

Relationship between knowledge and medication adherence among patients with tuberculosis: a cross-sectional survey



Muhammad Thesa Ghozali^{1*}, Cica Tri Murani¹

ABSTRACT

Background: The World Health Organization (WHO) stated that treatment adherence is one determinant of the successful management of pulmonary tuberculosis therapy. Non-adherence can result in recurrence or treatment failure. Knowledge of tuberculosis is crucial for a patient's adherence to treatment, and the level is proportional to the information obtained. This study aimed to determine the relationship between the knowledge level of pulmonary tuberculosis and adherence to anti-tuberculosis drugs (ATD).

Methods: This study is a non-experimental quantitative study with analytic correlation and a cross-sectional approach. Sampling was done at the Umbulharjo 1 Public Health Center, Yogyakarta, Indonesia, in November-December 2021, using purposive sampling with 43 respondents. The knowledge level and adherence were measured using a questionnaire and the Morisky Medication Adherence Scale (MMAS-8). Meanwhile, the relationship between the variables was analyzed using the Pearson Product Moment correlation test with a significance level of 95%.

Results: The results showed that respondents with high, moderate, and low knowledge levels were 88.37%, 11.63%, and 0%, respectively. Respondents with high, moderate, and low adherence to ATD were 95.34%, 4.7%, and 0%, respectively. Furthermore, analysis of the relationship to taking ATD obtained a p-value of 0.001 (<0.05) and a correlation value (r) of 0.609.

Conclusion: Most patients had high knowledge and adherence to medication, and the correlation showed a strong relationship between the variables and taking ATD.

Keywords: adherence, knowledge, medication, tuberculosis.

Cite This Article: Ghozali, M.T., Murani, C.T. 2023. Relationship between knowledge and medication adherence among patients with tuberculosis: a cross-sectional survey. *Bali Medical Journal* 12(1): 158-163. DOI: 10.15562/bmj.v12i1.3826

¹School of Pharmacy, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, Indonesia;

*Corresponding author:

Muhammad Thesa Ghozali;
School of Pharmacy, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta, Indonesia;
ghozali@umy.ac.id

Received: 2022-10-15

Accepted: 2022-12-16

Published: 2023-01-05

INTRODUCTION

Tuberculosis can be defined as a direct bacterial infection caused by *Mycobacterium tuberculosis* and transmitted through cough and inhaled saliva.¹ About 3,000 sputa can be expelled in one cough, and the incubation period is between 3 to 6 months. The treatment can be carried out in two stages: an active and a follow-up period of 2 and 4-6 months.² Regular treatment can achieve complete cure results, and when stopped, the bacteria multiply. It means that the patient should be treated again from the beginning.² In addition, 50% of people with tuberculosis are liable to die within 5 years, 25% may recover with a strong immune system, and 25% will become chronic cases and remain infectious when left untreated.³ The death rate from pulmonary tuberculosis can be reduced when the patient is given proper care and treatment.⁴

According to the World Health Organization (WHO), one determinant of the successful management of pulmonary tuberculosis therapy is adherence to treatment, and non-adherence can result in recurrence or treatment failure.⁵ It can cause resistance to germs and long-term disease transmission from individual to individual. The consequences in the long term can worsen health conditions and increase medical costs. Moreover, it impacts low cure rates, the resistance of tuberculosis bacteria to anti-tuberculosis drugs (ATD), increased recurrence, and high mortality rates, making disease cure difficult to achieve.⁶

The incidence in 2016 was equivalent to 10.4 million or 120 cases per 100,000 population. The countries with the highest case are India, Indonesia, China, the Philippines, and Pakistan.⁷ Most of the estimated incidence at 45% occurred

in Southeast Asia, including Indonesia, while 25% occurred in Africa.⁸ According to several reports, in 2017, the number of cases in Indonesia was 420,994 (data as of May 17, 2018).⁹ In Yogyakarta as the study site, the number increased in 2019 to 1048 cases.¹⁰ Furthermore, about 604 new cases were found, while 564 occurred in 2018. The data were obtained from 18 Public Health Centers and 12 Hospitals in Yogyakarta City as referral health facilities for patients.¹¹

