



## Original Research

# The Relationship between Knowledge and Medication Compliance Behavior among Patients with Tuberculosis

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### Abstract

Tuberculosis (TB) remains the highest priority among infectious diseases in the world today with increasing morbidity and mortality every year. Adherence to treatment plays an important role in the success of therapy among TB patients. This study aims to explore the relationship between demographic characteristics, knowledge, and medication compliance behavior among patients with tuberculosis in Indonesia. This study was descriptive correlational and cross-sectional design with the total sample was 150 tuberculosis confirmed in Medan Pulmonary Hospital, Indonesia. In this study found that there is a significant relationship between ethnicity and medication adherence (continues variable) with  $p = 0.01$ . Meanwhile when medication compliance behavior was treated as categorical variables, a significant relationship was found between medication compliance behavior and medical history ( $p = 0.03$ ), smoking ( $p = 0.005$ ), and alcohol ( $p = 0.03$ ) among tuberculosis patients in Indonesia. In the multivariate analysis, multiple linear regression was performed which surprisingly shows that education was significantly associated with knowledge of TB ( $p = 0,02$ ), and ethnicity (0.04).

## INTRODUCTION

The World Health Organization (WHO) ranks tuberculosis as the top priority among infectious diseases in the world today. According to WHO data, in 2018, tuberculosis was among the top 15 death by cause with over one million patients.<sup>28</sup> Globally, in 2016, the estimated incidence of tuberculosis was 10.4 million cases, equivalent to 120 per 100,000 persons. In recent decades, the countries with the highest incidence of tuberculosis are India, China, Indonesia, Nigeria, and Pakistan, in that order. Nationally, in Indonesia, the number of new cases of tuberculosis

reached 420,994 in 2018, with a prevalence rate of 297/100,000 and an incidence rate of 403/100,000 people. In 2017 there were more than 1,000 reported deaths from tuberculosis in Indonesia, which means 189 deaths per 100,000 persons. There were 3 cases among men for every 1 woman newly diagnosed with the disease.<sup>6</sup>

Several studies show that knowledge about the disease is a significant factor in its spread and distribution. In Indonesia, one factor that causes the high incidence of tuberculosis is the public's lack of knowledge about the causes, signs, symptoms, transmission, and treatments of

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tuberculosis infection.<sup>6</sup> A study in Tanzania showed that many TB patients there believe tuberculosis is caused by heredity, punishment from God, and spread by white people.<sup>19</sup> However, a study in the United State revealed that sufficient knowledge can lead to good attitudes and behaviour for managing the disease and helping to control its spread in the community. Furthermore, worldwide, studies have shown that providing patients with adequate knowledge about tuberculosis can significantly improve their treatment adherence, as found by a study done in Ethiopia and studies elsewhere.<sup>14, 17, 18</sup> Similarly, a study in Malawi found that TB patients' treatment-seeking behaviour is influenced by their level of knowledge about the disease.<sup>19</sup> Likewise, a study in Indonesia concluded that knowledge about tuberculosis and risk perception about the disease affects health-care-seeking behavior.<sup>20</sup>

Adherence to treatment plays an important role in the success of therapy. Webb and her colleagues state that compliance as personal actions to promote wellness, recovery, and rehabilitation recommended by a health professional.<sup>27</sup> Compliance behaviour can also be interpreted as the extent to which the patient acts according to advice from a health care provider. Compliance behaviour is a major factor in the successful treatment of tuberculosis patients in particular. Many studies have shown that patients in various countries stop TB treatment for various reasons. One study in India revealed that most non-compliant behaviours were caused by lack of knowledge and awareness of the disease, as well as low motivation during therapy.<sup>23</sup> Similarly, a study in Nepal also concluded that patients' treatment adherence is associated with their knowledge and perceptions of tuberculosis and its treatment.<sup>15</sup>

The number of tuberculosis patients is still high in Indonesia and the prevalence rate stands as the third-highest in the world.

