

Research Article



Household Contacts as Risk Factor for Tuberculosis: A Cross-Sectional Study

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ABSTRACT

Background: Tuberculosis (TBC), caused by *Mycobacterium tuberculosis*, is an infectious disease that is still a global problem. Indonesia has a high burden of pulmonary tuberculosis and is ranked second in the world with the highest number of TBC sufferers after India. Tuberculosis is transmitted through infected droplets when coughing or sneezing, and close contact is very susceptible to the transmission process and other supporting factors. This study aims to determine the risk factors for TBC.

Method: This study used a cross-sectional research design with Chi-Square analysis and continued with multivariate analysis and logistic Regression. The sample consisted of 430 respondents obtained using the Accidental Sampling technique.

Results: Factors associated with TBC in the Kapanewon Depok area were age (RP: 2.086; 95% CI: 1.247-3.490; $p=0.006$), gender (RP: 2.1; 95% CI: 1.302-3.393; $p=0.003$), family income (RP: 3.593; 95% CI: 2.322-5.560; $p=0.000$), history of household contact (RP: 8.438; 95% CI: 5.737-12.410; $p=0.000$), and history of close contact (RP: 3.881; 95% CI: 2.49-6.051; $p=0.000$). The factor that has the most influence on the incidence of TBC is a history of household contact with a value of $\text{Exp}(B)=17.699$.

Conclusion: Risk factors for pulmonary TBC in the Kapanewon Depok area are age, gender, family income, history of household contact, and history of close contact. A relationship, namely the history of household contact, has the most influence on the incidence of TBC in the Kapanewon Depok area.

Keywords: Age; History of Close Contact; Income; Tuberculosis; Sex

INTRODUCTION

Tuberculosis (TBC) is an infectious disease caused by *Mycobacterium tuberculosis*, and this bacterium usually attacks the lungs but can attack other organs.¹ TBC is still a health problem both in the world and in Indonesia; TBC is still the top ten cause of death globally.² Indonesia has a high TBC burden, ranked second in the world after India.³ The number of case findings in 2019-2020 in Indonesia has decreased because of the Coronavirus disease 2019 (COVID-19) pandemic. The case-finding rate is a way to assess progress in tuberculosis control and shows how many tuberculosis cases have been achieved by the program. If TBC cases are not detected as early as possible, it is suspected that people affected by TBC will not receive a TBC control program.⁴

Several factors influence the incidence of TBC. Several factors influence the prevalence of pulmonary TBC in Indonesia, namely place of residence, education, age, gender, and environment. Other factors include a history of contact with TBC sufferers, previous diagnosis of pulmonary TBC by a health worker, Diabetes Mellitus by a doctor, and smoking.⁵ TBC patients with positive BTA have a greater risk of causing infection compared to those with negative BTA; the higher the number of germs in the sputum droplets, the greater the risk of transmission, and the longer and more often they are exposed to germs, the greater the risk of transmission. Meanwhile, individual factors are age and gender. The group most vulnerable to contracting TBC is the young adult age group, which is also the productive age group, and according to the results of the TBC prevalence survey, more males are affected by TBC than females.⁴

Age is one of the factors associated with the incidence of TBC.⁶ TBC often occurs at the young age group; this can be because people at that age tend to have a lot of activity and mobility with lots of people. A person can contract the disease if he is around and close to many people. Based on the distribution of TBC case data in Indonesia, the number of TBC cases in men is higher than in women, namely 57.5% in men and 42.5% in women.⁷ Most smokers are men, and smoking can facilitate the transmission of TBC. More men are infected with TBC than women. In several previous studies, gender also played a role in increasing cases of pulmonary TBC, such as research in Anhui Province, China, which showed that pulmonary TBC was higher in men than women.⁸

