JOURNAL LA MEDIHEALTICO

VOL. 04, ISSUE 01 (020-028), 2023
DOI: 10.37899/journallamedihealtico.v4i1.793

Duration of Contact on Pulmonary Tb Transmission: Case Study - Control

Bellytra Talarima[1]

[1]*Public Health Study Program, Faculty of Health, UKIM Ambon, Indonesia*

**Corresponding Author: Bellytra Talarima*
Email: bellytra.talarima@gmail.com

Article Info

Article history:
Received 2 April 2023
Received in revised form 8 May 2023
Accepted 24 May 2023

Keywords:
Duration of Contact
Closeness of Contact
Contact Time
Pulmonary Tuberculosis

Abstract

The Ambon City Health Office, through the Prevention and Control of Infectious Diseases, pointed out that the number of new TB cases in Ambon City in the last three years has tended to increase, where in 2020 the number of cases was 716, in 2021 there were 961 and in 2022 there were 1,296 sufferers. with the number of deaths of 32 people in 2020, in 2022 and 2023 each of 23 people. This study used an analytic observational study with a case control study design, designed to determine the risk and the effect of exposure duration on pulmonary TB transmission with a total sample of 72, bivariate analysis using the chi square test and calculating the odds ratio (OR). multivariate analysis using binary logistic regression test. The results of the study found that close contact is a risk factor for TB transmission with OR = 4.857; contact time is a risk factor for TB transmission with OR = 6.143; and length of contact are risk factors for TB transmission with OR = 5.857. The binary logistic regression equation shows that someone who lives in the same house with a patient with pulmonary tuberculosis, exposure time > 8 hours/day and contact duration > 6 months, has a probability of suffering from pulmonary TB by 30% compared to someone without risk factors. In conclusion, the closeness of contact, contact time and duration of contact are risk factors for pulmonary TB transmission.

Introduction

Globally, the World Health Organization reports that the estimated number of people diagnosed with TB in 2021 is 10.6 million cases, an increase of around 600,000 cases from 2020 which is estimated to be 10 million cases of TB, of the 10.6 million cases, there are 6.4 million (60 .3% of people who have been reported and are undergoing treatment and 4.2 million (39.7%) others have not been found or diagnosed and reported. Anyone can suffer from TB, out of a total of 10.6 million cases in 2021, at least 6 million cases are adult men, 3.4 million cases are adult women and other TB cases are children, namely 1.2 million case. Deaths from TB as a whole were very high, around 1.6 million people died from TB, this figure increased from the previous year, which was around 1.3 million people. This makes TB the second deadliest infectious disease in the world (WHO, 2022).

Indonesia itself is in second place with the highest number of TB sufferers in the world after India, followed by China, the Philippines, Pakistan, Nigeria, Bangladesh and the Democratic Republic of the Congo respectively. In 2020, Indonesia is in third position with the highest number of cases, so that in 2021 there will be an increase in cases. TB cases in Indonesia are estimated at 969,000 TB cases (one person every 33 seconds). This figure is up 17% from 2020, namely 824,000 cases. The incidence of TB cases in Indonesia is 354 per 100,000 population, which means that for every 100,000 people in Indonesia there are 354 of them suffering from TB. The death rate due to TB in Indonesia has reached 150,000 cases (one person every 4

minutes), up 60% from 2020 where there were 93,000 deaths due to TB. With a death rate of 55 per 100,000 population, out of a total of 969,000 estimated TB cases in Indonesia, only 443,235 (45.7%) cases were found, while 525,765 (54.3%) other cases had not been found and reported. (RI Ministry of Health, 2020)

Maluku Province is one of 14 provinces whose notification rate for all tuberculosis cases per 100,000 population by province in 2021 exceeds the figure nationally, where Maluku Province is 156 per 100,000 population higher than the national figure of 146 per 100,000 population. The success rate of treatment of tuberculosis patients by province with a minimum target of 90% in 2021, shows that the Maluku province has achieved a success rate of treating all cases which is still below the national target of 87.2%, this indicates that a TB control strategy is still needed in Maluku Province in the future (Ministry of Health RI, 2022)

One strategy that needs to be done is to control close contacts, this is because around 3.5-10% of people who are in close contact with sufferers (patients) for a long duration will get TB disease and about a third will be infected but not sick with TB. Groups at high risk for infection include children, the elderly and people with compromised immune systems (poor nutrition, HIV infection). Among these infected people, there is a 5-10% chance that they will develop TB disease in their lifetime. Comparison of data for 2017, 2018 and 2019 shows that the proportion of case findings is greater in contact investigations compared to findings in the general public, even though with the same symptom screening, thus contact investigations can encourage more and earlier case detection which will eventually reduce the risk of transmission (Ministry of Health RI, 2019).

