



Association Between Treatment Adherence and Quality of Life of Tuberculosis Patients at TB-DOTS Polyclinic

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ABSTRACT

Background: Tuberculosis (TB) is the second leading cause of death from infectious diseases worldwide. The level of treatment adherence of TB patients is closely related to the quality of life. This study aims to analyze the association between treatment adherence and quality of life of pulmonary TB patients.

Method: This was an analytical observational study with a cross-sectional design. A total of 101 pulmonary TB patients who were undergoing treatment, as well as patients who had been lost to follow-up, were recruited from the TB-DOTS outpatient clinic. Data were collected through direct interviews using the MMAS-8 and WHOQOL-BREF questionnaire. Data was analyzed by the Chi-square test.

Result: Of the 101 patients, 40.6% showed high adherence, 47.5% moderate adherence, and 11.9% low adherence to tuberculosis medication. High quality of life was found to be more prevalent than low quality of life. Treatment adherence level was associated with the general quality of life ($p=0.008$), physical domain ($p=0.008$) and environmental domain ($p<0.001$). Treatment adherence level was not associated with the psychological and social relationship domain.

Conclusion: These findings underscore the importance of the strategies to support treatment adherence by education, counselling, and monitoring as a part of comprehensive TB care to optimize patient-centred outcomes.

Keywords: Pulmonary tuberculosis, quality of life, treatment adherence

ABSTRAK

Latar Belakang: Tuberkulosis merupakan penyebab kematian kedua terbesar akibat penyakit menular di seluruh dunia. Tingkat kepatuhan pengobatan pasien TB sangat berkaitan dengan kualitas hidup. Studi ini bertujuan untuk menganalisis hubungan antara kepatuhan pengobatan dan kualitas hidup pasien TB paru.

Metode: Studi ini merupakan studi observasional analitik dengan desain potong lintang. Sebanyak 101 pasien TB paru yang sedang menjalani pengobatan, serta pasien yang telah berhenti mengikuti pengobatan, direkrut dari klinik rawat jalan TB-DOTS. Data dikumpulkan melalui wawancara langsung menggunakan kuesioner MMAS-8 dan WHOQOL-BREF. Data dianalisis dengan uji Chi-square.

Hasil: Dari 101 pasien, 40,6% menunjukkan tingkat kepatuhan tinggi, 47,5% kepatuhan sedang, dan 11,9% kepatuhan rendah terhadap pengobatan tuberkulosis. Kualitas hidup tinggi ditemukan lebih banyak daripada kualitas hidup rendah. Tingkat kepatuhan pengobatan berhubungan dengan kualitas hidup secara umum ($p=0,008$), domain fisik ($p=0,008$) dan domain lingkungan ($p<0,001$). Tingkat kepatuhan pengobatan tidak berhubungan dengan domain psikologis dan hubungan sosial.



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Kesimpulan: Temuan ini menggarisbawahi pentingnya strategi untuk mendukung kepatuhan pengobatan melalui edukasi, konseling, dan pemantauan sebagai bagian dari perawatan TB komprehensif untuk mengoptimalkan hasil pengobatan yang berpusat pada pasien.

Kata kunci: Tuberkulosis paru, kualitas hidup, kepatuhan pengobatan.

1. Introduction

Tuberculosis (TB) is an infectious disease and is the second leading cause of death among infectious diseases in the world. There will be 7.5 million people with tuberculosis in the world by 2022. According to WHO, tuberculosis case notifications have rebounded after the COVID-19 pandemic, indicating improved access to TB diagnosis and treatment services globally. Tuberculosis remains a major global public health challenge despite ongoing efforts to improve case detection and treatment coverage [1]. According to the WHO Global Tuberculosis Report 2025, an estimated 10.7 million people are infected with tuberculosis worldwide, with 1.23 million deaths reported globally in 2024, indicating that tuberculosis remains a major global public health challenge [2].