Many individuals with tuberculosis believe they are healed and discontinue therapy due to a lack of knowledge about this disease. Several studies stated that education affects the patient's rules in taking medication. Therefore, the patient's education level is directly proportional to the information obtained about the treatment. Furthermore, several factors influencing adherence include

communication, knowledge, health service facilities, individual perceptions, and motivations.¹² The knowledge level influences a person's adherence to tuberculosis treatment; hence, patients need to understand the information well.¹³ Moreover, another factor influencing medication adherence is the knowledge of family members and health workers.¹⁴ Some of these factors necessitate an investigation of the association between patient understanding and adherence to anti-tuberculosis medications (ATD). Therefore, this study aimed to determine the relationship between the knowledge level of pulmonary tuberculosis with adherence to taking ATD using a non-experimental quantitative design with analytic correlation and a cross-sectional approach.

METHODS

This study used a non-experimental quantitative model with a cross-sectional design in November-December 2021. Direct data collection used a questionnaire distributed to tuberculosis patients subjected to active treatment at the Umbulharjo 1 Public Health Center, Yogyakarta.

The sample was taken using a purposive sampling method. The inclusion criteria were: (a) Patients diagnosed with tuberculosis and currently subjected to treatment at the Umbulharjo 1 Public Health Center, Yogyakarta; (b) aged 17-50 years; (c) volunteered to be respondents; and (d) ability to read and write. Meanwhile, the exclusion criteria included (a) Patients who could not communicate well; (b) Patients who did not fill out the questionnaire completely; and (c) Patients who were unwilling to cooperate.

Study Instrument

The instrument used was the questionnaire contained in the respondent data sheet and informed consent. The questionnaires used in this study are as follows:

Questionnaire about the knowledge level

The instrument used was a questionnaire to determine the knowledge level about pulmonary tuberculosis. The questionnaire consisted of one and four questions about the definition and

transmission of pulmonary tuberculosis. Furthermore, it includes one, three, and four questions about the causes, signs and symptoms, treatment, and prevention. Detail of the question items regarding the patient's knowledge level is shown in [Table 1](#).

Questionnaire about adherence to taking ATD

The instrument used to assess medication adherence in pulmonary tuberculosis patients is the MMAS-8 (Morisky Medication Adherence Scale) questionnaire, shown in [Table 2](#). It was developed by Morisky et al. to assess adherence to medication over a long period.¹⁵ It consists of 8 question items that indicate the frequency of forgetting to take medication and intentionally stopping without a doctor's confirmation.

Study Procedure

Respondents were asked for consent to become participants by filling out an informed consent form. Furthermore, they were asked to complete a questionnaire tested for validity and reliability. The data obtained were processed by several steps, including Editing, Coding, Data Entry, and Analysis Techniques.

Data Analysis

Knowledge Level

The form of the questionnaire used is True (T) and False (F) statements

with 16 question items. Questions are made in 2 types, namely favorable and unfavorable to the object. For quantitative analysis, each answer is given a score where the favorable item with the answers T (True) and F (False) has a score of 1 and 0. Meanwhile, the unfavorable item with the answers T (True) and F (False) scores 0 and 1.

Adherence to taking ATD

This questionnaire comprises 8 questions, and the response category consists of yes or no answers and 5 Likert scales for one last question. In the MMAS-8 measurement, questions 1 - 7 with the answer YES and NO have a score of 0 and 1, except for question number 5. It has a score of 1 and 0. Question number 8 with the answer never/ rarely has a score of 4, occasionally with 3, 2, 1, and always/ every time with 0. The adherence level is obtained from the total score in the overall assessment, namely the high, moderate, and low categories, with a total score of 8, 6-7, and <6.

