

Association between Health Literacy and Medication Adherence among Pulmonary Tuberculosis Patients Using Four Domains of the Integrated Health Literacy Model in Jember Regency, Indonesia

ABSTRACT

Background and Objective: Health literacy is one of the factors that can influence tuberculosis medication adherence. Due to inadequate health literacy, patients had not fully used the information received related to tuberculosis in their daily behavior to support recovery. This research analyzes the association between domains of health literacy and medication adherence among pulmonary tuberculosis patients.

Materials and Methods: This retrospective study analyzed the association between health literacy and medication adherence of 150 pulmonary tuberculosis patients in four primary healthcare units in Jember Regency. The participants were composed of; 1) adhere (had no history of interrupt medication > 1 month in 2021) and already recovered and 2) non-adhere (had a history of not taking medication for > 1 month in 2021). The prepared research assistants and health volunteers carried out the data collection. Descriptive statistics and the chi-square test were applied to analyze the data. Collection data held from October-November 2022.

Results: This study found that 128 participants adhered to and 22 did not adhere to tuberculosis medication. Forty-two percent of the participants (63 of 150) had a sufficient health literacy level. There was a significant association between health literacy level and medication adherence ($p < .001$). All health literacy domains significantly associated with medication adherence with access ($p = 0.001$), understand ($p < 0.001$), appraise ($p < 0.001$), and apply ($p < 0.001$).

Conclusion: Most participants had sufficient health literacy and good skills in accessing, understanding, appraising, and applying tuberculosis-related information. Health workers can improve tuberculosis patients' ability to appraise and apply tuberculosis health information by providing continuous health counseling.

Paper Type: Research Article

Keywords: Health Literacy, Medication Adherence, Patient Compliance, Tuberculosis

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Introduction

Tuberculosis (TB) is a severe public health problem and has become the third leading cause of mortality from infectious diseases globally. According to the WHO Global Tuberculosis Report 2022, in 2021, an estimated 10.6 million patients suffered from tuberculosis worldwide (134 per 100,000 population) (1). Indonesia is the third country that contributes the most significant incidence of tuberculosis. The incidence of tuberculosis in Indonesia in 2020 was 301 per 100,000 population. The death rate for tuberculosis patients is 34 per 100,000 population (2). Ministry of Health Indonesia has reported that Indonesia has budgeted 5.3 billion USD every year for tuberculosis eradication and treatment programs (3). According to the Indonesia Ministry of Health, in 2022, 91.0% of tuberculosis cases were pulmonary tuberculosis (4). In 2021, East Java was one of the provinces with the highest tuberculosis prevalence, with an incidence rate of 107 per 100,000 population (5). Jember Regency is the second-highest city in East Java Province, with a high prevalence of tuberculosis, with an incident rate of 139 per 100,000 population (5).

Based on the WHO, tuberculosis patients get short-course treatment. Short-course therapy is a treatment regimen ranging from six to nine months and uses a mixture of effective anti-TB medications (6). Nonadherence to tuberculosis treatment is the most vital barrier and the biggest obstacle to tuberculosis control globally and contributes to treatment failure (7). Nonadherence to the treatments leads to worsening tuberculosis conditions, increasing infectiousness, and initiating drug resistance, and can cause death (7,8). Forty percent of patients in developing countries worldwide had poor adherence to tuberculosis therapy (8).

A measure used to assess treatment compliance for tuberculosis is the success rate of the regimen.

The number of tuberculosis cases that have been completely treated and have been cured out of all treated and recorded tuberculosis cases is the treatment success rate (2). In 2019, the global success rate of patients treated for tuberculosis with first-line regimens was 86.0% (9). If referring to the target set by the Ministry of Health for the success rate in 2020, which is 90.0% nationally, the success rate for tuberculosis treatment in Indonesia has not yet been achieved, with 82.7% (2). Meanwhile, in East Java Province, the success rate or Treatment Success Rate (TSR) of East Java Province reached 88.9%. However, it still needs to reach the target of the Ministry of Health. Meanwhile, Jember Regency is also one of the regencies in East Java Province, with a success rate below the target of 87.5% (5).