Thirty high TB burden countries account for 87% of the world's TB cases, and two-thirds of the global total occurs in 8 countries namely: India (27%), Indonesia (10%), China (7.1%), Philippines (7.0%), Pakistan (5.7%), Nigeria (4.5%), Bangladesh (3.6%), and Democratic Republic of Congo (3.0%). Men remain disproportionately affected by tuberculosis worldwide, representing 54% of all estimated TB cases in 2024 [3]. The estimated incidence of TB in Indonesia in 2021 was 969,000 or 354 per 100,000 population [4]. In 2022, the TB incidence was 969,000 cases per year, with 724,309 cases notified (75%), of which there were no case notifications either unreached, undetected, or unreported by 25% [4]. The high rate of TB in Indonesia is a topic that must be studied more deeply about the problems that make TB cases continue to increase. The success of TB treatment can be hampered by many factors, one of which is incomplete treatment of TB patients, this can stem from irregularity and non-compliance of patients in taking drugs, doses, regimens, improper use of drugs, unavailable anti-tuberculosis drugs (OAT), and low drug quality. In addition, while undergoing treatment, patients often experience severe challenges, one of which is due to the long treatment period [5]. Non-compliance of TB patients during the treatment period is closely related to the patient's quality of life. TB patients experience physical and psychosocial changes during their treatment period [6]. Poor adherence to anti-tuberculosis treatment can lead to treatment failure, disease relapse, prolonged infectiousness, and the development of drug-resistant tuberculosis, which is associated with increased morbidity, mortality, and healthcare costs [2]. Several factors have been reported to influence treatment non-compliance, including adverse drug reactions, prolonged treatment duration, inadequate knowledge about TB, stigma, lack of social and family support, psychological distress, financial difficulties, and limited access to healthcare services [2]. Furthermore, TB patients frequently experience physical, psychological, and social challenges during treatment, which may adversely affect both treatment adherence and quality of life [7].

Adherence means the extent to which a person's behaviour takes medication, follows a diet, and/or makes lifestyle changes, according to the directions or recommendations of an agreed-upon health care provider. Adherence to taking medication for TB patients is closely related to the quality of life of TB patients, but when viewed from the increasing number of TB cases and the number of cases of TB recurrence understanding the association between treatment adherence and quality of life is essential for optimizing tuberculosis management and improving patient-centered outcomes [8].

Research conducted at the Bandung Health Centre, Indonesia using the Morisky Medication Adherence Scale-8/ MMAS-8 instrument and The World Health Organization Quality of Life-Bref / WHOQOL-BREF (quality of life instrument), stated that the low quality of life during the treatment period is related to the psychological impact of the disease, where there is isolation from the community or family which can trigger the patient's depression [8]. This research has also been conducted at the Summersari Health Centre in Jember Regency, East Java using the same instrument, stating that inferential analysis did not demonstrate a significant association between medication compliance and quality of life in this study. This finding suggests that the

relationship between treatment adherence and quality of life may be complex and influenced by other clinical, psychological, and social factors that were not fully captured in the present analysis [9].

However, a previous study conducted at Stella Maris Hospital Makassar found a significant association between treatment adherence and quality of life among tuberculosis patients. More than half of the respondents (54.3%) who adhered to treatment reported a good quality of life, whereas poor quality of life was more common among patients who were non-adherent to treatment [10].

Recent research conducted at the Bojong Rawalumbu Bekasi Community Health Centre, using the MMAS-8 questionnaire instrument and the EQ-5D-5L questionnaire, stated that the quality of life of TB patients is influenced by adherence to the treatment program undertaken, because with adherence in undergoing treatment it is expected that patients are better and do not feel the signs and symptoms of the disease so as to improve the physical, psychological and social conditions of sufferers [11].

Therefore, the researchers aimed to conduct a study on the association between treatment adherence and the quality of life of tuberculosis (TB) patients at the TB-DOTS Polyclinic of Prof. dr. Chairuddin P. Lubis Universitas Sumatera Utara Hospital, to analyze the association between these two factors. Based on tuberculosis case data, the city of Medan is recorded as one of the largest contributors to tuberculosis cases in North Sumatra, and treatment adherence and quality of life may vary across different healthcare facilities. Therefore, we wanted to examine the status of tuberculosis cases at the TB-DOTS Outpatient Clinic of Prof. Dr. Chairuddin P. Lubis University Hospital in North Sumatra, which is located near the city and serves as a teaching hospital. The findings may help healthcare providers identify patients at risk of poor adherence and design appropriate educational, psychosocial, and follow-up interventions to improve treatment outcomes and quality of life.