Low socio-economic conditions also play a role in TBC disease because tuberculosis affects people who live in slum housing; there is no air circulation and poor nutritional consumption. Economic status is critical in the family, and low income can impact tuberculosis because low income means people do not get the health care they need.⁹ TBC patients whose family income is less than the minimum wage are at risk of developing TBC than a person with a family income \geq minimum wage.⁹ Someone with sufficient income will invest more in their health in preventive terms, such as eating food with adequate nutritional status, consuming vitamins, and seeking treatment for healing and a clean home environment. The lower the income, the higher the risk of contracting pulmonary tuberculosis. This is closely related to nutritional status, housing conditions, neighbourhood population density, and the availability of adequate health services.¹⁰ Whether the air circulation is reasonable depends on the house's ventilation. Poor ventilation greatly influences TBC incidence because the presence

or absence of ventilation influences other factors that trigger tuberculosis germs to grow and reproduce well.¹¹

Environmental factors are also causing TBC disease, including household contact, which means contact with each other. Individuals stay indoors for at least one night or often during the day.¹² Previous research supports the theory that household contact is a causal factor for TBC. This study found that positive household contacts would have more TBC cases than negative ones.^{13,14} Contact with BTA+ has a source of transmission that depends on the likelihood, duration, and proximity of exposure to an infectious case. Meanwhile, in another study, it was found that there was no relationship between a history of household contact and the incidence of tuberculosis because most of the respondents did not have families living in the same house with the status of being infected with tuberculosis.¹⁵

One of the factors that increases the possibility of pulmonary TBC is close contact with TBC sufferers or sources of infection. Close contact is frequent encounters with a source of infection.¹⁶ In several previous studies, variations in the results of the relationship between close contact and TBC were found, including research that stated that a history of close contact was significantly related to the incidence of TBC,^{17,18} but this was different from other studies. Research states that there is no relationship between a history of close contact with TBC, the majority of respondents having no contact with adult BTA patients, and the presence of healthy living habits instilled in the family.¹⁹

Sleman Regency has the highest number of TBC cases compared to other districts/cities in DI Yogyakarta. Based on the results of a preliminary study, the highest number of tuberculosis cases was found in Kapanewon Depok, with 98 cases. Transmission at home and lack of knowledge about transmission factors led to the discovery of many new cases at the Depok I, Depok II, and Depok III Community Health Centers. Based on this, this research will be carried out to determine what factors are associated with tuberculosis at Depok I, II, and III Health Centers.

METHOD

This observational study uses a cross-sectional research design conducted in March-April 2023. The population underwent examinations at the Depok I, Depok II, and Depok III Community Health Centers, Sleman, Yogyakarta. The sample was calculated based on a sample size formula with a cross-sectional design with an unknown population of 432 people. Sampling was done using the accidental sampling technique, patients who visited the community health centre during the research period met the inclusion criteria, such as being willing to be respondents and residing in Depok were recruited in this study. The variables in this study were age, gender, family income, history of household contact, history of close contact, and incidence of tuberculosis. The instrument used for data collection was a questionnaire created by the researcher. Data were analyzed using the chi-square test and logistic regression test. This research has approved by the Ahmad Dahlan University research ethics board with registration number 012301010.

RESULTS

The characteristics of research respondents based on age, sex, family income, educational status, and type of work are presented in Table 1. The distribution of research respondents based on the age variable is that the productive age group 15-50 years dominates the research subjects with 232 people (54%). In comparison, age Unproductive aged <15 years and ≥ 51 years amounted to 198 people (46%). Based on gender, it is dominated by women, who have a more significant proportion, with 238 people (55.3%), than men, with 192 people (44.7%). The majority of respondents had a family income ≥Regency Minimum Salary per month, namely 354 people (82.3%), compared to respondents who had a family income <Regency Minimum Salary per month with a total of 76 people (17.7%). Most respondents had a high school/equivalent educational status, with 250 people (58.1%). Respondents were dominated by the type of work as Housewives (IRT), with 115 people (26.7%) compared to other kinds of work.