Health literacy is a person's ability to acquire, comprehend, and use health information to make judgments and decisions in daily life to preserve or enhance one's quality of life throughout one's life (10). Health literacy is vital in every kind of disease, especially in tuberculosis. Poor or insufficient health literacy was linked to lower adoption of protective behaviors such as disease prevention and a poor understanding of medications (11). Also, poor health literacy can lead to more significant numbers of individuals visiting the emergency room, ineffective utilization of medical resources, and inadequate treatment of chronic conditions (12). The lack of TB health literacy may impede treatment-seeking behavior and contribute to delays in diagnosis and treatment adherence, contributing to the high TB burden observed (13). Health literacy can influence the patient's health behaviors. From how a person can access reliable and righteous information regarding the disease, understanding and appraising the sufficient information that has been received

about tuberculosis will influence the patient's decision about how the treatment process should be carried out.

Besides having a good education and knowledge, someone must be able to apply their knowledge daily to improve their health status. A high literacy rate indicates that people with tuberculosis understand their disease well. According to current research, strengthening patients' health literacy may be an effective way and preventative approach to enhance illness management behaviors, such as medication adherence (14). Therefore, they need to have good health literacy. According to several studies, individuals with inadequate health literacy frequently pay more significant medical expenses and receive lower-quality health treatment (15). A similar study showed that health literacy could contribute to medication adherence among tuberculosis patients (16). Also, another similar study in Nigeria found that a higher health literacy level can increase the knowledge of disease processes. However, those studies only studied the correlation between health literacy and medication adherence and did not focus on how health literacy can affect medication adherence. In Jember Regency, the success rate is below the national standard. There were limited studies to retrospectively analyze the association between health literacy and medication adherence among pulmonary tuberculosis patients in Jember Regency. Hence, this research investigated the association between health literacy level and its domain to medication adherence among pulmonary tuberculosis patients in four primary healthcare units in Jember Regency, Indonesia.

Materials and Method

Design

This descriptive retrospective study aimed to

analyze the association between health literacy levels and medication adherence of pulmonary tuberculosis patients in primary healthcare at the Jember Regency. This study also studied the association between health literacy domains from Integrated Health Literacy Model (Access, Understand, Appraise, and Apply) to medication adherence. This study's participants were adult pulmonary tuberculosis patients (>18 years old) living in Jember Regency, East Java, Indonesia. These patients composed of; 1) the patients who adhered to tuberculosis medication (i.e., had no history of interrupt medication > 1 month) and already recovered in 2021 and 2) the patients who did not adhere to tuberculosis medication (i.e., had a history of not taken medication for one month continuously or more) in 2021. Collection data held from October-November 2022.

Study Setting and Sampling

This study was conducted in Jember Regency. The researcher chose Jember Regency as the research setting because Jember is one of the regencies in East Java Province with a success rate below the target of 87.5% and has a diversity of regions such as mountainous areas, rice fields, and the coast. There are four areas in Jember including; (a) north to east is a hilly area at the foot of the slope of mountains with a variety of plains for rice fields, (b) the middle part is the sub-district of the city where the business or administrative center is located, (c) the western part to the north is a sugarcane plantation plain to the slopes of the foot mountains for cocoa and coffee and rubber plantations, and (d) the west to the south is plain for agriculture to the coast. Based on those four areas, the study was conducted in four primary healthcare units with the highest number of tuberculosis patients at the Jember Regency. The study was conducted in four Primary Healthcare (PHC) units with the highest number of tuberculosis

patients in Jember Regency. The total number of pulmonary tuberculosis patients 2021 in the Jember Regency was 2,908.

