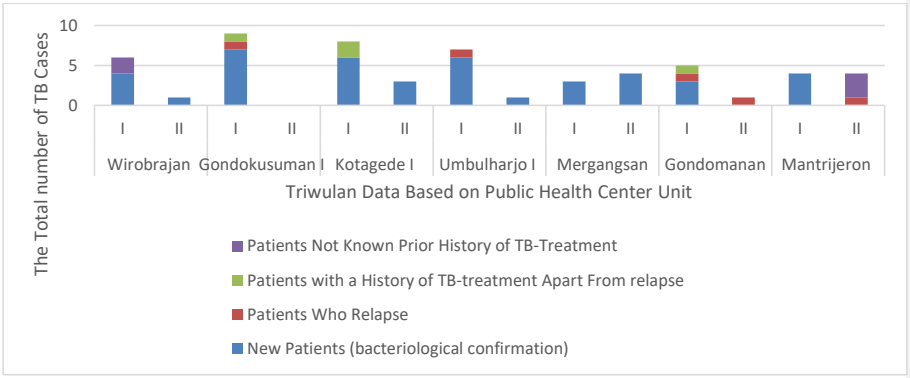


Figure 3. The Seven Highest TB Cases Data Based on Public Health Center Unit for the period January to June 2020

Based on the data Figure 3, the highest pulmonary TB cases were in the Kotagede I public health center unit and the lowest was found in the Gondomanan public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the

pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Ministry of Health The Republic of Indonesia, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the "Puskesmas" or public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the "Puskesmas" or public health center unit, or restrictions from the examination over there (Ministry of Health The Republic of Indonesia, 2020).

TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients who have a high risk of becoming a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021).

Analysis of the Physical Environment of Healthy Housing in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables that influence TB transmission. Based on Mahpudin's study, there was a relationship between the households environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015).

Factors affecting the incidence of tuberculosis is related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that coinfection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The healthy housing coverages data according to public health centers unit in Yogyakarta City in 2018

Public health center unit	Total Household	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the “non-healthy housing” data is compared with the TB incidence (prevalence) data, the following graph will showed (Figure 4):

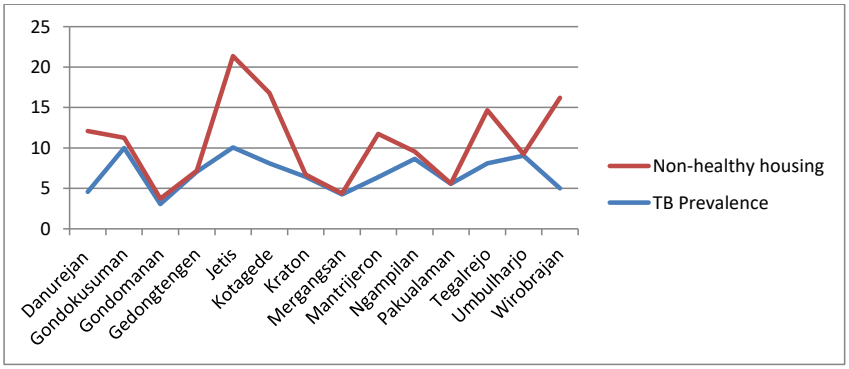


Figure 4. Graph of “non-healthy housing” and TB prevalence-based data trends on public health centers in 2018

Based on the chart above, it can be seen that the trend of the data the higher the number the house is not healthy, it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household filogenik related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density, it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. The lighting can enter through ventilation holes, windows, or doors that are opened, otherwise it can enter through glass tiles (Ministry of The Health Republic of Indonesia, 2014). In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru, et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous research that there is a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Ministry of Health the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser the occupancy in one house, the greater the interaction that occurs between residents in the one house. This facilitates the spread of disease, especially TB. Similar research results were obtained from Arifin, et. al., (2020) that the houses of respondents with households pulmonary tuberculosis have not met the requirements because the results of the assessment were that patients with pulmonary TB tended to have houses that did not meet the requirements. The physical condition of the house that does not meet the requirements has a risk of developing pulmonary TB 3 times greater than the physical condition of the house that meets the requirements.

Environmental condition and host information related risk factors were very important to control the spread of infection and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. Al., 2021). The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multisectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd, et al. 2018). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Commented [n1]: Mohon Pustaka yang saya blok merah salah duanya dapat diganti dengan artikel dari jurnal international. Terima kasih.

Aditama, W., Sitepu, F. Y., & Saputra, R. (2019). Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res*, 4(1) : 227-231.

Álvaro-Meca A, Díaz A, de Miguel Díez J, Resino R, Resino S. (2016). Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. PLoS One. 2016 Nov 3;11(11).

Arifin, S., Marlinae, L., Husaini, Khairiyatie, L, Waskito, A., (2020). Implementation of the Healthy Households Development Program to Accelerate the Health Status of TB Children. *PRO SEJAHTERA (Proceedings of the National Seminar on Community Service)*. Volume 2 Pages 43-51 March 2020.

Cardoso, B. A., Fonseca, F. D. O., Moraes Neto, A. H. A. D., Martins, A. C. G. S., Oliveira, N. V. D. S., Lima, L. N. G. C., ... & Saad, M. H. F. (2017). Environmental aspects related to tuberculosis and intestinal parasites in a low-income community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo*, 59.

Chen, Y., Peng, W. H., Lai, S. F., Luo, F., Luo, D., & Wang, B. G. (2021). Association of gene polymorphisms and environmental factors in tuberculosis patients and their household contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(1) : 20-29.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Duru, C. B., Iwu, A. C., Uwakwe, K. A., Diwe, K. C. & Merenu, I. A. Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State , Nigeria. *Int. J. Sci. Healthc. Res.* 1 : 57–69.

Floyd K, Glaziou P, Zumla A, Raviglione M. (2018). The global tuberculosis epidemic and progress in care, prevention, and research: an overview in year 3 of the End TB era. *Lancet Respir Med.* ;6(4):299-314.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major*. 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Health Official Department of Republic Indonesia. (2014). *National Poverty Reduction of TBC*. Jakarta.

Khaliq A, Khan IH, Akhtar MW, Chaudhry MN (2015) Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)* 5:201. doi:10.4172/2161-1165.1000201.

Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57–72.

Lo¨nnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. (2010). Tuberculosis control and elimination 2010–50: cure, care, and social development. *Lancet.* 2010; 375: 1814–1829.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J*. 2007; 1 (4): 14.

Ministry of Health The Republic of Indonesia. (2014). *National TBC Countermeasures*. Jakarta

Ministry of Health The Republic of Indonesia. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health The Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Narasimhan P, Wood J, MacIntyre CR, Mathai D. (2013). Risk factors for tuberculosis. *Pulm Med.* 2013:1–11

Pambudi, I., (2020). *TB Service Protocol during the Covid Pandemic*, Dit. P2PML, Directorate General of P2P, Ministry of Health The Republic of Indonesia.

Putri, A. S. E., Tari Amanda, R., & Ilham, R. (2019). Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah A, Mallhi TH, Khan YH, Iqbal MS, Alotaibi NH, Alzarea AI, Rasheed M. 2021. Evaluation of risk factors associated with the development of MDR- and XDR-TB in a tertiary care hospital: a retrospective cohort study. *PeerJ 9*:e10826. DOI 10.7717/peerj.10826.

Schmidt C. W. (2008). Linking TB and the environment: an overlooked mitigation strategy. *Environmental health perspectives*, 116(11), A478–A485.

Shimeles, E. et al. (2019) 'Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia', *PLoS ONE*, 14(4), pp. 1–19. doi: 10.1371/journal.pone.0214235.

Singh J, Sankar MM, Kumar S, Gopinath K, Singh N, Mani K, et al. (2013). Incidence and prevalence of tuberculosis among household contacts of pulmonary tuberculosis patients in a Peri-urban population of South Delhi, India. *PLoS One.*, 8(7):1–11.

Singh, S. K., Kashyap, G. C. and Puri, P. (2018) 'Potential effect of household environment on prevalence of tuberculosis in India: Evidence from the recent round of a cross-sectional survey', BMC Pulmonary Medicine. *BMC Pulmonary Medicine*, 18(1), pp. 1–10.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. Dynamics of Human Health; 2015: 2 (4). ISSN 2382-1019.Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS: Journal of Public Health*, 9 (1) : 85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2014). Tuberculosis: epidemiology and control. *Mediterranean journal of hematology and infectious diseases*, 6(1),Taha M, Deribew A, Tessema F, Assegid S, Duchateau L. (2011). Risk factors of active tuberculosis in people living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci.* 2011;21:131–139. e2014070. https://doi.org/10.4084/MJHID.2014.070.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F. (2015). Environmental and host-related determinants of tuberculosis in Metema district, north-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, 87.

WHO. (2015). *Global Tuberculosis Report 2015. 20th ed. NASN school nurse* (Print). Geneva: World Health Organization.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

World Health Organization. (2019). *Tuberculosis.* [Internet]. Available from:https://www.who.int/news-room/fact-sheets/detail/tuberculosis.

5. Revisi Ke-2 Manuskrip Versi Author

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Ahmad Dahlan University, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. One of the determinants of factors that affect the degree of public health is environmental health. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on TB data in DIY in 2019, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Helath Center Unit or "Puskesmas" Kota Yogyakarta. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Housing, TB

Introduction

Tuberculosis (TB) become world's communicable diseases (Álvaro-Meca, et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah and Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al., 2018). WHO estimates that the TB morbidity rate in 2017 reached 9 million people and the mortality rate was 1.6 million people, and the morbidity in Southeast Asia was 56% of the total 9 million people with TB in 2015 (WHO, 2015). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). The number of deaths from suffering from TB is quite large throughout the world. A total of 1.5 million people died caused by TB in 2018 (including 251,000 people with HIV). TB is one of the top 10 causes of death

and the leading cause of an infectious agent (above HIV / AIDS) in worldwide (WHO, 2019). According to the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 TB BTA (+) cases were still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha, et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling settings can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh, et al., 2013). Household contacts become primarily risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis, et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth, et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh, et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh, et al., 2018; Shimeles, et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the households environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 “Puskesmas” Public Health Center in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment

other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

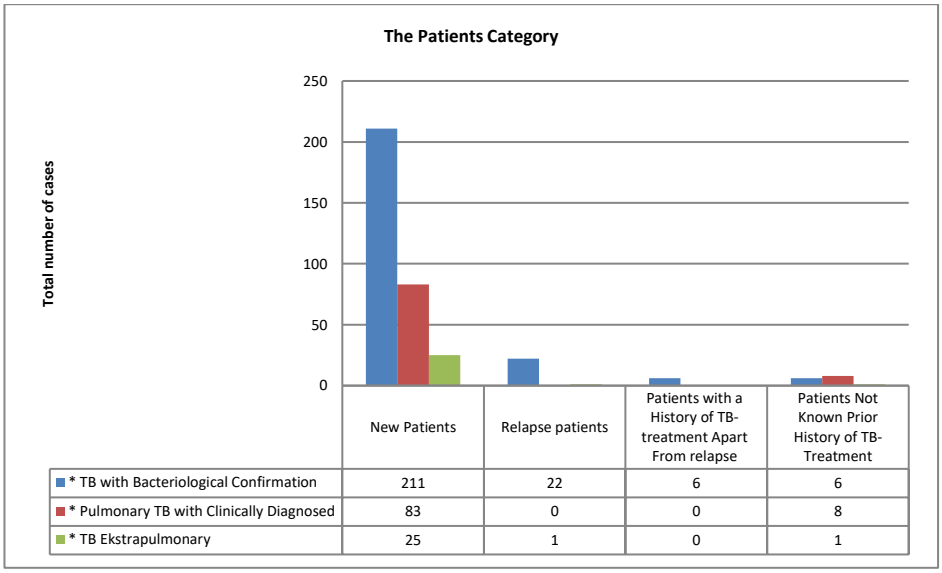


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

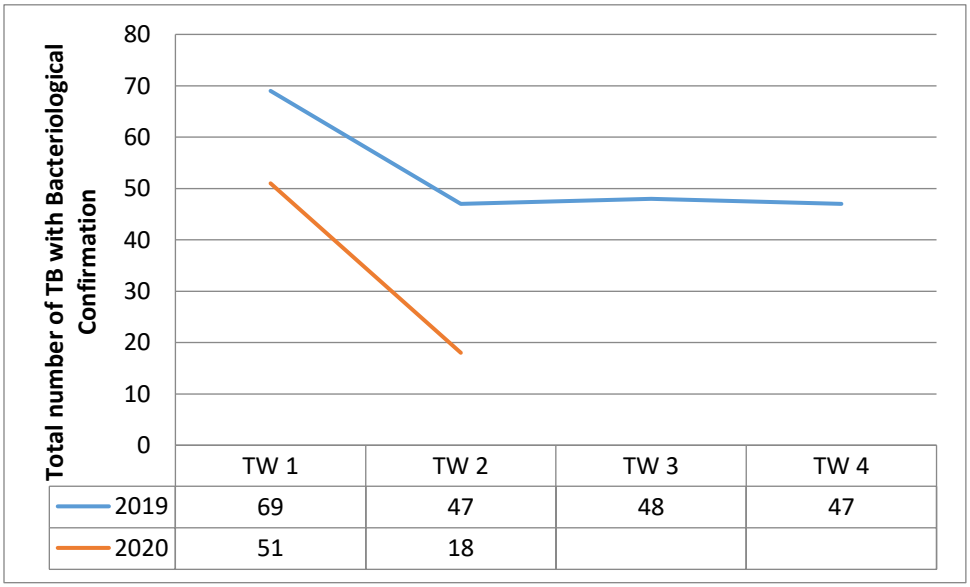


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The jurisdiction area of the Yogyakarta City Health Office has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following is a graph of new

bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

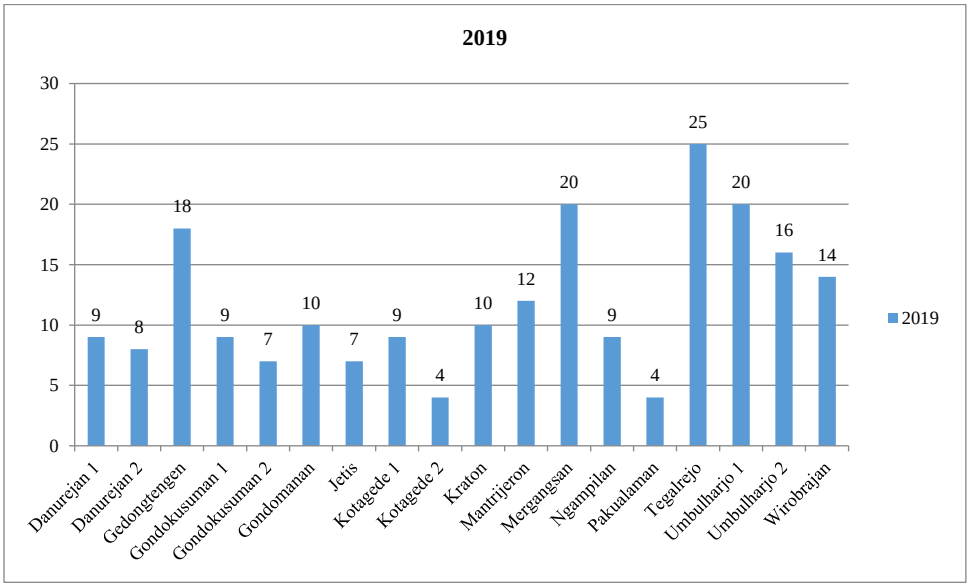


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers unit in 2019

The TB case data in 2020 were showed in Figure 3 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

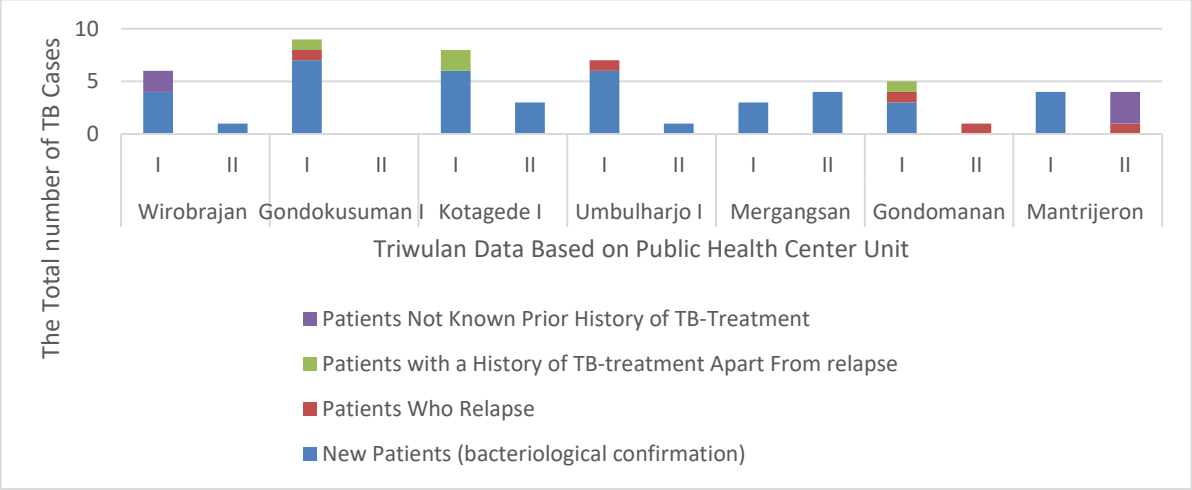


Figure 3. The Seven Highest TB Cases Data Based on Public Health Center Unit for the period January to June 2020

Based on the data Figure 3, the highest pulmonary TB cases were in the Kotagede I public health center unit and the lowest was found in the Gondomanan public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the

pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Ministry of Health The Republic of Indonesia, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the "Puskesmas" or public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the "Puskesmas" or public health center unit, or restrictions from the examination over there (Ministry of Health The Republic of Indonesia, 2020). TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients who have a high risk of becoming a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021). COVID-19 has provided an opportunity to launching several form of adaptation TB care as a community approach, capacity building of human resources, and to combat the stigma that exists by a multisectoral approach (Fatima, et. al., 2021).

Analysis of the Physical Environment of Healthy Housing in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables increases TB transmission. Based on Mahpudin's study, there was a relationship between the households environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015). Factors affecting the incidence of tuberculosis is related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that coinfection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The healthy housing coverages data according to public health centers unit in Yogyakarta City in 2018

Public health center unit	Total Household	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the “non-healthy housing” data is compared with the TB incidence (prevalence) data, the following graph will showed (Figure 4):

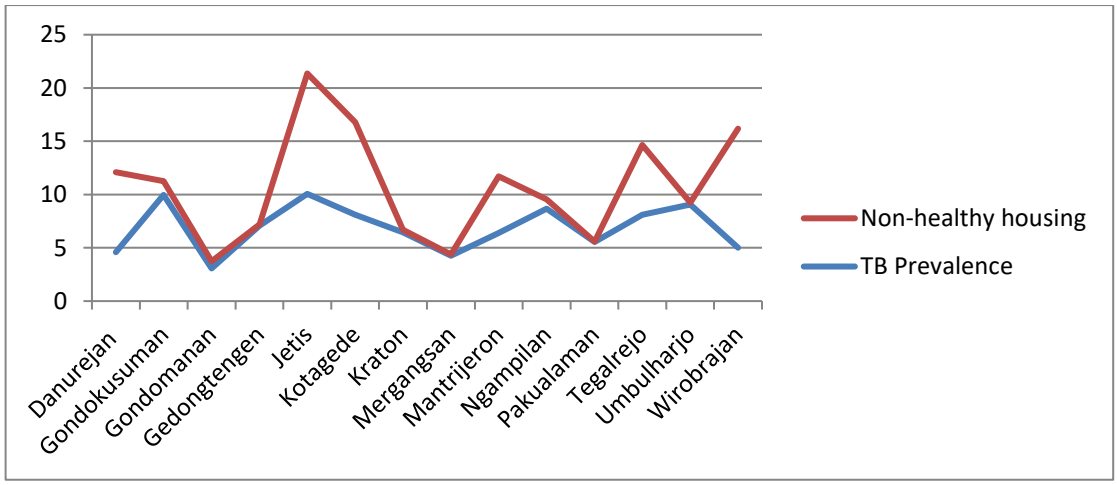


Figure 4. Graph of “non-healthy housing” and TB prevalence-based data trends on public health centers in 2018

Based on the chart above, it can be seen that the trend of the data the higher the number the house is not healthy, it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household filogenik related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density, it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). The associations between floor levels of residence and TB cases have been reported dependent on housing types because housing characteristics as main factor to explore an ecological study of the TB disease (Low, et al., 2013). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. The lighting can enter through ventilation holes, windows, or doors that are opened, otherwise it can enter through glass tiles (Ministry of Health The Republic of Indonesia, 2014). In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru, et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with

mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous study that there was a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Ministry of Health the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser of occupancy in one house, the greater the interaction that occurs between residents in the one house. The previous study only reported that people which living in crowded conditions were experience repeated and increase the TB infection for healthy people in the same house. Crowding was relationship both with risk of infection and risk of progression from infection to disease (Khan, 2016). The number of people per room was the only housing characteristic associated with progression to TB disease among infected participants, it caused by exposure to *M. tuberculosis* containing droplet particles during interactions in people's homes, it becomes to make exchange rates within the range of values standard measured in air. The similar studies in New Zealand showed that TB incidence was associated with household crowding (Baker, et. al., 2008). The other study results were obtained from Low, et. al., (2013), reported that TB outcome could be characterized by dwelling characteristics such as housing type and height, they suggest that communities with poor household condition had a higher risk of TB. There were significant public health implications for Asian cities especially in high density urban living.

Environmental condition and host information related risk factors were very important to control the spread of infection and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. al., 2021). Our study also shows credible results in the analysis of housing type by community. The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multisectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd, et al. 2018). The improvements in socio-environmental aspects are needed, but they must be combined with the improvement of education level (Cardoso, et. al., 2017). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Aditama, W., Sitepu, F. Y., & Saputra, R. (2019). Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res,* 4(1) : 227-231.

Álvaro-Meca A, Díaz A, de Miguel Díez J, Resino R, Resino S. (2016). Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. PLoS One. 2016 Nov 3;11(11).

Baker M, Das D, Venugopal K, Howden-Chapman P. (2008). Tuberculosis associated with household crowding in a developed country. *J Epidemiol Community Health.* 2008 Aug;62(8):715-21.

Cardoso, B. A., Fonseca, F. D. O., Moraes Neto, A. H. A. D., Martins, A. C. G. S., Oliveira, N. V. D. S., Lima, L. N. G. C., ... & Saad, M. H. F. (2017). Environmental aspects related to tuberculosis and intestinal parasites in a low-income community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo,* 59.

Chen, Y., Peng, W. H., Lai, S. F., Luo, F., Luo, D., & Wang, B. G. (2021). Association of gene polymorphisms and environmental factors in tuberculosis patients and their household contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(1) : 20-29.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Duru, C. B., Iwu, A. C., Uwakwe, K. A., Diwe, K. C. & Merenu, I. A. Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State , Nigeria. *Int. J. Sci. Healthc. Res.* 1 : 57–69.

