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The relationship between knowledge level and adherence to anti-tuberculosis treatment at primary health centers (Puskesmas) in Pekalongan city, Central Java, Indonesia

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ABSTRACT

Background: Adherence is one of the most critical factors in the success of pulmonary tuberculosis therapy. Non-compliance of patients taking anti-tuberculosis drug results in a high rate of treatment failure, increasing the risk of disease severity and death.

Objective: This study aims to investigate the impact of knowledge level on patient compliance in taking anti-tubercular medication.

Methods: This observational, cross-sectional study employed a total sampling method. The levels of knowledge and compliance were assessed using a validated questionnaire administered to patients with pulmonary tuberculosis at the Pekalongan City health center (Puskesmas).

Results: Among the 52 participants, 44.23% (n=23) demonstrated a high level of knowledge, and 86.5% (n=45) exhibited good compliance. Spearman correlation test analysis revealed a significant influence of knowledge level on patient compliance in taking antituberculosis drugs (p=0.001, r=0.341), indicating that higher knowledge levels correspond to better patient compliance.

Conclusion: The study suggests that patient compliance with antitubercular medication improves as knowledge level increases.

Keywords: adherence, knowledge, tuberculosis

Introduction

Pulmonary tuberculosis (TB) is an infectious respiratory disease caused by *Mycobacterium tuberculosis*. According to the 2017 World Health Organization (WHO) data, Indonesia ranks third in the world in terms of the prevalence of pulmonary tuberculosis. To combat this disease, the management of pulmonary tuberculosis in Indonesia has been continuously improving to reduce the incidence of tuberculosis and increase the success rate of pulmonary tuberculosis treatment [1]. However, treating pulmonary tuberculosis is a lengthy process, which can affect patient compliance in taking medication to achieve successful treatment therapy.

Several factors can affect patient compliance with taking medication for pulmonary tuberculosis, including the motivation to recover, the role of family support, the drug supervisor's role, the amount of medication taken, and the patient's experience [2]. Failure to adhere to TB treatment regularly and on time can lead to multi-drug-resistant tuberculosis, which is a significant concern in tuberculosis management. Non-compliance with treatment can result in high rates of pulmonary TB treatment failure, leading to an increased risk of morbidity and mortality. This can also cause the emergence of pulmonary TB patients with acid-resistant bacilli that are resistant to standard treatment, further complicating the management of the disease [3].

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A correlation exists between the education level of TB patients and their compliance with treatment [3]. The education level of TB patients can impact their knowledge and understanding of preventing transmission and treating TB. Patients with lower levels of education tend to have lower awareness of the risks associated with TB, both to themselves and to their surroundings. Furthermore, there is a statistically significant relationship between compliance with taking anti-tuberculosis drugs and knowledge, attitudes, and family support (p<0.05) [4]. Additionally, a study conducted at the Delanggu, Klaten Health Center showed that there is a significant relationship (p<0.05) between compliance with medication and the recovery of BTA-positive TB patients [5].

Primary Health Centers (Puskesmas) play a crucial role as the first point of contact for patients managing their TB infection. Puskesmas must establish a system to support patient compliance in regularly taking their medication to achieve the expected therapeutic outcomes. In 2020, the total number of pulmonary TB patients in Pekalongan city was 471, which represents 0.15% of the total population of 313,969 people. Given this situation, this study aimed to investigate the effect of knowledge level on patient compliance with taking anti-tuberculosis drugs at Puskesmas at Pekalongan city. The findings of this study could inform policymakers and health practitioners on how to improve patient education and support to ensure better management of pulmonary tuberculosis at the primary health care level.

Methods
Research design

This study employed an observational research design utilizing a cross-sectional study approach. Data were collected over a one-month period using a total sampling method. Ethical approval was obtained from the Health Research Ethics Commission of the Faculty of Health Sciences, Jenderal Soedirman University Purwokerto, under the number 552/EC/KEPK/X/2021.

Subjects

The study subjects consisted of outpatients seeking treatment at three Puskesmas in Pekalongan City, Central Java, Indonesia: Puskesmas Krapyak Kidul, Puskesmas Kusuma Bangsa, and Puskesmas Dukuh. Participants were required to be aged 18 years or older, diagnosed with pulmonary tuberculosis and undergoing intensive or advanced treatment, and willing to provide informed consent. Patients diagnosed with MDR-TB who did not complete the questionnaire were excluded from this study.

Data were collected from pulmonary tuberculosis patients during visits to Puskesmas from May to October 2021. Information was obtained through direct interviews with participants who met the inclusion criteria and answered questions from the questionnaire. The questionnaires were administered during face-to-face interviews with pulmonary tuberculosis patients visiting the Puskesmas or during home visits, accompanied by pulmonary tuberculosis cadres.