Determination of the number of samples to be carried out in this research uses the previous study with G*power version 3.1.9.4 application with $\alpha = 0.05$, power $(1-b) = 0.8$, and effect size from previous study = 0.2 (17). The total sample obtained from G*Power is 150 respondents. The estimation of the nonadherence group is 22 participants, and the estimation adherence group is 128 participants divided into four PHC units. To calculate samples from each PHC unit, the researcher used the fraction per cluster sampling formula.

Inclusion criteria in this research were as follows: (a) 18 years of age or older, (b) adherence group: adhered to the medication and declared cured of tuberculosis the of the treatment in 2021, (c) nonadherence group; had a history of interrupted for one month continuously or more in 2021, (d) Indonesia citizens, and (e) able to speak, write and read Indonesia language. The withdrawal criteria were (a) "transfer-out patient" to another regency/city and (b) tuberculosis patients who died during the treatment.

Instruments

This research used two questionnaires; a socio-demographic characteristic questionnaire and a health literacy questionnaire. From the literature review, the researchers developed the socio-demographic characteristic questionnaire. This questionnaire includes gender, age, level of education, income, occupation, marital status, comorbid, history of smoking, and health information sources. In this study, the researcher modified a questionnaire to measure health literacy in pulmonary tuberculosis patients. This questionnaire is modified from The European Health Literacy Survey Questionnaire (HLS-

EU-Q47) and a literature review about pulmonary tuberculosis. This questionnaire has 46 questions and uses the four domains from Integrated Health Literacy Model by Sorensen (2012); access domain (12 items), understand domain (10 items), appraise domain (10 items), and apply domain (14 items). The categorization and scoring are based on The European Health Literacy Survey Questionnaire (HLS-EU-Q47) (18). This questionnaire was graded on a 4-point Likert scale where one means very difficult, two means fairly difficult, three means fairly easy, and four means very easy. Consistent with the original instrument, health literacy scores were standardized on a metric from 0 to 50 using the formula: $(\text{mean} - 1) \times (50/3)$, where the mean is the average of all item responses for each participant. Four levels of health literacy were calculated based on this metric: 0-26 = "inadequate," 26-33 = "problematic," 34-42 = "sufficient," and 43-50 = "excellent."

Five experts carried out content validity for the health literacy questionnaire. The experts were community and family nursing lecturers and community nurses in primary healthcare. Experts were recruited to evaluate and suggest each scale item based on its usefulness, applicability, and accuracy. The researcher then evaluated, commented, modified, or deleted items using the Item Content Validation Index (I-CVI) (19). All elements were scored on a four-point scale: 1 point (unrelated assigns), 2 points (related), 3 points (fairly relevant), and 4 points (highly relevant). The I-CVI on the health literacy questionnaire was determined following expert examination. Acceptance points are 3 and 4. Finally, the result of I-CVI from five experts was 0.9, providing a high validity of the research instrument for this study.

The method of forward-backward translation was used to translate questionnaires for data

collection. Two Indonesians working in Language Center with translator certificates in English and Indonesian languages served as translators. One person translated from English to Indonesia (forward translation), while another translated from Indonesia to English (backward translation). Then, the researchers compared the backward version to the original version and decided that both were linguistically equivalent.

A pilot study was conducted to provide the reliability of the health literacy questionnaire. The questionnaire was submitted to 20 tuberculosis patients at the Jember Regency with similar characteristics. The reliability test was carried out using Cronbach Alpha. The Cronbach's alpha value accepted for the instrument is more than 0.7 (20). After that, interrater reliability was used in this study. Interrater reliability is a risk in most research to some degree because many data collectors may experience and interpret the phenomenon of interest differently (21). This rater test involved the researcher and two research assistants in assessing items and ensuring that all items were relevant to what was being measured. The Intraclass Correlation Coefficient (ICC) was applied for the interrater reliability test. The accepted ICC value was equal to and more than 0.8 (22). Finally, the result for Cronbach's alpha value was 0.9, and for ICC value was 0.8.