Relationship Between Patients' Knowledge and Medication Adherence

Data analysis was carried out using SPSS 26.0 for windows computing.

Univariate test

The univariate test was conducted using SPSS 26.0 for windows to determine the distribution and percentage of the knowledge level about pulmonary tuberculosis and adherence to ATD.

Table 1. A list of question items of knowledge on tuberculosis.

No	Question Items	True	False
1	Mycobacterium tuberculosis infection always causes people to suffer from pulmonary tuberculosis.		
2	Pulmonary tuberculosis can only attack the lungs.		
3	The duration of treatment for pulmonary tuberculosis is 6 months.		
4	The eradication of pulmonary tuberculosis is only the responsibility of the Ministry of Health.		
5	Environmental hygiene can reduce the risk of transmission.		
6	The improvement of community nutrition has no effect on disease prevention.		
7	Pulmonary tuberculosis is an incurable disease.		
8	Pulmonary tuberculosis patients do not need to adhere to treatment and take medication.		
9	Pulmonary tuberculosis can be transmitted through the patient's droplets inhaled by other people.		
10	The type of treatment I am currently on is a long-term treatment.		

Table 2. A list of question items of knowledge on tuberculosis.

No	Question Items	Yes	No
1	Do you sometimes forget to take your medication for tuberculosis?		
2	People sometimes do not have time to take medication, not because they forget. During the past 2 weeks, have you intentionally not taken your medication?		
3	Have you ever cut back or stopped taking the medication without telling your doctor because you felt your condition got worse when you took the medication?		
4	When you go on a trip or leave the house, do you sometimes forget to bring your drugs?		
5	Did you take your medication yesterday?		
6	When you feel better, do you also sometimes stop taking your medication?		
7	Taking medication daily is an unpleasant thing for some people. Have you ever felt disturbed by your obligations towards tuberculosis treatment that you have to undergo?		
8	How often do you have trouble taking your medication?		
	a. Never/rarely		
	b. Several times		
	c. Sometimes		
	d. Often		
	e. Always		

Write: Yes (if selected: b/c/d/e); No (if selected: a)

- *Bivariate test*

Pearson Product Moment correlation statistical test was conducted to examine the relationship between the variables at a significance level of 95% or $\alpha \leq 0.05$. This test analyzed the independent (knowledge about pulmonary tuberculosis) and the dependent variable (adherence to taking ATD). Furthermore, conclusions can be drawn based on the analysis results.

RESULTS

Characteristics of respondents

Respondents were patients with pulmonary tuberculosis subjected to active treatment at the Umbulharjo 1 Public Health Center, Yogyakarta, consisting of 43 people. From all existing respondents, a demographic description regarding the characteristics was obtained. In this study, the characteristics discussed include age, education, gender, and occupation, as shown in Table 3.

Based on the demographic data, most respondents (17 people or 39.53%) were

17-25 years old. The education level was Senior High School with a percentage of 37.2%. The data above showed that most respondents (26 people or 60.5%) were female, while 17 (39.5%) were male. Among respondents with pulmonary tuberculosis, 12 (27.9%) worked, and 31 (72.1%) did not. A detail of the respondent's characteristics is shown in Table 3.

Knowledge level

The patients' knowledge level about pulmonary tuberculosis was classified into three categories, namely high ($\geq 75\%$), moderate (55-75%), and low ($\leq 55\%$). The results showed that 38 (88.37%), 5 (11.63%), and 0% respondents had high, moderate, and low knowledge. Patients must be educated and knowledgeable about their disease and treatment method. The results of descriptive statistics of knowledge level are shown in Table 4.

Adherence

The medication adherence was classified into 3 categories, namely high ($\geq 75\%$), moderate (55-75%), and low ($\leq 55\%$).