The results of research conducted by Nurwitasari and Wahyuni, 2015 showed that 87.5% of children in the case group had a history of contact with previous adult tuberculosis patients, the results of statistical tests showed a significant relationship between contact history and the incidence of tuberculosis ($p = 0.000$) , Likewise, the duration of contact indicated that 75% of children in the case group had a history of contact of more than 6 months with previous adult tuberculosis sufferers, statistical test results showed a significant relationship between the duration of contact and the incidence of TB ($p = 0.000$) (Anasyia Nurwitasari, 2015).

The Ambon City Health Office, through the Prevention and Control of Infectious Diseases, pointed out that the number of new TB cases in Ambon City in the last three years has tended to increase, where in 2020 the number of cases was 716, in 2021 there were 961 and in 2022 there were 1,296 sufferers. with the number of deaths of 32 people in 2020, in 2022 and 2023 each of 23 people. Data in the medical records of the Waihaong Public Health Center, Ambon City, in 2020 there were 39 cases of pulmonary TB of which there were 22 cases of pulmonary tuberculosis for men and 17 pulmonary tuberculosis patients for women and in 2021 there were 51 cases of pulmonary tuberculosis among them for men there were 25 pulmonary tuberculosis patients and for women there were 24 pulmonary tuberculosis patients, 1 patient moved for treatment and 1 patient died. in 2022 there will be 5 cases of pulmonary TB of which for men there will be 3 pulmonary TB patients and for women there will be 2 pulmonary TB patients. Based on the description of the background above, the aim of this study was to determine the risk and influence of contact duration on the transmission of pulmonary TB in the work area of the Waihaong Public Health Center, Ambon City

Methods

This study used an analytic observational study with a case control study design, designed to determine the risk and effect of duration of exposure to pulmonary TB transmission in TB patients in the work area of the Waihaong Health Center, Ambon City, this study was conducted in the work area of the Waihaong Health Center Ambon City, carried out in August - October 2022. The population in this study were pulmonary tuberculosis patients in the working area of the Waihaong Public Health Center, Ambon City. The sampling technique

used was total sampling. The ratio between the number of samples in the case and control groups was 1: 2 with matching age, for the case group there were 24 pulmonary tuberculosis patients and a control group sample of 48 patients who were not affected by pulmonary tuberculosis, so that the total sample was 72. The study variables included; closeness of contact, contact time and length of contact, data collection was carried out using a questionnaire that had been tested for validity and reliability through an interview process with respondents, the data collection process in the field was assisted by program staff. Data analysis was carried out univariately to describe the characteristics of the respondents in terms of frequency distribution, bivariate analysis using the chi square test to test the relationship with a value of $\alpha = 0.05$ and the magnitude of the risk of contact duration was determined by calculating the odds ratio (OR) and multivariate analysis using the binary logistic test regression to test the effect of duration of contact on the transmission of pulmonary tuberculosis, the variables tested in the multivariate analysis are variables that have a p value <0.25. The research ethics applied during the research process were that each respondent was asked to fill out an informed consent form, each respondent was kept confidential and each respondent's data was used anonymously.

Results and Discussion

The following will display the results of research analyzed univariately, bivariately and multivariately and presented in table form as follows;

Univariate Analysis

Univariate analysis, conducted to describe the characteristics of respondents in the form of; gender and age group and describe the frequency distribution of research variables.