There are many patients already suffering and dying from the complications of the disease. Some important factors are believed to control the spread of infection. For instance, promoting knowledge through health education can increase adherence to tuberculosis treatment. With adequate knowledge, many patients with tuberculosis will become more compliant and complete treatment. Previously, some studies in Indonesia have investigated knowledge and compliance behaviour in tuberculosis patients. Unfortunately, most of the studies only focused on rehabilitation of adult patients and adolescents and prevention training for health workers and medical students. However, studies emphasizing awareness about tuberculosis and adherence to treatment are still needed. This study will contribute significantly to describing the state of knowledge about the disease and compliance behaviour among tuberculosis patients in Indonesia.

## METHODS

This study was a descriptive correlational and cross-sectional design to identify significant variables and to examine the relationship between them, including demographic data, knowledge of tuberculosis, and medication compliance behaviour.

This study used a convenient sampling technique to collect data. A total of 150 participants diagnosed with tuberculosis from chest outpatient clinic, Medan pulmonary hospital. The Data was collected by using a questionnaire from The Tuberculosis Knowledge Questionnaire Developed by Dr Lock (2011) consisting of 14 question items. As for medication adherence, using the Medication Adherence Scale consisting of 8 question items developed by Hayati (2011).

The inclusion criteria in this study were male or female aged  $\geq 18$  years old, diagnosed with tuberculosis (Acid-Fast Bacilli or Thorax Rontgen) by a specialist

physician, received TB drug therapy at least one month, and agreed to participate by signing an informed consent form. Exclusion criteria are patients who have met the inclusion criteria but those who have failed in first TB treatment, and those who were foreigners.

The data collection was performed from July to August 2019. After IRB was approved and get permission, the data collection began with patients with positive tuberculosis diagnoses who were visiting for routine checkups. If agreed to participate the researcher has to be explaining the procedures, purpose, and give informed consent. After participants went through these steps, the data collection started using the questionnaire by performing face-to-face interviews.

The analysis was done descriptively by describing the patient's characteristics. In the univariate analysis, the researcher used the Pearson correlation, one-way ANOVA, t-test, and chi-square to find the relationship between the variables. The medication compliance behaviour variables were performed two times with different model (categorical and continues). In the multivariate analysis, the researcher used multiple linear regression to find which factors were the most associated with medication compliance behaviour and tuberculosis knowledge.

Data were collected after obtaining approval from IRB NTUNHS, department of health North Sumatera, Indonesia, and the University of North Sumatera with the approval number was 1826/VII/SP/2019.

## RESULTS

### ***Descriptive Statistic of the population, Tuberculosis Knowledge and Medication Compliance Behavior***

The result showed that the age of participants in this study ranged from 18-78 years old with the mean age score was 40.03

(SD = 16.21). The majority of participants were men (n = 87, 58%), married (n = 75, 50%) and lived in the rural area (n = 94, 62.7%). A large number of participants graduated from senior high school (n= 67, 44.7%), and belongs to the Batak ethnic (n = 57, 38.0%). Over three-quarters of participants stated that they had heard about tuberculosis before (n = 115, 76.7%). Almost two-thirds of the participants revealed that they had a family history of tuberculosis (n = 96, 64.0%), and over one-third said they did not (n = 54, 36%). The great majority of participants stated that they received support from family for carrying out self-care (n = 138, 92.0%), with a smaller number saying they received such support from friends (n = 6, 4.0%), and health workers (n = 5, 3.3%). Regarding living arrangements, a large majority lived with family (n = 138, 92.0%), and a much smaller number lived alone (n = 9, 6.0%), with the rest residing in geriatric homes (n = 3, 2.0%). As for participants' occupations, 2.7% were farmers, 2% were fishermen, 24% were entrepreneurs, 5.3% were civil servants, 37.3% were unemployed, 2% of the participants were retired, and 27% had a mix of other occupations. Interestingly, well over half of the participants stated that they did not have a medical history of long-term disease such as diabetes or tuberculosis (n = 91, 60.7%), and ironically, 33% of them were still smoking while taking medication, and 16.7% were still drinking alcohol while on medication.

The descriptive statistics were shown in table 1 for the tuberculosis knowledge scale and medical compliance behaviour among patients with tuberculosis. On the tuberculosis questionnaire, possible scores ranged from 0 (minimum) to 14 (maximum). The mean score on tuberculosis knowledge was 8.67 (SD = 2.10), ranging from 1 to 13. Among participants, the mean score on medication compliance behaviour was 6.91 (SD = 1.09) ranging from 4 to 8. On this questionnaire, a score of eight is considered compliant; whereas a score less than eight is

considered noncompliant. In this questionnaire score, 8 is considered compliance; whereas scoring <8 is considered incompliance.