Data Collection

After obtaining permission to conduct research, the researcher went to the primary healthcare unit to ask permission to conduct research and explained all of the information about the study to the head offices of PHC. The head of each PHC unit contacted the participants to participate and asked about their willingness to give their medical data to the researcher. After they agreed, the researchers asked permission from the Head office of the PHC unit to collect the data and

access the patient information. After getting the data, the researcher did a screening and contacted participants by telephone to ask if they were willing to do a home visit. The participants were free to choose the date and time to meet.

The researcher took data with research assistants. The researcher divided the area of collecting data with the research assistant. The researchers and research assistants conducted home visits together with health volunteers. The participants were given an informed consent sheet as a sign that the participants were willing to be a respondent. The questionnaires were given to participants to be filled out within one day after the questionnaire was given so that participants could fill out the questionnaire freely. Afterward, the participants could return the questionnaire to the PHC or health volunteers the next day. If the participants forgot to return the questionnaire, the researcher/research assistant followed up with participants by calling or visiting the participant's house.

Clinical Ethical permission for the study was obtained under record reference number HE652156. The study also adhered to the Declaration of Helsinki. Participation in the survey was voluntary, and completion implied the participant's consent. There was no collection of personal data. All participants were assured of the confidentiality and privacy of their survey responses.

Data analysis

Bivariate analysis is conducted to determine the independent variable using the chi-square test at a significance level of 95% ($\alpha = 0.05$). In addition, a Chi-square test was used to test whether there is a significant difference between categorical variables, level of health literacy, and socio-demographic characteristics between the two groups (Adherence and nonadherence group).

Results

Sample Characteristics

This study found that of 150 participants, 128 adhered to the tuberculosis medication, and 22 did not adhere or had a history of medication interruption for more than or equal to one month. The majority of the participants in this study were 41-60 years old (34.7%), male (54.7%), high school education level (32.7%), had enough but no saving monthly income (44.0%), unemployed (44.0%), married (64.6%), had

no comorbidity (83.3%), had no exposure to cigarettes (44.7%) and health information sources from health providers (80.0%). Moreover, the socio-demographic variables that were associated with medication adherence were age group ($p=.034$), educational level ($p=.033$), income ($p=0.019$), comorbid ($p=.007$), and history of smoking ($p=.025$) (Table 1).

Table 1 Association between socio-demographic variables and Medication adherence among Tuberculosis Patients (N=150)

Socio-demographic variables	Total (N, %)	Medication Adherence		p-value
		Adherence N= 128 (85.3%)	Non-adherence N=22 (14.7%)	
Age				
<25	39 (26.0%)	33 (25.8%)	6 (27.3%)	.034*
26-40	36 (24.0%)	35 (27.3%)	1 (4.5%)	
41-60	52 (34.7%)	44 (34.4%)	8 (36.4%)	
>60	23 (15.3%)	16 (12.5%)	7 (31.8%)	
Gender				
Male	82 (54.7%)	69 (53.9%)	13 (59.1%)	.652
Female	68 (45.3%)	59 (46.1%)	9 (40.9%)	
Education level				
No school	14 (9.3%)	13 (10.2%)	1 (4.5%)	.033*
Elementary school	47 (31.3%)	36 (28.0%)	11 (50.0%)	
Junior school	23 (15.4%)	17 (13.3%)	6 (27.3%)	
High school	49 (32.7%)	45 (35.2%)	4 (18.2%)	
Bachelor/higher	17 (11.3%)	17 (13.3%)	0 (0.0%)	
Income				
Enough, have some saved	44 (29.3%)	43 (33.6%)	1 (4.5%)	.019*
Enough, no saving	66 (44.0%)	53 (41.4%)	13 (59.1%)	
Not enough, but not borrow	34 (22.7%)	26 (20.3%)	8 (36.4%)	
Not enough and debt	6 (4.0%)	6 (4.7%)	0 (0.0%)	
Occupation				
Unemployed	66 (44.0%)	58 (45.3%)	8 (36.4%)	.079
Farmer	18 (12.0%)	11 (8.6%)	7 (31.9%)	
Government officer	6 (4.0%)	5 (3.9%)	1 (4.5%)	
Trader/merchant	22 (14.7%)	20 (15.6%)	2 (9.1%)	
Labour/employee	29 (19.3%)	26 (20.3%)	3 (13.6%)	
Other	9 (6.0%)	8 (6.3%)	1 (4.5%)	