Fatima, R., Akhtar, N., Yaqoob, A., Harries, A.D., Khan, M.S. (2021). Building Better Tuberculosis Control Systems In A Post-COVID World: Learning From Pakistan During The COVID-19 Pandemic. *International Journal of Infectious Diseases*. Available online 17 March 2021.

Floyd K, Glaziou P, Zumla A, Raviglione M. (2018). The global tuberculosis epidemic and progress in care, prevention, and research: an overview in year 3 of the End TB era. *Lancet Respir Med.* ;6(4):299-314.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major.* 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Khaliq A, Khan IH, Akhtar MW, Chaudhry MN (2015) Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)* 5:201. doi:10.4172/2161-1165.1000201.

Khan, F. A., Fox, G. J., Lee, R. S., Riva, M., Benedetti, A., Proulx, J. F., Jung, S., Hornby, K., Behr, M. A., & Menzies, D. (2016). Housing and tuberculosis in an Inuit village in northern Quebec: a case-control study. *CMAJ open*, 4(3), E496–E506.

Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57–72.

Lo¨nnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. (2010). Tuberculosis control and elimination 2010–50: cure, care, and social development. *Lancet.* 2010; 375: 1814–1829.

Low CT, Lai PC, Tse WS, Tsui CK, Lee H, Hui PK. (2013). Exploring tuberculosis by types of housing development. *Soc Sci Med.* 2013 Jun ;87:77-83.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J*. 2007; 1 (4): 14.

Ministry of Health The Republic of Indonesia. (2014). *National TBC Countermeasures*. Jakarta

Ministry of Health The Republic of Indonesia. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health The Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Narasimhan P, Wood J, MacIntyre CR, Mathai D. (2013). Risk factors for tuberculosis. *Pulm Med.* 2013:1–11

Pambudi, I., (2020). *TB Service Protocol during the Covid Pandemic*, Dit. P2PML, Directorate General of P2P, Ministry of Health The Republic of Indonesia.

Putri, A. S. E., Tari Amanda, R., & Ilham, R. (2019). Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah A, Mallhi TH, Khan YH, Iqbal MS, Alotaibi NH, Alzarea AI, Rasheed M. 2021. Evaluation of risk factors associated with the development of MDR- and XDR-TB in a tertiary care hospital: a retrospective cohort study. *PeerJ 9*:e10826. DOI 10.7717/peerj.10826.

Schmidt C. W. (2008). Linking TB and the environment: an overlooked mitigation strategy. *Environmental health perspectives*, 116(11), A478–A485.

Shimeles, E. et al. (2019) 'Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia', *PLoS ONE*, 14(4), pp. 1–19. doi: 10.1371/journal.pone.0214235.

Singh J, Sankar MM, Kumar S, Gopinath K, Singh N, Mani K, et al. (2013). Incidence and prevalence of tuberculosis among household contacts of pulmonary tuberculosis patients in a Peri-urban population of South Delhi, India. *PLoS One.*, 8(7):1–11.

Singh, S. K., Kashyap, G. C. and Puri, P. (2018) 'Potential effect of household environment on prevalence of tuberculosis in India: Evidence from the recent round of a cross-sectional survey', BMC Pulmonary Medicine. *BMC Pulmonary Medicine*, 18(1), pp. 1–10.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. Dynamics of Human Health; 2015: 2 (4). ISSN 2382-1019.Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS: Journal of Public Health*, 9 (1) : 85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2014). Tuberculosis: epidemiology and control. *Mediterranean journal of hematology and infectious diseases*, 6(1),Taha M, Deribew A, Tessema F, Assegid S, Duchateau L. (2011). Risk factors of active tuberculosis in people living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci*. 2011;21:131–139. e2014070. https://doi.org/10.4084/MJHID.2014.070.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F. (2015). Environmental and host-related determinants of tuberculosis in Metema district, north-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, 87.

WHO. (2015). *Global Tuberculosis Report 2015. 20th ed. NASN school nurse* (Print). Geneva: World Health Organization.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

World Health Organization. (2019). *Tuberculosis.* [Internet]. Available from:https://www.who.int/news-room/fact-sheets/detail/tuberculosis.

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Ahmad Dahlan University, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. One of the determinants of factors that affect the degree of public health is environmental health. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on TB data in DIY in 2019, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Helath Center Unit or "Puskesmas" Kota Yogyakarta. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Housing, TB

Introduction

Tuberculosis (TB) become world's communicable diseases (Álvaro-Meca, et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah and Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al., 2018). WHO estimates that the TB morbidity rate in 2017 reached 9 million people and the mortality rate was 1.6 million people, and the morbidity in Southeast Asia was 56% of the total 9 million people with TB in 2015 (WHO, 2015). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). The number of deaths from suffering from TB is quite large throughout the world. A total of 1.5 million people died caused by TB in 2018 (including 251,000 people with HIV). TB is one of the top 10 causes of death

and the leading cause of an infectious agent (above HIV / AIDS) in worldwide (WHO, 2019). According to the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 TB BTA (+) cases were still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha, et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling settings can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh, et al., 2013). Household contacts become primarily risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis, et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth, et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh, et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh, et al., 2018; Shimeles, et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the households environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 “Puskesmas” Public Health Center in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Commented [n1]: Mohon maaf jika nanti artikel akan diterbitkan maka kemungkinan gambar akan dicetak dalam warna monocrom, mohon yg masih berwarna dapat disesuaikan. Terima kasih.

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment

other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

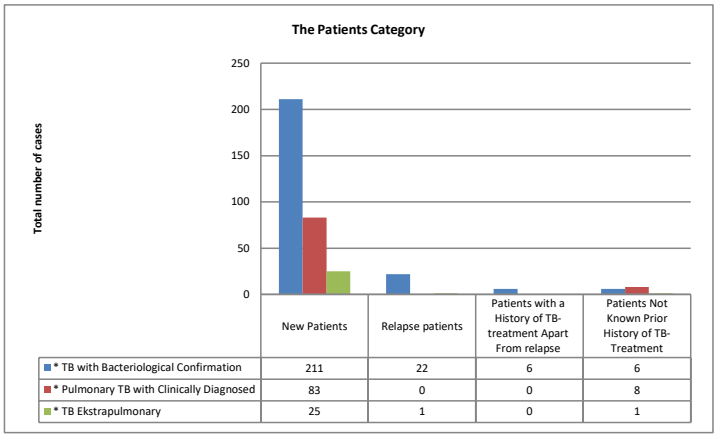


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

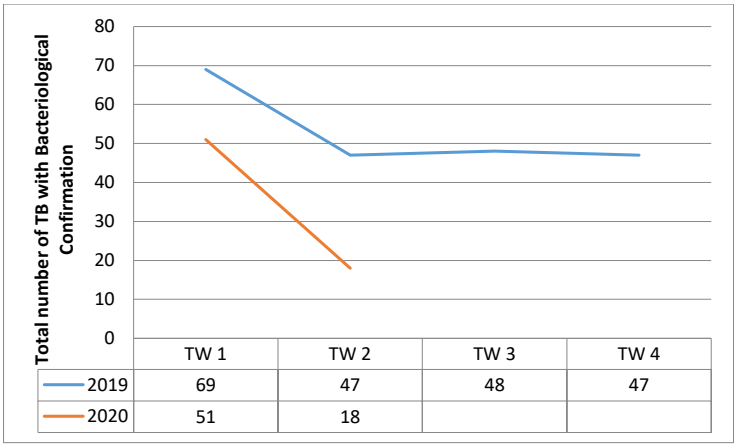


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The jurisdiction area of the Yogyakarta City Health Office has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following is a graph of new

bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

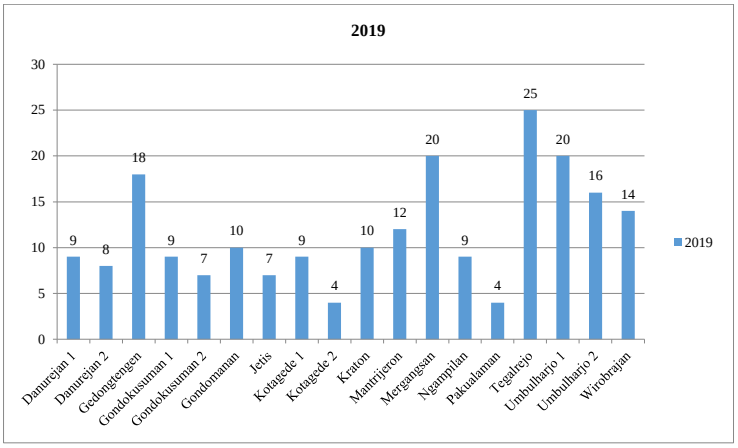


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers unit in 2019

The TB case data in 2020 were showed in Figure 3 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

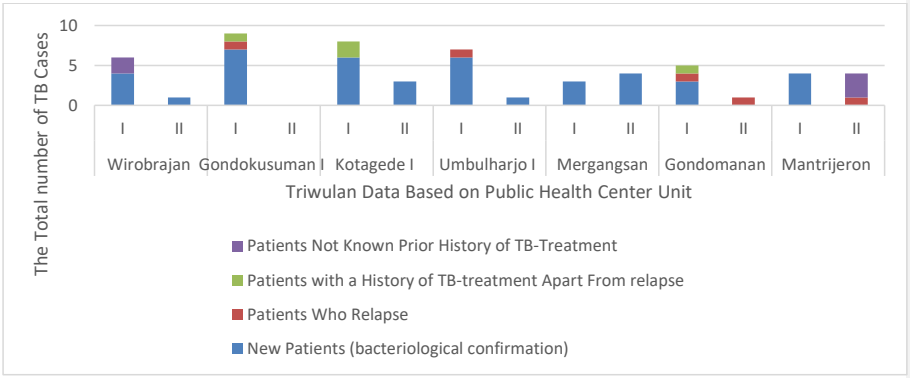


Figure 3. The Seven Highest TB Cases Data Based on Public Health Center Unit for the period January to June 2020

Based on the data Figure 3, the highest pulmonary TB cases were in the Kotagede I public health center unit and the lowest was found in the Gondomanan public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the

pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Ministry of Health The Republic of Indonesia, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the "Puskesmas" or public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the "Puskesmas" or public health center unit, or restrictions from the examination over there (Ministry of Health The Republic of Indonesia, 2020). TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients who have a high risk of becoming a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021). COVID-19 has provided an opportunity to launching several form of adaptation TB care as a community approach, capacity building of human resources, and to combat the stigma that exists by a multisectoral approach (Fatima, et. al., 2021).

Analysis of the Physical Environment of Healthy Housing in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables increases TB transmission. Based on Mahpudin's study, there was a relationship between the households environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015). Factors affecting the incidence of tuberculosis is related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that coinfection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The healthy housing coverages data according to public health centers unit in Yogyakarta City in 2018

Public health center unit	Total Household	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the “non-healthy housing” data is compared with the TB incidence (prevalence) data, the following graph will showed (Figure 4):

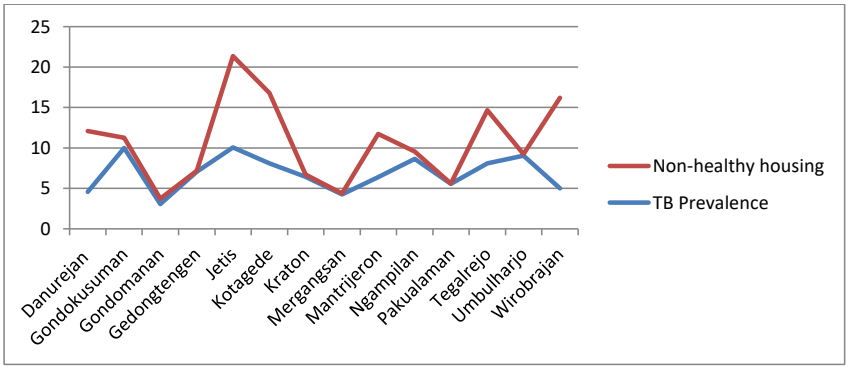


Figure 4. Graph of “non-healthy housing” and TB prevalence-based data trends on public health centers in 2018

Based on the chart above, it can be seen that the trend of the data the higher the number the house is not healthy, it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household filogenik related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density, it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). The associations between floor levels of residence and TB cases have been reported dependent on housing types because housing characteristics as main factor to explore an ecological study of the TB disease (Low, et al., 2013). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. The lighting can enter through ventilation holes, windows, or doors that are opened, otherwise it can enter through glass tiles (Ministry of Health The Republic of Indonesia, 2014). In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru, et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with

mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous study that there was a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Ministry of Health the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser of occupancy in one house, the greater the interaction that occurs between residents in the one house. The previous study only reported that people which living in crowded conditions were experience repeated and increase the TB infection for healthy people in the same house. Crowding was relationship both with risk of infection and risk of progression from infection to disease (Khan, 2016). The number of people per room was the only housing characteristic associated with progression to TB disease among infected participants, it caused by exposure to *M. tuberculosis* containing droplet particles during interactions in people's homes, it becomes to make exchange rates within the range of values standard measured in air. The similar studies in New Zealand showed that TB incidence was associated with household crowding (Baker, et. al., 2008). The other study results were obtained from Low, et. al., (2013), reported that TB outcome could be characterized by dwelling characteristics such as housing type and height, they suggest that communities with poor household condition had a higher risk of TB. There were significant public health implications for Asian cities especially in high density urban living.

Environmental condition and host information related risk factors were very important to control the spread of infection and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. al., 2021). Our study also shows credible results in the analysis of housing type by community. The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multisectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd, et al. 2018). The improvements in socio-environmental aspects are needed, but they must be combined with the improvement of education level (Cardoso, et. al., 2017). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Aditama, W., Sitepu, F. Y., & Saputra, R. (2019). Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res*, 4(1) : 227-231.

Álvaro-Meca A, Díaz A, de Miguel Díez J, Resino R, Resino S. (2016). Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. PLoS One. 2016 Nov 3;11(11).

Baker M, Das D, Venugopal K, Howden-Chapman P. (2008). Tuberculosis associated with household crowding in a developed country. *J Epidemiol Community Health.* 2008 Aug;62(8):715-21.

Cardoso, B. A., Fonseca, F. D. O., Moraes Neto, A. H. A. D., Martins, A. C. G. S., Oliveira, N. V. D. S., Lima, L. N. G. C., ... & Saad, M. H. F. (2017). Environmental aspects related to tuberculosis and intestinal parasites in a low-income community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo*, 59.

Chen, Y., Peng, W. H., Lai, S. F., Luo, F., Luo, D., & Wang, B. G. (2021). Association of gene polymorphisms and environmental factors in tuberculosis patients and their household contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(1) : 20-29.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Duru, C. B., Iwu, A. C., Uwakwe, K. A., Diwe, K. C. & Merenu, I. A. Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State , Nigeria. *Int. J. Sci. Healthc. Res.* 1 : 57–69.

Fatima, R., Akhtar, N., Yaqoob, A., Harries, A.D., Khan, M.S. (2021). Building Better Tuberculosis Control Systems In A Post-COVID World: Learning From Pakistan During The COVID-19 Pandemic. *International Journal of Infectious Diseases*. Available online 17 March 2021.

Floyd K, Glaziou P, Zumla A, Raviglione M. (2018). The global tuberculosis epidemic and progress in care, prevention, and research: an overview in year 3 of the End TB era. *Lancet Respir Med.* ;6(4):299-314.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major*. 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Khaliq A, Khan IH, Akhtar MW, Chaudhry MN (2015) Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)* 5:201. doi:10.4172/2161-1165.1000201.

Khan, F. A., Fox, G. J., Lee, R. S., Riva, M., Benedetti, A., Proulx, J. F., Jung, S., Hornby, K., Behr, M. A., & Menzies, D. (2016). Housing and tuberculosis in an Inuit village in northern Quebec: a case-control study. *CMAJ open*, 4(3), E496–E506.

Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57–72.

Lo¨nnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. (2010). Tuberculosis control and elimination 2010–50: cure, care, and social development. *Lancet.* 2010; 375: 1814–1829.

Low CT, Lai PC, Tse WS, Tsui CK, Lee H, Hui PK. (2013). Exploring tuberculosis by types of housing development. *Soc Sci Med.* 2013 Jun ;87:77-83.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J*. 2007; 1 (4): 14.

Ministry of Health The Republic of Indonesia. (2014). *National TBC Countermeasures*. Jakarta

Ministry of Health The Republic of Indonesia. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health The Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Narasimhan P, Wood J, MacIntyre CR, Mathai D. (2013). Risk factors for tuberculosis. *Pulm Med.* 2013:1–11

Pambudi, I., (2020). *TB Service Protocol during the Covid Pandemic*, Dit. P2PML, Directorate General of P2P, Ministry of Health The Republic of Indonesia.

Putri, A. S. E., Tari Amanda, R., & Ilham, R. (2019). Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah A, Mallhi TH, Khan YH, Iqbal MS, Alotaibi NH, Alzarea AI, Rasheed M. 2021. Evaluation of risk factors associated with the development of MDR- and XDR-TB in a tertiary care hospital: a retrospective cohort study. *PeerJ 9*:e10826. DOI 10.7717/peerj.10826.

Schmidt C. W. (2008). Linking TB and the environment: an overlooked mitigation strategy. *Environmental health perspectives*, 116(11), A478–A485.

Shimeles, E. et al. (2019) 'Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia', *PLoS ONE*, 14(4), pp. 1–19. doi: 10.1371/journal.pone.0214235.

Singh J, Sankar MM, Kumar S, Gopinath K, Singh N, Mani K, et al. (2013). Incidence and prevalence of tuberculosis among household contacts of pulmonary tuberculosis patients in a Peri-urban population of South Delhi, India. *PLoS One.*, 8(7):1–11.

Singh, S. K., Kashyap, G. C. and Puri, P. (2018) 'Potential effect of household environment on prevalence of tuberculosis in India: Evidence from the recent round of a cross-sectional survey', BMC Pulmonary Medicine. *BMC Pulmonary Medicine*, 18(1), pp. 1–10.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. Dynamics of Human Health; 2015: 2 (4). ISSN 2382-1019.Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS: Journal of Public Health*, 9 (1) : 85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2014). Tuberculosis: epidemiology and control. *Mediterranean journal of hematology and infectious diseases*, 6(1),Taha M, Deribew A, Tessema F, Assegid S, Duchateau L. (2011). Risk factors of active tuberculosis in people living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci.* 2011;21:131–139. e2014070. https://doi.org/10.4084/MJHID.2014.070.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F. (2015). Environmental and host-related determinants of tuberculosis in Metema district, north-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, 87.

WHO. (2015). *Global Tuberculosis Report 2015. 20th ed. NASN school nurse* (Print). Geneva: World Health Organization.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

World Health Organization. (2019). *Tuberculosis.* [Internet]. Available from:https://www.who.int/news-room/fact-sheets/detail/tuberculosis.

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. One of the determinants of factors that affect the degree of public health is environmental health. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on TB data in DIY in 2019, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Helath Center Unit or "Puskesmas" Kota Yogyakarta. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Housing, TB

Introduction

Tuberculosis (TB) become world's communicable diseases (Álvaro-Meca, et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah and Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al., 2018). WHO estimates that the TB morbidity rate in 2017 reached 9 million people and the mortality rate was 1.6 million people, and the morbidity in Southeast Asia was 56% of the total 9 million people with TB in 2015 (WHO, 2015). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). The number of deaths from suffering from TB is quite large throughout the world. A total of 1.5 million people died caused by TB in 2018 (including 251,000 people with HIV). TB is one of the top 10 causes of death

and the leading cause of an infectious agent (above HIV / AIDS) in worldwide (WHO, 2019). According to the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 TB BTA (+) cases were still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha, et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling settings can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh, et al., 2013). Household contacts become primarily risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis, et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth, et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh, et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh, et al., 2018; Shimeles, et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the households environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 “Puskesmas” Public Health Center in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment

other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

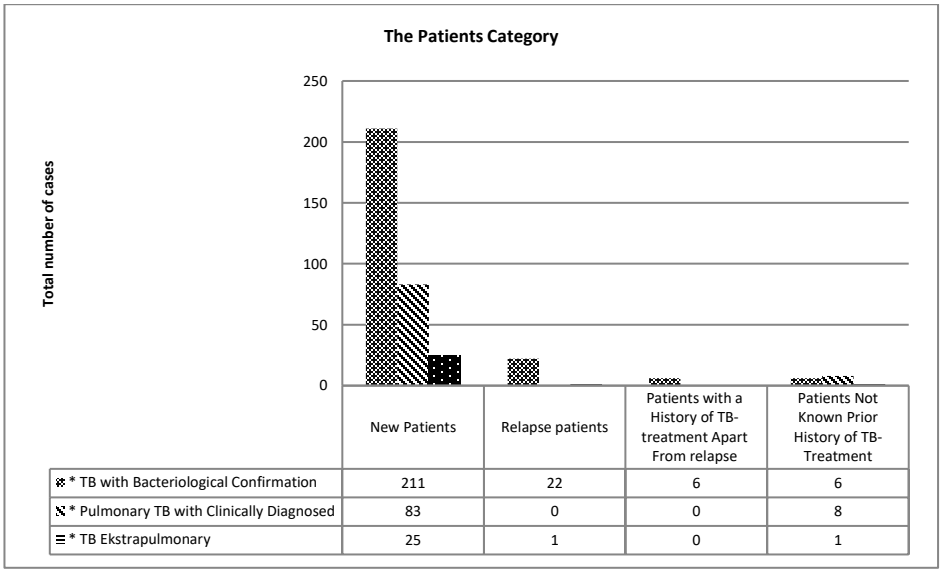


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

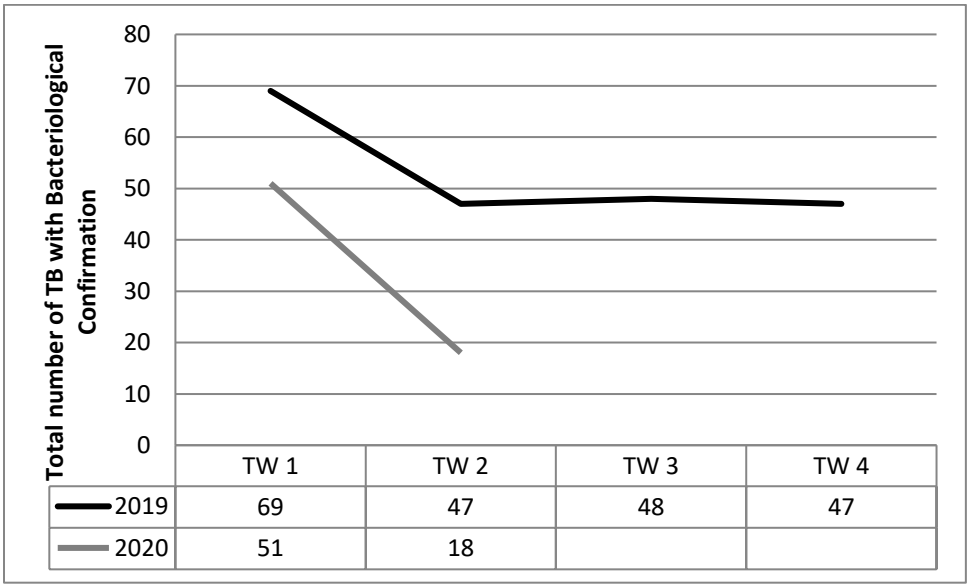


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The jurisdiction area of the Yogyakarta City Health Office has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following is a graph of new

bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

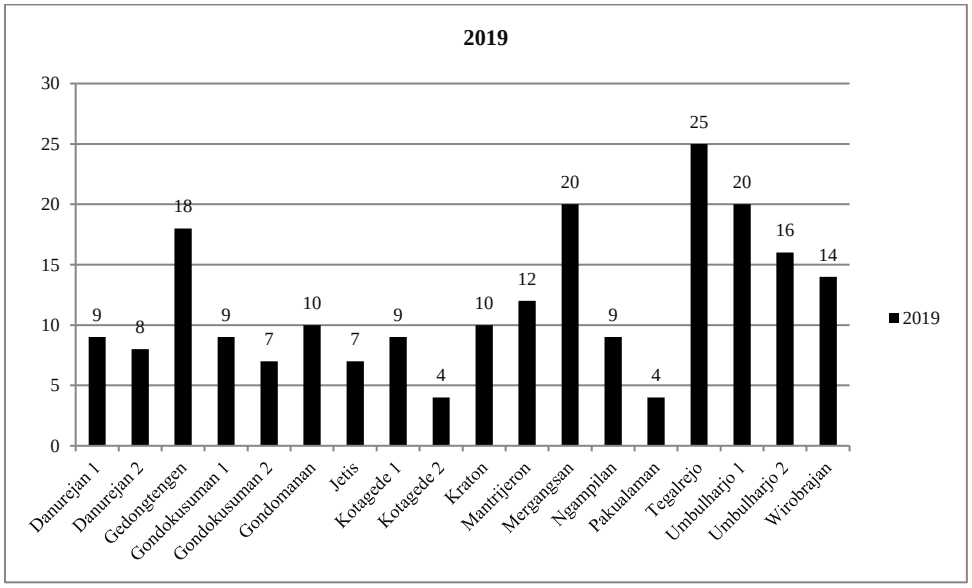


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers unit in 2019

The TB case data in 2020 were showed in Figure 3 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