2. Methods

2.1. Study Design

A cross-sectional study was used to analyze the association between treatment adherence and quality of life of pulmonary TB patients. In this study, quality of life is determined as the dependent variable was assessed using the Indonesian version of the *World Health Organization Quality of Life-BREF* (WHOQOL-BREF) questionnaire. Meanwhile, the level of treatment adherence of pulmonary TB patients as an independent variable was assessed using the Morisky Medication Adherence Scale-8 (MMAS-8) questionnaire. Demographic data from this study included age, gender, education level, occupation, comorbid diseases, and length of treatment. Age was classified into 3 categories; 19-40 years old, 41-60 years old, and >60 years old. Gender was classified into male and female. Education level was classified into 4 categories namely; elementary school, junior high school, senior high school/intermediate technical school, and college. Occupation was classified as employed and unemployed. Comorbid diseases were classified as having no comorbidities and having comorbidities. Treatment duration was classified as intensive phase lasting from 0-2 months and continuation phase lasting >2 months.

2.2. Study area and duration

This study was conducted from June to November 2024 at the TB-DOTS Polyclinic of Prof. dr. Chairuddin P. Lubis Universitas Sumatera Utara Hospital, Medan, Indonesia.

2.3. Inclusion and Exclusion Criteria

Subjects was 101 pulmonary TB patients selected using consecutive sampling in accordance with the inclusion and exclusion criteria. Inclusion criteria were pulmonary TB patients willing to become respondents by signing informed consent, aged >18 years, patients who were undergoing treatment and pulmonary TB patients who had dropped out of treatment (lost to follow up). Exclusion criteria were uncommunicative and uncooperative pulmonary TB patients. These patients may have been unable or unwilling to provide complete and reliable information, which could have affected the validity and accuracy of the study data. To determine the number of samples, the minimum sample size was determined using the Slovin formula with a 5% margin of error.

Based on a population of 135 pulmonary tuberculosis patients, the minimum required sample size was 101 participants.

2.4. Statistical analysis

Primary data were obtained through direct interviews using the MMAS-8 questionnaire for treatment adherence and the WHOQOL-BREF questionnaire for quality of life. Statistics were analyzed using SPSS version 25.0. Descriptive statistics and chi-square test were used for data analysis.

2.5. Instrument of study

Morisky Medication Adherence Scale-8 (MMAS-8) is a measurement tool for medication adherence developed by Dr. Morisky in 2008 and a development of the Medication Adherence Questionnaire (MAQ) method [12]. Validity and reliability tests have been carried out and the results of the MMAS-8 questionnaire validity test obtained an r value of 0.355 and the reliability test obtained a Cronbach alpha value of 0.729 [13]. The Morisky Medication Adherence Scale-8 (MMAS-8) questionnaire consists of 8 question items. For the answer options of the existing questions the respondent can answer “Yes” or “No”. The assessment for each question with the answer “Yes” score = 1 and “No” score = 0. It is said that high compliance is obtained when the score = 0, moderate compliance scores = 1-2, and low compliance when the score is > 2 [9].

WHOQOL-BREF is a measuring tool created by WHO and has been valid ($r = 0.89-0.95$) and reliable ($R = 0.66-0.87$) [14]. This questionnaire has been translated into Indonesian and can be accessed directly on the WHO website. Validity and reliability tests have also been conducted in a study of tuberculosis patients and found the r table value of > 0.361 and a Cronbach alpha value of 0.880 [15]. The WHOQOL-BREF questionnaire consists of 26 question items. There are 24 questions included in 4 qualities of life domains; physical domain, psychological domain, social association domain, and environmental domain, while 2 more questions are general quality of life (QOL) and general health. The calculation is done by calculating the average score of each domain, then multiplied by 4 so that the domain score can be compared with the score used by WHOQOL-100. Later the value obtained will be transformed to a 0-100 scale using the formula $(\text{value} - 4) \times (100/16)$ [14]. Quality of life is classified based on the mean value of each domain; if the value is greater than the mean value then the quality of life is good, and if the value is lower than the mean value then the quality of life is poor [16].

2.6. Ethical consideration

This study was approved by the Health Research Ethics Committee, Faculty of Medicine, University of North Sumatra (Number 875/KEPK/USU/2024). Each participant was required to sign the appropriate consent prior to data collection.