Table 1. Characteristics of respondents based on age, gender, family income, educational status, and type of work

Variable	n=432	%
Age group		
a. Productive (15-50 years)	232	54
b. Unproductive (<15 years and >50 years)	198	46
Sex		
a. Male	192	44.7
b. Female	238	55.3
Family income		
a. < Regency Minimum Salary (2,159,519 IDR)	76	17.7
b. ≥ Regency Minimum Salary (2,159,519 IDR)	354	82.3
Educational		
a. Not yet in school	11	2.6
b. Elementary school	24	5.6
c. Junior high school	36	8.4
d. Senior high school	250	58.1
e. Vocational/bachelor's degree	107	24.9
f. Magister degree	2	0.5
Occupation		
a. Labourers/non-formal workers	51	11.9
b. Drivers	14	3.3
c. Teacher	8	1.9
d. Housewife	115	26.7
e. Private sector employee	50	11.6
f. BUMN/BUMD employees	2	0.5
g. Student/Students	97	22.6
h. Health workers	8	1.9
i. PNS/TNI/POLRI	14	3.3
j. Retired	23	5.3
k. Self-employed	20	4.7
l. Businessman	11	2.6
m. No/Not Yet Working	17	4

Bivariate analysis is an analysis that determines the relationship between independent variables and dependent variables. Based on the results of statistical analysis of the Chi-Square test between the variables age, gender, family income, history of household contacts, and history of close contacts, it shows a relationship with the incidence of tuberculosis in the Kapanewon Depok area. This can be seen from the p-value <0.05 (Table 2). Multivariate analysis in this study used logistic Regression (Table 3). Factors that are associated and are risk factors for tuberculosis include age (p-value: 0.006; RP: 2.086), gender (p-value: 0.003; RP: 2.102), family income (p-value: 0.000; RP: 3.593), history of household contacts (p-value: 0.000; RP 8.438) and history of close contact (p-value: 0.000; RP 3.881).

Table 2. Relationship between age, gender, family income, history of household contact, and history of close contact with the incidence of tuberculosis in the Kapanewon Depok, Sleman

Variable	Tuberculosis				RP	Sig. (CI 95%)
	Yes		No			
	f	%	f	%		
Age						
Productive	44	19	188	81	2.086	0.006* (1.247-3.490)
Unproductive	18	9	180	91		
Sex						
Male	39	20	153	80	2.102	0.003* (1.302-3.393)
Female	23	10	215	90		
Family income						
< Regency Minimum Salary	27	36	49	64	3.593	0.000* (2.322-5.560)
≥ Regency Minimum Salary	35	10	319	90		
History of household contact						
Yes	30	70	13	30	8.438	0.000* (5.737-12.410)
No	32	8	355	92		
History of close contact						
Yes	18	44	23	56	3.881	0.000* (2.49-6.051)
No	44	11	345	89		

Table 3. Multivariate Analysis of Factors Affecting Pulmonary Tuberculosis in the Kapanewon Area, Depok

Variable	Koefisien	S.E	Wald	df	Sig	OR Exp(B)	CI 95%	
							Min	Max
Age	1.049	0.418	6.297	1	0.012	2.855	1.258	6.479
Sex	0.938	0.358	6.847	1	0.009	2.554	1.265	5.154
Family income	1.684	0.421	15.996	1	0.000	5.386	2.360	12.293
History of household contact	2.873	0.421	46.33	1	0.000	17.699	7.751	40.411
History of close contact	1.733	0.439	15.544	1	0.000	5.655	2.390	13.381

Based on logistic regression analysis (Table 3), history of household contact is the most dominant factor associated with the occurrence of tuberculosis with a value of Exp(B) = 17,699 (CI 95%; 7,751-40,411) compared to other variables because it has the largest Exp(B). This indicates that tuberculosis is 17.6 times more likely to occur in people with a history of

household contact with tuberculosis patients compared to people who do not have a history of household contact.