Meanwhile, 37 (86.05%), 6 (13.95%), and 0% had high, moderate, and low adherence at the Umbulharjo 1 Public Health Center, Yogyakarta. The results of descriptive statistics of medication adherence are shown in Table 5.

Relationship between patients' knowledge and medication adherence

The following results are obtained from data analysis using Pearson Moment Product with SPSS for windows version 15.0 program and 95% confidence level or $\alpha: 0.05$. The results show a p-value of 0.001 (< 0.05) and a correlation value (r) of 0.609, shown in Table 6, which means that the knowledge level has a strong correlation with adherence to taking ATD. Based on the hypothesis, 38 (88.37%) and 37 respondents (86.05%) had high knowledge and medication adherence.

DISCUSSION

This study aimed to describe the knowledge level and adherence to anti-tuberculosis drugs and analyze the relationship between the two variables. The population was patients subjected to active treatment at the Umbulharjo 1 Public Health Center, Yogyakarta. The sample was taken using the purposive sampling method, and the data was taken through a questionnaire directly. From the data collection, the results obtained were 43 respondents.

Most respondents diagnosed with pulmonary tuberculosis (17 people or 40.5%) were aged 17-25 (productive). According to the National Population and Family Planning Agency (2013), residents of productive age are between 15 and 59 years.¹⁶ Residents of productive age tend to have more interactions outside the home and have a higher rate of contracting tuberculosis. There is a strong suspicion that age is associated with the development of cases. It is in line with Kanmani et al. (2021) that tuberculosis, on average, occurs at a productive age due to the many activities outside the home and work environment.¹⁷

The analysis results showed that respondents with an education level of Elementary School, Junior High School, Senior High School, and Undergraduate were 5 (11.6%), 13 (30.2%), 16 (37.2%), and 9 (20.9%), respectively. The highest

percentage is in respondents with a Senior High School education level. Kaaffah et al. (2021) stated that people with higher levels of education have 1.185 times more

Table 3. Demographic information of study participants (n=43).

Demographics	n (%)
Gender	
• Male	17 (39.5)
• Female	26 (60.5)
Age	
• 17-25	17 (39.5)
• 26-35	9 (20.9)
• 36-45	8 (18.6)
• >45	9 (20.9)
Education	
• Elementary School	5 (11.6)
• Junior High School	13 (30.2)
• Senior High School	16 (37.2)
• Undergraduate	9 (20.9)
Occupation	
• Employed	12 (27.9)
• Unemployed	31 (72.1)

Table 4. Results of descriptive statistics of knowledge level (n=43).

No	Knowledge Levels	n(%)
1	High	38 (88.37)
2	Moderate	5 (11.63)
3	Low	0 (0)
	Total	43 (100)

Table 5. Results of descriptive statistics of medication adherence (n=43).

No	Knowledge Levels	n(%)
1	High	37 (86.05)
2	Moderate	6 (13.95)
3	Low	0 (0)
	Total	43 (100)

Table 6. Relationship between patients' knowledge and medication adherence.

Variable	P-Value	Correlation Value (r)
Knowledge Level		
Adherence to taking ATD	0.001	0.609

adherence relationships.¹⁸ According to Ayllón (2019), higher education levels are more informative and knowledgeable.¹⁹ A lack of education will hinder the development of one's attitude toward newly introduced values. The relationship between education and knowledge about tuberculosis and its impact on medication adherence varies.