Table 1  
Descriptive statistic of the scale

Scale	M	SD	Min	Max
Tuberculosis Knowledge	8.67	2.10	1.00	13.00
The Medication Adherence	6.91	1.09	4.00	8.00

***The relationship between demographic characteristics to medication compliance behaviour (Continues variable).***

Table 2  
Characteristics of the participants

Variables	n	M ± SD	t/F/r	p
Age		40.03 ± 16.21	-0.05 <sup>c</sup>	.57
Gender			-1.45 <sup>b</sup>	.15
Male	87	6.80 ± 1.12		
Female	63	7.06 ± 1.03		
Education			0.24 <sup>a</sup>	.96
Never	1	6.00 ± 0.00		
Elementary	22	6.82 ± 1.30		
Junior Secondary School	34	6.97 ± 1.11		
Senior Secondary School	67	6.90 ± 1.12		
Collage	4	7.00 ± 0.82		
University	19	6.95 ± 0.85		
Master	3	7.33 ± 0.58		
Ethnicity			2.54 <sup>a</sup>	.01*
(1) Java	50	7.06 ± 1.00		1>9 <sup>d</sup>
(2) Batak	57	6.93 ± 1.10		2>9 <sup>d</sup>
(3) Chinese	2	8.00 ± 0.00		
(4) Mandailing	10	6.60 ± 0.97		
(5) Minangkabau	4	7.50 ± 0.58		
(6) Melayu	8	6.63 ± 0.92		
(7) Karo	9	7.00 ± 1.00		
(8) Aceh	2	8.00 ± 0.00		
(9) Others	8	5.63 ± 1.41		
(10) Geriatric home	3	7.00 ± 1.00		

***The relationship between demographic characteristics to medication compliance behaviour (Categorical variable).***

Another variable that showed significant relationship were medical history ( $\chi^2 = 4.63$ ,

The following table revealed how demographic characteristic associated with medication compliance behaviour (continues variables) among TB patients in Indonesia. The result showed that ethnicity had a significant relationship with medication adherence ( $F = 2.54$ ,  $p = 0.01$ ). A Tukey post hoc test found that the Javanese (1) and the Batak (2) had better adherence than others (9). Meanwhile, another variable including age, gender, and education had no significant relationship with medication adherence among TB patients in Indonesia.

$p = 0.03$ ). The result showed that patients with the previous medical history of chronic disease that require long term medication had better adherence in treatment compared to new patients. Similarly, there was a significant association between

smoking and treatment adherence among TB patients in Indonesia ( $\chi^2 = 7.72$ ,  $p = 0.005$ ). Likewise, alcohol showed significant relationship with adherence patients in medication ( $\chi^2 = 4.91$ ,  $p = 0.03$ ).

Table 3  
The relationship between demographic characteristics to medication compliance behaviour

Variables	Medication compliance behaviour		$t/\chi^2$	$p$
	Incompliance $n$ (%)	Compliance $n$ (%)		
Medical history			4.6 3 <sup>b</sup>	.03*
Yes	32 (32.99)	27 (50.94)		
No	65 (67.01)	26 (49.06)		
Smoking			7.7 2 <sup>b</sup>	.005 **
Yes	40 (41.24)	10 (18.87)		
No	57 (58.76)	43 (81.13)		
Alcohol			4.9 1 <sup>b</sup>	.03*
Yes	21 (21.65)	4 (7.55)		
No	76 (78.35)	49 (92.45)		

### ***Factors predictors of tuberculosis knowledge and medication compliance behaviour***

Multiple linear regression was conducted to determine the most linear combination of sub-variables in demographic characteristics both knowledge of TB and treatment adherence. Two predictors variables including education and ethnicity had a significant result with  $p = 0.02$ , and  $p = 0.04$ .