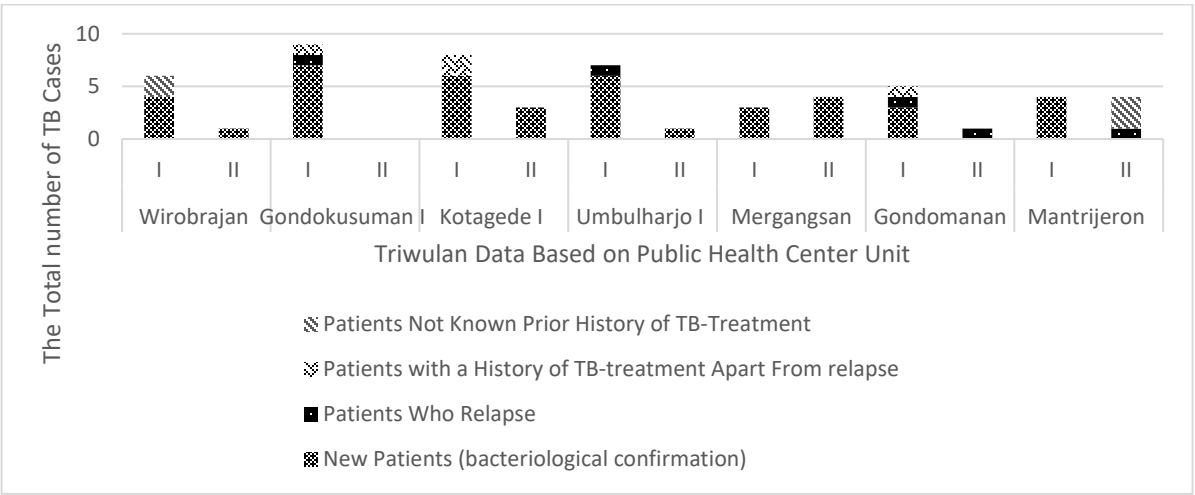


Figure 3. The Seven Highest TB Cases Data Based on Public Health Center Unit for the period January to June 2020

Based on the data Figure 3, the highest pulmonary TB cases were in the Kotagede I public health center unit and the lowest was found in the Gondomanan public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the

pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Ministry of Health The Republic of Indonesia, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the "Puskesmas" or public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the "Puskesmas" or public health center unit, or restrictions from the examination over there (Ministry of Health The Republic of Indonesia, 2020). TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients who have a high risk of becoming a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021). COVID-19 has provided an opportunity to launching several form of adaptation TB care as a community approach, capacity building of human resources, and to combat the stigma that exists by a multisectoral approach (Fatima, et. al., 2021).

Analysis of the Physical Environment of Healthy Housing in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables increases TB transmission. Based on Mahpudin's study, there was a relationship between the households environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015). Factors affecting the incidence of tuberculosis is related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that coinfection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The healthy housing coverages data according to public health centers unit in Yogyakarta City in 2018

Public health center unit	Total Household	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the “non-healthy housing” data is compared with the TB incidence (prevalence) data, the following graph will showed (Figure 4):

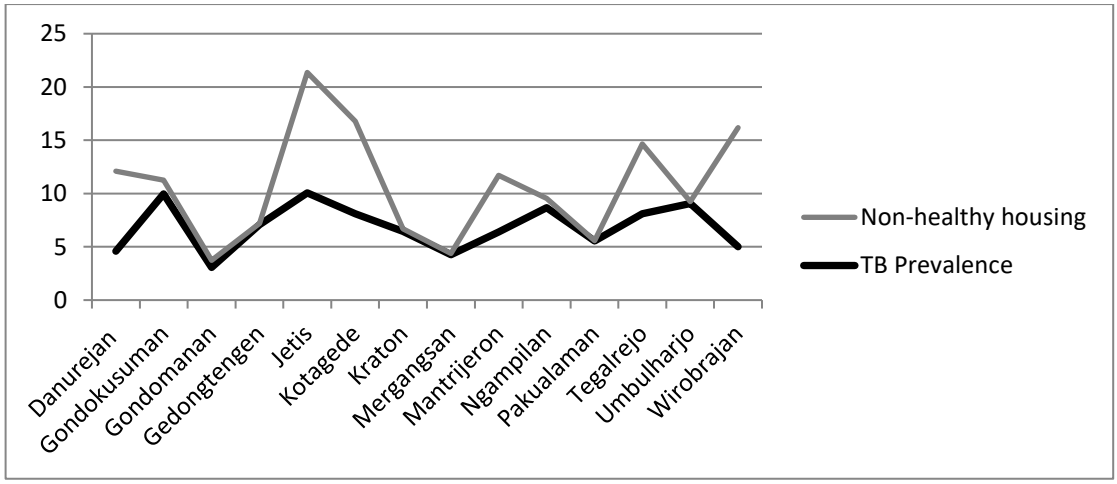


Figure 4. Graph of “non-healthy housing” and TB prevalence-based data trends on public health centers in 2018

Based on the chart above, it can be seen that the trend of the data the higher the number the house is not healthy, it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household filogenik related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density, it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). The associations between floor levels of residence and TB cases have been reported dependent on housing types because housing characteristics as main factor to explore an ecological study of the TB disease (Low, et al., 2013). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. The lighting can enter through ventilation holes, windows, or doors that are opened, otherwise it can enter through glass tiles (Ministry of Health The Republic of Indonesia, 2014). In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru, et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with

mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous study that there was a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Ministry of Health the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser of occupancy in one house, the greater the interaction that occurs between residents in the one house. The previous study only reported that people which living in crowded conditions were experience repeated and increase the TB infection for healthy people in the same house. Crowding was relationship both with risk of infection and risk of progression from infection to disease (Khan, 2016). The number of people per room was the only housing characteristic associated with progression to TB disease among infected participants, it caused by exposure to *M. tuberculosis* containing droplet particles during interactions in people's homes, it becomes to make exchange rates within the range of values standard measured in air. The similar studies in New Zealand showed that TB incidence was associated with household crowding (Baker, et. al., 2008). The other study results were obtained from Low, et. al., (2013), reported that TB outcome could be characterized by dwelling characteristics such as housing type and height, they suggest that communities with poor household condition had a higher risk of TB. There were significant public health implications for Asian cities especially in high density urban living.

Environmental condition and host information related risk factors were very important to control the spread of infection and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. al., 2021). Our study also shows credible results in the analysis of housing type by community. The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multisectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd, et al. 2018). The improvements in socio-environmental aspects are needed, but they must be combined with the improvement of education level (Cardoso, et. al., 2017). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Aditama, W., Sitepu, F. Y., & Saputra, R. (2019). Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res,* 4(1) : 227-231.

Álvaro-Meca A, Díaz A, de Miguel Díez J, Resino R, Resino S. (2016). Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. PLoS One. 2016 Nov 3;11(11).

Baker M, Das D, Venugopal K, Howden-Chapman P. (2008). Tuberculosis associated with household crowding in a developed country. *J Epidemiol Community Health.* 2008 Aug;62(8):715-21.

Cardoso, B. A., Fonseca, F. D. O., Moraes Neto, A. H. A. D., Martins, A. C. G. S., Oliveira, N. V. D. S., Lima, L. N. G. C., ... & Saad, M. H. F. (2017). Environmental aspects related to tuberculosis and intestinal parasites in a low-income community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo,* 59.

Chen, Y., Peng, W. H., Lai, S. F., Luo, F., Luo, D., & Wang, B. G. (2021). Association of gene polymorphisms and environmental factors in tuberculosis patients and their household contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(1) : 20-29.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Duru, C. B., Iwu, A. C., Uwakwe, K. A., Diwe, K. C. & Merenu, I. A. Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State , Nigeria. *Int. J. Sci. Healthc. Res.* 1 : 57–69.

Fatima, R., Akhtar, N., Yaqoob, A., Harries, A.D., Khan, M.S. (2021). Building Better Tuberculosis Control Systems In A Post-COVID World: Learning From Pakistan During The COVID-19 Pandemic. *International Journal of Infectious Diseases*. Available online 17 March 2021.

Floyd K, Glaziou P, Zumla A, Raviglione M. (2018). The global tuberculosis epidemic and progress in care, prevention, and research: an overview in year 3 of the End TB era. *Lancet Respir Med.* ;6(4):299-314.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major.* 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Khaliq A, Khan IH, Akhtar MW, Chaudhry MN (2015) Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)* 5:201. doi:10.4172/2161-1165.1000201.

Khan, F. A., Fox, G. J., Lee, R. S., Riva, M., Benedetti, A., Proulx, J. F., Jung, S., Hornby, K., Behr, M. A., & Menzies, D. (2016). Housing and tuberculosis in an Inuit village in northern Quebec: a case-control study. *CMAJ open*, 4(3), E496–E506.

Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57–72.

Lo¨nnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. (2010). Tuberculosis control and elimination 2010–50: cure, care, and social development. *Lancet.* 2010; 375: 1814–1829.

Low CT, Lai PC, Tse WS, Tsui CK, Lee H, Hui PK. (2013). Exploring tuberculosis by types of housing development. *Soc Sci Med.* 2013 Jun ;87:77-83.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J*. 2007; 1 (4): 14.

Ministry of Health The Republic of Indonesia. (2014). *National TBC Countermeasures*. Jakarta

Ministry of Health The Republic of Indonesia. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health The Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Narasimhan P, Wood J, MacIntyre CR, Mathai D. (2013). Risk factors for tuberculosis. *Pulm Med.* 2013:1–11

Pambudi, I., (2020). *TB Service Protocol during the Covid Pandemic*, Dit. P2PML, Directorate General of P2P, Ministry of Health The Republic of Indonesia.

Putri, A. S. E., Tari Amanda, R., & Ilham, R. (2019). Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah A, Mallhi TH, Khan YH, Iqbal MS, Alotaibi NH, Alzarea AI, Rasheed M. 2021. Evaluation of risk factors associated with the development of MDR- and XDR-TB in a tertiary care hospital: a retrospective cohort study. *PeerJ 9*:e10826. DOI 10.7717/peerj.10826.

Schmidt C. W. (2008). Linking TB and the environment: an overlooked mitigation strategy. *Environmental health perspectives*, 116(11), A478–A485.

Shimeles, E. et al. (2019) 'Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia', *PLoS ONE*, 14(4), pp. 1–19. doi: 10.1371/journal.pone.0214235.

Singh J, Sankar MM, Kumar S, Gopinath K, Singh N, Mani K, et al. (2013). Incidence and prevalence of tuberculosis among household contacts of pulmonary tuberculosis patients in a Peri-urban population of South Delhi, India. *PLoS One.*, 8(7):1–11.

Singh, S. K., Kashyap, G. C. and Puri, P. (2018) 'Potential effect of household environment on prevalence of tuberculosis in India: Evidence from the recent round of a cross-sectional survey', BMC Pulmonary Medicine. *BMC Pulmonary Medicine*, 18(1), pp. 1–10.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. Dynamics of Human Health; 2015: 2 (4). ISSN 2382-1019.Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS: Journal of Public Health*, 9 (1) : 85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2014). Tuberculosis: epidemiology and control. *Mediterranean journal of hematology and infectious diseases*, 6(1),Taha M, Deribew A, Tessema F, Assegid S, Duchateau L. (2011). Risk factors of active tuberculosis in people living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci*. 2011;21:131–139. e2014070. https://doi.org/10.4084/MJHID.2014.070.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F. (2015). Environmental and host-related determinants of tuberculosis in Metema district, north-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, 87.

WHO. (2015). *Global Tuberculosis Report 2015. 20th ed. NASN school nurse* (Print). Geneva: World Health Organization.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

World Health Organization. (2019). *Tuberculosis.* [Internet]. Available from:https://www.who.int/news-room/fact-sheets/detail/tuberculosis.

8. Review Ke-4 Manuskrip

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. One of the determinants of factors that affect the degree of public health is environmental health. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on TB data in DIY in 2019, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Helath Center Unit or "Puskesmas" Kota Yogyakarta. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Housing, TB

Introduction

Tuberculosis (TB) become world's communicable diseases (Álvaro-Meca, et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah and Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al., 2018). WHO estimates that the TB morbidity rate in 2017 reached 9 million people and the mortality rate was 1.6 million people, and the morbidity in Southeast Asia was 56% of the total 9 million people with TB in 2015 (WHO, 2015). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). The number of deaths from suffering from TB is quite large throughout the world. A total of 1.5 million people died caused by TB in 2018 (including 251,000 people with HIV). TB is one of the top 10 causes of death

and the leading cause of an infectious agent (above HIV / AIDS) in worldwide (WHO, 2019). According to the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 TB BTA (+) cases were still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha, et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling settings can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh, et al., 2013). Household contacts become primarily risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis, et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth, et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh, et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh, et al., 2018; Shimeles, et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the households environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 “Puskesmas” Public Health Center in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment

other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

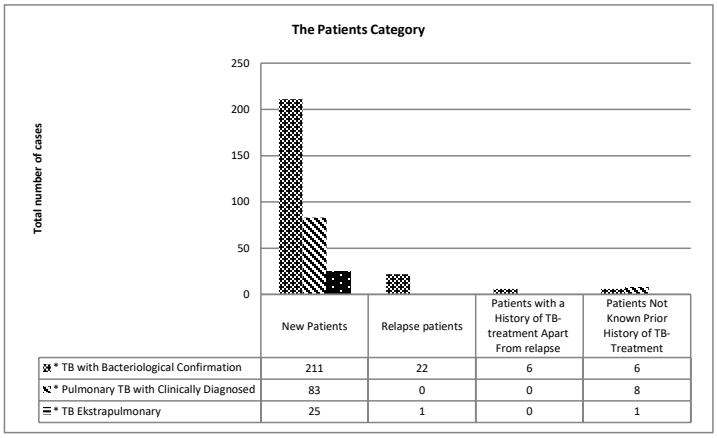


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

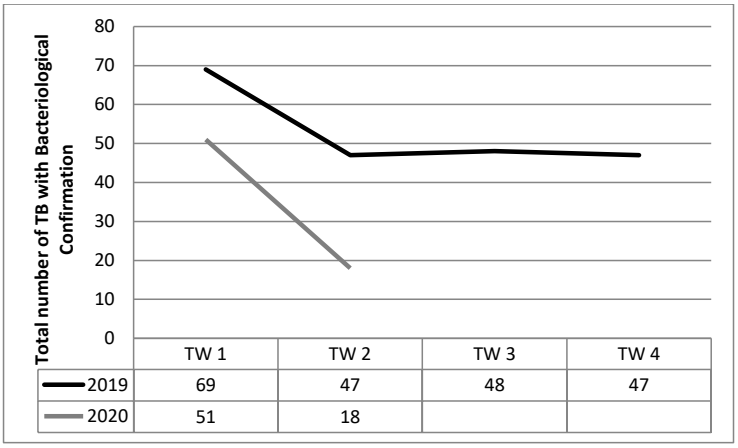


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The jurisdiction area of the Yogyakarta City Health Office has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following is a graph of new

bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

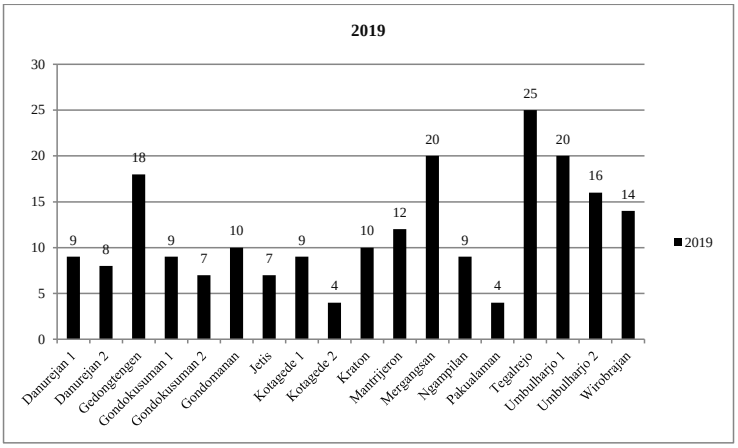


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers unit in 2019

The TB case data in 2020 were showed in Figure 3 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

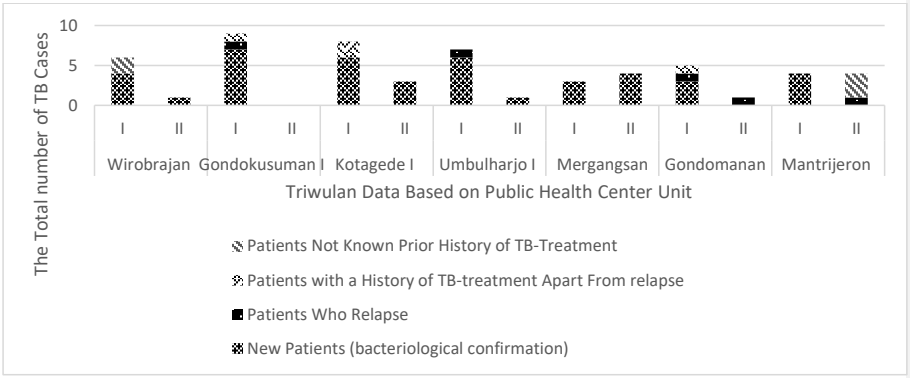


Figure 3. The Seven Highest TB Cases Data Based on Public Health Center Unit for the period January to June 2020

Based on the data Figure 3, the highest pulmonary TB cases were in the Kotagede I public health center unit and the lowest was found in the Gondomanan public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the

pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Ministry of Health The Republic of Indonesia, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the "Puskesmas" or public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the "Puskesmas" or public health center unit, or restrictions from the examination over there (Ministry of Health The Republic of Indonesia, 2020). TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients who have a high risk of becoming a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021). COVID-19 has provided an opportunity to launching several form of adaptation TB care as a community approach, capacity building of human resources, and to combat the stigma that exists by a multisectoral approach (Fatima, et. al., 2021).

Analysis of the Physical Environment of Healthy Housing in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables increases TB transmission. Based on Mahpudin's study, there was a relationship between the households environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015). Factors affecting the incidence of tuberculosis is related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that coinfection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The healthy housing coverages data according to public health centers unit in Yogyakarta City in 2018

Public health center unit	Total Household	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the "non-healthy housing" data is compared with the TB incidence (prevalence) data, the following graph will showed (Figure 4):

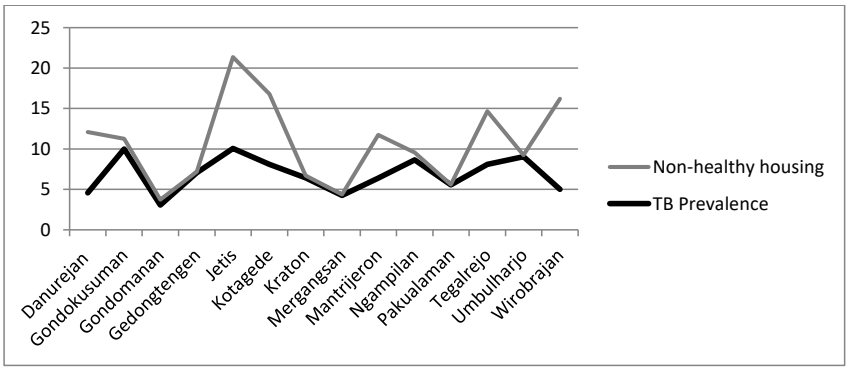


Figure 4. Graph of "non-healthy housing" and TB prevalence-based data trends on public health centers in 2018

Based on the chart above, it can be seen that the trend of the data the higher the number the house is not healthy, it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household filogenik related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density, it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). The associations between floor levels of residence and TB cases have been reported dependent on housing types because housing characteristics as main factor to explore an ecological study of the TB disease (Low, et al., 2013). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. The lighting can enter through ventilation holes, windows, or doors that are opened, otherwise it can enter through glass tiles (Ministry of Health The Republic of Indonesia, 2014). In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru, et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with

mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous study that there was a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Ministry of Health the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser of occupancy in one house, the greater the interaction that occurs between residents in the one house. The previous study only reported that people which living in crowded conditions were experience repeated and increase the TB infection for healthy people in the same house. Crowding was relationship both with risk of infection and risk of progression from infection to disease (Khan, 2016). The number of people per room was the only housing characteristic associated with progression to TB disease among infected participants, it caused by exposure to *M. tuberculosis* containing droplet particles during interactions in people's homes, it becomes to make exchange rates within the range of values standard measured in air. The similar studies in New Zealand showed that TB incidence was associated with household crowding (Baker, et. al., 2008). The other study results were obtained from Low, et. al., (2013), reported that TB outcome could be characterized by dwelling characteristics such as housing type and height, they suggest that communities with poor household condition had a higher risk of TB. There were significant public health implications for Asian cities especially in high density urban living.

Environmental condition and host information related risk factors were very important to control the spread of infection and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. al., 2021). Our study also shows credible results in the analysis of housing type by community. The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multisectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd, et al. 2018). The improvements in socio-environmental aspects are needed, but they must be combined with the improvement of education level (Cardoso, et. al., 2017). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Aditama, W., Sitepu, F. Y., & Saputra, R. (2019). Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res*, 4(1) : 227-231.

Álvaro-Meca A, Díaz A, de Miguel Díez J, Resino R, Resino S. (2016). Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. PLoS One. 2016 Nov 3;11(11).