Table 1. Frequency Distribution of Respondent Characteristics with the Incidence of Pulmonary TB

Characteristics of Respondents	Category	Pulmonary tuberculosis				Sum	
		Case		Control			
		n	%	n	%	N	%
Gender	Male	15	65,5	29	60,4	44	61,1
	Forandmpuan	9	37,5	19	39,6	28	38,9
Age Group (years)	17 - 24	7	29,1	14	29,1	21	29,1
	25 - 34	5	20,8	10	20,8	15	20,8
	35 - 44	1	4,2	2	4,2	3	4,2
	45 - 54	3	12,5	6	12,5	9	12,5
	55 - 65	4	16,7	8	16,7	12	16,7
	> 65	4	16,7	8	16,7	12	16,7
Total		**24**	**100,0**	**48**	**100,0**	**72**	**100,0**

As depicted in Table 1, the distribution of respondents based on gender revealed a higher proportion of male participants, comprising 44 individuals (61.1%), in comparison to their female counterparts, who accounted for 28 individuals (38.9%). Based on the demographic characteristics of the respondents, it was observed that the age group with the highest number of participants was the 17-24 year old group, comprising 21 individuals (29.1%), while the age group with the lowest number of participants was the 35-44 year old group, consisting of only 3 individuals (4.2%).

Table 2. Frequency Distribution of Contact Duration with Pulmonary TB Incidence

Contact Duration	Category	Pulmonary tuberculosis				Sum	
		Case		Control			
		n	%	n	%	N	%
	Housekeeping	17	70,8	16	33,3	33	45,8

Close Contact	Tidak Serumah	7	29,2	32	66,7	39	54,2
Contact Time	> 8 hours/day	10	41,7	5	10,4	15	20,8
	≤ 8 hours/day	14	58,3	43	89,6	57	79,2
Length of Contact	> 6 months	12	50,0	7	14,6	19	26,4
	≤ 6 months	12	50,0	41	85,4	53	73,6
Total		**24**	**100,0**	**48**	**100,0**	**72**	**100.0**

Source: Primary Data 2022

The findings presented in Table 2 indicate that the duration of contact, as determined by the level of proximity to individuals with tuberculosis (TB), differed significantly between the case and control groups. Specifically, a greater proportion of individuals in the case group (70.8%) reported living in the same house as TB sufferers, compared to the control group (33.3%). Conversely, a larger proportion of individuals in the control group (66.7%) reported not living in the same house as TB sufferers, compared to the case group (29.2%). The study revealed that individuals in the case group had a higher contact duration when exposed to the category for more than 8 hours per day, with 10 individuals (41.7%) compared to the control group, which had 5 individuals (10.4%). Conversely, the control group had a higher incidence of contact duration when exposed to the category for less than or equal to 8 hours per day, with 43 individuals (89.6%) compared to the case group, which had 14 individuals (58.3%). The study revealed that the case group had a higher number of individuals with a contact duration of more than 6 months, with 12 people (50.0%) compared to the control group, which had 7 people (14.6%). Conversely, the control group had a higher number of individuals with a contact duration of less than or equal to 6 months, with 41 people (85.4%) compared to the case group, which had 12 people (50.0%).

Bivariate Analysis

Bivariate analysis was carried out using the *chi-square* test with α = 0.05 to prove the hypothesis and a large risk analysis was carried out by calculating the *odds ratio* (OR) value.

Table 3. Large Risk Analysis of Contact Duration with Pulmonary TB Incidence

Contact Duration	**Category**	***p value***	**OR**	**CI 95%**	
				LL	**HIVE**
Close Contact	Housekeeping	0,006	4,857	1,674	14,094
	Tidak House				
Contact Time	> 8 hours/day	0,006	6,143	1,793	21,044
	≤ 8 hours/day				
Length of Contact	> 6 months	0,003	5,857	1,887	18,178
	≤ 6 months				