3. Results

Table 1 Characteristics of respondents

Demographic Factors	Frequency (n=101)	Percentage (%)
Age		
19-40 years	45	44.5
41-60 years	32	31.7
>60 years	24	23.8
Mean	44.66	
Standard deviation (SD)	17.41	
Gender		
Male	61	60.4
Female	40	39.6
Education level		
Elementary school	11	10.9

Junior high school	18	17.8
Senior high school	44	43.6
College	28	27.7
Occupation		
Not working	56	55.4
Employed	45	44.6
Comorbid diseases		
None	53	52.5
Present:		
Hypertension	12	11.9
Diabetes Mellitus	30	29.7
Other diseases	6	5.9
Treatment phase		
Intensive (0-2 months)	42	41.6
Continuation (>2 months)	59	58.4

Table 1 illustrates general information about the research subjects. Of the 101 respondents, this study was dominated by the age of 19-40 years (44.6%) with Mean $\pm$ SD (44.66 $\pm$ 17.41), male gender (60.4%), high school education level (43.6%), not working (55.4%), and did not have comorbid diseases (52.5%). Meanwhile, the most common comorbid disease suffered by pulmonary TB patients was diabetes mellitus (29.7%). Most respondents in this study had undergone pulmonary TB treatment for >2 months (58.4%).

Table 2 Description of Treatment Adherence Level

Medication Adherence Level	Frequency (n=101)	Percentage (%)
Low adherence	12	11.9
Moderate adherence	48	47.5
High adherence	41	40.6

Table 2 shows the level of treatment adherence of pulmonary TB patients including low adherence, moderate adherence, and high adherence. In this study, that the level of treatment adherence of pulmonary TB patients was dominated by a moderate level of adherence, namely 48 respondents (47.5%) compared to other levels of adherence.

Table 3. Description of Quality of Life

Quality of Life	Frequency (n=101)	Percentage (%)
General quality of life (QOL)		
Poor	32	31.7
Good	69	68.3
Mean	3.65	
Standard deviation (SD)	0.75	
Physical domain		
Poor	32	31.7
Good	69	68.3
Mean	1.68	
Standard deviation (SD)	0.46	
Psychological domain		
Poor	30	29.7
Good	71	70.3
Mean	1.70	

Standard deviation (SD)	0.45	
Social relationship domain		
Poor	37	36.6
Good	64	63.4
Mean	1.63	
Standard deviation (SD)	0.48	
Environmental domain		
Poor	13	12.9
Good	88	87.1
Mean	1.87	
Standard deviation (SD)	0.33	

Table 3 shows on the overall quality of life of pulmonary TB patients, both those with good quality of life and those with poor quality of life. Quality of life is classified based on the mean value of each domain; if the value is greater than the mean value then the quality of life is good, and vice versa. In this study, all respondents predominated with a good quality of life.

Table 4. Association between Treatment Adherence Level and General Quality of Life

Treatment Adherence Level	General quality of life			p-value
	Poor (n)	Good (n)	Total (n)	
Low	8	4	12	0.008
Moderate	16	32	48	
High	8	33	41	
Total	32	69	101	

Table 4 shows that in this study, respondents with low compliance had good overall quality of life (QOL) in only 4 respondents. Meanwhile, for respondents with moderate and high compliance in treatment, 89 respondents had a higher quality of life. The statistical analysis obtained shows that the p-value = 0.008 is statistically significant. This confirms that there is an association between adherence to treatment and overall quality of life.

Table 5 Association between Treatment Adherence Level and Physical Domain

Treatment Adherence Level	Physical Domain			p-value
	Poor (n)	Good (n)	Total (n)	
Low	8	4	12	0.008
Moderate	16	32	48	
High	8	33	41	
Total	32	69	101	

Table 5 shows that in this study, respondents with low compliance had good physical domain quality of life in only 4 respondents. Meanwhile, 65 respondents with moderate and high compliance in treatment had a better physical domain quality of life. The statistical analysis obtained shows that the p-value = 0.008 is statistically significant. This confirms that there is an association between medication adherence and physical domain quality of life.

Table 6 Association between Treatment Adherence Level and Psychological Domain

Treatment Adherence Level	Psychological Domain			p-value
	Poor (n)	Good (n)	Total (n)	
Low	5	7	12	0.611
Moderate	13	35	48	
High	12	29	41	
Total	30	71	101	

Table 6 shows that, in this study, the overall psychological domain of respondents was found to be in good condition. The statistical analysis obtained shows that the p-value = 0.611 has a statistically insignificant result. This confirms that there is no significant association between treatment compliance and psychological domain quality of life.