Baker M, Das D, Venugopal K, Howden-Chapman P. (2008). Tuberculosis associated with household crowding in a developed country. *J Epidemiol Community Health.* 2008 Aug;62(8):715-21.

Cardoso, B. A., Fonseca, F. D. O., Moraes Neto, A. H. A. D., Martins, A. C. G. S., Oliveira, N. V. D. S., Lima, L. N. G. C., ... & Saad, M. H. F. (2017). Environmental aspects related to tuberculosis and intestinal parasites in a low-income community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo*, 59.

Chen, Y., Peng, W. H., Lai, S. F., Luo, F., Luo, D., & Wang, B. G. (2021). Association of gene polymorphisms and environmental factors in tuberculosis patients and their household contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(1) : 20-29.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Duru, C. B., Iwu, A. C., Uwakwe, K. A., Diwe, K. C. & Merenu, I. A. Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State , Nigeria. *Int. J. Sci. Healthc. Res.* 1 : 57–69.

Fatima, R., Akhtar, N., Yaqoob, A., Harries, A.D., Khan, M.S. (2021). Building Better Tuberculosis Control Systems In A Post-COVID World: Learning From Pakistan During The COVID-19 Pandemic. *International Journal of Infectious Diseases*. Available online 17 March 2021.

Floyd K, Glaziou P, Zumla A, Raviglione M. (2018). The global tuberculosis epidemic and progress in care, prevention, and research: an overview in year 3 of the End TB era. *Lancet Respir Med.* ;6(4):299-314.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major*. 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Khaliq A, Khan IH, Akhtar MW, Chaudhry MN (2015) Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)* 5:201. doi:10.4172/2161-1165.1000201.

Commented [nn1]: Mohon Pustaka yg saya blok kuning dapat dikurangi 3, agar Pustaka minimal 80% dr artikel jurnal international. Terima kasih. Artikel akan kami proses administrasi jika telah diperbaiki.

Khan, F. A., Fox, G. J., Lee, R. S., Riva, M., Benedetti, A., Proulx, J. F., Jung, S., Hornby, K., Behr, M. A., & Menzies, D. (2016). Housing and tuberculosis in an Inuit village in northern Quebec: a case-control study. *CMAJ open*, 4(3), E496–E506.

Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57–72.

Lo¨nnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. (2010). Tuberculosis control and elimination 2010–50: cure, care, and social development. *Lancet.* 2010; 375: 1814–1829.

Low CT, Lai PC, Tse WS, Tsui CK, Lee H, Hui PK. (2013). Exploring tuberculosis by types of housing development. *Soc Sci Med.* 2013 Jun ;87:77-83.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J*. 2007; 1 (4): 14.

Ministry of Health The Republic of Indonesia. (2014). *National TBC Countermeasures*. Jakarta

Ministry of Health The Republic of Indonesia. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health The Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Narasimhan P, Wood J, MacIntyre CR, Mathai D. (2013). Risk factors for tuberculosis. *Pulm Med.* 2013:1–11

Pambudi, I., (2020). *TB Service Protocol during the Covid Pandemic*, Dit. P2PML, Directorate General of P2P, Ministry of Health The Republic of Indonesia.

Putri, A. S. E., Tari Amanda, R., & Ilham, R. (2019). Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah A, Mallhi TH, Khan YH, Iqbal MS, Alotaibi NH, Alzarea AI, Rasheed M. 2021. Evaluation of risk factors associated with the development of MDR- and XDR-TB in a tertiary care hospital: a retrospective cohort study. *PeerJ 9*:e10826. DOI 10.7717/peerj.10826.

Schmidt C. W. (2008). Linking TB and the environment: an overlooked mitigation strategy. *Environmental health perspectives*, 116(11), A478–A485.

Shimeles, E. et al. (2019) 'Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia', *PLoS ONE*, 14(4), pp. 1–19. doi: 10.1371/journal.pone.0214235.

Singh J, Sankar MM, Kumar S, Gopinath K, Singh N, Mani K, et al. (2013). Incidence and prevalence of tuberculosis among household contacts of pulmonary tuberculosis patients in a Peri-urban population of South Delhi, India. *PLoS One.*, 8(7):1–11.

Singh, S. K., Kashyap, G. C. and Puri, P. (2018) 'Potential effect of household environment on prevalence of tuberculosis in India: Evidence from the recent round of a cross-sectional survey', BMC Pulmonary Medicine. *BMC Pulmonary Medicine*, 18(1), pp. 1–10.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. Dynamics of Human Health; 2015: 2 (4). ISSN 2382-1019.Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS: Journal of Public Health*, 9 (1) : 85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2014). Tuberculosis: epidemiology and control. *Mediterranean journal of hematology and infectious diseases*, 6(1),Taha M, Deribew A, Tessema F, Assegid S, Duchateau L. (2011). Risk factors of active tuberculosis in people living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci.* 2011;21:131–139. e2014070. https://doi.org/10.4084/MJHID.2014.070.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F. (2015). Environmental and host-related determinants of tuberculosis in Metema district, north-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, 87.

WHO. (2015). *Global Tuberculosis Report 2015. 20th ed. NASN school nurse* (Print). Geneva: World Health Organization.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

World Health Organization. (2019). *Tuberculosis*. [Internet]. Available from:https://www.who.int/news-room/fact-sheets/detail/tuberculosis.

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. Environmental health is one of the determinants factors toward the public health status. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on previous TB data in local study, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Helath Center Unit or "Puskesmas" Kota Yogyakarta. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Housing, TB

Introduction

Tuberculosis (TB) become world's communicable diseases (Álvaro-Meca, et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah and Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al., 2018). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). According to the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 TB BTA (+) cases were still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha, et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling settings can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh, et al., 2013). Household contacts become primarily risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis, et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth, et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh, et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh, et al., 2018; Shimeles, et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the households environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 “Puskesmas” Public Health Center in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

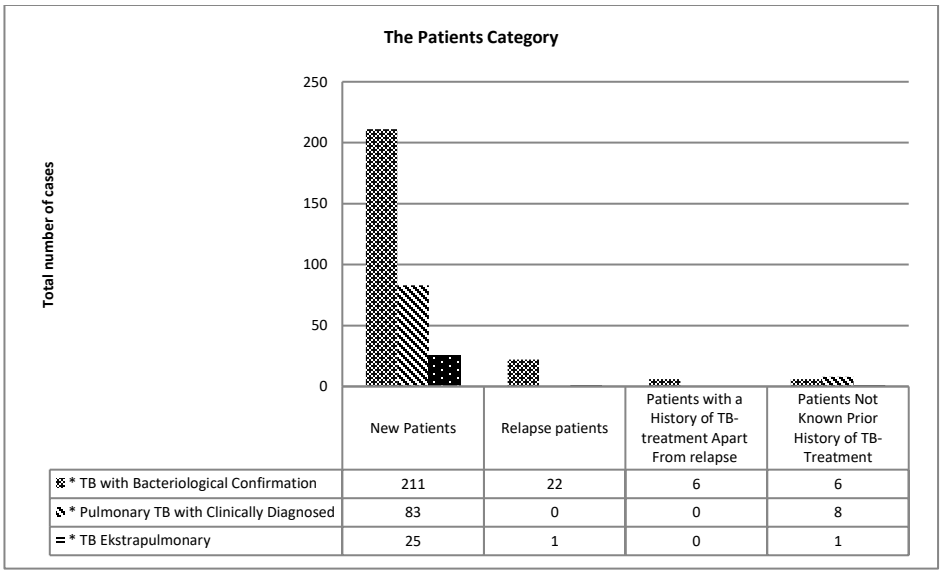


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

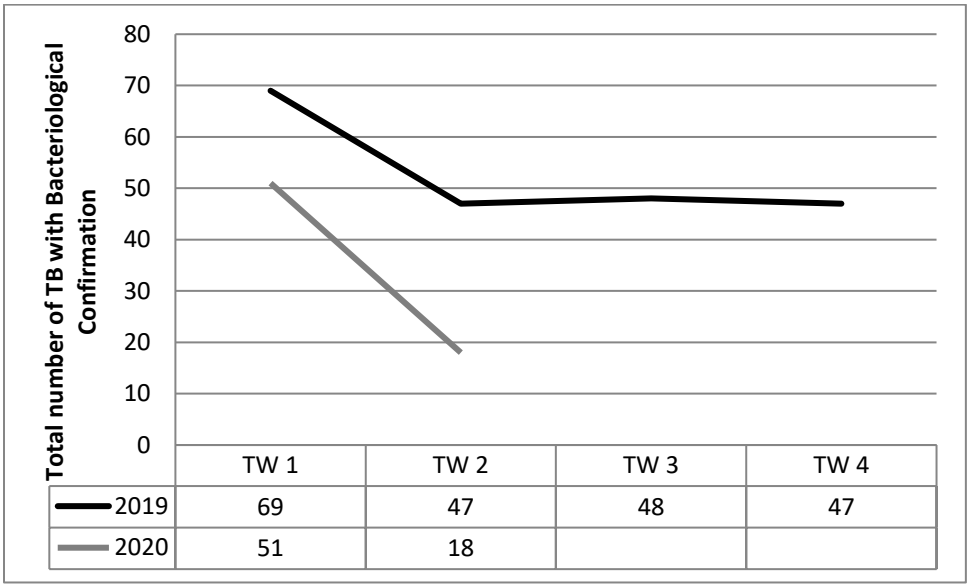


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The jurisdiction area of the Yogyakarta City Health Office has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following is a graph of new bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

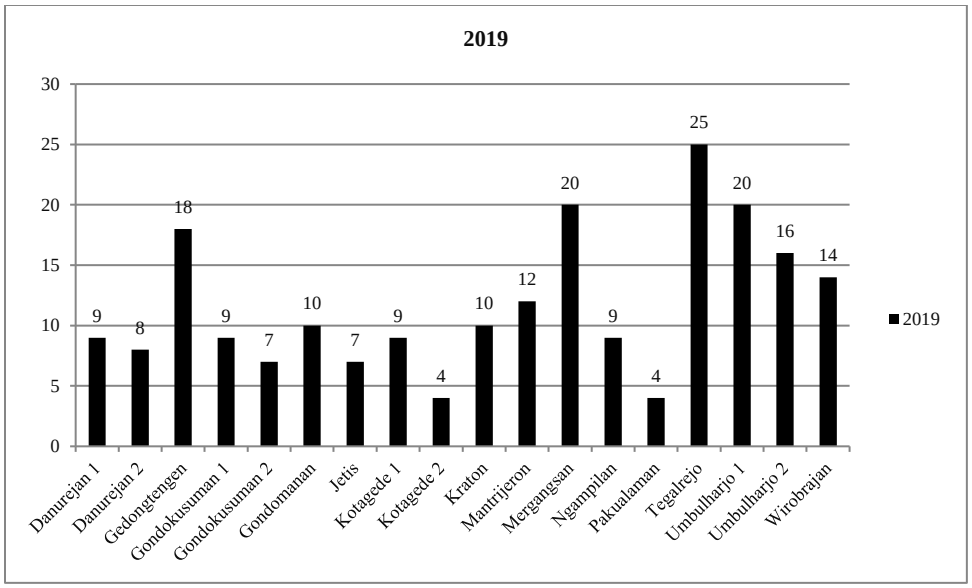


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers unit in 2019

The TB case data in 2020 were showed in Figure 3 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

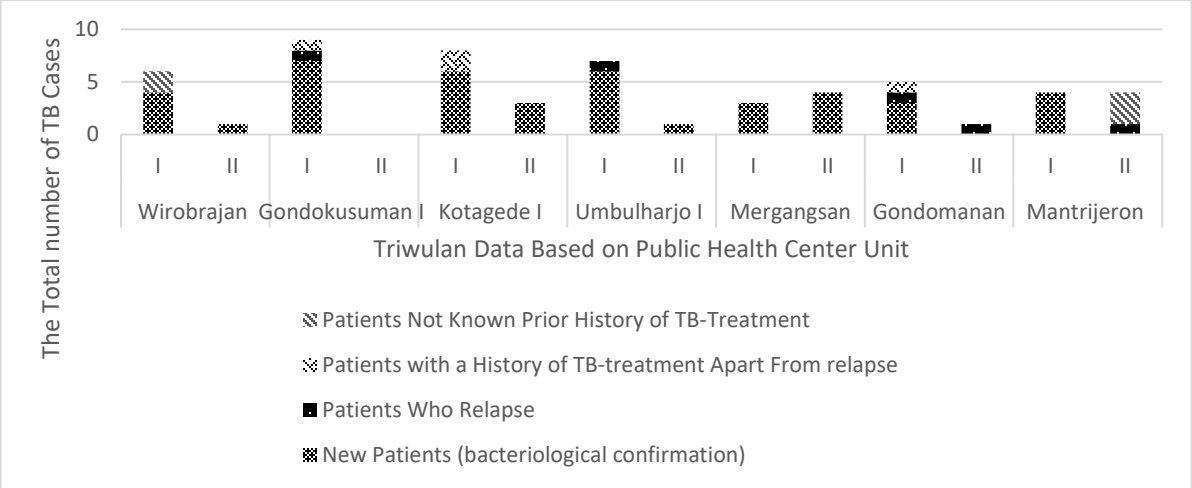


Figure 3. The Seven Highest TB Cases Data Based on Public Health Center Unit for the period January to June 2020

Based on the data Figure 3, the highest pulmonary TB cases were in the Kotagede I public health center unit and the lowest was found in the Gondomanan public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring

services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Ministry of Health The Republic of Indonesia, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the "Puskesmas" or public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the "Puskesmas" or public health center unit, or restrictions from the examination over there (Ministry of Health The Republic of Indonesia, 2020). TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients who have a high risk of becoming a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021). COVID-19 has provided an opportunity to launching several form of adaptation TB care as a community approach, capacity building of human resources, and to combat the stigma that exists by a multisectoral approach (Fatima, et. al., 2021).

Analysis of the Physical Environment of Healthy Housing in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables increases TB transmission. Based on Mahpudin's study, there was a relationship between the households environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015). Factors affecting the incidence of tuberculosis is related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that coinfection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The healthy housing coverages data according to public health centers unit in Yogyakarta

City in 2018

Public health center unit	Total Household	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the “non-healthy housing” data is compared with the TB incidence (prevalence) data, the following graph will showed (Figure 4):

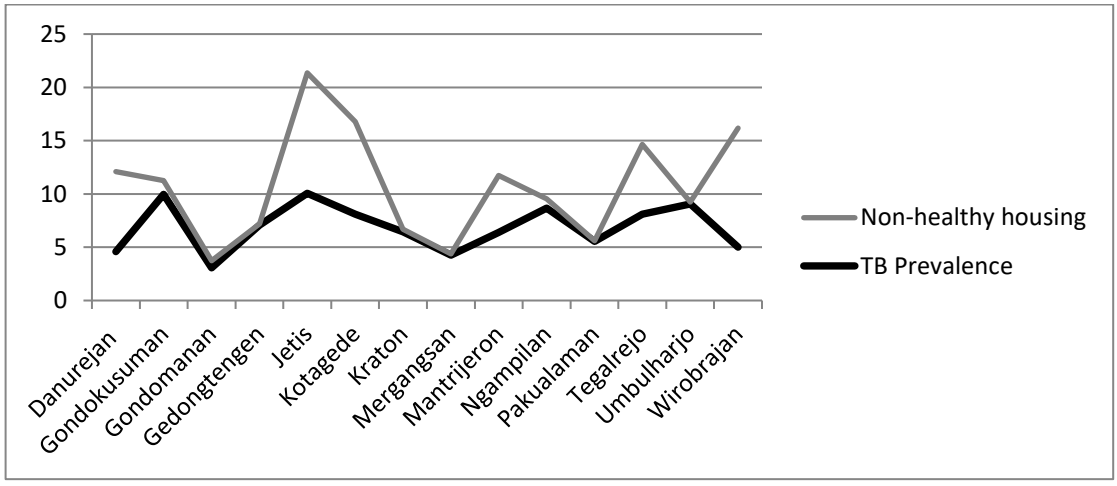


Figure 4. Graph of “non-healthy housing” and TB prevalence-based data trends on public health centers in 2018

Based on the chart above, it can be seen that the trend of the data the higher the number the house is

not healthy, it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household filogenik related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density, it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). The associations between floor levels of residence and TB cases have been reported dependent on housing types because housing characteristics as main factor to explore an ecological study of the TB disease (Low, et al., 2013). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru, et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households

ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous study that there was a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Ministry of Health the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser of occupancy in one house, the greater the interaction that occurs between residents in the one house. The previous study only reported that people which living in crowded conditions were experience repeated and increase the TB infection for healthy people in the same house. Crowding was relationship both with risk of infection and risk of progression from infection to disease (Khan, 2016). The number of people per room was the only housing characteristic associated with progression to TB disease among infected participants, it caused by exposure to *M. tuberculosis* containing droplet particles during interactions in people's homes, it becomes to make exchange rates within the range of values standard measured in air. The similar studies in New Zealand showed that TB incidence was associated with household crowding (Baker, et. al., 2008). The other study results were obtained from Low, et. al., (2013), reported that TB outcome could be characterized by dwelling characteristics such as housing type and height, they suggest that communities with poor household condition had a higher risk of TB. There were significant public health implications for Asian cities especially in high density urban living.

Environmental condition and host information related risk factors were very important to control the spread of infection and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. al., 2021). Our study also shows credible results in the analysis of housing type by community. The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multisectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd, et al. 2018). The improvements in socio-environmental aspects are needed, but they must be combined with the improvement of education level (Cardoso, et. al., 2017). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Aditama, W., Sitepu, F. Y., & Saputra, R. (2019). Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res,* 4(1) : 227-231.

Álvaro-Meca A, Díaz A, de Miguel Díez J, Resino R, Resino S. (2016). Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. PLoS One. 2016 Nov 3;11(11).

Baker M, Das D, Venugopal K, Howden-Chapman P. (2008). Tuberculosis associated with household crowding in a developed country. *J Epidemiol Community Health.* 2008 Aug;62(8):715-21.

Cardoso, B. A., Fonseca, F. D. O., Moraes Neto, A. H. A. D., Martins, A. C. G. S., Oliveira, N. V. D. S., Lima, L. N. G. C., ... & Saad, M. H. F. (2017). Environmental aspects related to tuberculosis and intestinal parasites in a low-income community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo,* 59.

Chen, Y., Peng, W. H., Lai, S. F., Luo, F., Luo, D., & Wang, B. G. (2021). Association of gene polymorphisms and environmental factors in tuberculosis patients and their household contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(1) : 20-29.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Duru, C. B., Iwu, A. C., Uwakwe, K. A., Diwe, K. C. & Merenu, I. A. Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State , Nigeria. *Int. J. Sci. Healthc. Res.* 1 : 57–69.

Fatima, R., Akhtar, N., Yaqoob, A., Harries, A.D., Khan, M.S. (2021). Building Better Tuberculosis Control Systems In A Post-COVID World: Learning From Pakistan During The COVID-19 Pandemic. *International Journal of Infectious Diseases*. Available online 17 March 2021.

Floyd K, Glaziou P, Zumla A, Raviglione M. (2018). The global tuberculosis epidemic and progress in care, prevention, and research: an overview in year 3 of the End TB era. *Lancet Respir Med.* ;6(4):299-314.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major.* 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Khaliq A, Khan IH, Akhtar MW, Chaudhry MN (2015) Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)* 5:201. doi:10.4172/2161-1165.1000201.

Khan, F. A., Fox, G. J., Lee, R. S., Riva, M., Benedetti, A., Proulx, J. F., Jung, S., Hornby, K., Behr, M. A., & Menzies, D. (2016). Housing and tuberculosis in an Inuit village in northern Quebec: a case-control study. *CMAJ open*, 4(3), E496–E506.

Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57–72.

Lo¨nnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. (2010). Tuberculosis control and elimination 2010–50: cure, care, and social development. *Lancet.* 2010; 375: 1814–1829.

Low CT, Lai PC, Tse WS, Tsui CK, Lee H, Hui PK. (2013). Exploring tuberculosis by types of housing development. *Soc Sci Med.* 2013 Jun ;87:77-83.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J*. 2007; 1 (4): 14.

Ministry of Health The Republic of Indonesia. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health The Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Narasimhan P, Wood J, MacIntyre CR, Mathai D. (2013). Risk factors for tuberculosis. *Pulm Med.* 2013:1–11

Pambudi, I., (2020). *TB Service Protocol during the Covid Pandemic*, Dit. P2PML, Directorate General of P2P, Ministry of Health The Republic of Indonesia.

Putri, A. S. E., Tari Amanda, R., & Ilham, R. (2019). Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah A, Mallhi TH, Khan YH, Iqbal MS, Alotaibi NH, Alzarea AI, Rasheed M. 2021. Evaluation of risk factors associated with the development of MDR- and XDR-TB in a tertiary care hospital: a retrospective cohort study. *PeerJ 9*:e10826. DOI 10.7717/peerj.10826.

Schmidt C. W. (2008). Linking TB and the environment: an overlooked mitigation strategy. *Environmental health perspectives*, 116(11), A478–A485.

Shimeles, E. et al. (2019) 'Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia', *PLoS ONE*, 14(4), pp. 1–19. doi: 10.1371/journal.pone.0214235.

Singh J, Sankar MM, Kumar S, Gopinath K, Singh N, Mani K, et al. (2013). Incidence and prevalence of tuberculosis among household contacts of pulmonary tuberculosis patients in a Peri-urban population of South Delhi, India. *PLoS One.*, 8(7):1–11.

Singh, S. K., Kashyap, G. C. and Puri, P. (2018) 'Potential effect of household environment on prevalence of tuberculosis in India: Evidence from the recent round of a cross-sectional survey', BMC Pulmonary Medicine. *BMC Pulmonary Medicine*, 18(1), pp. 1–10.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. Dynamics of Human Health; 2015: 2 (4). ISSN 2382-1019.

Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS: Journal of Public Health*, 9 (1) : 85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2014). Tuberculosis: epidemiology and control. *Mediterranean journal of hematology and infectious diseases*, 6(1) : 2014070.