Instrument

The research instrument utilized in this study was a knowledge and compliance questionnaire, consisting of 10 question items, which were administered to participants through interviews. The questionnaire was developed based on previous research [6]. To ensure its validity and reliability, the questionnaire underwent validation and testing processes. Language validation was conducted at the Britannia English Language Institute Purwokerto. Content validation was carried out by two pharmacy lecturers, who evaluated the questionnaire based on their professional judgment.

Furthermore, the construct validity of the questionnaire was assessed by administering it to 30 participants who met the inclusion criteria, using the Pearson product-moment correlation test. It is note that the results were not included in the research data sample, and the trial was conducted at a predetermined research location.

Finally, the reliability of the questionnaire was assessed after validating each question item. The questionnaire's reliability was found to be good, with a Cronbach Alpha value > 0.6.

Data analysis

The data obtained from the study were analyzed using univariate and bivariate statistical tests. The univariate analysis aimed to determine the percentage of knowledge and compliance with antituberculosis drugs among patients with pulmonary tuberculosis. The level of knowledge and patient compliance with therapy were presented in tabular form and explained descriptively.

The participants' knowledge level was categorized into three, based on the mean value, subject score (x), and standard deviation (SD): high (x > (mean+1SD)),

Table 1. Characteristics of research subjects

No.	Characteristics	Total (n=52)	Percentage (%)
1	**Gender**		
	Male	37	71.1
	Female	15	28.9
2	**Age (years)**		
	18-25	11	21.3
	26-35	12	23.1
	36-45	14	26.9
	>45	15	28.8
3	**Treatment phase**		
	1st month intensive	7	13.4
	2nd month intensive	11	21.1
	3rd month advanced	4	7.7
	4th month advanced	9	17.3
	5th month advanced	12	23.1
	6th month advanced	9	17.3
4	**Education level**		
	Low (no school, elementary, junior high school)	29	55.77
	Secondary (senior high school)	22	42.31
	Higher (D3, S1, S2)	1	1.92
5	**Jobs**		
	Self-employed	6	11.5
	Labor	16	30.7
	Civil servant	1	1.9
	Private employee	16	30.7
	Students	5	9.6
	Housewife	3	5.7
	Not working	5	9.6

medium $((\text{mean}-1SD) \leqslant x \leqslant (\text{mean}+1SD))$, and low $(x < (\text{mean}-1SD))$ knowledge level. The compliance level was determined based on the mean value, with the "good" category assigned if $x \geqslant \text{mean}$ and the "poor" category assigned if $x < \text{mean}$.

Moreover, bivariate analysis was conducted using the Spearman correlation test to investigate the relationship between knowledge of disease and their compliance with anti-tuberculosis drugs. This analysis aimed to determine the effect of knowledge level on patients' compliance with therapy.

Results

Characteristics of subjects

A total of 52 participants participated in this study, with 22 from Puskesmas Krapyak Kidul (42.31%), 15 from Puskesmas Kusuma Bangsa (28.85%), and 15 from Puskesmas Dukuh (28.85%). Among the participants, 37 were men (71.1%) and 15 were women (28.9%). The age of the participants ranged from 18 to 65 years old, with most of them belonging to the productive age group of 18-45 years.

During the phase of pulmonary tuberculosis treatment at the Puskesmas, the majority of patients were in the second month of the intensive treatment stage (n=11; 21.1%) and the fifth month of the advanced treatment phase (n=12; 23.1%). Regarding the education level, most participants had low levels of education, with 29 participants (55.77%) being either uneducated or had only graduated from elementary or junior high school. In terms of occupation, the majority of participants worked as laborers or private employees, with 16 participants (30.7%) each (Table 1).

Overview of participants' knowledge level

Figure 1 provides an overview of the participants' knowledge level about pulmonary tuberculosis disease, presented as the percentage of participants who answered correctly for each question item. The average percentage of correct answers for the knowledge level was 73.04%. The study found that the majority of participants (92.3%) were aware that coughing with phlegm for three weeks, coughing up blood, and weight loss are symptoms of tuberculosis. Additionally,