DISCUSSION

The identical productive age group has a very high level of mobility every day, so the possibility of being exposed to *Mycobacterium tuberculosis* is greater than that of the non-productive age group, whose mobility is not as high as that of the productive age group. A crowded work or school environment and contact with many people can also increase the risk of pulmonary TBC. People of productive age suffer from this disease more easily because work or school environments like this make it more easily transmitted. Thus, people who meet many people can also more easily contract the disease. This productive age requires a lot of time and energy to work, with less rest time, lowering body endurance.²⁰ Productive age is difficult for the transmission level because at this age, those affected easily interact with other people, have high mobility, and are allowed to spread to different people and the environment where they live.²¹ The productive age group has a relatively high frequency of travel, a busy work environment, various risky jobs, and extensive networks, which are often associated with the productive age group so that the productive age group can contract and transmit tuberculosis. Higher than the non-productive age group.²² Apart from that, a factor that can increase a person's risk of being infected by tuberculosis sufferers in the surrounding environment is the high mobility of those of productive age to work, which requires contact and interaction with many people.²³ With much time spent working, people of productive age ignore health problems that can disrupt their immune system and cause them to be infected with *Mycobacterium tuberculosis*.²⁴

TBC cases are dominated by males.³ Males generally have high mobility outside the home because they have to work, with frequent mobility. So, the risk of contracting tuberculosis is more excellent for males than females. Tuberculosis cases in males are more common than in females; this could also be because males have better access to healthcare facilities, so more tuberculosis cases in males are recorded. This is following previous research, which found that men are 1.8 times more likely to suffer from TBC, and there is a relationship between gender and TBC cases.^{25,26} Most studies show that males are more susceptible to TBC infection than females. This can be caused by a heavier workload, less rest, and unhealthy lifestyles outside the home, such as smoking and drinking alcohol, as well as more social interaction and industrial pollution.²⁷ Smoking is less common in females than males, so males are more susceptible to contracting pulmonary TBC.²⁸

Family income is an essential factor in disease prevention because having sufficient income makes it possible to cover medical costs, maintain a healthy home environment, and eat well. Someone with enough income will invest more in their health in preventive terms, such as food with adequate and adequate nutritional status, consuming vitamins, and seeking treatment for healing and a clean home environment. The lower the income, the higher the risk of contracting pulmonary tuberculosis. This is closely related to nutritional status, housing conditions, neighborhood population density, and the availability of adequate health services.²⁹ Low socio-economic status in the community is related to pulmonary TBC cases. This is because the income level ensures the quality and quantity of food consumed. A family's ability to buy food depends on whether the family income is high or low.³⁰ In line with other

research, most respondents in their study came from low-income families with confirmed TBC.³¹ Poverty has a close relationship with tuberculosis rates in Indonesia.³² People with low income and classified as poor will find it challenging to meet their food needs, so they will experience malnutrition; they will be at higher risk of contracting TBC compared to those who have good nutritional status.³¹

The results show that people diagnosed with pulmonary TBC also have family members who have or have previously suffered from TBC. Transmission can occur through airborne diseases, where TBC bacilli are found in the saliva splashes released by TBC when coughing, sneezing, or singing. Household contact with TBC patients is a factor that causes TBC, and this study found that positive household contact caused more TBC cases than harmful household contact.³³ Apart from that, other research supports that the status of the contact relationship with the sufferer and the place of residence are factors in the occurrence of symptoms in pulmonary TBC. One of the factors causing this relationship is that families tend to have the intensity and frequency of making direct contact with sufferers. The existence of family relationships also makes it difficult for someone to avoid contact because of the responsibility to care for or visit patients.³⁴

The possibility of a relationship between a history of household contact and the incidence of TBC is caused by unhealthy home conditions. One of the health requirements for a residential home is ventilation, which meets the requirements for air circulation, lighting, and supporting factors for air quality. High levels of residential density and unhealthy housing conditions can cause poor air quality. This makes it easier for pulmonary TBC to spread to people who live in the same house and the surrounding environment.³⁵