## **DISCUSSION**

### ***Descriptive Statistics of the Study Population, tuberculosis knowledge, and medication compliance behaviour***

The age of participants ranged from 18 to 78 years old with a mean age of 40.03 (SD = 16.21), which means that the participants, on average, were still young and productive. This is similar to subjects in a

study by Dotulong et al. (2015) which observed that patients from 15 to 55 years old had high mobility and outdoor activity, so their potential exposure to pulmonary Mycobacterium tuberculosis was also high. Subjects in another study done in Indonesia also had similar characteristics, with the mean age of TB patients 40 years old.<sup>2</sup> Likewise, a majority of TB patients in a study done in Nepal were between 35 and 54 years old.<sup>15</sup> The similarity of those study characteristics might be contributed by the socioeconomic factors and study design.

The gender breakdown of participants in this study—87 males (58%) and 63 females (42%)—was similar to that of a study conducted by Ratnasari and Nurtanty (2018) in her research about TB in Indonesia which found that men with tuberculosis were more numerous than women, probably due to heavier workloads, insufficient rest, and unhealthy habits, such as smoking and drinking.<sup>22</sup> In Ethiopia, TB patients were more common among men than women.<sup>1</sup>

As for the education background of participants in the current study, most participants (44.7%) graduated from senior high school, 22.7% graduated from junior high school, 14.7% only finish in elementary, 12.7% reached until university, 2.7% finish in college, and only 0.7% do not have formal education. This characteristic is similar to participants in a study conducted in another part in Nigeria.<sup>25</sup> The fact that most TB participants graduated from senior high school among those countries is probably because of the socioeconomic status where not all people can afford to continue to study at the university level.

In this study, most participants' ethnicity was Batak ( $n = 57$ , 38%). Half of the participants in this study were married ( $n = 75$ ) and 62.7% ( $n = 94$ ) lived in rural areas. Just over three-quarters of participants also stated that they had heard of tuberculosis before being diagnosed (76.7%,  $n = 115$ ),

and 64% had no family history of tuberculosis (n = 96).

***The relationship between demographic characteristics to medication compliance behaviour (Continues variable).***

The study found that ethnicity had a significant relation ( $p = 0.01$  or less than 0.05) with treatment adherence among tuberculosis patients in Indonesia. The posthoc test result showed that both the Javanese and the Batak ethnicity were more compliant compared to the category of others. Others here refers to ethnic groups with only one or two members represented in the data collected, such as the Ambonese, the Buginese (people from the South-Sulawesi tribe), or the Sundanese (people from West Java). The different levels of treatment adherence among ethnicities in Indonesia might be attributed to unequal access to health information across the country or to differences in cultural beliefs that affect individual points of viewpoint regarding Western-style medication.

This finding is similar to findings of studies in other countries that found differences in medication adherence between ethnic groups. For example, in the United States, numerous studies have demonstrated differences in medication adherence between ethnic groups as well as identifying a range of reasons for them. Some studies conducted in the U.S. that explored race and ethnicity with adherence to prescription medication among seniors revealed that Blacks and Hispanics were less likely to adhere to treatment compared to whites. This is one of the reasons why Blacks are more likely to die from heart disease than any other U.S ethnic group and Hispanic Americans have twice the mortality from diabetes compared to whites.<sup>9, 10</sup> Likewise, one literature review which explored medication adherence to oral hypoglycemic agents among diabetes patients in different ethnic groups reported that Filipinos had poorer medication adherence, while blacks were less adherent to medication

treatment, compared to whites.<sup>21</sup> Although little research had done on differences between ethnicities in Indonesia due to the political sensitivity of the topic, it seems likely that there are economic and educational differences between groups. Moreover, access to medical care may be affected by geographic factors as medical professionals tend to be concentrated in urban areas, but some ethnicities live primarily in rural areas.

***The relationship between demographic characteristics to medication compliance behaviour (Categorical variable).***

This section will show another study finding form different model of medication compliance behaviour. In the previous section, the medication compliance variable was treated as a continuous variable. However, in this part, the variable will be treated as categorical.