Source: Primary Data 2022

The findings presented in Table 3 indicate that a statistical analysis utilizing the chi square test was conducted to examine the duration of contact in relation to the number of contacts. The results revealed a p value of 0.006, which is less than the predetermined significance level of 0.05, leading to the rejection of the null hypothesis. This suggests that there exists a significant association between close contact and the incidence of pulmonary tuberculosis. Furthermore, the odds ratio (OR) was calculated to be 4.857, which is greater than 1, with a 95% confidence interval (CI) of 1.674 to 14.094. This indicates that close contact is a risk factor for pulmonary tuberculosis, with the case group having a 4.857 times higher risk than the control group. The statistical analysis of contact duration in relation to contact time has yielded significant results. The p value of 0.006, which is less than the predetermined level of significance of 0.05,

indicates that the null hypothesis (H0) is rejected. This implies that there is a significant association between contact time and the incidence of pulmonary tuberculosis. The odds ratio (OR) of 6.143, which is greater than 1, with a 95% confidence interval (CI) of 1.793 to 21.044, suggests that contact time is a risk factor for pulmonary tuberculosis. Specifically, the risk of contracting pulmonary tuberculosis in the case group is 6.143 times higher than that of the control group. The statistical analysis conducted on the relationship between contact duration and the incidence of pulmonary tuberculosis revealed a p value of 0.003, which is less than the significance level of 0.05. This indicates that the null hypothesis (H0) is rejected, and there is indeed a significant association between the length of contact time and the occurrence of pulmonary tuberculosis. The odds ratio (OR) was calculated to be 5.857, which is greater than 1, with a 95% confidence interval ranging from 1.887 to 18.178. These findings suggest that contact duration is a risk factor for pulmonary tuberculosis, with the case group having a 5.857 times higher risk than the control group.

Multivariate Analysis

The study employed multivariate analysis and utilized the binary logistic regression test to examine the impact of contact duration on the transmission of pulmonary tuberculosis. The multivariate analysis examined variables that exhibited a p value of less than 0.25 during the bivariate analysis phase. Based on this criterion, all independent variables satisfied the conditions for inclusion in the model. multivariate.

Table 4. Analysis of the Effect of Contact Duration with the Incidence of Pulmonary TB

Contact Duration	B	*P value*	OR	CI 95%	
				LL	HIVE
Close Contact	0,738	0,031	2,093	0,502	8,727
Contact Time	0,843	0,028	2,322	0,493	10,946
Length of Contact	0,808	0,030	2,243	0,472	10,649
Constant	-1,520	0,000	0,219		

Source: Primary Data 2022

Table 4 above shows thatthe results of multivariate analysis obtained a logistic regression equation model as follows: Logit P (Incidence ofPulmonary TB C) = -1.520 + (0.738*contact tightness) + (0.843*contact time) + (0.808*contact duration). Based on these calculations can be made a calculation of a person's probability of suffering from Pulmonary C TB, with the formula:

$$P = \frac{1}{1 + e^{-[-1,520+0,738+0,843+0,808]}} = 0,30$$

In the event that an individual cohabitates with a patient diagnosed with pulmonary tuberculosis, and is exposed to said patient for a duration exceeding eight hours per day, and for a contact duration exceeding six months, the likelihood of contracting pulmonary tuberculosis is estimated to be 30% higher than that of an individual without such risk factors. Furthermore, the probability of contracting pulmonary tuberculosis may be further increased when additional risk factors are present. Based on the odds ratio (OR) values, it can be inferred that proximity, duration, and frequency of contact are significant risk factors for pulmonary tuberculosis. Specifically, an increase of 1 in proximity (defined as residing in the same household as a pulmonary tuberculosis patient) corresponds to a 2.093-fold increase in the likelihood of developing pulmonary tuberculosis. Similarly, an increase of 1 in contact time per day corresponds to a 2.322-fold increase in the incidence of TB, while an increase of 1 in duration of contact per month corresponds to a 2.243-fold increase in the likelihood of developing pulmonary tuberculosis.