Respondents often interact with TBC patients for quite a long time, and the intensity of their contact is almost the same as household contact. Most respondents did not know of colleagues or colleagues who had TBC, so this could result in infection without the respondents realizing it. People with close contact with active TBC patients are more likely to become infected and suffer from the disease. TBC risk increases in cases of close contact and long periods.³⁶ Individuals who interact with people with pulmonary tuberculosis for more than six months have a seven times greater risk of infection than those who do not interact for less than six months.³⁷ A person's level of *Mycobacterium tuberculosis* infection is determined by the number of droplets in the air and the length of time they breathe the air. The longer the contact with a high concentration of droplets, the more germs will enter the lung tissue. Post-primary infection occurs when the body's health declines. This happens in the lung tissue over several months to years if the body's condition is stable.³⁶

CONCLUSION

Based on the research results, there is a relationship between age, gender, family income, history of household contact, and close contact with the incidence of TBC in the Kapanewon Depok area. The factor that most influences the incidence of pulmonary TBC is a history of household contact with TBC sufferers. Suggestions to the Community Health Center are to increase screening activities to detect cases in high-risk groups early, for example, people

who have a history of contact with TBC sufferers. Advice to the public to increase awareness of preventive measures if they have household contact or close contact with TBC sufferers.

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Declarations

Authors' contribution

The authors of this article have contributed to its writing, including the first author, who contributed to data collection, data processing, data analysis, and discussion; the second author, who contributed to data collection, data validity, data processing, data analysis, and preparation of the discussion; and the third author, who contributed to data processing, data analysis, and discussion.

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Conflict of interest

There is no conflict of interest in this research.

REFERENCES

1. World Health Organization. Global Tuberculosis Report. World Health Organization. Geneva; 2021. 1–43 p.
2. Indonesia Ministry of Health. Indonesia Health Profile 2020. Indonesia Ministry of Health. Jakarta: Indonesia Ministry of Health; 2021. 1–240 p. (in Bahasa)
3. World Health Organization. Global Tuberculosis Report. 2022. 1–51 p.
4. Indonesia Ministry of Health. Indonesian Minister of Health Regulation Number 67 of 2016 Concerning Tuberculosis Control. Indonesia Ministry of Health. 2017. 163 p. (in Bahasa)
5. Pangaribuan L, Kristina, Perwitasari D, Tejayanti T, Lolong DB. Faktor - Faktor yang Mempengaruhi Kejadian Tuberkulosis pada Umur 15 tahun ke Atas di Indonesia (Analisis Data Survei Prevalensi Tuberkulosis (SPTB) Di Indonesia 2013-2014). Buletin Penelitian Sistem Kesehatan. 2020;23(1):10–7.
6. Pramono JS. Faktor Risiko Peningkatan Angka Insidensi Tuberkulosis. Jurnal Ilmiah Pannmed. 2021;16(1):106–13.
7. Indonesia Ministry of Health. Indonesia Health Profile 2021. Pusdatin.Kemendes.Go.Id. 2022. Indonesia Ministry of Health. (in Bahasa)
8. Zhu QQ, Wu Q, Wang AM, Bao FJ, Zhang YZ, Liu J, et al. Epidemiological characteristics of pulmonary tuberculosis in Anhui Province, Eastern China from 2013 to 2018. PLoS ONE. 2020;15(8 August):1–11.