This study found that the medical history of chronic illness was significantly associated with medication adherence of tuberculosis patients in Indonesia. The study result showed that TB patients with a history of long-term disease with long-term treatment tend to be more compliant compared to TB patients without a medical history. The experience of long-term medication train patients to be more discipline in medication timing, dosage, and duration. This result is similar to studies from some countries. A study by Urata and colleagues about the impact of diabetes perception on medication adherence among diabetes patients in Japan found that patients with long-term medication history were consistently had greater adherence than patients without medication history, had a higher percentage of recovery and had low percentage of failing in treatment.<sup>26</sup> Similarly, a study by Choi found that having experience of TB treatment was associated with good medication adherence among TB patients in Korea.<sup>4</sup>

A similar result also showed that smoking was significantly associated with medical compliance behaviour. The study result from the bivariate analysis shows that the  $p$ -value was 0.005 which means that participants who were smoking will be more likely to have poor adherence. This finding is similar to a study from the U.S identifying factor predictors of medication adherence and smoking cessation among smokers found that active smoking was significantly associated with poor adherence among tuberculosis patients.<sup>5</sup>

This study found that alcohol use had a significant relationship with medication compliance behaviour among tuberculosis patients in Indonesia. The finding of the study shows the small number of alcohol use among participants ( $n = 25, 16.7\%$ ). The  $p$ -value was 0.03 indicating that patients with no alcohol consumption tend to be more compliant. Some studies around the world have similar results. For example, a study in Nigeria found that alcoholic use among TB patients had poor treatment adherence such as forget medication timing, hospital appointment, and which lead to interruption and non-adherence behaviour.<sup>13</sup> Similarly, a study in Uzbekistan investigating the factor that makes patients default in tuberculosis treatment and poor adherence found that the high percentage of defaulter was patients with alcohol use.<sup>11</sup>

### ***Factor Predictor of Medication Compliance Behavior***

As illustrated in the result found that education was statistically significant and indicating the most powerful factor in tuberculosis knowledge of patients. The standardized coefficients showed  $\beta = 0.22$  and the  $p$ -value was  $p = 0.02$ . The unstandardized coefficient of the variable of education was  $\beta = 0.36$  indicating that patients who have a high level of education were more likely to have a high of tuberculosis knowledge score. The higher education levels the better tuberculosis

knowledge, and the lower education level of the patients the lower knowledge of tuberculosis patients. Likewise, the result found that ethnicity had statistically significant results compared to other variables and indicating that ethnicity was recognized as predictive factors, as shown in the table, the standardized coefficient was ( $\beta = -0.18, p = 0.04$ ). Moreover, the unstandardized coefficient for the ethnicity was ( $\beta = -0.08$ ) indicating that people from ethnic Java and Batak are more likely to compliance compared to other groups ethnic in Indonesia.

### **CONCLUSION**

Tuberculosis remains the highest priority among infectious diseases in the world today with increasing morbidity and mortality every year (WHO). The purpose of this study was to explore the relationship between knowledge and medication adherence among patients with tuberculosis in Indonesia. This study found that ethnicity had a significant relationship with medication adherence (as a continuous variable). Moreover, a significant was found between medication compliance behaviour and the categorical variables, including the medical history of chronic illness, smoking, and alcohol use. In the univariate analysis, education was significantly associated with tuberculosis knowledge and ethnicity was consistently associated with medication adherence.

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## CONFLICTS OF INTEREST

Neither of the authors has any conflicts of interest that would bias the findings presented here.