Socio-demographic variables	Total (N, %)	Medication Adherence		p-value
		Adherence N= 128 (85.3%)	Non-adherence N=22 (14.7%)	
Marital status				
Unmarried	43 (28.7%)	35 (27.4%)	8 (36.4%)	.660
Married	97 (64.6%)	84 (65.6%)	13 (59.1%)	
Divorced/widowed	10 (6.7%)	9 (7.0%)	1 (4.5%)	
Comorbid				
No comorbid	125 (83.3%)	111 (86.7.0%)	14 (63.6%)	.007*
Has comorbid	25 (16.7%)	17 (13.3%)	8 (36.4%)	
History of smoking				
Have no exposure to cigarettes	67 (44.7%)	59 (46.1%)	8 (36.4%)	.025*
Passive smoker	48 (32.0%)	44 (34.4%)	4 (18.1%)	
Active smoker	35 (23.3%)	25 (19.5%)	10 (45.5%)	
Health information sources				
Health provider	120 (80.0%)	103 (80.5%)	17 (77.3%)	.917
Television	5 (3.3%)	4 (3.1%)	1 (4.5%)	
Internet	25 (16.7%)	21 (16.4%)	4 (18.2%)	

*P-value <0.05 = Significant

Health Literacy Level and Medication Adherence among Tuberculosis Patients

After bivariate analysis using the Chi-square test, there was a significant association between health literacy level and medication adherence. The higher level of health literacy, the more the patients adhere to the medication. It showed that most of the adhere participants had sufficient and excellent health literacy. In comparison, the non adhere participants had inadequate and

problematic levels of health literacy. The study indicated that most participants who adhered to the medication had sufficient and excellent health literacy levels (48.4% and 26.6%). In contrast, participants who did not adhere to the medication were at inadequate (54.5%) and problematic health literacy levels (36.5%) (Table 2).

Table 2 Association between health literacy level and medication adherence among tuberculosis patients (N=150)

Health Literacy Level	Total (N, %)	Medication Adherence		p-value
		Adherence N= 128 (85.3%)	Non-adherence N=22 (14.7%)	
Inadequate	26 (17.3%)	14 (10.9%)	12 (54.5%)	<.001
Problematic	26 (17.3%)	18 (14.1%)	8 (36.5%)	
Sufficient	63 (42.0%)	62 (48.4%)	1 (4.5%)	
Excellent	35 (23.4%)	34 (26.6%)	1 (4.5%)	

* P-value <0.05 = Significant

Health Literacy Level (Domain) and Medication Adherence among Tuberculosis Patients

All health literacy domains are significantly associated with medication adherence with a p-value for access of .001; meanwhile, understand, appraise, and apply domains have the same result with a p-value <.001. The study revealed that most nonadherence participants had inadequate and problematic health literacy levels in all health literacy levels; 45.5% were problematic in the access domain, 45.5% were problematic in the understanding domain, 50.0% were inadequate in appraise domain, 54.5% were inadequate the applied domain. Most adherence participants

had sufficient health literacy levels; 39.8% in the access domain and 43.0% in the understanding domain. While in the appraised domain, the number of participants with sufficient health literacy levels decreased to 31.3%. For apply domain, 39.8% had problematic health literacy levels. It showed that although most adherence participants had sufficient and excellent health literacy levels, some experienced difficulties deciding and applying health information, especially regarding tuberculosis treatment (Table 3).