9. Saputra RM, Herlina N. Hubungan Antara Status Sosial Ekonomi dengan Kejadian Tuberkulosis Paru di Puskesmas, Studi Literature Review. *Borneo Student Research*. 2021;2(3):1772–80.
10. Nurjana MA. Faktor Risiko Terjadinya Tuberculosis Paru Usia Produktif (15-49 Tahun) di Indonesia. *Media Penelitian dan Pengembangan Kesehatan*. 2015;25(3):163–70.
11. Sahadewa S, Eufemia E, Edwin E, Niluh N, Shita S. Hubungan Tingkat Pencahayaan, Kelembaban Udara, Dan Ventilasi Udara Dengan Faktor Risiko Kejadian TB Paru BTA Positif Di Desa Jatikalang Kecamatan Krian Kabupaten Sidoarjo. *Jurnal Ilmiah Kedokteran Wijaya Kusuma*. 2019;8(2):118–30.
12. Indonesia Ministry of Health. *Technical Guidelines for TB Patient Contact Investigation for Health Workers and Cadres*. Jakarta; 2019. 1–2 p. (in Bahasa)
13. Butiop HML, Kandou GD, Palandeng HMF. Hubungan Kontak Serumah, Luas Ventilasi, Dan Suhu Ruangan Dengan Kejadian Tuberkulosis Paru Di Desa Wori. *Jurnal Kedokteran Komunitas dan Tropik*. 2015;3(4a):241–8.
14. Reny M. Hubungan Antara Karakteristik Kontak dengan Adanya Gejala TB Pada Kontak Penderita TB Paru BTA+. *Jurnal Berkala Epidemiologi*. 2014;2(2):274–85.
15. Fahdhienie Farrah. et.al. Analisis Faktor Risiko Terhadap Kejadian Tuberkulosis di Wilayah Kerja Puskesmas Pidie Kabupaten Pidie. *SEL Jurnal Penelitian Kesehatan*. 2020;7(2):52–60.
16. Damayati D, Susilawaty A, Maqfirah. Risiko Kejadian TB Paru di Wilayah Kerja Puskesmas Liukang Tupabbiring Kabupaten Pangkep. *Higiene*. 2018;4(2):121–30.
17. Faturrahman Y, Setiyono A, A RS. Analisis faktor risiko kejadian tuberkulosis di wilayah Puskesmas Kelurahan Cipinang Besar Utara Kota Administrasi Jakarta Timur. *Jurnal Kesehatan Komunitas Indonesia*. 2021;17(2):346–54.
18. Riyanto A. Hubungan Kontak Erat dan Kapasitas Rumah dengan Terjadinya Tuberkulosis Paru di Cimahi Selatan. *Hearty*. 2021 Aug;9(2):86.
19. Puspitasari R, Saraswati L, Hestningsih R. Faktor Yang Berhubungan Dengan Kejadian Tuberkulosis Pada Anak (Studi Di Balai Kesehatan Paru Masyarakat Semarang). *Jurnal Kesehatan Masyarakat*. 2015;3(1):191–7.
20. Konde CP, Asrifuddin A, Lang FLFG. Hubungan antara Umur, Status Gizi dan Kepadatan Hunian dengan Tuberkulosis Paru di Puskesmas Tuminting Kota Manado. *Jurnal Kesmas*. 2020;9(1):106–13.
21. Octaviani P, Kusuma IY. Studi Pengaruh Umur dan Jenis Kelamin Pada Pasien Tuberkulosis di Rumah Sakit DKT Purwokerto. *Viva Medika*. 2018;11(13):40–5.
22. Yosephine MK, Hardy FR, Wenny DM, Nurrizka RH, Pulungan RM. Faktor yang Memengaruhi Kejadian Tuberkulosis Paru pada Penderita Diabetes Mellitus di Rumah Sakit X. *Jurnal Kesehatan*. 2021;12(3):344.
23. Widiastuti EN, Subronto YW, Promono D. Determinan Kejadian Multi-Drug Resistant Tuberculosis di Rumah Sakit Dr. Sardjito Yogyakarta. *Berita Kedokteran Masyarakat*. 2017;33(7):325.
24. Ayu CK, Wardani HE, Alma LR, Gayatri RW. Analisis Faktor Risiko Tuberkulosis Berdasarkan Sistem Informasi Tuberkulosis di Kabupaten Malang Tahun 2020- 2021. 2023;5(4):447–63.
25. Budi IS, Ardillah Y, Sari IP, Septiawati D. Analisis Faktor Risiko Kejadian penyakit Tuberculosis Bagi Masyarakat Daerah Kumuh Kota Palembang. *Jurnal Kesehatan Lingkungan Indonesia*. 2018;17(2):87–94.
26. Pangaribuan L, Kristina, Perwitasari D, Tejayanti T, Lolong DB. Faktor - Faktor yang Mempengaruhi Kejadian Tuberkulosis pada Umur 15 tahun ke Atas di Indonesia (Analisis Data Survei Prevalensi Tuberkulosis (SPTB) Di Indonesia 2013-2014). *Buletin Penelitian Sistem Kesehatan*. 2020;23(1):10–7.
27. Nunkaidah M, Lestari H, Afa J. Prevalensi Risiko Kejadian Tuberkulosis Multi Drug Resistance (Tb-Mdr) Di Kabupaten Muna Tahun 2013 – 2015. *Jurnal Ilmiah Mahasiswa Kesehatan Masyarakat Unsyiah*. 2017;2(6):198308.