Women are more susceptible to tuberculosis than men because they are mostly passive smokers. In theory, passive smoking is more dangerous than active, and most women seek treatment at the Umbulharjo 1 Public Health Center in the surrounding area smoke. According to Tahseen et al. in 2020, gender differences affect tuberculosis incidence in the detection, diagnosis, and treatment process.²⁰ It is consistent with Moyo (2022) in South Africa, which stated that 55% of patients with pulmonary tuberculosis were women, mostly homemakers.²¹

Among respondents with pulmonary tuberculosis, 12 people worked (27.9%), and 31 did not work (72.1%). These results indicate that the percentage of respondents who do not work is high. Adults are susceptible to tuberculosis, and one of the causes is the factor of their work activities, which expose them to many tuberculosis sufferers. Moreover, workers are prone to fatigue, which can cause decreased immunity, and are susceptible to infection.⁴ According to Rathnayake et al. (2021), patients who do not work have a higher knowledge level and more time to get information from health workers and neighbors.²²

Adherence to the ATD treatment regimen plays a very important role in the healing process of pulmonary tuberculosis for complete recovery. It is strongly influenced by knowledge and attitude to adapt to change by managing and taking the time and opportunity needed. It occurs when the rules for the use and administration of prescribed drugs are followed correctly. Some of the reasons that make patients stop taking

medication are (1) boredom from taking long treatment, (2) patients feel healthy after receiving treatment for some time and then stop, (3) lack of knowledge about pulmonary tuberculosis, (4) far distance between the patients' house and the Public Health Center. This study found a statistically significant relationship between knowledge level and adherence to ATD. The knowledge about pulmonary tuberculosis is directly proportional to the awareness of treatment. In this case, pulmonary tuberculosis patients with good knowledge have awareness and a positive perspective about the importance of undergoing regular treatment to completion, which will result in optimal recovery.²³

Knowledge of pulmonary tuberculosis plays an important role in the patient's recovery process. Non-adherence to the treatment regimen for six months causes resistance to anti-tuberculosis drugs and increases the source of pulmonary tuberculosis transmission. Furthermore, Orok et al. (2022) found a relationship between knowledge and medication adherence. Respondents with good knowledge were 5,833 times more likely to adhere to taking medication compared to those with poor or less knowledge.²⁴

One factor determining the success of treatment is the patients' knowledge and attitude about the mode of transmission and treatment of pulmonary tuberculosis. Therefore, patients have awareness and adherence to take ATD in the pulmonary tuberculosis treatment program.

Further studies are suggested to analyze other factors influencing medication adherence in pulmonary tuberculosis patients to optimize therapy, such as respondent characteristics, including age, education level, occupation, and gender. In addition, professional healthcare practitioners must provide information about the importance of knowing the patients' medication adherence to obtain optimal results.

Limitations of the study

During the implementation, scientific procedures were conducted, but they still had limitations. Therefore, further studies are expected to improve and develop the results, and the limitations are (1)

Some patients asked to be represented by their family members in filling out the questionnaire. Therefore, obtaining real patient results regarding their knowledge level and adherence took much work; and (2) It was not easy to communicate freely due to the crowded waiting room at the Public Health Center where the study was conducted.

CONCLUSION

The knowledge level of pulmonary tuberculosis patients strongly and significantly correlates with medication adherence.

ACKNOWLEDGMENTS

The authors would like to thank the Department of Pharmaceutical Management, School of Pharmacy, Universitas Muhammadiyah Yogyakarta, Indonesia.

AUTHOR CONTRIBUTION

All authors contributed to this study's conception and design, data analysis and interpretation, article drafting, critical revision, final approval, and data collection.

FUNDING

This research received no specific grant from public, commercial, or not-for-profit funding agencies.

CONFLICT OF INTEREST

All authors declare no conflicts of interest.

ETHICAL CONSIDERATION

This study was officially approved by the Research Ethics Committee (KEPK) of the Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta (Number 026/EC-KEPK FKIK UMY/I/2022).