According to the study findings, a significant proportion of pulmonary tuberculosis cases (83.3%) were observed in the age group that is considered to be productive (15-64 years). The findings of Rahmawati et al. (2022) indicate a statistically significant correlation between productive age and the occurrence of pulmonary tuberculosis, as evidenced by a p-value of 0.003. This relationship can be attributed to the heightened level of activity associated with productive age, which increases the susceptibility of individuals to exposure from TB patients. According to Tobing et al. (2021), a significant proportion of tuberculosis (TB) patients in Indonesia belong to the 15-54 year age group, which constitutes 56% of the total cases. Additionally, a majority of these patients are diagnosed with co-morbidities, particularly HIV/AIDS. In contrast to findings from prior studies, which indicated that individuals aged 35-54 years were 1.4 times more likely to develop tuberculosis (TB) and those aged > 55 years were 2.3 times more likely to develop TB compared to the age group 15-34 years, this observation may be attributed to the positive correlation between age and TB risk. According to Pangaribuan et al. (2020), as individuals age, their immune system tends to weaken, rendering them more susceptible to illnesses. The findings of this investigation indicate that a significant proportion of pulmonary tuberculosis (TB) cases (65.5%) were observed in males, which is consistent with prior research conducted in Morocco. Specifically, a study conducted by Eddabra and Neffa (2020) reported that a greater proportion of pulmonary TB cases were detected in males (59.20%). This trend may be attributed to the higher prevalence of smoking among males, which is known to increase the susceptibility to pulmonary TB (Sbayi et al., 2020). According to the 2018 Basic Health Research (Riskesdas), the prevalence of smoking, including daily smokers, occasional smokers, and former smokers, is higher among men (65.0%) than women (3.2%) (Ministry of Health Republic of Indonesia, 2018).

The degree of proximity among individuals can be discerned by the prevalence of social interactions occurring within the confines of one's residence and those transpiring beyond its boundaries. The study's findings indicate a notable disparity in risk levels between individuals who have had contact within their household and those who have had contact outside of their household. According to a study conducted by Simbolon Demsa, individuals who are in close contact with pulmonary TB patients at home are at a significantly higher risk of developing the disease, with a 4.857 times greater likelihood compared to those who have contact with TB patients outside the home. The study also found that individuals residing in households with TB patients have a 3.897 times higher risk of developing pulmonary TB compared to those who have contact outside the home. The level of contact, specifically the duration and proximity of contact, is a crucial factor in determining the risk of contracting the disease. (Simbolon, 2007). The transmission of tuberculosis from adults to children is a common occurrence, particularly in infants and children who have close contact with adult TB sufferers, as noted by Lawalata and Talarima (2020). Saunders J Matthew and colleagues conducted a study which demonstrated that cohabiting with individuals affected by tuberculosis had a statistically significant p value of 0.0001, indicating the potential for transmission to others (Saunders et al., 2020).

The study examined the relationship between contact time and TB infection risk, specifically comparing individuals who had contact with TB sufferers for more than 8 hours per day versus those who had contact for 8 hours or less per day. The results indicated a statistically significant difference in risk between these two groups. Individuals who are exposed to pulmonary tuberculosis patients for more than 8 hours per day are at a 4.857 times higher risk of contracting pulmonary tuberculosis compared to those who have contact for 8 hours or less per day. Furthermore, the likelihood of a child acquiring TB is greater among children who have contact for more than 8 hours per day compared to those who have contact for 8 hours or less per day, as reported by Diani et al. in 2016. According to Orme's (2014) literature, proximity to the source of infection is positively correlated with the likelihood of tuberculosis (TB) infection in children. The proximity to adult tuberculosis patients can be analyzed from two

perspectives: the spatial aspect, which involves the use of the "one bed" criterion, and the temporal aspect, which pertains to the level of contact intensity, as demonstrated in our research. According to a study conducted by Hajarsyah et al, it was found that 73.8% of children in the case group had more than 6 hours per day of close contact with adult tuberculosis patients, which resulted in a 4.88 times higher risk of contracting the disease. Additionally, poor nutritional status, particularly in children, may exacerbate this risk, as noted by Kristini and Hamidah in 2020.