28. Ruswanto B, Nurjazuli, Raharjo M. Analisis Spasial Sebaran Kasus Tuberkulosis Paru Ditinjau Dari Faktor Lingkungan Dalam dan Luar Rumah di Kabupaten Pekalongan. 2012;11(1):22–8.
29. Nurjana MA. Faktor Risiko Terjadinya Tuberculosis Paru Usia Produktif (15-49 Tahun) di Indonesia. *Media Penelitian dan Pengembangan Kesehatan*. 2015;25(3):163–70.
30. Budi AS, Tuntun M. Faktor-Faktor Yang Berhubungan Dengan Kejadian Tuberkulosis Paru BTA Positif Pada Pasien Rawat Jalan Di UPT Puskesmas Wonosobo Kabupaten Tanggamus. *Jurnal Analis Kesehatan*. 2013;5(5):566–73.
31. Yuniar I, Lestari SD. Hubungan Status Gizi Dan Pendapatan Terhadap Kejadian Tuberkulosis Paru. *Jurnal Perawat Indonesia*. 2017;1(1):18.
32. Sihalo ED, Amru DS, Agustina NI, Tambak HSP. Pengaruh Angka Kemiskinan Terhadap Angka Tuberkulosis di Indonesia. *Jurnal of Applied Business and Economics (JABE)*. 2021;7(3):325–37.
33. Butiop HML, Kandou GD, Palandeng HMF. Hubungan Kontak Serumah, Luas Ventilasi, Dan Suhu Ruangan Dengan Kejadian Tuberkulosis Paru Di Desa Wori. *Jurnal Kedokteran Komunitas dan Tropik*. 2015;3(4a):241–8.
34. Reny M. Hubungan Antara Karakteristik Kontak dengan Adanya Gejala TB Pada Kontak Penderita TB Paru BTA+. *Jurnal Berkala Epidemiologi*. 2014;2(2):274–85.
35. Alberta LT, Tyas DTP, Muafiroh A, Yuniarti S. Faktor Yang Berhubungan Dengan Kejadian Tuberkulosis Paru di Wilayah Puskesmas Pacarkeling Surabaya. *Media Publikasi Promosi Kesehatan Indonesia (MPPKI)*. 2020;3(3):223–8.
36. Aditama W, Sitepu FY, Depari E. Having contact history with TB active cases and malnutrition as risk factors of TB incidence: A cross-sectional study in North Sumatera, Indonesia. *Malaysian Journal of Public Health Medicine*. 2020;20(1):192–8.
37. Samsugito I, Hambyah. Hubungan Jenis Kelamin Dan Lama Kontak Dengan Kejadian Tuberkulosis Paru Di Rumah Sakit A. Wahab Sjahranie Samarinda. *Jurnal Kesehatan Pasak Bumi Kalimantan*. 2018;1(1):28–40.