## REFERENCES

1. Abebe, G., Deribew, A., Apers, L., Woldemichael, K., Shiffa, J., Tesfaye, M., & Bezabih, M. (2010). Knowledge, health-seeking behaviour and perceived stigma towards tuberculosis among tuberculosis suspects in a rural community in southwest Ethiopia. *Plos One*, 5(10), 1-7. doi:10.1371/journal.pone.0013339
2. Aditama, H. P., & Aris, A. (2013). Hubungan pengetahuan dan motivasi pasien TBC (Tuberculosis) dengan kepatuhan berobat pasien TBC yang berobat di UPT puskesmas Mantup kabupaten Lamongan. *Surya 2* (15), *Agust 2013 Tuberculosis (TB)*. 33-39. [Aditama, H. P., & Aris, A. (2013). The relationship of TBC (Tuberculosis) patients' knowledge and motivation with TB treatment patients who seek treatment at the UPT Pusup Mantup Lamongan regency. *Surya 2* (15), *Agust 2013 Tuberculosis (TB)*. 33-39.]
3. Alikari, V., Tsironi, M., Matziou, V., Tzavella, F., Stathoulis, J., Babatsikou, F., & Zyga, S. (2019). The impact of education on knowledge, adherence and quality of life among patients on haemodialysis. *Quality of Life Research*, 28(1), 73-83. doi:10.1007/s11136-018-1989-y
4. Choi, H., Chung, H., Muntaner, C., Lee, M., Kim, Y., Barry, C., & Cho, S. (2016). The impact of social conditions on patient adherence to pulmonary tuberculosis treatment. *The International Journal of Tuberculosis and Lung Disease*, 20(7), 948-954. doi:10.5588/ijtld.15.0759
5. Cropsey, K. L., Clark, C. B., Stevens, E. N., Schiavon, S., Lahti, A. C., & Hendricks, P. S. (2017). Predictors of medication adherence and smoking cessation among smokers under community corrections supervision. *Addictive Behaviors*, 65, 111-117. doi:10.1016/j.addbeh.2016.10.010
6. DepKes, (2010). *Profil kesehatan indonesia*. Jakarta, Indonesia: Departemen kesehatan Republik Indonesia. [Ministry of Health, (2010). *Indonesian health profile*. Jakarta, Indonesia: Ministry of health of the Republic of Indonesia]
7. Dotulong, J., Sapulete, M. R., & Kandou, G. D. (2015). Hubungan faktor risiko umur, jenis kelamin, dan kepadatan hunian dengan kejadian penyakit TB Paru di Desa Wori Kecamatan Wori. *Jurnal Kedokteran Komunitas dan Tropik*, 3(2), 57-65. [Dotulong, J., Sapulete, M. R., & Kandou, G. D. (2015). The relationship between risk factors for age, sex, and occupancy density with the incidence of pulmonary TB disease in Wori Village, Wori District. *Journal of Community and Tropical Medicine*, 3 (2), 57-65.]
8. Erawatyningsih, E., & Purwanta, H. S. (2009). Faktor-faktor yang mempengaruhi ketidakpatuhan berobat pada penderita tuberkulosis paru. *Berita Kedokteran Masyarakat*, 25(3), 117-124. doi:10.22146/bkm.3558. [Erawatyningsih, E., & Purwanta, H. S. (2009). Factors that influence non-compliance with treatment in patients with pulmonary tuberculosis. *Community Medicine News*, 25 (3), 117-124. doi:10.22146/bkm.3558]
9. Gellad, W. F., Haas, J. S., & Safran, D. G. (2007). Race/ethnicity and nonadherence to prescription medications among seniors: Results of a national study. *Journal of General Internal Medicine*, 22(11), 1572-1578. doi:10.1007/s11606-007-0385-z
10. Gerber, B. S., Cho, Y. I., Arozullah, A. M., & Lee, S. Y. (2010). Racial differences in medication adherence: A cross-sectional study of medicare enrollees. *The American Journal of Geriatric Pharmacotherapy*, 8(2), 136-145. doi:10.1016/j.amjopharm.2010.03.002
11. Hasker, E., Khodjikhonov, M., Usarova, S., Asamidinov, U., Yuldashova, U., van der Werf, M. J., & Veen, J. (2008). Default from tuberculosis treatment in Tashkent, Uzbekistan; Who are these defaulters and why do they default? *BioMed Central Infectious Diseases*, 8(1), 1-7. doi:10.1186/1471-2334-8-97
12. Hayati, A. (2011). Evaluasi kepatuhan berobat penderita tuberkulosis paru tahun 2010-2011 di puskesmas kecamatan pancoran mas depok (unpublished bachelor's thesis), Universitas Indonesia, Jakarta, Indonesia. [Hayati, A. (2011). Evaluation of compliance with pulmonary tuberculosis treatment in 2010-2011 at Pancoran Mas Depok sub-district health center (unpublished bachelor's thesis), University of Indonesia, Jakarta, Indonesia.]
13. Ibrahim, L. M., Hadejia, I. S., Nguku, P., Dankoli, R., Waziri, N. E., Akhimien, M. O., & Nwanyanwu, O. (2014). Factors associated with interruption of treatment among pulmonary tuberculosis patients in Plateau State, Nigeria. 2011. *Pan African Medical Journal*, 17(1), 1-8. doi:10.11604/pamj.2014.17.78.3464
14. Kaona, F. A., Tuba, M., Siziya, S., & Sikaona, L. (2004). An assessment of factors contributing to treatment adherence and knowledge of TB transmission among patients on TB treatment. *BioMed Central Public Health*, 4(1), 1-8. doi:10.1186/1471-2458-4-68