The study examined the duration of contact with individuals affected by tuberculosis, distinguishing between those with an intensity of contact exceeding six months and those with a duration of contact equal to or less than six months. The study's findings indicate a noteworthy disparity in risk when comparing contact duration exceeding six months to contact duration equal to or less than six months. According to research conducted by Anasyia Nurwitasari et al, individuals who have been in contact with pulmonary tuberculosis sufferers for more than six months have a significantly higher risk of contracting pulmonary TB compared to those who have been in contact for six months or less. Specifically, the study found that children with a history of contact with adult TB sufferers for more than six months have a 69-fold increased risk of contracting the disease compared to those with no history of contact or contact for less than six months (Anasyia Nurwitasari, 2015). The duration of contact with the transmission source is closely associated with the heightened likelihood of tuberculosis exposure. According to Asyary et al. (2017), the period of highest susceptibility to tuberculosis infection is within the first year of exposure, with particular emphasis on the initial six months. Infants, in particular, exhibit a brief interval between infection and disease manifestation, with symptoms typically appearing within one year of exposure. According to Laghari et al. (2019), individuals who have prolonged exposure to individuals with tuberculosis are at a higher risk of contracting the disease compared to those who do not have such exposure. The duration between the introduction of tuberculosis pathogens and the full development of the primary complex is referred to as the incubation period of tuberculosis. The typical duration of the incubation period for tuberculosis is between 4 to 8 weeks, with a range of 2 to 12 weeks. Lawalata and Talarima (2022) posit that during the incubation period, the microorganisms proliferate to a level that triggers a cellular immune reaction

Conclusion

According to the logistic regression equation, an individual's likelihood of developing pulmonary tuberculosis increases to 30% if they reside with a pulmonary tuberculosis patient, have an exposure time exceeding 8 hours per day, and have a contact duration exceeding 6 months. This probability is higher than that of an individual without any risk factors. Furthermore, the probability of developing pulmonary tuberculosis may increase when additional risk factors are present.

References

Anasyia Nurwitasari, C. U. W. (2015). Pengaruh Status Gizi dan Riwayat Kontak Terhadap Kejadian Tuberkulosis Anak di Kabupaten Jember. *Junral Berkala Epidemiologi*, *3*(2), 158–169. http://download.garuda.kemdikbud.go.id/article.php?article=423721&val=7403&title=The Effect of Nutritional Status and Contact History toward Childhood Tuberculosis in Jember

Asyary, A., Eryando, T., Purwantyastuti, Junadi, P., Clark, C., & Teijlingen, E. van. (2017). Level of exposure to childhood tuberculosis in household contacts with adult pulmonary tuberculosis. *Kesmas: National Public Health Journal*, *12*(1), 1–6. https://doi.org/10.21109/kesmas.v12i1.1469

Diani, A., Setyanto, D. B., & Nurhamza, W. (2016). Proporsi Infeksi Tuberkulosis dan Gambaran Faktor Risiko pada Balita yang Tinggal dalam Satu Rumah dengan Pasien Tuberkulosis Paru Dewasa. *Sari Pediatri*, *13*(1), 62. https://doi.org/10.14238/sp13.1.2011.62-9

Eddabra, R., & Neffa, M. (2020). Epidemiological profile among pulmonary and extrapulmonary tuberculosis patients in Laayoune, Morocco. *Pan African Medical Journal*, *37*(56), 1–8. https://doi.org/10.11604/pamj.2020.37.56.21111

Hajarsjah, N., Daulay, R. M., Ramayani, O. R., Dalimunthe, W., Daulay, R. S., & Meirina, F. (2018). Tuberculosis risk factors in children with smear-positive tuberculosis adult as household contact. *Paediatrica Indonesiana*, *58*(2), 66–70. https://doi.org/10.14238/pi58.2.2018.66-70

Kemenkes RI. (2018). Hasil Riset Kesehatan Dasar Tahun 2018. In *Kementrian Kesehatan RI* (Vol. 53, Issue 9). https://kesmas.kemkes.go.id/assets/upload/

Kemenkes RI. (2019). Petunjuk Teknis Investigasi kontak Pasien TBC bagi Petugas Kesehatan dan Kader. *Dirjen Pencegahan Dan Pengendalian Penyakit Menular*, 1–2. https://htbs.tbindonesia.or.id/wp-content/uploads/2020/03/Petunjuk-Teknis-Investigasi-Kontak.pdf

Kemenkes RI. (2020). Strategi Nasional Penanggulangan Tuberkulosis di Indonesia 2020-2024. In *Pertemuan Konsolidasi Nasional Penyusunan STRANAS TB* (p. 135).