REFERENCES

- Du L, Chen X, Zhu X, Zhang Y, Wu R, Xu J, et al. Determinants of Medication Adherence for Pulmonary Tuberculosis Patients During Continuation Phase in Dalian, Northeast China. *Patient Prefer Adherence*. 2020;14:1119–28. Available from: <https://pubmed.ncbi.nlm.nih.gov/32753852>
- Fang EF, Xie C, Schenkel JA, Wu C, Long Q, Cui H, et al. A research agenda for ageing in China in the 21st century (2nd edition): Focusing on basic and translational research, long-term care, policy and social networks. *Ageing Res Rev*. 2020;64:101174. Available from: <https://pubmed.ncbi.nlm.nih.gov/32971255>
- Kim K, Kim B, Chung AJ, Kwon K, Choi E, Nah J. Algorithm and System for improving the medication adherence of tuberculosis patients [Internet]. 2018 International Conference on Information and Communication Technology Convergence (ICTC). IEEE; 2018. Available from: <http://dx.doi.org/10.1109/ictc.2018.8539402>
- Thi AM, Zimmerman C, Pocock NS, Chan CW, Ranganathan M. Child Domestic Work, Violence, and Health Outcomes: A Rapid Systematic Review. *Int J Environ Res Public Health*. 2021;19(1):427. Available from: <https://pubmed.ncbi.nlm.nih.gov/35010705>
- Watermeyer J, Penn C. Community perspectives on tuberculosis care in rural South Africa. *Heal & Soc Care Community*. 2018;27(1):182–90. Available from: <http://dx.doi.org/10.1111/hsc.12637>
- Liu H, Salem Y, Aggarwal S. Effects of Tai Chi on biomarkers and their implication to neurorehabilitation – a systemic review. *Eur J Integr Med*. 2022;50:101391. Available from: <http://dx.doi.org/10.1016/j.eujim.2021.101391>
- M'imunya JM, Kreda T, Volmink J. Patient education and counselling for promoting adherence to treatment for tuberculosis. *Cochrane database Syst Rev*. 2012;2012(5):CD006591–CD006591. Available from: <https://pubmed.ncbi.nlm.nih.gov/22592714>
- Sahile Z, Yared A, Kaba M. Patients' experiences and perceptions on associates of TB treatment adherence: a qualitative study on DOTS service in public health centers in Addis Ababa, Ethiopia. *BMC Public Health*. 2018;18(1):462. Available from: <https://pubmed.ncbi.nlm.nih.gov/29631558>
- Sari YS, Kamil H, Marthoenis. The patient with multi-drug resistant – Pulmonary tuberculosis adherence to treatment: A qualitative study. *Enfermería Clínica*. 2022;32:S58–61. Available from: <http://dx.doi.org/10.1016/j.enfcli.2022.03.019>
- Kurniawati A, Padmawati RS, Mahendradhata Y. Acceptability of mandatory tuberculosis notification among private practitioners in Yogyakarta, Indonesia. *BMC Res Notes*. 2019;12(1):543. Available from: <https://pubmed.ncbi.nlm.nih.gov/31455388>
- Saktiawati AMI, Subronto YW, Stienstra Y, Sumardi, Supit F, van der Werf TS. Sensitivity and specificity of routine diagnostic work-up for tuberculosis in lung clinics in Yogyakarta, Indonesia: a cohort study. *BMC Public Health*. 2019;19(1):363. Available from: <https://pubmed.ncbi.nlm.nih.gov/30940123>
- Soewondo W, Kusumaningrum CS, Hanafi M, Adiputri A, Hayuningrat PK. Co-existing active pulmonary tuberculosis with aspergilloma in a diabetic patient: A rare case report. *Radiol case reports*. 2022;17(4):1136–42. Available from: <https://pubmed.ncbi.nlm.nih.gov/35169416>
- Fournet N, Mollema L, Ruijs WL, Harmsen IA, Keck F, Durand JY, et al. Under-vaccinated groups in Europe and their beliefs, attitudes and reasons for non-vaccination; two systematic reviews. *BMC Public Health*. 2018;18(1):196. Available from: <https://pubmed.ncbi.nlm.nih.gov/29378545>