15. Keiwkarnka, B., Sermsri, S., Shiyalap, K., & Nepal, A. K. (2012). Compliance with DOTS among tuberculosis patients under community based DOTS strategy in Palpa District, Nepal. *International Journal of Infection and Microbiology*, 1(1), 14-19. doi:10.3126/ijim.v1i1.6717
16. Lock, W. A., Ahmad, R. A., Ruiter, R. A., van der Werf, M. J., Bos, A. E., Mahendradhata, Y., & de Vlas, S. J. (2011). Patient delay determinants for patients with suspected tuberculosis in Yogyakarta province, Indonesia. *Tropical Medicine & International Health*, 16(12), 1501-1510. doi:10.1111/j.1365-3156.2011.02864.x
17. Martin, L. R., Williams, S. L., Haskard, K. B., & DiMatteo, M. R. (2005). The challenge of patient adherence. *Therapeutics and Clinical Risk Management*, 1(3), 189-199.
18. Munro, S. A., Lewin, S. A., Smith, H. J., Engel, M. E., Fretheim, A., & Volmink, J. (2007). Patient adherence to tuberculosis treatment: A systematic review of qualitative research. *Plos Medicine*, 4(7), e238. 1230-1245.
19. Nyasulu, P., Sikwese, S., Chirwa, T., Makanjee, C., Mmanga, M., Babalola, J. O., & Munthali, A. C. (2018). Knowledge, beliefs, and perceptions of tuberculosis among community members in Ntcheu district, Malawi. *Journal Multidiscipline of Healthcare*, 11, 375-389. doi:10.2147/JMDH.S156949
20. Palupi, D. L. M. (2013). Pengaruh pendidikan kesehatan terhadap perubahan pengetahuan, sikap dan perilaku penderita tuberculosis yang berobat di wilayah kerja puskesmas surakarta. Surakarta, CJ, Indonesia: Sebelas Maret University. [Palupi, D. L. M. (2013). The effect of health education on changes in knowledge, attitudes and behavior of tuberculosis patients who seek treatment in the work area of the Surakarta puskesmas. Surakarta, CJ, Indonesia: Eleven March University.]
21. Peeters, B., Van Tongelen, I., Boussery, K., Mehuys, E., Remon, J. P., & Willems, S. (2011). Factors associated with medication adherence to oral hypoglycaemic agents in different ethnic groups suffering from type 2 diabetes: A systematic literature review and suggestions for further research. *Diabetic Medicine*, 28(3), 262-275.
22. Ratnasari, N. Y., & Nurtanti, S. (2018). Analysis on factors related with treatment behavior of pulmonary tuberculosis patient. *KEMAS: Jurnal Kesehatan Masyarakat*, 14(1), 81-89. doi:10.15294/kemas.v14i1.12518
23. Sakalle, S., Waskel, B., Dixit, S., Pandey, D., Sirohi, S., & Saroshe, S. (2014). A study on patient compliance of tuberculosis enrolled under revised national tuberculosis control programme. *National Journal Community Medicine*, 5, 96-99.
24. Uchenna, O. U., Chukwu, J., Oshi, D., Nwafor, C., & Meka, A. (2014). Assessment of tuberculosis-related knowledge, attitudes and practices in Enugu, South East Nigeria. *Journal of Infectious Diseases and Immunity*, 6(1), 1-9. doi:10.5897/JIDI2011.0020
25. Urata, K., Hashimoto, K., Horiuchi, R., Fukui, K., & Arai, K. (2019). Impact of diabetes perceptions on medication adherence in Japan. *Pharmacy*, 7(4), 1-14. doi:10.3390/pharmacy7040144
26. Webb, C. A., DeRubeis, R. J., & Barber, J. P. (2010). Therapist adherence/competence and treatment outcome: A meta-analytic review. *Journal of Consulting and Clinical Psychology*, 78(2), 200-211. doi.org/10.1037/a0018912
27. WHO. (2018). *Global tuberculosis report 2018*. Geneva, Switzerland: The World Health Organisation.