Table 3 Association between health literacy level (per domain) and medication adherence among tuberculosis patients (N=150)

Health Literacy Level (Per-domains)	Total (N, %)	Medication Adherence		p-value
		Adherence N= 128 (85.3%)	Nonadherence N=22 (14.7%)	
Access				
Inadequate	22 (14.7%)	15 (11.7%)	7 (31.8%)	.001
Problematic	36 (24.0%)	26 (20.3%)	10 (45.5%)	
Sufficient	55 (36.6%)	51 (39.8%)	4 (18.2%)	
Excellent	37 (24.7%)	36 (28.2%)	1 (4.5%)	
Understand				
Inadequate	22 (14.6%)	14 (10.9%)	8 (36.4%)	<.001
Problematic	36 (24.0%)	26 (20.3%)	10 (45.5%)	
Sufficient	58 (38.7%)	55 (43.0%)	3 (13.6%)	
Excellent	34 (22.7%)	33 (25.8%)	1 (4.5%)	
Appraise				
Inadequate	29 (19.3%)	18 (14.1%)	11 (50.0%)	<.001
Problematic	43 (28.7%)	36 (28.1%)	7 (31.8%)	
Sufficient	43 (28.7%)	40 (31.3%)	3 (13.6%)	
Excellent	35 (23.3%)	34 (26.5%)	1 (4.5%)	
Apply				
Inadequate	31 (20.7%)	19 (14.8%)	12 (54.5%)	<.001
Problematic	59 (39.3%)	51 (39.8%)	8 (36.5%)	
Sufficient	31 (20.7%)	30 (23.5%)	1 (4.5%)	
Excellent	29 19.3%)	28 (21.9%)	1 (4.5%)	

* P-value <0.05 = Significant

Discussion

There was a significant association between health literacy level and medication adherence among tuberculosis patients in Jember Regency, Indonesia. This finding implied that the better the level of health literacy in accessing, understanding, appraising, and applying tuberculosis health information; the more obedient tuberculosis patients are in undergoing tuberculosis treatment. Furthermore, participants with sufficient and excellent levels of health literacy were better at complying with treatment than participants with inadequate and problematic levels of health literacy. This result aligns with the previous study that those with higher levels of health literacy have higher adherence rates than patients with low levels of health literacy (15). However, another study found that health literacy was not associated with medication adherence. Health literacy is crucial, but it is insufficient for encouraging people to get involved with healthy activities, and other factors are likely to be more effective in disease self-management (23).

Accessing or finding information is the first step of health literacy. The study revealed an association between how to access health information and medication adherence among tuberculosis patients. Although most participants had sufficient access to health information, most nonadherence participants had inadequate (31.8%) and problematic (45.5%) in finding health information. From that result, it can be concluded that if the patient has difficulty accessing health information, they will also experience difficulties understanding and complying with treatment. The ability to find information related to tuberculosis, which is still low, indicates that there is still little information that is spread in the community related to tuberculosis (24). Increasing access to health information and the capacity to use this information effectively

is essential in health literacy because health information that is comprehensive, accessible, and appropriate to individual needs and socio-cultural backgrounds will result in good health decisions (25). However, other studies revealed that access and the use of digital information correlated with lower medication compliance (26). Although access to health information is crucial for good health, many respondents lacked confidence in their ability to use information from the internet to make health-related decisions (27). This study also found that most participants only relied on health workers to access health information because they felt sufficient with the information they provided. A related study found that all respondents did not try to find additional information using other media, such as the internet, because they were in late middle age and elderly, so they felt sufficient with the information obtained from healthcare providers only (28).

This study found a significant association between understanding health information and medication adherence among tuberculosis patients. Understanding health conditions and medication's role is central to treatment success. Understanding health-related information necessitates knowledge, experience, skills, and access to health-related information. Participants with sufficient and excellent health literacy levels in understanding tuberculosis-related information tended to comply with the tuberculosis treatment. A study stated that inadequate health literacy in understanding treatment requirements was a significant barrier to treatment adherence (29). A lack of understanding of illness processes and required treatments may result from low health literacy. In contrast with the result, another study discovered no correlation between medication adherence and health literacy among patients

with chronic renal disease. It also revealed that patients had difficulty understanding health information, which could be stressful and anxiety-inducing (30). Healthcare practitioners must ensure that their patients understand and comprehend their treatment requirements by adopting literacy-based teaching and reinforcing education about the patient's diseases over time. In the research setting, healthcare providers play essential roles in providing health information. Every time patients take their medication stocks, the doctors/nurses will give them information regarding their treatment and tuberculosis-related information. Healthcare practitioners must identify patients at high risk of being unable to absorb and understand the health information delivered to them.