- Erlich JR, To EE, Liang S, Brooks R, Vlahos R, O'Leary JJ, et al. Targeting Evolutionary Conserved Oxidative Stress and Immunometabolic Pathways for the Treatment of Respiratory Infectious Diseases. *Antioxid Redox Signal*. 2020;32(13):993–1013. Available from: <https://pubmed.ncbi.nlm.nih.gov/32008371>
- Martinez-Perez P, Orozco-Bletrán D, Pomares-Gomez F, Hernández-Rizo JL, Borrás-Gallen A, Gil-Guillen VF, et al. Validation and psychometric properties of the 8-item Morisky Medication Adherence Scale (MMAS-8) in type 2 diabetes patients in Spain. *Aten primaria*. 2021/01/25. 2021;53(2):101942. Available from: <https://pubmed.ncbi.nlm.nih.gov/33508739>
- Amran Y, Nasir NM, Dachlia D, Yelda F, Utomo B, Ariawan I, et al. Perceptions of Contraception and Patterns of Switching Contraceptive Methods Among Family-planning Acceptors in West Nusa Tenggara, Indonesia. *J Prev Med Public Health*. 2019/07/19. 2019;52(4):258–64. Available from: <https://pubmed.ncbi.nlm.nih.gov/31390689>
- Kanmani S, Logaraj M, John R, Arumai MM. Is economic burden still a problem among the patients with tuberculosis - A cost analysis: A descriptive cross-sectional study in Tamil Nadu. *Indian J Tuberc*. 2021; Available from: <http://dx.doi.org/10.1016/j.ijtb.2021.09.006>
- Kaaffah S, Soewondo P, Riyadina W, Renaldi FS, Sauriasari R. Adherence to Treatment and Glycemic Control in Patients with Type 2 Diabetes Mellitus: A 4-Year Follow-up PTM Bogor Cohort Study, Indonesia. *Patient Prefer Adherence*. 2021;15:2467–77. Available from: <https://pubmed.ncbi.nlm.nih.gov/34803376>
- Ayllón S, Alsina Á, Colomer J. Teachers' involvement and students' self-efficacy: Keys to achievement in higher education. *PLoS One*. 2019;14(5):e0216865–e0216865. Available from: <https://pubmed.ncbi.nlm.nih.gov/31125346>
- Tahseen S, Khanzada FM, Baloch AQ, Abbas Q, Bhutto MM, Alizai AW, et al. Extrapulmonary tuberculosis in Pakistan- A nation-wide multicenter retrospective study. *PLoS One*. 2020;15(4):e0232134–e0232134. Available from: <https://pubmed.ncbi.nlm.nih.gov/32343714>
- Moyo S, Ismail F, Van der Walt M, Ismail N, Mkhondo N, Dlamini S, et al. Prevalence of bacteriologically confirmed pulmonary tuberculosis in South Africa, 2017–19: a multistage, cluster-based, cross-sectional survey. *Lancet Infect Dis*. 2022/05/17. 2022;22(8):1172–80. Available from: <https://pubmed.ncbi.nlm.nih.gov/35594897>

22. Rathnayake S, Dasanayake D, Maithreepala SD, Ekanayake R, Basnayake PL. Nurses' perspectives of taking care of patients with Coronavirus disease 2019: A phenomenological study. *PLoS One*. 2021;16(9):e0257064–e0257064. Available from: <https://pubmed.ncbi.nlm.nih.gov/34478482>
23. Dumpeti S, Jothula KY, Naidu NK. Awareness about tuberculosis and RNTCP services among rural people in Nalgonda district, Telangana. *J Fam Med Prim care*. 2020;9(7):3281–7. Available from: <https://pubmed.ncbi.nlm.nih.gov/33102284>
24. Orok E, Ndem E, Daniel E. Knowledge, attitude and perception of medical students on COVID-19 vaccines: A study carried out in a Nigerian University. *Front public Heal*.

2022;10:942283. Available from: <https://pubmed.ncbi.nlm.nih.gov/36211686>



This work is licensed under a Creative Commons Attribution