88.5% of participants knew that regular treatment is necessary to cure tuberculosis, and failing to do so could make the disease difficult to cure. However, the lowest percentage of correct answers was related to the drugs used for tuberculosis treatment, specifically isoniazid, rifampicin, pyrazinamide, and ethambutol (HRZE), with only 21 participants (40.5%) answering correctly.
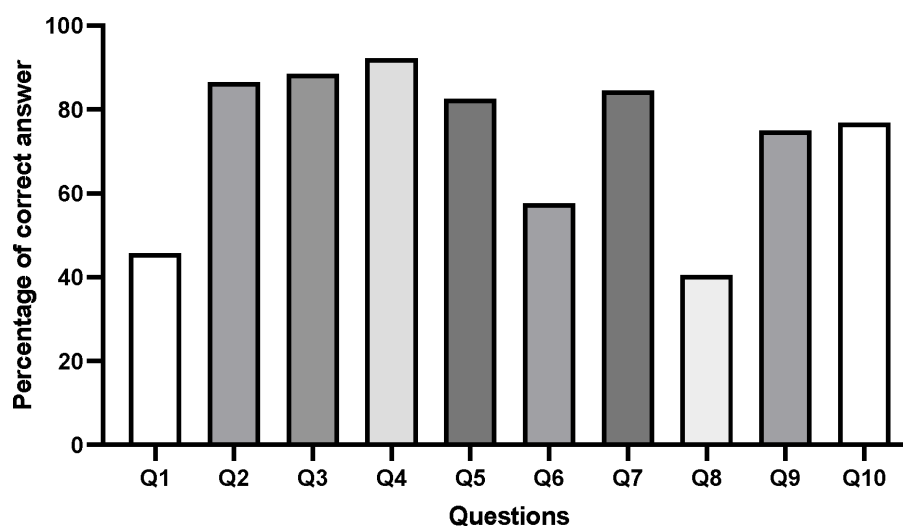
Figure 1. Overview of the knowledge level of pulmonary tuberculosis patients

Question Item

1. Penyakit tuberkulosis (TBC) disebabkan karena bakteri *Mycobacterium tuberculosis*. *(Tuberculosis (TB) is caused by the bacteria Mycobacterium tuberculosis)*

2. Penyakit tuberkulosis dapat disembuhkan jika selama pengobatan Anda rutin meminum obat OAT. *(Tuberculosis can be cured if you take your antitubercular medication regularly during treatment)*

3. Penyakit tuberkulosis akan sulit disembuhkan jika tidak melakukan pengobatan secara rutin. *(Tuberculosis disease will be difficult to cure if you do not take regular treatment)*

4. Batuk berdahak selama tiga minggu, batuk berdarah, dan penurunan berat badan merupakan gejala dari penyakit tuberkulosis paru. *(Coughing with phlegm for three weeks, coughing up blood, and weight loss are symptoms of pulmonary tuberculosis)*

5. Penyakit tuberkulosis bisa menular melalui udara saat bersin, batuk tanpa menutup mulut, menggunakan peralatan makan secara bersamaan, dan berkerumun. *(Tuberculosis can be transmitted through the air when sneezing, coughing without covering your mouth, using utensils together, and crowding)*

6. Penyakit tuberkulosis bisa menular melalui berjabat tangan, bersentuhan, dan hubungan seksual. *(Tuberculosis can be transmitted through handshaking, contact, and sexual intercourse)*

7. Pencegahan penyakit tuberkulosis dapat dilakukan dengan cara penderita menutup mulut saat batuk, dan tidak berhadapan secara langsung pada saat berbicara dengan orang lain. *(Prevention of Tuberculosis disease can be done by the patient covering their mouth when coughing and not facing directly when talking to other people)*

8. Obat yang digunakan untuk pengobatan tuberculosis adalah isoniazid rifampisin, pirazinamid, dan etambutol (RHZE). *(The drugs used to treat tuberculosis are isoniazid, rifampicin, pyrazinamide, and ehambutol (RHZE))*

9. Penyakit tuberculosis memerlukan pengobatan jangka panjang/durasi waktu yang lama minimal 6 bulan. *(Tuberculosis disease requires long-term treatment / long duration of at least six months)*

10. Penggunaan OAT dapat menyebabkan efek samping, salah satunya obat rifampisin dapat menyebabkan air kemih berwarna merah. *(The use of antituberculosis drug can cause side effects, one of which is the drug rifampicin can cause red urine)*

Table 2. Knowledge level of TB patients at Puskesmas at Pekalongan city

Location	Patient knowledge (n)			Total (n)
	High	**Medium**	**Low**	
Puskesmas Krapyak Kidul	10 (45.4%)	6 (27.3%)	6 (27.3%)	22 (42.31%)
Puskesmas Dukuh	7 (46.6%)	5 (33.3%)	3 (20%)	15 (28.85%)
Puskesmas Kusuma Bangsa	6 (40%)	6 (40%)	3 (20%)	15 (28.85%)
Total (n)	23 (44.23%)	17 (32.69%)	12 (23.08%)	52 (100%)