Taha M, Deribew A, Tessema F, Assegid S, Duchateau L. (2011). Risk factors of active tuberculosis in people living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci*. 2011;21:131–139. e2014070. https://doi.org/10.4084/MJHID.2014.070.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F. (2015). Environmental and host-related determinants of tuberculosis in Metema district, north-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, 87.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. Environmental health is one of the determinants factors toward the public health status. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on previous TB data in local study, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Helath Center Unit or "Puskesmas" Kota Yogyakarta. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Housing, TB

Introduction

Tuberculosis (TB) become world's communicable diseases (Álvaro-Meca, et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah and Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al., 2018). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). According to the recapitulation of surveillance data from the Yogyakarta City Health Office, in 2019 TB BTA (+) cases were still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha, et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling settings can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo and Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh, et al., 2013). Household contacts become primarily risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis, et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth, et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh, et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh, et al., 2018; Shimeles, et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the households environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 “Puskesmas” Public Health Center in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

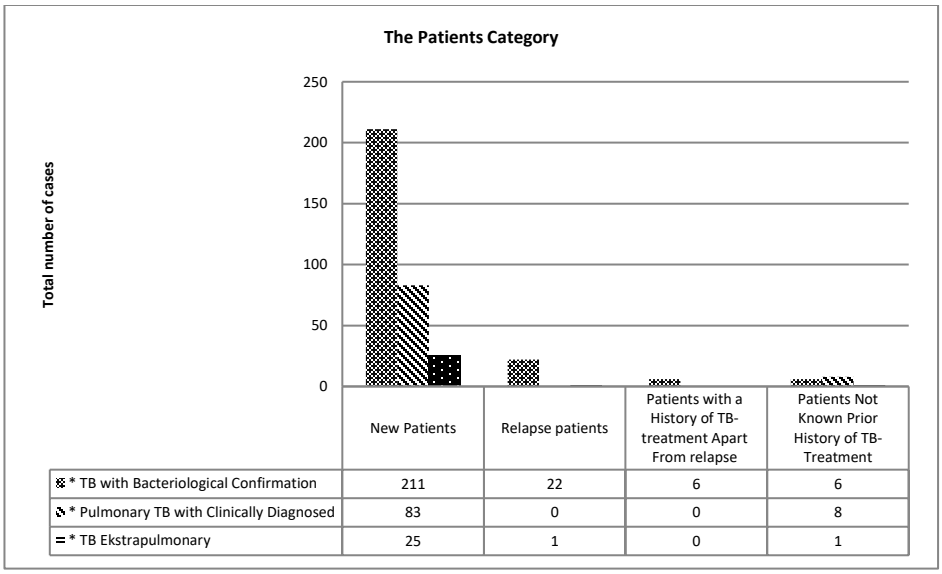


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

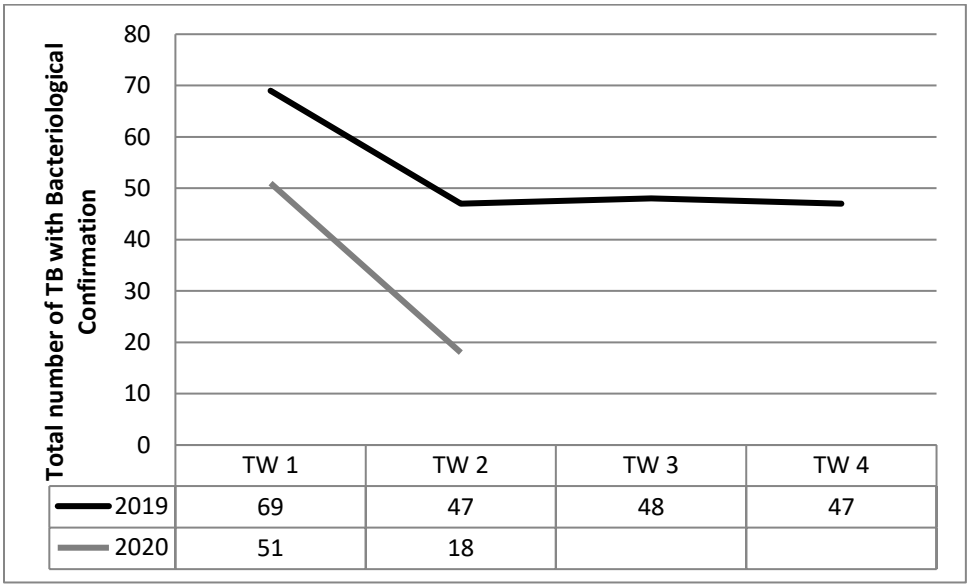


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The jurisdiction area of the Yogyakarta City Health Office has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following is a graph of new bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

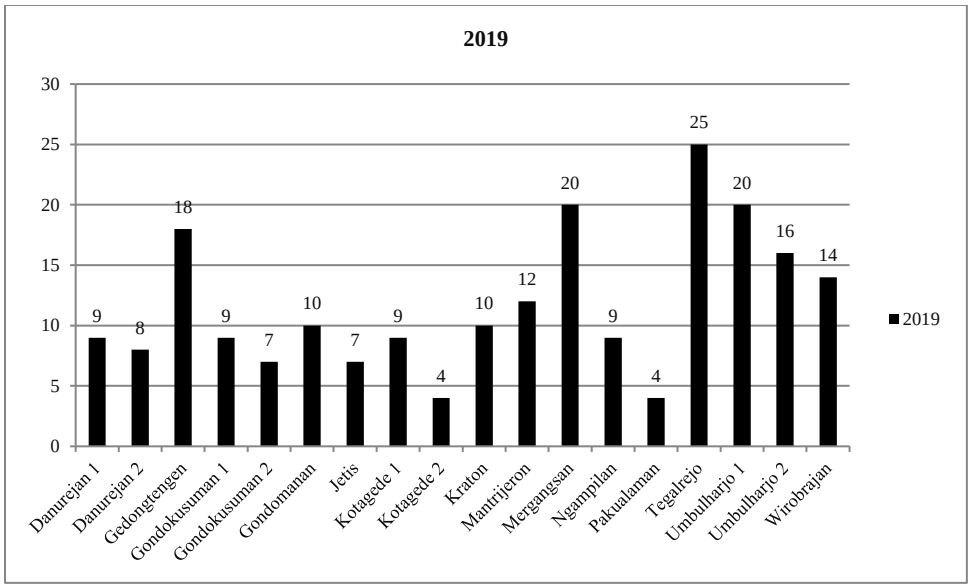


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers unit in 2019

The TB case data in 2020 were showed in Figure 3 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

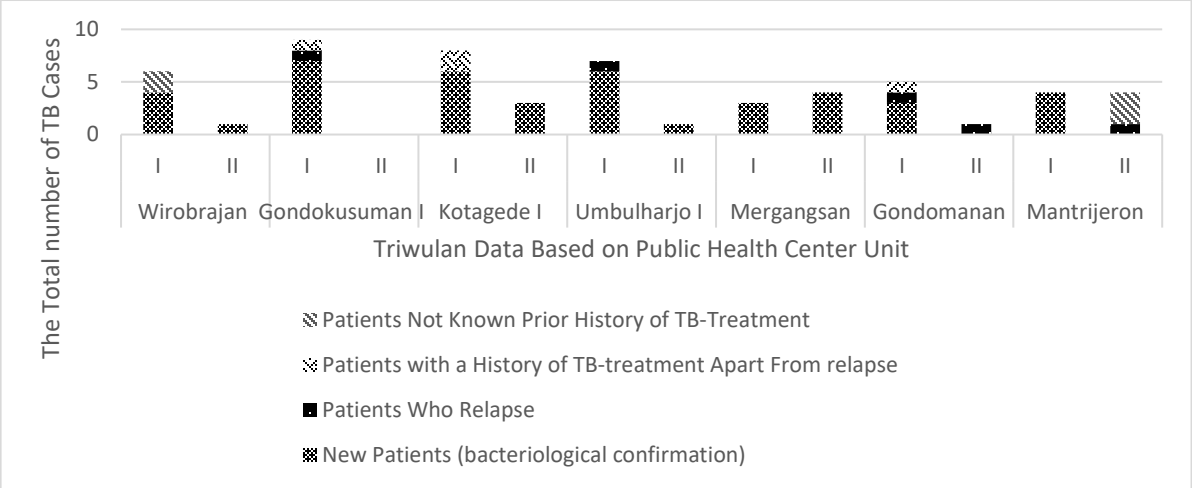


Figure 3. The Seven Highest TB Cases Data Based on Public Health Center Unit for the period January to June 2020

Based on the data Figure 3, the highest pulmonary TB cases were in the Kotagede I public health center unit and the lowest was found in the Gondomanan public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring

services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Ministry of Health The Republic of Indonesia, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the "Puskesmas" or public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the "Puskesmas" or public health center unit, or restrictions from the examination over there (Ministry of Health The Republic of Indonesia, 2020). TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients who have a high risk of becoming a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021). COVID-19 has provided an opportunity to launching several form of adaptation TB care as a community approach, capacity building of human resources, and to combat the stigma that exists by a multisectoral approach (Fatima, et. al., 2021).

Analysis of the Physical Environment of Healthy Housing in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables increases TB transmission. Based on Mahpudin's study, there was a relationship between the households environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin and Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo and Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015). Factors affecting the incidence of tuberculosis is related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that coinfection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The healthy housing coverages data according to public health centers unit in Yogyakarta

City in 2018

Public health center unit	Total Household	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the “non-healthy housing” data is compared with the TB incidence (prevalence) data, the following graph will showed (Figure 4):

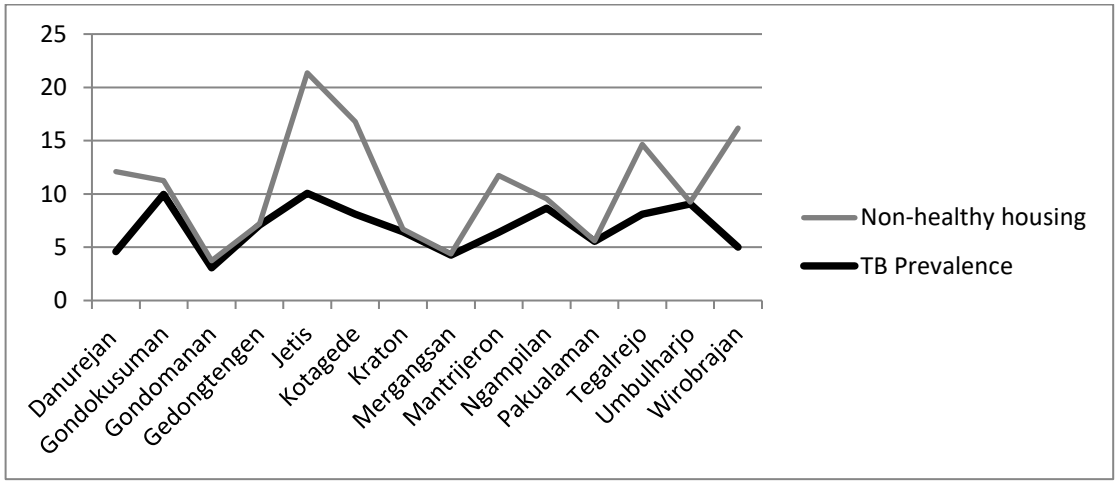


Figure 4. Graph of “non-healthy housing” and TB prevalence-based data trends on public health centers in 2018

Based on the chart above, it can be seen that the trend of the data the higher the number the house is

not healthy, it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household filogenik related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density, it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). The associations between floor levels of residence and TB cases have been reported dependent on housing types because housing characteristics as main factor to explore an ecological study of the TB disease (Low, et al., 2013). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru, et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households

ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous study that there was a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Decree of the Ministry of Health the Republic of Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser of occupancy in one house, the greater the interaction that occurs between residents in the one house. The previous study only reported that people which living in crowded conditions were experience repeated and increase the TB infection for healthy people in the same house. Crowding was relationship both with risk of infection and risk of progression from infection to disease (Khan, 2016). The number of people per room was the only housing characteristic associated with progression to TB disease among infected participants, it caused by exposure to *M. tuberculosis* containing droplet particles during interactions in people's homes, it becomes to make exchange rates within the range of values standard measured in air. The similar studies in New Zealand showed that TB incidence was associated with household crowding (Baker, et. al., 2008). The other study results were obtained from Low, et. al., (2013), reported that TB outcome could be characterized by dwelling characteristics such as housing type and height, they suggest that communities with poor household condition had a higher risk of TB. There were significant public health implications for Asian cities especially in high density urban living.

Environmental condition and host information related risk factors were very important to control the spread of infection and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. al., 2021). Our study also shows credible results in the analysis of housing type by community. The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multisectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd, et al. 2018). The improvements in socio-environmental aspects are needed, but they must be combined with the improvement of education level (Cardoso, et. al., 2017). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Aditama, W., Sitepu, F. Y., & Saputra, R. (2019). Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res,* 4(1) : 227-231.

Álvaro-Meca A, Díaz A, de Miguel Díez J, Resino R, Resino S. (2016). Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. PLoS One. 2016 Nov 3;11(11).

Baker M, Das D, Venugopal K, Howden-Chapman P. (2008). Tuberculosis associated with household crowding in a developed country. *J Epidemiol Community Health.* 2008 Aug;62(8):715-21.

Cardoso, B. A., Fonseca, F. D. O., Moraes Neto, A. H. A. D., Martins, A. C. G. S., Oliveira, N. V. D. S., Lima, L. N. G. C., ... & Saad, M. H. F. (2017). Environmental aspects related to tuberculosis and intestinal parasites in a low-income community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo,* 59.

Chen, Y., Peng, W. H., Lai, S. F., Luo, F., Luo, D., & Wang, B. G. (2021). Association of gene polymorphisms and environmental factors in tuberculosis patients and their household contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(1) : 20-29.

DI Yogyakarta Provincial Health Office. (2019). *TB Case Discovery in DIY Period of 17 July 2019*. Yogyakarta.

Duru, C. B., Iwu, A. C., Uwakwe, K. A., Diwe, K. C. & Merenu, I. A. Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State , Nigeria. *Int. J. Sci. Healthc. Res.* 1 : 57–69.

Fatima, R., Akhtar, N., Yaqoob, A., Harries, A.D., Khan, M.S. (2021). Building Better Tuberculosis Control Systems In A Post-COVID World: Learning From Pakistan During The COVID-19 Pandemic. *International Journal of Infectious Diseases*. Available online 17 March 2021.

Floyd K, Glaziou P, Zumla A, Raviglione M. (2018). The global tuberculosis epidemic and progress in care, prevention, and research: an overview in year 3 of the End TB era. *Lancet Respir Med.* ;6(4):299-314.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Social Determinants as Risk Factors for Pulmonary Tuberculosis at Puskesmas Panjang. *J Major.* 2017; 7 (1): 1–5.

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Khaliq A, Khan IH, Akhtar MW, Chaudhry MN (2015) Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)* 5:201. doi:10.4172/2161-1165.1000201.

Khan, F. A., Fox, G. J., Lee, R. S., Riva, M., Benedetti, A., Proulx, J. F., Jung, S., Hornby, K., Behr, M. A., & Menzies, D. (2016). Housing and tuberculosis in an Inuit village in northern Quebec: a case-control study. *CMAJ open*, 4(3), E496–E506.

Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57–72.

Lo¨nnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. (2010). Tuberculosis control and elimination 2010–50: cure, care, and social development. *Lancet.* 2010; 375: 1814–1829.

Low CT, Lai PC, Tse WS, Tsui CK, Lee H, Hui PK. (2013). Exploring tuberculosis by types of housing development. *Soc Sci Med.* 2013 Jun ;87:77-83.

Mahpudin AH, Mahkota R. (2007). Physical Environmental Factors of the House, Biological Response and Incidence of Pulmonary TB in Indonesia. *Kesmas Natl Public Heal J*. 2007; 1 (4): 14.

Ministry of Health The Republic of Indonesia. KEPMENKES No 829 / Menkes / SK / VII / 1999.

Ministry of Health The Republic of Indonesia. *Tuberculosis Elimination Bulletin*, Volume I, 2020.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Narasimhan P, Wood J, MacIntyre CR, Mathai D. (2013). Risk factors for tuberculosis. *Pulm Med.* 2013:1–11

Pambudi, I., (2020). *TB Service Protocol during the Covid Pandemic*, Dit. P2PML, Directorate General of P2P, Ministry of Health The Republic of Indonesia.

Putri, A. S. E., Tari Amanda, R., & Ilham, R. (2019). Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah A, Mallhi TH, Khan YH, Iqbal MS, Alotaibi NH, Alzarea AI, Rasheed M. 2021. Evaluation of risk factors associated with the development of MDR- and XDR-TB in a tertiary care hospital: a retrospective cohort study. *PeerJ 9*:e10826. DOI 10.7717/peerj.10826.

Schmidt C. W. (2008). Linking TB and the environment: an overlooked mitigation strategy. *Environmental health perspectives*, 116(11), A478–A485.

Shimeles, E. et al. (2019) 'Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia', *PLoS ONE*, 14(4), pp. 1–19. doi: 10.1371/journal.pone.0214235.

Singh J, Sankar MM, Kumar S, Gopinath K, Singh N, Mani K, et al. (2013). Incidence and prevalence of tuberculosis among household contacts of pulmonary tuberculosis patients in a Peri-urban population of South Delhi, India. *PLoS One.*, 8(7):1–11.

Singh, S. K., Kashyap, G. C. and Puri, P. (2018) 'Potential effect of household environment on prevalence of tuberculosis in India: Evidence from the recent round of a cross-sectional survey', BMC Pulmonary Medicine. *BMC Pulmonary Medicine*, 18(1), pp. 1–10.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. Dynamics of Human Health; 2015: 2 (4). ISSN 2382-1019.

Sugandi, YS, Soemarwoto, R., Mardotillah, M., (2018). Healthy Households Social Movement and Bcg Immunization as Steps to Reduce the Incidence of Tuberculosis (TB) in Children. *HUMANIKA*, Vol. 25 No.1, p. 38-50.

Suharyo. (2013). Determination of Tuberculosis in Rural Areas. *KEMAS: Journal of Public Health*, 9 (1) : 85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2014). Tuberculosis: epidemiology and control. *Mediterranean journal of hematology and infectious diseases*, 6(1) : 2014070.

Taha M, Deribew A, Tessema F, Assegid S, Duchateau L. (2011). Risk factors of active tuberculosis in people living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci*. 2011;21:131–139. e2014070. https://doi.org/10.4084/MJHID.2014.070.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F. (2015). Environmental and host-related determinants of tuberculosis in Metema district, north-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, 87.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah[1,a)], Desi Nurfita[1], Ahmad Faizal Rangkuti[1]

[1]*Faculty of Public Health, Universitas Ahmad Dahlan, Yogyakarta*

[a)]*Corresponding author: musfirah@ikm.uad.ac.id*

Abstract. Environmental health is one of the determinants factors toward the public health status. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on previous TB data in local study, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Helath Center Unit or "Puskesmas" Kota Yogyakarta. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Results: Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Keyword: Physical Environment, Urban; Healthy Housing, TB

Introduction

Tuberculosis (TB) become world's communicable diseases (Álvaro-Meca, et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah & Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al., 2018). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). According to the recapitulation of surveillance data from Dinas Kesehatan Provinsi DI Yogyakarta, in 2019 TB BTA (+) cases were still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially households conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha, et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling settings can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo & Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh, et al., 2013). Household contacts become primarily risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis, et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth, et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh, et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh, et al., 2018; Shimeles, et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the households environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 “Puskesmas” Public Health Center in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result And Discussion

Tuberculosis Prevalence Rate

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extrapulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

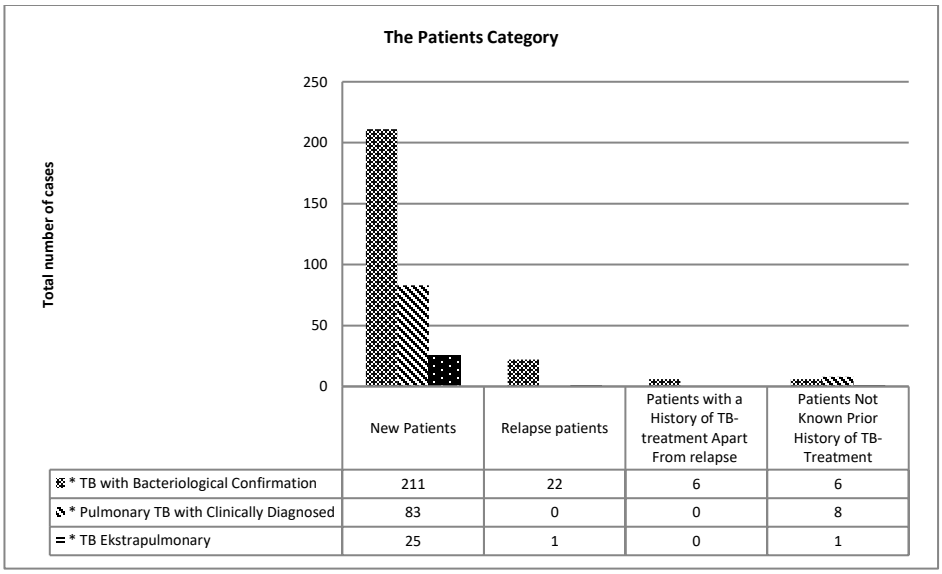


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Yogyakarta City Health Office from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

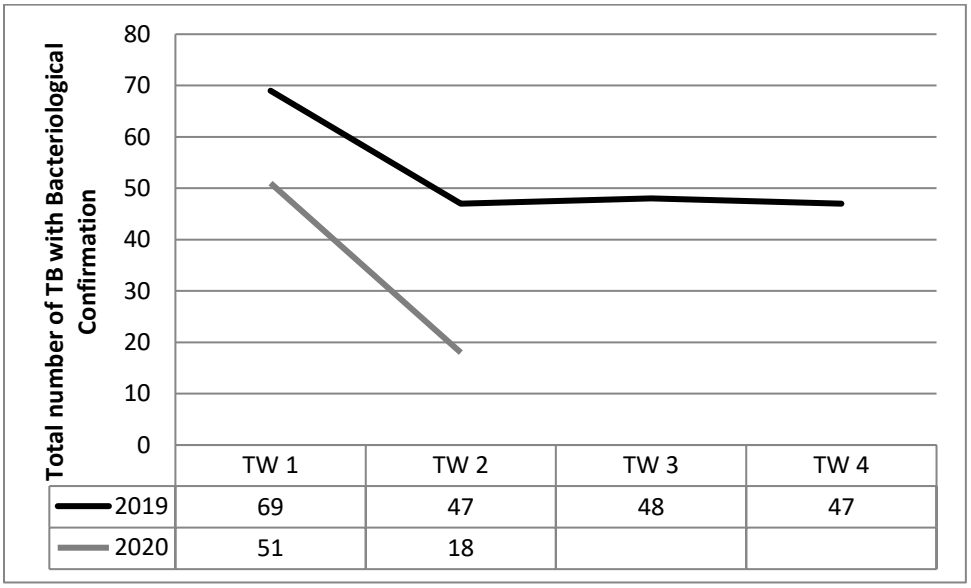


Figure 2. Comparison of bacteriologically confirmed pulmonary TB cases in 2019 and 2020

The jurisdiction area of the Yogyakarta City Health Office has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following Figure 3 is a graph of new bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

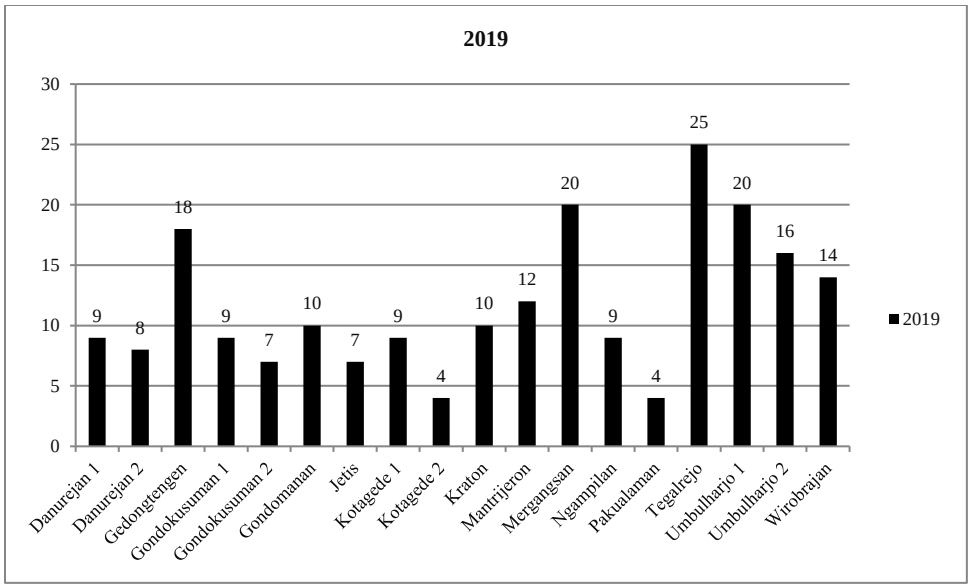


Figure 3.Graph of new bacteriological confirmed pulmonary TB cases based on health centers unit in 2019

The TB case data in 2020 were showed in Figure 4 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

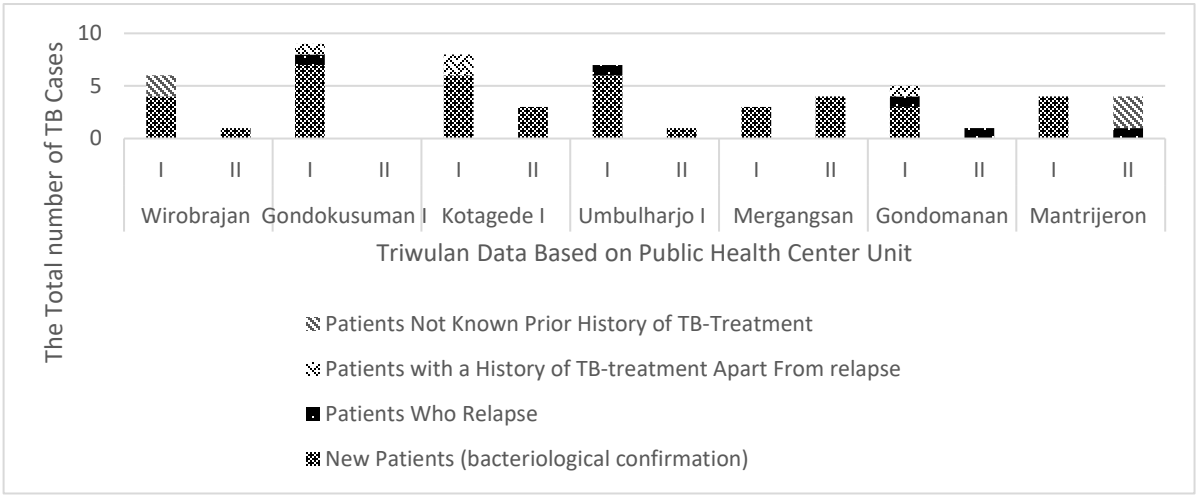


Figure 4. The Seven Highest TB Cases Data Based on Public Health Center Unit for the period January to June 2020

Based on the data Figure 4, the highest pulmonary TB cases were in the Kotagede I public health center unit and the lowest was found in the Gondomanan public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients.The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and table. During the pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring

services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Kementerian Kesehatan RI, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the "Puskesmas" or public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the "Puskesmas" or public health center unit, or restrictions from the examination over there (Kementerian Kesehatan RI, 2020). TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does very important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients who have a high risk of becoming a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021). COVID-19 has provided an opportunity to launching several form of adaptation TB care as a community approach, capacity building of human resources, and to combat the stigma that exists by a multisectoral approach (Fatima, et. al., 2021).