Appraising information is an essential step in making decisions about their conditions. Tuberculosis patients who can appraise information well will make the right decisions, especially regarding their treatment. Individuals must thoroughly grasp collected information to assess or judge any information. This study found a significant association between how the patients appraise the information and medication adherence. Adherence patients had more ability to appraise health information. While in nonadherence patients, 50.0% had inadequate, and 31.8% had problematic levels. This study showed that the more participants had an excellent capability to appraise and assess tuberculosis-health-related information, they had the decision to stick to the regimen and adhere to the therapy. However, other studies indicated that people could overestimate their judgment skills when they believe they are highly health-literate, which can lead to their being less open to information that they believe to be false (31). This study found that most participants relied on health information from healthcare providers,

so they judged that the information was the best for them. It is similar to the previous study that all respondents believed the explanations given by health workers. However, some respondents re-clarified the explanation from health workers. For example, by seeking information from media such as newspapers or magazines or asking other health workers to ensure the truth of the information they get (32).

Applying the information is the last step of health literacy. The study found that health literacy level was associated with how respondents applied their information. For this domain, 39.8% of adherence participants had a problematic level, while 54.5% of nonadherence participants had an inadequate level. Both adherence and nonadherence participants had difficulties applying health information for their health and tuberculosis medication. Individuals who did not get health information to judge had a significantly lower capacity to apply health information. Even if they had reliable health information, it might be challenging to apply this knowledge (33). Other studies have also found that respondents had not fully utilized the information received regarding tuberculosis in their daily behavior to improve their health status. Some respondents still smoked and did not continue treatment (28). Also, other studies found that health literacy was not reflected in assumptions of the COVID-19 threat's seriousness, determined understanding of its signs and symptoms or general prevention methods, or reported modifications to daily routines and plans (34).

Policymakers should consider strengthening nonformal education, especially among the low socioeconomic living in rural areas, to improve their educational status and better access and understanding of health information and services. Another is for the government policymakers;

they should help increase media advertisements through television and social media about tuberculosis-related information to increase knowledge in society.

This study provides valuable information to help understand the stages of health literacy that can affect medication adherence among pulmonary tuberculosis patients. From the results of this study, it can be shown which domains of health literacy require attention in order to increase the level of literacy so that patients can make the right decisions in their treatment. And also, this study links socio-demographic factors that can affect medication adherence in tuberculosis patients. However, there are some weaknesses to this study. This study depended on the participant's answers to the questionnaires. Memory recall and interviewer relationship bias could not be excluded. Moreover, this study used a retrospective study, so participants may forget their medical history, affecting how they fill out the questionnaire.

Conclusion

This study found that all of domains health literacy related to medication adherence among pulmonary tuberculosis in Jember Regency, Indonesia. Moreover, the results showed that most participants had sufficient health literacy and good skills in accessing, understanding, appraising, and applying tuberculosis-related information, However, the participants had difficulties appraising and applying health information. Further research can implement the program, such as continuous health education, to increase the ability to appraise and apply health information of tuberculosis patients in order to improve their health literacy skills. Thus, this study can provide the information necessary to increase policymakers' and healthcare providers' understanding of the medication adherence

problem's magnitude and boost health literacy among tuberculosis patients.

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Consent for Publication; Not applicable

Ethical considerations: This study was carried out in accordance with the Helsinki Declaration. Clinical Ethical permission for the study had been obtained from the office of Khon Kaen University, Ethics Committee for Human Research (ECKKU), Thailand, under record reference number HE652156 with the date of approval 9th September 2022. All participants provided written informed consent.

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