Table 3. Patient adherence to medication

No.	Questions	Answer assessment				Percentage (%)
		Never	**Rare**	**Often**	**Always**	
		4	**3**	**2**	**1**	
1	Seberapa sering Anda lupa minum obat anti-tuberculosis (OAT)? *(How often do you forget to take your anti-tuberculosis drugs?)*	45	7	0	0	86.5
2	Seberapa sering Anda sengaja tidak minum OAT? *(How often do you intentionally skip antituberculosis drug?)*	49	0	3	0	94.2
3	Seberapa sering Anda tidak mengecek / memperhatikan jadwal kontrol rutin sebagai antisipasi kehabisan obat? *(How often do you not check/pay attention to the routine control schedule in anticipation of running out of medicine?)*	46	6	0	0	88.4
4	Seberapa sering Anda melewatkan jadwal pengobatan tuberkulosis selanjutnya? *(How often do you miss your next tuberculosis treatment appointment?)*	40	9	3	0	76.9
5	Seberapa sering Anda kehabisan obat antituberkulosis dan baru tahu pada saat akan minum obat? *(How often do you run out of anti-tuberculosis drugs and only find out when you are about to take them?)*	49	2	0	0	94.2
6	Seberapa sering Anda tidak minum OAT ketika akan kontrol lanjutan? *(How often do you not take your antituberculosis drug when you go for a follow-up?)*	40	12	0	0	76.9
7	Jika Anda merasa membaik, seberapa sering Anda sengaja tidak minum OAT? *(If feel better, how often do you intentionally not take antituberculosis drug?)*	50	2	0	0	96.1
8	Ketika kondisi tubuh Anda sedang sakit yang lain (misal influenza, diare), seberapa sering Anda sengaja tidak minum OAT dengan alasan sedang minum obat yang lain? *(When you are sick with something else (e.g., influenza, diarrhea), how often do you intentionally skip antituberculosis drug because you are taking another medicine?)*	46	5	1	0	88.5
9	Jika kehabisan obat, seberapa sering Anda minum OAT milik orang lain? *(How often do you take someone else's antituberculosis drug if you run out of medicine?)*	46	6	0	0	88.4
10	Jika Anda merasa tidak peduli dengan pengobatan tuberkulosis yang sedang dijalani, seberapa sering Anda tidak minum OAT? *(If you feel unconcerned about your ongoing tuberculosis treatment, how often do you not take your antituberculosis drug?)*	46	6	0	0	88.4
					Average score	87.85

Table 4. Antituberculosis drug adherence results for each Puskesmas

Research location	Antituberculosis drug adherence (n)		Total (n)
	Good	Poor	
Puskesmas Krapyak Kidul	20 (90.9%)	2	22
Puskesmas Dukuh	14 (93.3%)	1	15
Puskesmas Kusuma Bangsa	11 (73%)	4	15
Total (n)	45 (86.5%)	7	52

Table 5. Test results of knowledge level on compliance

Knowledge level	Compliance rate (n)		Total (n)	Statistical test results
	Good	Poor		
High	20 (38.5%)	3	23	
Medium	14 (26.9%)	3	17	p = 0.001
Low	11 (21.1%)	1	12	r=0.341
Total	45 (86.5%)	7	52	

Table 2 presents the participants' knowledge levels concerning pulmonary tuberculosis, divided into high, medium, and low categories. Knowledge level categories were determined by the mean value of correct answer percentages, which in this case was 73.04, with a standard deviation (SD) of 10.51. This results in an assessment range of $62.53 \leq x \leq 83.55$. The study found that 44.23% (n=23) of participants had a high knowledge level.

Patient adherence level

The average score for each statement in the study was 87.85%, indicating an overall excellent level of participant engagement ($x > 83.29$) in responding to the research questionnaire. Question 7, which asked how often participants intentionally skipped antituberculosis medication when their condition improved, received the highest percentage of "never" responses at 96.1% (n = 50). The second and third highest percentages of "never" responses were for Question 2, which inquired about the frequency of intentionally not taking antituberculosis drugs, and Question 5, which addressed how often participants ran out of medication and only discovered this when they were about to take it (94.2%, n=49) (Table 3).

Among the 15 participants, 14 patients from the Puskesmas Dukuh demonstrated the highest compliance (93.3%), followed by Puskesmas Krapyak Kidul and Puskesmas Kusuma Bangsa. Overall, better compliance was observed in 86.5% (n=45) of participants (Table 4).