Analysis of the Physical Environment of Healthy Housing in Yogyakarta City

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables increases TB transmission. Based on Mahpudin's study, there was a relationship between the households environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin & Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo & Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015). Factors affecting the incidence of tuberculosis is related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that coinfection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The healthy housing coverages data according to public health centers unit in Yogyakarta City in 2018

Public health center unit	Total Household	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the “non-healthy housing” data is compared with the TB incidence (prevalence) data, the following graph will showed (Figure 5):

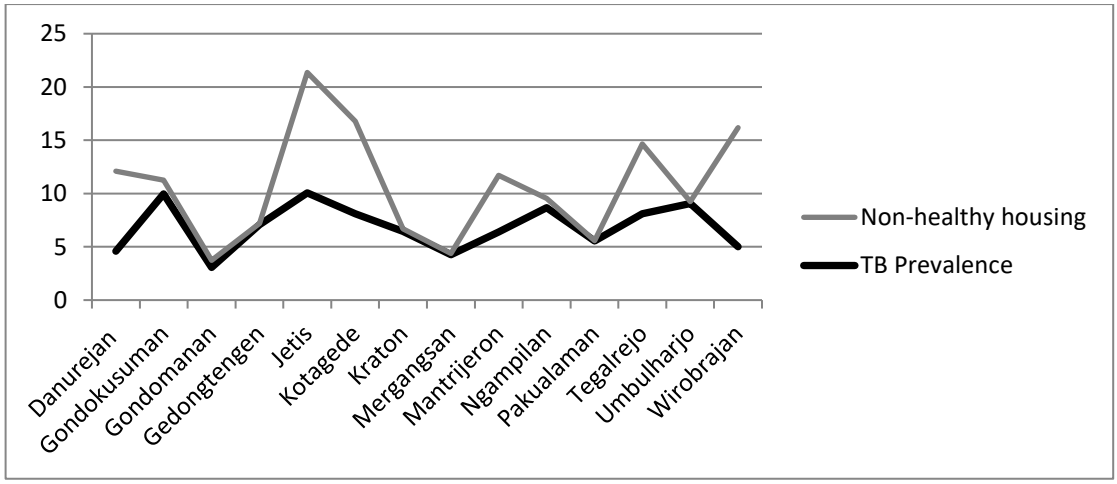


Figure 5. Graph of “non-healthy housing” and TB prevalence-based data trends on public health centers in 2018

Based on the chart above, it can be seen that the trend of the data the higher the number the house is not healthy, it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the households environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household filogenik related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy households indicators that can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density, it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). The associations between floor levels of residence and TB cases have been reported dependent on housing types because housing characteristics as main factor to explore an ecological study of the TB disease (Low, et al., 2013). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru, et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Households ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous study that there was a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy households according to the Kementerian Kesehatan Republik Indonesia Number: 829 / Menkes / SK / VII / 1999. A household that has an occupancy density of> 9 m^2 meets the requirements for a healthy house. The denser of occupancy in one house, the greater the interaction that occurs between residents in the one house. The previous study only reported that people which living in crowded conditions were experience repeated and increase the TB infection for healthy people in the same house. Crowding was relationship both with risk of infection and risk of progression from infection to disease (Khan, 2016). The number of people per room was the only housing characteristic associated with progression to TB disease among infected participants, it caused by exposure to *M. tuberculosis* containing droplet particles during interactions in people's homes, it becomes to make exchange rates within the range of values standard measured in air. The similar studies in New Zealand showed that TB incidence was associated with household crowding (Baker, et. al., 2008). The other study results were obtained from Low, et. al., (2013), reported that TB outcome could be characterized by dwelling characteristics such as housing type and height, they suggest that communities with poor household condition had a higher risk of TB. There were significant public health implications for Asian cities especially in high density urban living.

Environmental condition and host information related risk factors were very important to control the spread of infection and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. al., 2021). Our study also shows credible results in the analysis of housing type by community. The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multisectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd, et al. 2018). The improvements in socio-environmental aspects are needed, but they must be combined with the improvement of education level (Cardoso, et. al., 2017). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage were associated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collector and team member of this study.

References

Aditama, W., Sitepu, F. Y., & Saputra, R. (2019). Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res,* 4(1) : 227-231.

Álvaro-Meca A, Díaz A, de Miguel Díez J, Resino R, Resino S. (2016). Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. *PLoS One.* 2016 Nov 3;11(11).

Baker M, Das D, Venugopal K, Howden-Chapman P. (2008). Tuberculosis associated with household crowding in a developed country. *J Epidemiol Community Health.* 2008 Aug;62(8):715-21.

Cardoso, B. A., Fonseca, F. D. O., Moraes Neto, A. H. A. D., Martins, A. C. G. S., Oliveira, N. V. D. S., Lima, L. N. G. C., ... & Saad, M. H. F. (2017). Environmental aspects related to tuberculosis and intestinal parasites in a low-income community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo,* 59.

Chen, Y., Peng, W. H., Lai, S. F., Luo, F., Luo, D., & Wang, B. G. (2021). Association of gene polymorphisms and environmental factors in tuberculosis patients and their household contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene,* 115(1) : 20-29.

Dinas Kesehatan Provinsi DI Yogyakarta. (2019). *Penemuan Kasus TBC di DIY* Periode 17 Juli 2019. Yogyakarta.

Duru, C. B., Iwu, A. C., Uwakwe, K. A., Diwe, K. C. & Merenu, I. A. Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State , Nigeria. *Int. J. Sci. Healthc. Res.* 1 : 57–69.

Fatima, R., Akhtar, N., Yaqoob, A., Harries, A.D., Khan, M.S. (2021). Building Better Tuberculosis Control Systems In A Post-COVID World: Learning From Pakistan During The COVID-19 Pandemic. *International Journal of Infectious Diseases*. Available online 17 March 2021.

Floyd K, Glaziou P, Zumla A, Raviglione M. (2018). The global tuberculosis epidemic and progress in care, prevention, and research: an overview in year 3 of the End TB era. *Lancet Respir Med.* ;6(4):299-314.

Hamidah, Kandau GD, Posangi J. (2015). Relationship between the quality of the physical environment of the house and the incidence of pulmonary tuberculosis in the working area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*. 2015; 3 (3).

Handriyo RG, Dyah Wulan SRW. (2017). Determinan Sosial Sebagai Faktor Risiko Kejadian Tuberkulosis Paru Di Puskesmas Panjang. *J Major*. 2017;7(1):1–5

Harfadhilah D, Noor NN, Sunarka IN. (2013). Analysis of environmental risk factors for the incidence of pulmonary tuberculosis. *Medula.* 2013; 1 (1): 7–13.

Khaliq A, Khan IH, Akhtar MW, Chaudhry MN (2015) Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)* 5:201. doi:10.4172/2161-1165.1000201.

Khan, F. A., Fox, G. J., Lee, R. S., Riva, M., Benedetti, A., Proulx, J. F., Jung, S., Hornby, K., Behr, M. A., & Menzies, D. (2016). Housing and tuberculosis in an Inuit village in northern Quebec: a case-control study. *CMAJ open*, 4(3), E496–E506.

Lawn SD, Zumla AI (2011) Tuberculosis. *Lancet* 378: 57–72.

Lo¨nnroth K, Castro KG, Chakaya JM, Chauhan LS, Floyd K, Glaziou P, et al. (2010). Tuberculosis control and elimination 2010–50: cure, care, and social development. *Lancet.* 2010; 375: 1814–1829.

Low CT, Lai PC, Tse WS, Tsui CK, Lee H, Hui PK. (2013). Exploring tuberculosis by types of housing development. *Soc Sci Med.* 2013 Jun ;87:77-83.

Mahpudin AH, Mahkota R. (2007). Faktor Lingkungan Fisik Rumah, Respon Biologis dan Kejadian TBC Paru di Indonesia. *Kesmas Natl Public Heal J.* 2007;1(4):14.

Kementerian Kesehatan Republik Indonesia. KEPMENKES No 829/Menkes/SK/VII/1999.

Kementerian Kesehatan Republik Indonesia. *Buletin Eliminasi Tuberkulosis,* Volume I Tahun 2020.

Musadad. A., (2006). Relationship between environmental factors and households contact with pulmonary tuberculosis. *Health Ecol.* 2006; 5 (3): 486–96.

Muslimah L, Dwi D. (2019). Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur Public Health Center. *J Environmental Health.* 2019; 11 (1): 26.

Narasimhan P, Wood J, MacIntyre CR, Mathai D. (2013). Risk factors for tuberculosis. *Pulm Med.* 2013:1–11

Pambudi, I.,(2020). *Protokol Layanan TB di Masa Pandemi Covid* ,Dit. P2PML, Ditjen P2P, Kementerian Kesehatan Republik Indonesia.

Putri, A. S. E., Tari Amanda, R., & Ilham, R. (2019). Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah A, Mallhi TH, Khan YH, Iqbal MS, Alotaibi NH, Alzarea AI, Rasheed M. 2021. Evaluation of risk factors associated with the development of MDR- and XDR-TB in a tertiary care hospital: a retrospective cohort study. *PeerJ 9*:e10826. DOI 10.7717/peerj.10826.

Schmidt C. W. (2008). Linking TB and the environment: an overlooked mitigation strategy. *Environmental health perspectives*, 116(11), A478–A485.

Shimeles, E. et al. (2019) 'Risk factors for tuberculosis: A case–control study in Addis Ababa, Ethiopia', *PLoS ONE*, 14(4), pp. 1–19. doi: 10.1371/journal.pone.0214235.

Singh J, Sankar MM, Kumar S, Gopinath K, Singh N, Mani K, et al. (2013). Incidence and prevalence of tuberculosis among household contacts of pulmonary tuberculosis patients in a Peri-urban population of South Delhi, India. *PLoS One.*, 8(7):1–11.

Singh, S. K., Kashyap, G. C. and Puri, P. (2018) 'Potential effect of household environment on prevalence of tuberculosis in India: Evidence from the recent round of a cross-sectional survey', BMC Pulmonary Medicine. *BMC Pulmonary Medicine*, 18(1), pp. 1–10.

Srivastava, K., Kant, S., Verma, A., (2015). Role of Environmental factors in Transmission of Tuberculosis. *Dynamics of Human Health*; 2015: 2 (4). ISSN 2382-1019.

Sugandi, Y.S., Soemarwoto, R., Mardotillah, M., (2018). Gerakan Sosial Rumah Sehat Dan Imunisasi Bcg Sebagai Langkah Menurunkan Kejadian Tuberkulosis (TB) Anak. *HUMANIKA* , Vol.25 No.1 , Hal. 38-50.

Suharyo. (2013). Determinasi Penyakit Tuberkulosis Di Daerah Pedesaan. *KEMAS : Jurnal Kesehatan Masyarakat*, KEMAS 9 (1) (2013) 85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M. C. (2014). Tuberculosis: epidemiology and control. *Mediterranean journal of hematology and infectious diseases*, 6(1) : 2014070.

Taha M, Deribew A, Tessema F, Assegid S, Duchateau L. (2011). Risk factors of active tuberculosis in people living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci.* 2011;21:131–139. e2014070. https://doi.org/10.4084/MJHID.2014.070.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F. (2015). Environmental and host-related determinants of tuberculosis in Metema district, north-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, 87.

WHO. (2010). *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.

12. Lampiran Surat Pemberitahuan Bebas Plagiat dan Kesediaan Pembayaran

SURAT PERNYATAAN BEBAS PLAGIAT

Dengan ini saya:

Nama :

No. HP :

Instansi :

Alamat Instansi :

Email :

Menyatakan bahwa artikel yang berjudul:

……

Bukan merupakan hasil plagiat dan tidak mengandung unsur plagiat. Naskah artikel merupakan karya penulis yang **belum pernah dipublikasikan dan tidak sedang diproses di berkala ilmiah lain untuk dipublikasikan**.

Apabila di kemudian hari ditemukan ketidaksesuaian dengan ketentuan di atas, maka Dewan Redaksi KEMAS tidak bertanggung jawab terhadap segala bentuk akibat yang ditimbulkan, serta penulis diwajibkan untuk:

1. Membuat surat permohonan maaf tertulis ditujukan kepada Dewan Redaksi Jurnal KEMAS
2. Membayar biaya kompensasi sebesar Rp 3.000.000,00 (Tiga Juta Rupiah) Kepada Dewan Redaksi Jurnal KEMAS.

Demikian, atas perhatian dan kebijakannya diucapkan terima kasih.

……., ……..

Penulis,

materai

(…….)

SURAT KESEDIAAN PEMBAYARAN BIAYA SUBMIT

Yth.
Ketua Dewan Redaksi Jurnal KEMAS (Kesehatan Masyarakat)
di tempat

Dengan hormat,

Dengan ini saya:

Nama :

No. HP :

Instansi :

Alamat Instansi :

Email :

Menyetujui untuk Publikasi artikel dengan judul:

……..

dan bersedia dengan sukarela untuk melakukan pembayaran biaya publish Rp 1.700.000,00.

Atas perhatian dan kerjasamanya yang baik, diucapkan terima kasih.

……,…….

Penulis,

Materai

(……)

UNIVERSITAS
AHMAD DAHLAN

Musfirah FKM UAD <musfirah@ikm.uad.ac.id>

Pemberitahuan Administrasi Jurnal KEMAS

1 message

Jurnal Kemas <kemas@mail.unnes.ac.id> Tue, Nov 9, 2021 at 8:55 AM
To: Nuraidah Ai <Nuraidah.ai@gmail.com>, Musfirah Musfirah <musfirah@ikm.uad.ac.id>, lailiilmi@gmail.com, ppraptana@gmail.com

Yth. Penulis di Jurnal KEMAS

Dengan hormat,

Kami beritahukan bahwa artikel Bapak/ Ibu dengan No. Artikel, Judul dan Penulis berikut:

23220	Kepatuhan Minum Obat ARV pada Remaja dengan HIV/AIDS	Nuraidah, Dessie Wanda	Universitas Indonesia
28692	Analysis of Healthy Housing and TB Prevalence in Yogyakarta City	Musfirah, Desi Nurfita, Ahmad Faizal Rangkuti	Universitas Ahmad Dahlan
28577	Trend for risk Covid-19: A case study in Indonesia	Laili Rahmatul Ilmi, Praptana	Univiversity of Jenderal Achmad Yani

akan segera kami proses untuk penerbitan di Jurnal KEMAS Volume : **17.3 Januari 2022**

Sesuai dengan syarat administratif, bagi artikel yang akan dimuat:

1. Penulis dikenakan biaya Publish sebesar Rp. 1.700.000,00.

Biaya tersebut dikirim ke Jurnal KEMAS ke no rek. BNI 0328641658 a.n Widya Hary Cahyati **untuk mendapatkan surat LAYAK MUAT**.

b. Bukti transfer harap dikirim ke email : kemas@mail.unnes.ac.id

c. Apabila penulis menghendaki lebih dari 1 eksemplar cetak jurnal, maka bisa melakukan konfirmasi ke Redaksi KEMAS dan mengganti biaya cetak Rp 200.000/ eksemplar.

2. Bagi Bapak/Ibu yang belum menyertakan **Surat Bebas Plagiat dan Surat Kesediaan Membayar Biaya Publish**, mohon segera mengirimkan surat pernyataan tersebut ke email kemas@mail.unnes.ac.id (Form terlampir, mohon bubuhkan materai 10.000 pada kedua form tersebut).

Demikian pemberitahuan kami, atas perhatian dan kerjasamanya kami ucapkan terimakasih.

Ketua Dewan Redaksi

Prof. Dr. dr. Oktia Woro K.H., M.Kes.

KEMAS Journal
F5 Building, 2nd Floor, Public Health Department, Sport Science Faculty, Semarang State University, Semarang, Central Java, Indonesia, 50229
http://journal.unnes.ac.id/nju/index.php/kemas

SURAT PERNYATAAN BEBAS PLAGIAT dan KESEDIAAN PEMBAYARAN BIAYA SUBMIT-2020 (3).doc
33K

SURAT PERNYATAAN BEBAS PLAGIAT

Dengan ini saya:

Nama	: Musfirah, S.Si., M.Kes.
No. HP	: 085298907347
Instansi	: Universitas Ahmad Dahlan
Alamat Instansi	: Jln. Prof.Dr.Soepomo, SH., Janturan Yogyakarta
Email	: musfirah@ikm.uad.ac.id

Menyatakan bahwa artikel yang berjudul:

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Bukan merupakan hasil plagiat dan tidak mengandung unsur plagiat. Naskah artikel merupakan karya penulis yang **belum pernah dipublikasikan dan tidak sedang diproses di berkala ilmiah lain untuk dipublikasikan**.

Apabila di kemudian hari ditemukan ketidaksesuaian dengan ketentuan di atas, maka Dewan Redaksi KEMAS tidak bertanggung jawab terhadap segala bentuk akibat yang ditimbulkan, serta penulis diwajibkan untuk:

1. Membuat surat permohonan maaf tertulis ditujukan kepada Dewan Redaksi Jurnal KEMAS
2. Membayar biaya kompensasi sebesar Rp 3.000.000,00 (Tiga Juta Rupiah) Kepada Dewan Redaksi Jurnal KEMAS.

Demikian, atas perhatian dan kebijakannya diucapkan terima kasih.

Yogyakarta, 12 November 2021

Penulis,

(Musfirah, S.Si., M.Kes.)

SURAT KESEDIAAN PEMBAYARAN BIAYA SUBMIT

Yth.
Ketua Dewan Redaksi Jurnal KEMAS (Kesehatan Masyarakat)
di tempat

Dengan hormat,

Dengan ini saya:

Nama	: Musfirah, S.Si., M.Kes.
No. HP	: 085298907347
Instansi	: Universitas Ahmad Dahlan
Alamat Instansi	: Jln. Prof.Dr.Soepomo, SH., Janturan Yogyakarta
Email	: musfirah@ikm.uad.ac.id

Menyetujui untuk Publikasi artikel dengan judul:

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

dan bersedia dengan sukarela untuk melakukan pembayaran biaya publish Rp 1.700.000,00.

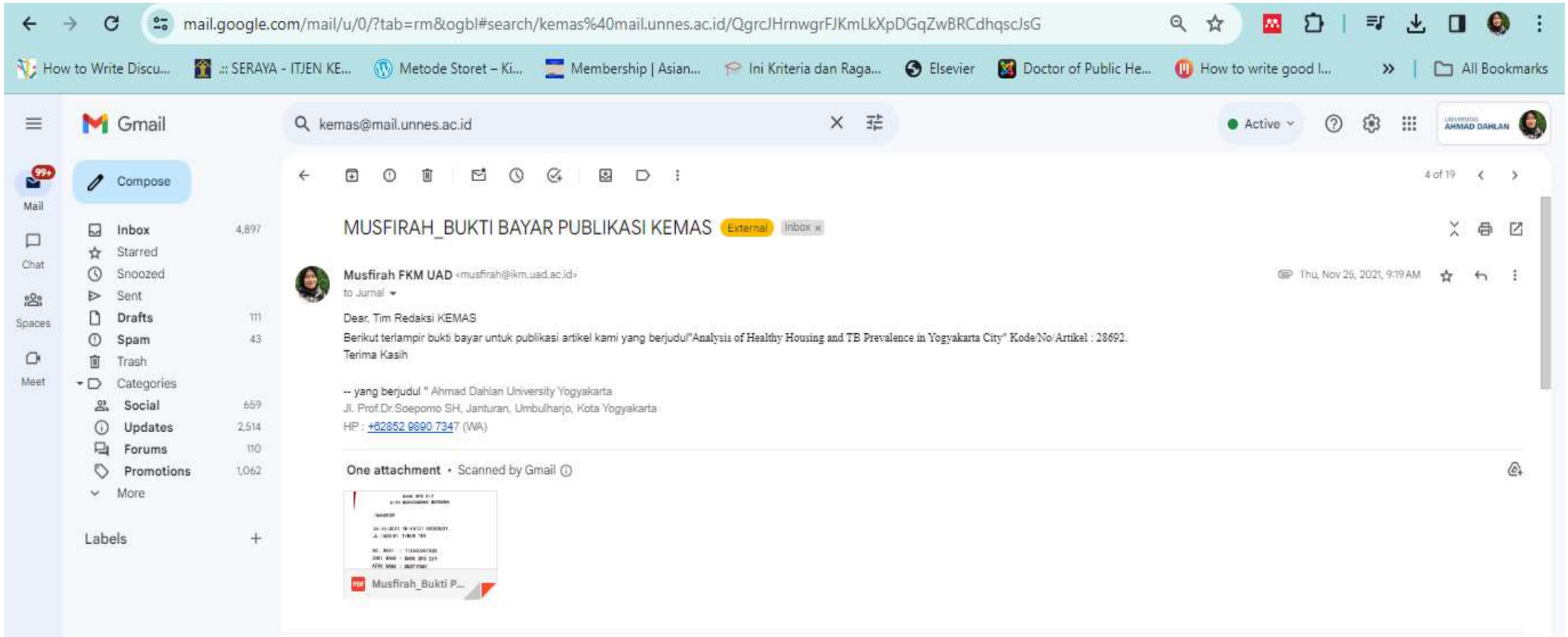
Atas perhatian dan kerjasamanya yang baik, diucapkan terima kasih.