Kemenkes RI. (2022). Profil Kesehatan Indonesia 2021. In *Pusdatin.Kemenkes.Go.Id*. https://pusdatin.kemkes.go.id/

Kristini, T., & Hamidah, R. (2020). Potensi Penularan Tuberculosis Paru pada Anggota Keluarga Penderita. *Jurnal Kesehatan Masyarakat Indonesia*, *15*(1), 24. https://doi.org/10.26714/jkmi.15.1.2020.24-28

Laghari, M., Sulaiman, S. A. S., Khan, A. H., & Memon, N. (2019). A prospective study of socio-demographic, clinical characteristics and treatment outcomes of children with tuberculosis in Sindh, Pakistan. *BMC Infectious Diseases*, *19*(1), 1–11. https://doi.org/10.1186/s12879-019-3702-3

Lawalata, I. V., & Talarima, B. (2020). Risk Factors for Child Tuberculosis in Ambon City in 2019. *Journal La Medihealtico*, *1*(3), 1–8. https://doi.org/10.37899/journallamedihealtico.v1i3.123

Lawalata, I. V., & Talarima, B. (2022). TB Specimen Transportation Model as a Strategy for Increasing Service Access through Toss-TBC. *Journal La Medihealtico*, *3*(6), 459–468. https://doi.org/10.37899/journallamedihealtico.v3i6.748

Orme, I. M. (2014). A New Unifying theory of the pathogenesis of tuberculosis. *NIH Public Access*, *94*(1), 1–16. https://doi.org/10.1016/j.tube.2013.07.004.A

Pangaribuan, L., Kristina, K., Perwitasari, D., Tejayanti, T., & Lolong, D. B. (2020). Factors Infl uencing Pulmonary Tuberculosis Occurrence of 15 Years Old or Above in Indonesia (Tuberculosis Prevalence Survey Data Analysis in Indonesia Year 2013-2014). *Buletin Penelitian Sistem Kesehatan*, *23*(1), 10–17. https://doi.org/10.22435/hsr.v23i1.2594

Rahmawati, A., Vionalita, G., Mustikawati, I., & Handayani, R. (2022). Faktor – Faktor Yang Berhubungan Dengan Kejadian Tuberkulosis Paru Pada Usia Produktif Di Puskesmas Kecamatan Pasar Minggu Tahun 2021. *Jurnal Kesehatan Masyarakat*, *10*(5), 570–578. https://doi.org/DOI : 10.14710/jkm.v%vi%i.35178

Saunders, M. J., Wingfield, T., Datta, S., Montoya, R., Ramos, E., Baldwin, M. R., Tovar, M. A., Evans, B. E. W., Gilman, R. H., & Evans, C. A. (2020). A household-level score to predict the risk of tuberculosis among contacts of patients with tuberculosis: a derivation and external validation prospective cohort study. *The Lancet Infectious Diseases*, *20*(1), 110–122. https://doi.org/10.1016/S1473-3099(19)30423-2

Sbayi, A., Arfaoui, A., Janah, H., Koraichi, S. E. L., & Quyou, A. (2020). Epidemiological characteristics and some risk factors of extrapulmonary tuberculosis in larache, morocco. *Pan African Medical Journal*, *36*(381), 1–9. https://doi.org/10.11604/pamj.2020.36.381.24870

Simbolon, D. (2007). Faktor Risiko Tuberculosis Paru di Kabupaten Rejang Lebong. *Kesmas: National Public Health Journal*, *2*(3), 112. https://doi.org/10.21109/kesmas.v2i3.266

Tobing, K. L., Nainggolan, O., Rachmawati, F., Manalu, H. S. P., Sagala, R. D., & Kusrini, I. (2021). The Relationship Between Malnutrition and Tuberculosis (TB) At The Age Group More Than 18 Years Old In Indonesia (Analysis Of The Basic Health Research 2018). *International Journal of Innovation, Creativity and Change*, *15*(9), 332–348. https://doi.org/10.53333/ijicc2013/15941

WHO, G. T. R. (2022). *Global Tuberculosis Report 2022*. https://www.who.int/teams/global-tuberculosis-programme/tb-reports/global-tuberculosis-report-202