Influence of knowledge level on patient adherence to taking medication

Spearman correlation analysis produced a p-value of 0.001 (p<0.05), indicating a significant influence of knowledge level on compliance (Table 5). The correlation coefficient of 0.341 suggests a moderate, unidirectional relationship between the variables; higher knowledge levels correspond to better compliance with antituberculosis drug regimens. The study concluded that participants' knowledge levels were in the high category, and their compliance with antitubercular medication was in the good category.

Discussion

This study aims to examine the impact of knowledge level on patient compliance in taking antitubercular medication. The participant pool included more males than females, which is significant as males tend to have higher mobility and are more likely to engage in behaviors such as smoking and alcohol consumption that can reduce immunity, making them more susceptible to pulmonary tuberculosis [7]. This finding is supported by the Indonesian Health Profile (2012), which indicated that men are 1.5 times more vulnerable to the disease than women.

The majority of participants were in the productive age group of 18-45 years, which aligns with other research suggesting that most pulmonary tuberculosis patients are of working age [8]. As many as 75% of these

patients fall within the 15-49-year age range, during which a pulmonary tuberculosis diagnosis can render an individual unproductive and potentially burdensome to their family [9].

In the advanced treatment phase, patients reported considerable improvement in their condition, as evidenced by a steady increase in their weight.

Most participants in this study were undergoing treatment for pulmonary tuberculosis in either the second-month intensive phase or the fifth-month advanced phase. This is consistent with prior research that found 54.5% of participants were undergoing advanced phase antituberculosis drug treatment [10]. In this stage, patients reported considerable improvement in their condition compared to in the intensive phase, as evidenced by a steady increase in their weight.

The study revealed that participants' knowledge level was in the high category, which corresponds with research that found 76.19% of 42 participants to be well-informed [11]. Good knowledge can influence patients with pulmonary tuberculosis to adopt regular behaviors that can affect their health. However, some patients were unaware of the specific drugs used for tuberculosis treatment. As we asked during the interview session, most patients recognized Fixed Dose Combination (FDC) antituberculosis drug formulations (like red for intensive stages, and yellow for advanced stages), but they did not read further about the contents or drug components in the FDC. This highlights the critical role of health workers in educating patients about their disease and the importance of regular treatment.

Health workers's education efforts can increase tuberculosis patients' knowledge and improve treatment compliance. Research by Netty et al. (2018) showed a significant relationship between health worker involvement, family support, and medication compliance among pulmonary tuberculosis patients [12]. Positive communication from health workers helps build patient motivation for recovery and fosters education that supports medication adherence. Family support, including medication supervision, is essential for patients to maintain regular treatment [13].

In this study, 85% of participants demonstrated very high compliance with their tuberculosis medication, attributed to factors such as awareness of the disease's risks and a high motivation to recover [14]. The quality of interaction between health workers and patients is crucial for determining compliance. Support from

health workers is another factor that can influence medication adherence in pulmonary tuberculosis treatment [10].

There were some differences in compliance levels among participants at the three Puskesmas involved in the study. These differences were attributed to variations in participants' education levels, with those at Puskesmas Dukuh generally having higher education compared to participants at other Puskesmas. Education level affects an individual's knowledge and lifestyle, which in turn influences compliance [7].

The findings of this study align with previous research, showing that good knowledge levels can be acquired through counseling, information from others, and print or electronic media [4]. Patient compliance in taking antitubercular medication is positively correlated with increasing knowledge levels. Participants were generally less knowledgeable about the specific drugs used to treat pulmonary tuberculosis, which could be due to the fixed-dose combination (FDC) packaging that may lead to patients taking medication without reading the contents.

It is important for participants to improve their knowledge about the antituberculosis drugs they take, including the antibiotics that must be taken regularly to prevent drug resistance. Enhancing knowledge about tuberculosis treatment can support treatment continuity, leading to changes in a person's perceptions and habits [13]. Treatment success relies on patient knowledge and other supporting factors, including individual motivation and family support.

Patient compliance in consuming drugs can be affected by a lack of effort or motivation from both the patient and their family in providing support for complete treatment. It should be noted that this study is limited to the information provided by the participants through questionnaires, which may not always reflect their actual opinions. This is because the participants' drug-taking supervisors may influence their responses when filling out the questionnaires.

Conclusions

In conclusion, knowledge level affects anti-tubercular medication compliance. Knowledgeable patients are more likely to follow their treatment plan, improving health outcomes. Health care providers must educate and support patients to improve treatment compliance and drug adherence.

Acknowledgment

Author contributions

PG contributed to design the research concept, recruit of participants, collect the data, analyse the data, and write the manuscript. NEE and MWS contributed to validate questionnaire and write the manuscript and approve the the final version of the manuscript.

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