Yogyakarta, 12 November 2021

Penulis,

(Musfirah, S.Si., M.Kes.)

14. Bukti Bayar Publikasi Kemas



14. Bukti Bayar

BANK BPD DIY
KITA BERKEMBANG BERSAMA

TRANSFER

24-11-2021 18:49:01 00063001
JL IMOGIRI TIMUR 155

NO. RESI : 112400007530
DARI BANK : BANK BPD DIY
ATAS NAMA : MUSFIRAH

NO. KARTU : 627427XXXXXXXX2305
NO. REK : 804211000338
NILAI : RP 1.700.000
KEPADA
BANK : BANK BNI
NO. REK : 0328641658
NAMA : IBU WIDYA HARY CAHYATI

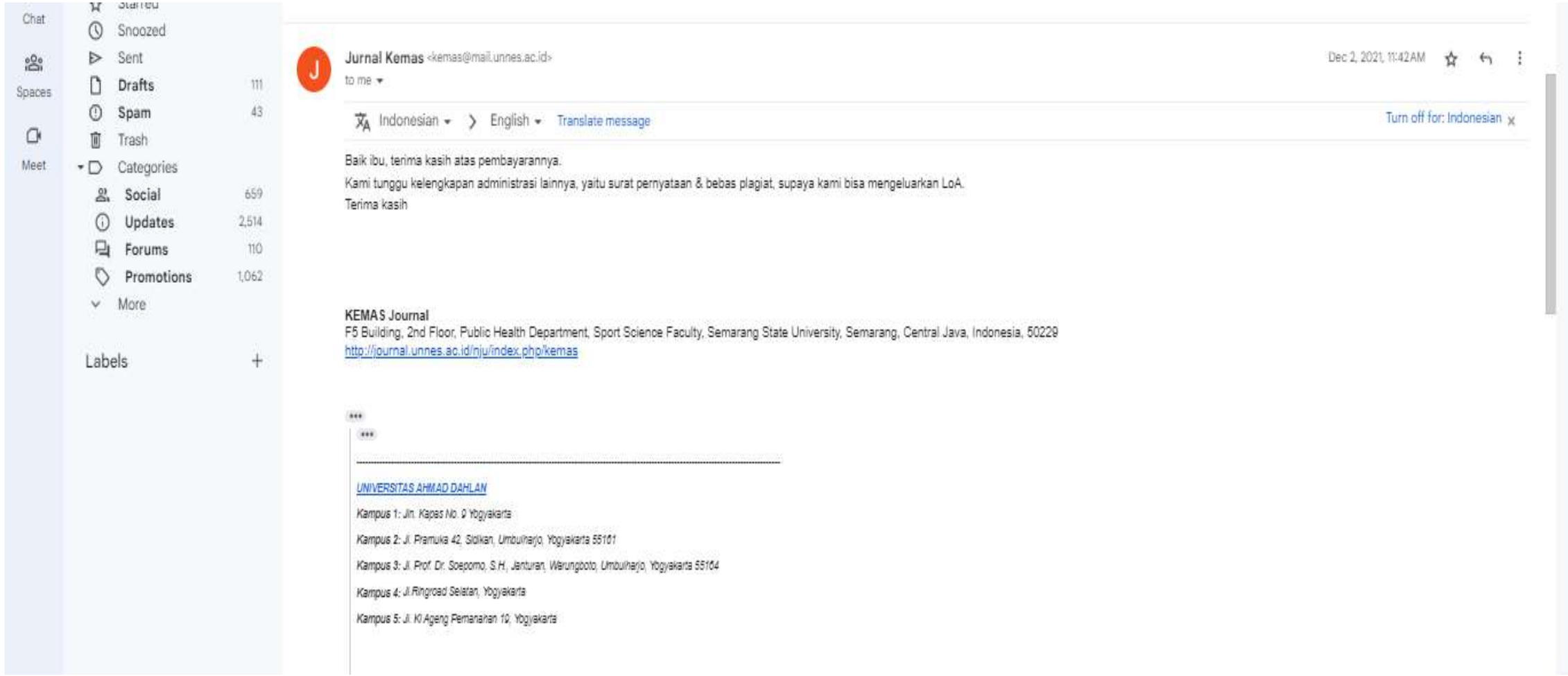
NO REF :

TRANSAKSI BERHASIL
MOHON RESI INI DISIMPAN SEBAGAI
BUKTI TRANSAKSI YANG SAH

GUNAKAN ATM BANK BPD DIY UNTUK
BAYAR TIKET GARUDA, KERETA API, PLN,
TELEPON, PDAM, BPJS, ISI PULSA HP,
PAJAK KENDARAAN, PBB & MPNG2

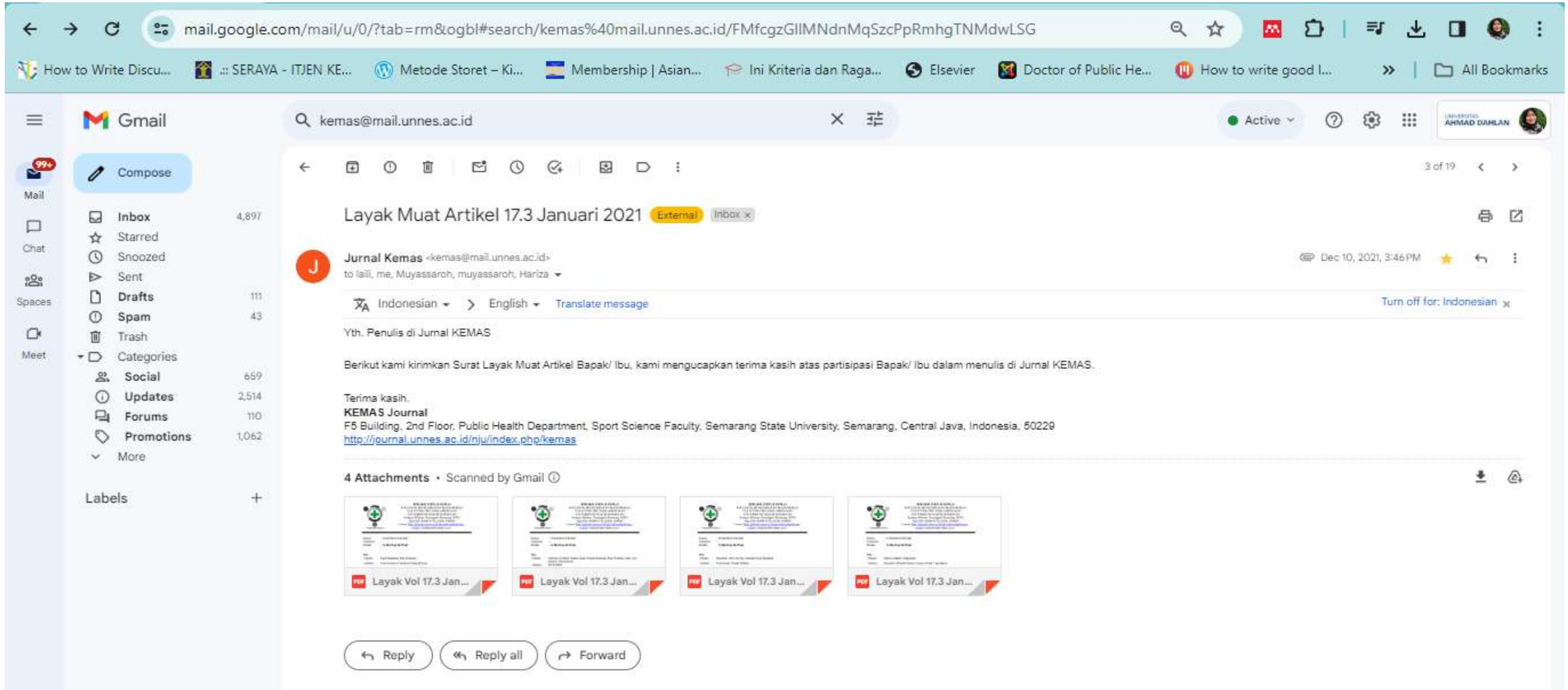
Dipindai dengan CamScanner

15. *Feedback* Pengelola Jurnal Kemas Tentang Pembayaran Publikasi



16. Pemberitahuan Layak Muat Artikel 17.3 Januari 2022 (LoA Artikel)

Bukti Email : Ada *typo* Tahun dalam *Subject Email*, namun isi dokumen sudah sesuai yaitu Tahun 2022



Terakreditasi Sinta 2

REDAKSI JURNAL KEMAS
JURUSAN ILMU KESEHATAN MASYARAKAT
FAKULTAS ILMU KEOLAHRAGAAN
UNIVERSITAS NEGERI SEMARANG
Kampus Sekaran Gunungpati Semarang 50229
Telp (024) 8508107 Fax (024) 8508007
Laman: http://journal.unnes.ac.id/nju/index.php/kemas,
e-mail: kemas@mail.unnes.ac.id

Nomor : 10/KEMAS/XII/2021
Lampiran : -
Perihal : **Artikel Layak Muat**

Yth:
Penulis : Musfirah, Desi Nurfita, Ahmad Faizal Rangkuti
Institusi : Universitas Ahmad Dahlan

Berdasarkan artikel Sejawat yang diajukan ke Redaksi Jurnal KEMAS dengan judul:

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Bersama ini kami sampaikan bahwa hasil penilaian dari dewan redaksi, artikel Sejawat layak untuk dimuat di Jurnal KEMAS Volume 17 No. 3 Januari 2022.
Atas perhatian dan kerjasama yang baik diucapkan terima kasih.

Semarang, **24 November 2021**
Ketua Dewan Redaksi,

Prof. Dr. dr. Oktia Woro K.H., M.Kes.
NIP. 19591001 198703 2 001

17. Artikel ilmiah dipublikasikan secara *online*

KEMAS 17 (3) (2022) 405-414

Jurnal Kesehatan Masyarakat

http://journal.unnes.ac.id/nju/index.php/kemas

Analysis of Healthy Housing and TB Prevalence in Yogyakarta City

Musfirah✉, Desi Nurfita, Ahmad Faizal Rangkuti
Faculty of Public Health, Ahmad Dahlan University, Yogyakarta , Indonesia

Article Info

Article History:
Submitted January 2021
Accepted December 2021
Published January 2022

Keywords:
Physical Environment, Urban; Healthy Housing, TB

DOI
https://doi.org/10.15294/kemas.v17i3.28692

Abstract

Environmental health is one of the determinants factors toward the public health status. Transmission of tuberculosis (TB) is influenced by environmental factors. Based on previous TB data in local study, it shows that urban areas (urban) have a high case rate. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households. The method of study used is quantitative descriptive analysis of secondary data. The data used were the physical environment of the house which is obtained from healthy housing data and TB prevalence data in Yogyakarta City. The secondary data spread over 18 Public Health Centers in Yogyakarta City. The data collected include healthy housing data and BTA (+) cases data in the study scope using total sampling technique. Based on the trend analysis, it was found that there was a significant trend in data. The higher percentage of non-healthy housing coverage wasassociated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Introduction

Tuberculosis (TB) becomes world's communicable diseases (Álvaro-Meca et al., 2016). TB is a chronic infection which takes from weeks to months for manifestation of the disease by the Mycrobacterium tuberculosis bacteria, whose spread is influenced by environmental factors through environmental air compartments (Muslimah & Dwi, 2019). This environmental-based disease still reaches high rates every year and important public health problem in Indonesia (Sugandi, et.al. 2018). The number of pulmonary TB patients in Indonesia was ranks fourth in the world after India, China, South Africa with a TB prevalence of 285 per 100,000 population or 302,861 cases in 2010 (WHO, 2010). According to the recapitulation of surveillance data from Provincial Health Office in Yogyakarta, in 2019 TB BTA (+) cases was still found in Yogyakarta City. The number of TB category BTA (+) in Yogyakarta City has increased for three consecutive months, 32 cases in May, 37 cases in June, and 40 cases in July 2019.

TB cases related with environmental factors include physical environment (Schmidt, 2008). Environmental conditions, especially household conditions also have a role in the spread of pulmonary TB bacteria to healthy people (Taha et al., 2011). This study in line with Suharyo (2013) that the cleanliness of the households environment can also affect the spread of the virus, for example a house that is poor ceiling setting which can facilitate the spread of TB. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated house (Handriyo & Wulan, 2017).

People exposed to a person with TB caused by household contacts (Singh et al., 2013). Household contacts become primarily

✉ Correspondence Address:
Faculty of Public Health, Ahmad Dahlan University, Yogyakarta , Indonesia.
Email : musfirah@ikm.uad.ac.id

pISSN 1858-1196
eISSN 2355-3596

risk factors for TB with high index cases, such as poverty, poor housing and environmental conditions (Sulis et al., 2014), health determinants, including HIV status, nutrition and access to healthcare (Lo¨nnroth et al., 2010). The previous study reported that prevalence of TB was found to be the highest among elderly people (0.9%), no education (0.4%) and people belonging to the poorest wealth quintile (0.53%) (Singh et al., 2018). In fact, there were multiple risk factors that are strongly associated with Tuberculosis such us smoking habit in house, cooking fuel type, floor, number of persons sleeping in a room (Narasimhan et. al., 2013) and individual characteristics such as age, sex, educational attainment, marital status, place of residence and wealth index (Singh et al., 2018; Shimeles et al., 2019).

The poor quality of physical environment in the house will be potential risk factors to the pulmonary TB diseases. It has attracted the attention of the author to further examine the perspective of the household environment quality as a determinant of TB incidence in urban areas and to formulate appropriate strategies for TB control. Therefore, this study aims to reveal the disparity of urban TB sufferers, especially in the city of Yogyakarta based on indicators of the physical environment of the house from the coverage of healthy households based on community data. Research is limited on this topic, so that environmental quality studies need to be carried out in a comprehensive TB disease control towards elimination of End TB 2030 program which is in line with national programs and SDGs goals.

Method

The method used in this study is quantitative descriptive analysis. The data used is the physical environment data of the house which is obtained from data on healthy houses in Yogyakarta City and TB prevalence data for Yogyakarta City in the period 2018-2020. The sample study comes from secondary data spread over 18 Public Health Centers in Yogyakarta City. The data collected include healthy houses data and BTA (+) cases data in the study scope. The sampling technique used the total sampling which the sample size similar as the population number, all secondary data sources from all health centers in Yogyakarta city. The data analysis used was descriptive analysis to describe the trend indicators for healthy households with TB incidence. Ethical approval for this study was approved in 2020 by the Ethics Committee of Ahmad Dahlan University No. : 012004016.

Result and Discussion

The tuberculosis prevalence rate describes the number of new TB patients and it is recorded per 100,000 population. The classifications of TB reported in the Yogyakarta City Health Office include bacteriological confirmed of pulmonary TB cases, clinically diagnosed pulmonary TB, and extra-pulmonary TB. There were four types of patients, including new patients, relapse patients, patients with a history of TB treatment other than relapse, and patients with no previous history of TB treatment. Here are graph of TB cases in Yogyakarta City in 2019 (Figure 1):

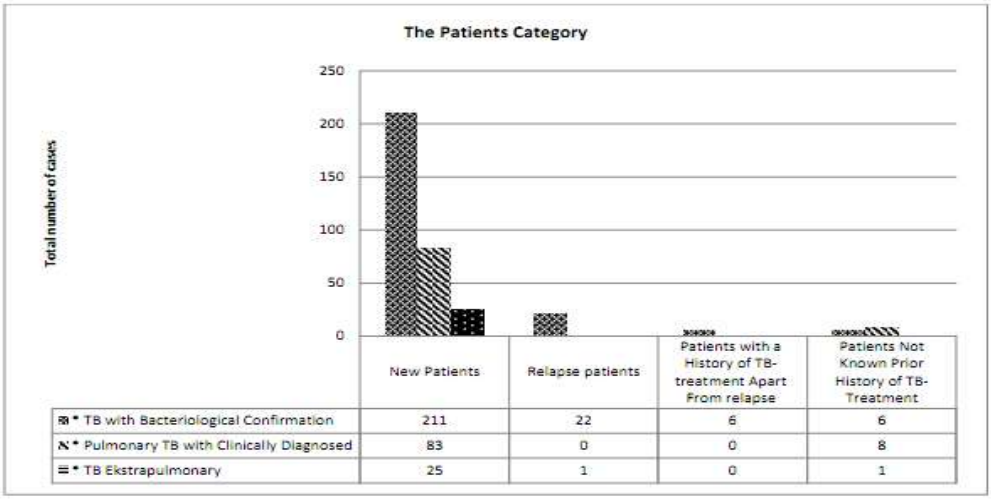


Figure 1. Graph of TB in Yogyakarta City in 2019

This study focuses on new bacteriologically confirmed pulmonary TB cases. The cases recorded at the Health Office of Yogyakarta City from the January-June Period (TW1-TW2) were 69 cases in 2020. Meanwhile, the Q3 data is still validation by the Yogyakarta City Health Office and Q4 2020 is still in the entry process at the respective public health center office. Based on 2020 data, there was a decrease in cases. Comparison of bacteriological confirmed pulmonary TB cases in 2019 and 2020 can be seen in the following graph:

The jurisdiction area of the Health Office of Yogyakarta City has 18 public health centers unit. Each public health center carries out its TB surveillance function regularly. The following Figure 3 is a graph of new bacteriological confirmed pulmonary TB cases based on public health centers unit in 2019:

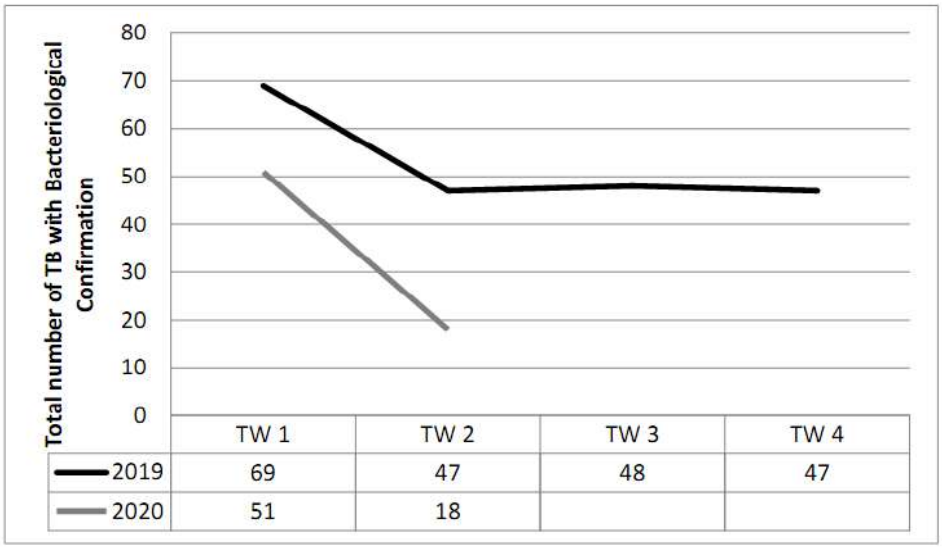


Figure 2. Comparison of Bacteriologically Confirmed Pulmonary TB Cases in 2019 and 2020

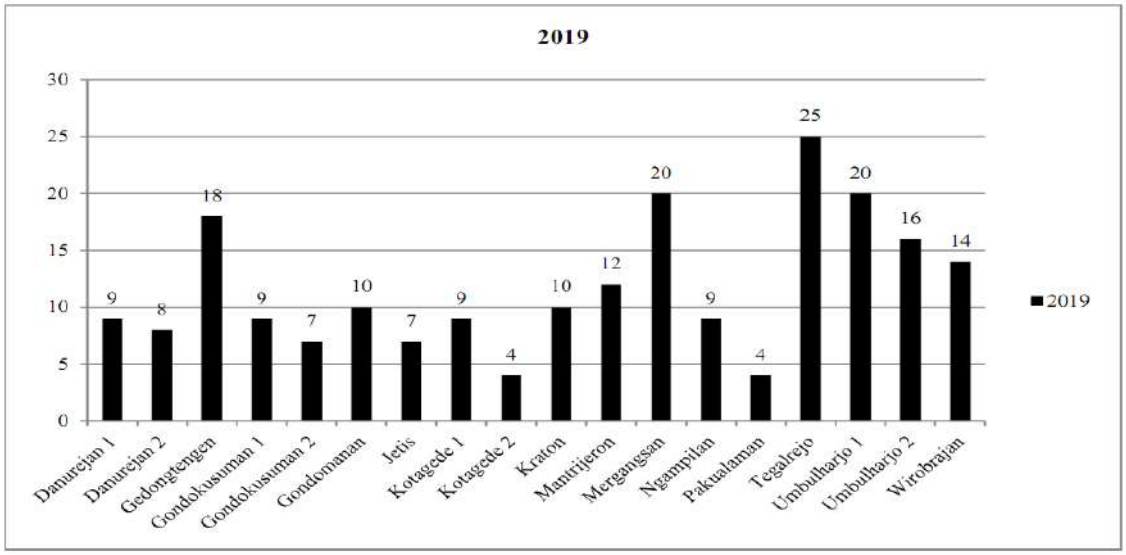


Figure 3.Graph of New Bacteriological Confirmed Pulmonary TB cases Based on Health Centers Unit in 2019

The TB case data in 2020 were showed in Figure 4 below which contains bacteriological confirmed data of New TB Patients, relapse patients, patients with treatment history, and patients without treatment history.

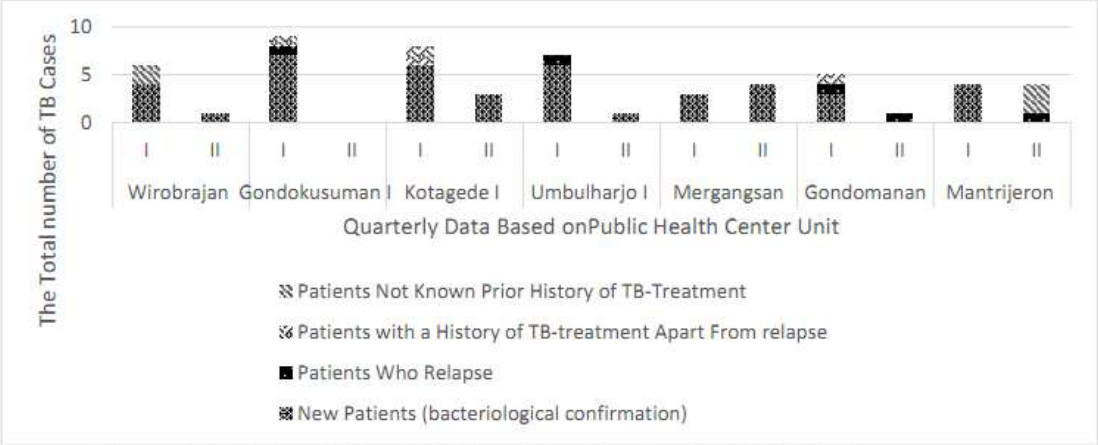


Figure 4. The Seven Highest TB Cases Data Based on Public Health Center for the Period January to June 2020

Based on the data Figure 4, the highest pulmonary TB cases were in the Kotagede I of Public health center and the lowest was found in the Gondomanan of public health center unit. The cumulative number of TB cases from the 7 (seven) health centers was 42 cases based on bacteriological confirmed data for TB patients. The fluctuation of data on bacteriologically confirmed New Pulmonary TB cases is very visible in the description of the quarterly data trend that has been presented both graphically and in table. During the pandemic, the trend of cases tends to decrease due to the lack of new visits and TB treatment. Even though during the Covid-19 pandemic, the continuity of Tuberculosis services must be pursued by ensuring services for TB patients and TB patients with resistance. Drugs or RO, both TB suspects and TB patients who are currently in the treatment stage should run without interruption and until they recover (Ministry of Health of the Republic of Indonesia, 2020).

Some of the challenges faced in the implementation of socialization and case finding screening activities during this online method pandemic, namely cadres are not too familiar with online mechanisms and prefer face-to-face activities with the community, constraints in operating social media and google forms, lack of community participation to fill in links online screening, limited pulse quota, and limited care network. Regarding the referral and examination for tuberculosis, many of the people already have symptoms but refuse to go to the Public health center unit on the grounds that they feel healthy, enter the area with social distancing regulations, worry about contracting Covid-19 and personal safety when going to the Public health center unit, or restrictions from the examination over there (Ministry of Health of the Republic of Indonesia, 2020). TB patients must take action to be protected from COVID-19 and continue to treat TB as directed. Every TB patient will get a surgical mask that must be worn when the patient is in control of treatment and does highly important outside activities. TB patients are strongly advised to limit activities outside the households to avoid the possibility of being exposed to the SARS Cov-2 virus that causes COVID-19 (Pambudi, 2020). Identification of patients having a high risk becomes a reference in determining the choice of prevention, treatment and disease management strategy in formulating appropriate. The control method and efficient transmission approach should be taken to prevent disease transmission (Saifullah, et. al., 2021). COVID-19 has provided an opportunity to launching several form of adaptation TB care as a community approach, capacity building of human resources, and to combat the stigma that exists by multi-sectoral

approaches (Fatima, et. al., 2021).

Environment is one of the factors causing pulmonary TB incidence. The physical environment of the house is one of the environmental factors variables increases TB transmission. Based on Mahpudin's study, there was a relationship between the household environment and the incidence of TB. The healthy housing environment studied included room lighting, room ventilation, floor type, occupancy density, and household contact (Mahpudin & Mahkota, 2007). Based on data from the Yogyakarta City Health Office in 2018, the average coverage of healthy housing reached 96,29%. The healthy housing coverage according to public health centers data in Yogyakarta City in 2018 were listed in table 1.

The environmental factor also affects TB cases that covering the physical environment. Environmental conditions, especially healthy housing conditions also have a role in the spread of pulmonary TB bacteria to healthy people. The spread of pulmonary tuberculosis bacteria will attack healthy people more quickly if they are in a humid, less light and densely populated-house(Handriyo & Wulan, 2017). Environmental conditions playing a role in disease development were humidity and number of people living in the house. Housing densely populated and poor ventilation conditions increase the potential exposure to Mycobacterium tuberculosis (MTB) (Srivastava, et.al., 2015). Factors affecting the incidence of tuberculosis are related to the host and the environment. The study of tuberculosis can be started by identifying the number of family members per household, educational status, room area per person, history of contact with TB sufferers, availability and number of windows, location of kitchens in the house, and whether there are restrictions on contact with TB sufferers. People should build a house with a kitchen separate from the main living area, and add a ceiling and more than one window. In addition, smoking should be avoided indoors because this habit will contribute to the risk of TB transmission. Further research has also revealed that co-infection with human immunodeficiency viruses, worms, and malnutrition is important to control in TB prevention (Tesema et al., 2015)

Table 1. The Healthy Housing Coverages Data According to Public Health Centers in Yogyakarta City in 2018

Public health center	Total Households	A house that meets the requirements for a healthy housing	
		Total	%
Danurejan 1	1,571	1,521	96,82
Danurejan 2	2,456	2,165	88,15
Gondokusuman 1	5,353	5,344	99,83
Gondokusuman 2	2,297	2,242	97,61
Gondomanan	3,148	3,127	99,33
Gedongtengen	5,469	5,462	99,87
Jetis	5,559	4,931	88,70
Kotagede 1	3,809	3,788	99,45
Kotagede 2	3,447	2,867	83,17
Kraton	3,645	3,636	99,75
Mergangsan	5,967	5,960	99,88
Mantrijeron	8,167	7,731	94,66
Ngampilan	3,422	3,392	99,12
Pakualaman	3,028	3,027	99,97
Tegalrejo	6,271	5,860	93,45
Umbulharjo 1	10,652	10,616	99,96
Umbulharjo 2	4,516	4,514	99,96
Wirobrajan	4,381	3,891	88,82

The Trend Analysis of the Physical Environment For Healthy Households Indicators with TB Prevalence in the Yogyakarta City

Data on the healthy housing for the "non-healthy housing" category is obtained from the difference between the 100% coverage of a healthy housing and the actual coverage of a healthy housing. If the "non-healthy housing" data is compared with the TB incidence (prevalence) data, the following graph will be showed (Figure 5):

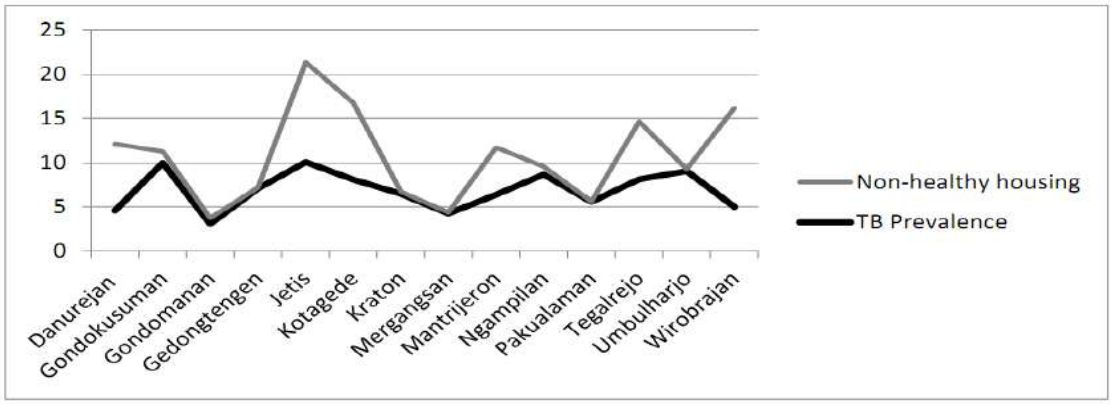


Figure 5. Graph of "Non-healthy Housing" and TB Prevalence-based Data Trends in Public Health Center in 2018

Based on the chart above, it can be seen that the trend of the data that the higher the number the house will not be healthy, because it will cause the higher the prevalence of their tuberculosis. This can be seen from the trend analysis in the chart above. When the number of unhealthy houses has decreased, the TB prevalence tends to fall and vice versa. This study examines the condition of the household environment with the incidence of TB in Yogyakarta City. The condition of the households environment is seen from secondary data on the number of non-healthy housing, where indicators of a healthy housing include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. Based on the results of the trend analysis, it was found that there was a possible relationship between non-healthy housing and the incidence of TB. The higher the number of non-healthy housing will impact to the higher the TB prevalence rate too. It can be seen from trend analysis chart carried out.

The results study were in line with other study which conducted by Sugandi et. al., (2018) that the healthy housing condition plays a role in the incidence of TB in Bandung as much as 73.75% of the population's house condition in the good category. Each family who children exposed to TB cases actually caused by the lack of ventilation and lighting conditions in the house, besides that the inadequate house area is a trigger for the occurrence of TB cases in children. In addition to these factors, previous studies reported that there was a relationship between house occupancy density, ventilation, floor type, wall type, and household contact with a TB family with the incidence of pulmonary TB (Harfadhilah, et. al., 2013). Other studies contradict, only sunlight factor was associated with TB incidence. The factors of the presence of windows, windows opened every morning, room ventilation, lighting in the room, room humidity, and the presence of smokers in the house were not related to the incidence of TB (Musadad, 2006). Healthy housing and household phylogenic related to socio-demographic factors and the environment against the prevalence of pulmonary tuberculosis. It is expected that the Department of Health, community health centers and stakeholders can improve the prevention and control of pulmonary TB disease. A family-based approach is one of the right ways to reduce the risk of pulmonary tuberculosis so that it can increase the percentage of households with

healthy housing coverage and households with healthy behavior (Putri, et. al., 2019).

Healthy house indicators include building materials; components and house space arrangement; lighting; air quality; ventilation; infectious animals; water; available means of safe food storage; waste; and density of bed occupancy. The data obtained is the overall data, not the detailed data for each variable. Healthy household indicators that it can affect the incidence of TB include lighting, air quality, ventilation, and occupancy density; it can be a factor in the incidence of TB. There was a correlation between home environment factors and incidence of pulmonary TB transmission (Aditama, et. al., 2019). This study consistent with several previous studies, study on Muslim women which stated that temperature, humidity, and lighting were statistically proven to affect the incidence of TB, while ventilation, floors, walls, ceilings, and occupancy density were not statistically proven (Muslimah and Dwi, 2019). The associations between floor levels of residence and TB cases have been reported dependent on housing types because housing characteristics as main factor to explore an ecological study of the TB disease (Low et al., 2013). Another study stated that there was a significant relationship between occupancy density, humidity, ventilation area, and natural lighting with the incidence of pulmonary tuberculosis but there was no relationship between floor type and the incidence of pulmonary tuberculosis (Hamidah, et. al., 2015).

Direct natural lighting or sunlight can reduce the incidence of pulmonary tuberculosis transmission, because ultraviolet light from sunlight entering the house can kill TB germs. In other hand, housing environmental factors can increase the incidence of pulmonary TB include room ventilation, humidity, temperature, lighting, type of floor, and occupancy density (Duru et al., 2016). Then, relevant with other study that the risk of TB infection transmission was high in setting with increased number of person/room (OR=2,78), having tiny house (OR=4,25) poor ventilation system with less number of windows per room (OR=8,83) with p value of 0,0001. It was also reported that the risk of TB increased if the wall and floor of the houses were built with mud/brick rather than cement (OR=2,50 and 1.89) with a significant p-value of 0.0001 (Khaliq, et. al., 2015).

Houses with less ventilation will affect the incidence of pulmonary tuberculosis. Household ventilation functions to remove polluted air (bacteria, CO2) in the house and replace it with fresh and clean air or to circulate air where ultra violet light enters. In this study, ventilation was a risk factor associated with pulmonary tuberculosis. These results are consistent with previous study that there was a relationship between ventilation and the incidence of pulmonary tuberculosis. Residential density is one of the requirements for a healthy household according to the Ministry of Health of the Republic of Indonesia Number: 829 / Minister of Health / SK / VII / 1999. A household that has an occupancy density of> 9 m2 meets the requirements for a healthy house. The density of occupancy is in one house, the greater the interaction that occurs between residents in the one house. The previous study only reported that people which living in crowded conditions were experience repeated and increase the TB infection for healthy people in the same house. Crowding was relationship both with risk of infection and risk of progression from infection to disease (Khan, 2016). The number of people per room was the only housing characteristic associated with progression to TB disease among infected participants, it caused by exposure to M. tuberculosis containing droplet particles during interactions in people's homes, it becomes making exchange rates within the range of values standard measured in air. The similar studies in New Zealand showed that TB incidence was associated with household crowding (Baker, et. al., 2008). The other study results were obtained from Low, et. al., (2013), reported that TB outcome could be characterized by dwelling characteristics such as housing type and height; they suggest that communities with poor household condition had a higher risk of TB. There were significant public health implications for Asian cities especially in high density urban living.

Environmental condition and host information related risk factors were very important to control the spread of infection

and disease (Khaliq, et. al., 2015). Household environmental conditions and indoor cleanliness are associated with the incidence of TB (Chen, et. al., 2021). Our study also shows credible results in the analysis of housing type by community. The actions needed to accelerate the reduction in the global burden of tuberculosis disease set for 2020, 2025, 2030 and 2035 consist of coverage in testing, case reporting, and overall access to health facilities, especially in developing countries, multi-sectoral efforts to reduce the prevalence of the major risks factor to disease infection and then increased investment in research and development (Floyd et al., 2018). The improvements in socio-environmental aspects are needed, but they must be combined with the improvement of education level (Cardoso, et. al., 2017). Thus, information regarding environmental and host risk factors is very important to control the spread of infection and disease (Khaliq, et. al., 2015).

Conclusion

The number of TB (BTA +) is increasing each year in terms of the distribution of data according to the focus of the study. The higher percentage of non-healthy housing coverage wasassociated in line with the higher the TB prevalence rate. It can be concluded that the physical environment factor of the house as an indicator of a healthy housing is closely related to the incidence of TB in Yogyakarta City. Environmental quality studies need to be carried out for comprehensive TB disease control towards elimination (End TB 2030) which is in line with national programs and SDGs goals.

Acknowledgment

The research was funded by the Basic Research Grant of the Ahmad Dahlan University Institute for Research and Community Service (LPPM) With Contract No. PD-164 / SP3 / LPPM-UAD / 2020. The authors would like to thank to Yogyakarta City Health Office for their support. Appreciations were also granted for all secondary data collectors and team member of this study.

References

Aditama, W., Sitepu, F.Y., & Saputra, R., 2019. Relationship between Physical Condition of House Environment and the Incidence of Pulmonary Tuberculosis, Aceh, Indonesia. *Int J Sci Healthc Res*, 4(1), pp. 227-231.

Álvaro-Meca, A., Díaz, A., de-Miguel, D.J., Resino, R., & Resino, S., 2016. Environmental Factors Related to Pulmonary Tuberculosis in HIV-Infected Patients in the Combined Antiretroviral Therapy (cART) Era. *PLoS One*, 11(11).

Baker, M., Das, D., Venugopal, K., & Howden-Chapman, P., 2008. Tuberculosis Associated with Household Crowding in a Developed Country. *J Epidemiol Community Health*, 62(8), pp. 715-21.

Cardoso, B.A., Fonseca, F.D.O., Moraes-Neto, A.H.A.D., Martins, A.C.G.S., Oliveira, N.V.D.S., Lima, L.N.G.C., Dias, G.A.D.S., & Saad, M.H.F., 2017. Environmental Aspects Related to Tuberculosis and Intestinal Parasites in a Low-income Community of the Brazilian Amazon. *Revista do Instituto de Medicina Tropical de São Paulo*, 59.

Chen, Y., Peng, W.H., Lai, S.F., Luo, F., Luo, D., & Wang, B.G., 2021. Association of Gene Polymorphisms and Environmental Factors in Tuberculosis Patients and Their Household Contacts. *Transactions of The Royal Society of Tropical Medicine and Hygiene*, 115(1), pp.20-29.

Provincial Health Office in Yogyakarta Special Region., 2019. *Discovery of TB Cases in DIY for the Period of July 17, 2019*. Yogyakarta.

Duru, C.B., Iwu, A.C., Uwakwe, K.A., Diwe, K.C., & Merenu, I.A., Pulmonary Tuberculosis Preventive Practices and Its Determinants among Residents in Communities in Orlu, Imo State, *Nigeria. Int. J. Sci. Healthc. Res*., 1, pp.57–69.

Fatima, R., Akhtar, N., Yaqoob, A., Harries, A.D., & Khan, M.S., 2021. Building Better Tuberculosis Control Systems In A Post-COVID World: Learning From Pakistan During The COVID-19 Pandemic. *International Journal of Infectious Diseases*, 2021.

Floyd, K., Glaziou, P., Zumla, A., & Raviglione, M., 2018. The Global Tuberculosis Epidemic and Progress in Care, Prevention, and Research: An Overview in Year 3 of the End TB era. *Lancet Respir Med*., 6(4), pp.299-314.

Hamidah., Kandau, G.D., & Posangi, J., 2015. Relationship between the Quality of the Physical Environment of the House and the Incidence of Pulmonary Tuberculosis in the Working Area of the Siko Nursing Health Center, North Ternate District, Ternate City, North Maluku Province. *J e-Biomedics*, 3(3).

Handriyo, R.G., & Dyah-Wulan, S.R.W., 2017. Social Determinants as Risk Factors for Pulmonary Tuberculosis Incidence at the Public Health Center of Panjang. *J Major*, 7(1), pp.1–5.

Harfadhilah, D., Noor, N.N., & Sunarka, I.N., 2013. Analysis of Environmental Risk Factors for the Incidence of Pulmonary Tuberculosis. *Medula*, 1(1), pp.7–13.

Khaliq, A., Khan, I.H., Akhtar, M.W., & Chaudhry, M.N., 2015. Environmental Risk Factors and Social Determinants of Pulmonary Tuberculosis in Pakistan. *Epidemiology (sunnyvale)*, 5, pp.201.

Khan, F.A., Fox, G.J., Lee, R.S., Riva, M., Benedetti, A., Proulx, J.F., Jung, S., Hornby, K., Behr, M.A., & Menzies, D., 2016. Housing and Tuberculosis in an Inuit Village in Northern Quebec: A Case-control Study. *CMAJ Open*, 4(3), pp.E496–E506.

Lawn, S.D., & Zumla, A.I., 2011. Tuberculosis. *Lancet*, 378, pp.57–72.

Lo¨nnroth, K., Castro, K.G., Chakaya, J.M., Chauhan, L.S., Floyd, K., Glaziou, P., & Raviglione, M.C., 2010. Tuberculosis Control and Elimination 2010–50: Cure, Care, and Social Development. *Lancet*, 375, pp.1814–1829.

Low, C.T., Lai, P.C., Tse, W.S., Tsui, C.K., Lee, H., & Hui, P.K., 2013. Exploring Tuberculosis by Types of Housing Development. *Soc Sci Med*., 87, pp.77-83.

Mahpudin, A.H., & Mahkota, R., 2007. Home Physical Environmental Factors, Biological Responses and Incidence of Pulmonary Tuberculosis in Indonesia. *Kesmas Natl Public Heal J*., 1(4), pp.14.

Ministry of Health Republic of Indonesia., 1999. *KEPMENKES No 829/Menkes/SK/VII/1999 tentang Persyaratan Kesehatan Pemukiman*. Jakarta.

Ministry of Health Republic of Indonesia., 2020. Indonesia Commitment to Eliminate TB by 2030 Supported by the Highest-level Government. *Tuberculosis Elimination Bulletin*, 1.

Musadad. A., 2006. Relationship between Environmental Factors and Households Contact with Pulmonary Tuberculosis. *Health Ecol*., 5(3), pp.486–96.

Muslimah, L., & Dwi, D., 2019. Physical Environmental Factors and Its Association with the Existence of Mycobacterium Tuberculosis: A Study in The Working Region of Perak Timur-Public Health Center. *J Environmental Health*, 11(1), pp.26.

Narasimhan, P., Wood, J., MacIntyre, C.R., & Mathai, D., 2013. Risk Factors for Tuberculosis. *Pulm Med*., 2013, pp.1–11.

Pambudi, I., 2020. TB Service Protocol During the Covid Pandemic. Dit. P2PML, Ditjen P2P, *Ministry of Health Republic of Indonesia*.

Putri, A.S.E., Tari-Amanda, R., & Ilham, R., 2019. Mapping of Tuberculosis (TB) Prevalence in Padang City. *Indian Journal of Public Health Research & Development*, 10(3).

Saifullah, A., Mallhi, T.H., Khan, Y.H., Iqbal, M.S., Alotaibi, N.H., Alzarea, A.I., & Rasheed, M., 2021. Evaluation of Risk Factors Associated with the Development of MDR- and XDR-TB in a Tertiary Care Hospital: A Retrospective Cohort Study. *PeerJ*., 9, pp.:e10826.

Schmidt, C.W., 2008. Linking TB and the Environment: An Overlooked Mitigation Strategy. *Environmental Health Perspectives*, 116(11), pp.A478–A485.

Shimeles, E., Enguselassie, F., Aseffa, A., Tilahun, M., Mekonen, A., Wondimagegn, G., & Hailu, T., 2019. Risk Factors for Tuberculosis: A Case–control Study in Addis Ababa, Ethiopia. *PLoS ONE*, 14(4), pp.1–19.

Singh, J., Sankar, M.M., Kumar, S., Gopinath, K., Singh, N., Mani, K., et al., 2013. Incidence and Prevalence of Tuberculosis Among Household Contacts of Pulmonary Tuberculosis Patients in a Peri-urban Population of South Delhi, India. *PLoS One*, 8(7), pp.1–11.

Singh, S.K., Kashyap, G.C., & Puri, P., 2018. Potential Effect of Household Environment on Prevalence of Tuberculosis in India: Evidence from the Recent Round of A Cross-sectional Survey. *BMC Pulmonary Medicine*, 18(1), pp.1–10.

Srivastava, K., Kant, S., & Verma, A., 2015. Role of Environmental Factors in Transmission of Tuberculosis. *Dynamics of Human Health*, 2(4).

Sugandi, Y.S., Soemarwoto, R., & Mardotillah, M., 2018. Healthy Home Social Movement and BCG Immunization as a Step to Reduce the Incidence of Tuberculosis (TB) in Children. *Humanika*, 25(1), pp.38-50.

Suharyo., 2013. Determination of Tuberculosis Disease in Rural Areas. *KEMAS: Journal of Public Health*, 9(1), pp.85-91.

Sulis, G., Roggi, A., Matteelli, A., & Raviglione, M.C., 2014. Tuberculosis: Epidemiology and Control. *Mediterranean Journal of Hematology and Infectious Diseases*, 6(1).

Taha, M., Deribew, A., Tessema, F., Assegid, S., & Duchateau, L., 2011. Risk Factors of Active Tuberculosis in People Living with HIV/AIDS in Southwest Ethiopia. *Ethiop J Health Sci*., 21, pp.131–139.

Tesema, C., Tadesse, T., Gebrehiwot, M., Tsegaw, A., & Weldegebreal, F., 2015. Environmental and Host-related Determinants of Tuberculosis in Metema District, North-west Ethiopia. *Drug, Healthcare and Patient Safety*, 7, pp.87.

WHO., 2010. *Global Tuberculosis Control 2010*. WHO Press. Geneva: World Health Organization.