Table 7 Association between Treatment Adherence Level and Social Relationship Domain

Treatment Adherence Level	Social Relationship Domain			p-value
	Poor (n)	Good (n)	Total (n)	
Low	7	5	12	0.061
Moderate	20	28	48	
High	10	31	41	
Total	37	64	101	

Table 7 shows that in this study, respondents with low compliance had good social relationships in only 5 respondents. Meanwhile, 59 respondents with moderate and high compliance in treatment had better quality of life in terms of social relationships. The statistical analysis obtained shows that the p-value = 0.061 is not statistically significant, meaning there is no association between medication adherence and the social relationships domain of quality of life.

Table 8 Association between Treatment Adherence Level and Environmental Domain

Treatment Adherence Level	Environmental Domain			p-value
	Poor (n)	Good (n)	Total (n)	
Low	6	6	12	< 0.001
Moderate	5	43	48	
High	2	39	41	
Total	13	88	101	

Table 8 shows that, in this study, the overall dominance of respondents in the environmental domain was good. The statistical analysis obtained shows that low compliance, moderate compliance, and high compliance have p-values < 0.001. These results are statistically significant. This means that there is an association between treatment compliance and quality of life in the environmental domain.

4. Discussion

Bivariate analysis using the Chi-square test showed significant results between treatment adherence and general quality of life ($p=0.008$), physical domain quality of life ($p=0.008$) and environmental domain quality of life ($p<0.001$). In particular, pulmonary TB patients are dominated by the age group 19-40 years (44.6%) with an average age of (44.66) and (17.41) standard deviation. This is different from research conducted at Stella Maris Makassar Hospital (Monika et al., 2023) to 100 respondents where pulmonary TB patients were

mostly found in the age range of 43-49 years (45.7%) [10]. Meanwhile, research conducted at the Segiri Samarinda Health Centre to 46 respondents where pulmonary TB patients were mostly found in the early elderly 46-55 years (39.1%) [17]. Research conducted in Manado, Indonesia to 42 respondents found the most cases of pulmonary TB in productive age (15-55 years) compared to old age (>55 years) [18]. Research conducted in Lagos, Nigeria to 204 respondents found pulmonary TB patients aged 18-39 years (70.6%) [19]. There are several factors that put a person at risk of developing pulmonary TB including productive age, old age and congenital diseases. Productive age is a risk because at that age a person spends a lot of time outside the home which is draining so that it can reduce the body's immunity [18]. Meanwhile, in old age, the body's organs and immunological system have decreased, making it vulnerable to diseases such as TB [20]. In this study, pulmonary TB patients were predominantly male (60.4%). This is in line with research conducted in the Mbeya and Songwe regions, Tanzania to 30 respondents found 24 respondents (80%) were male [21]. A study in Banda Aceh involving 196 respondents also found an increase in pulmonary TB cases among male respondents, numbering 111 respondents (56.6%) [22]. According to the Ministry of Health of the Republic of Indonesia, the results obtained from the survey of the prevalence of pulmonary TB cases in men increased 3 times higher than women. This is because men are more often exposed to TB risk factors such as smoking and lack of knowledge about the disease [20].

The last level of education in this study was dominated by high school respondents (43.6%). This is in line with research conducted at the Puskesmas in Bandung City, where pulmonary TB patients had the highest level of education at the high school level (56%) (8). Research conducted in Ghana, West Africa also showed that the last education level of pulmonary TB patients was at the secondary school level at 96% [12]. Then for the employment variable, it was dominated by respondents who did not work (55.4%). This is supported based on a systematic analysis for the 2021 global burden of disease study conducted in London, England where a decrease in life expectancy including work opportunities occurs in TB patients. This finding is consistent with previous studies showing that tuberculosis can negatively affect patients' socioeconomic conditions, including employment status, work productivity, and overall well-being. The physical limitations and prolonged treatment associated with tuberculosis may contribute to reduced participation in the workforce [23].

In the results of the study conducted by researchers, there were more pulmonary TB patients without comorbid diseases (52.5%). Meanwhile, the most common comorbid disease suffered by pulmonary TB patients is diabetes mellitus (29.7%). This is in line with research conducted in Kyber Pakhtunkhwa, Pakistan, on 269 pulmonary TB patients obtained pulmonary TB patients without comorbid diseases (60.59%), suffering from diabetes mellitus (20.82%), suffering from heart disease (12.64%), and suffering from hepatitis (5.95%) [24]. According to Diandra et al. (2024), in Medan, Indonesia, it was also found that 69% of pulmonary TB patients had no comorbidities, while 31% had comorbidities, with 25% of pulmonary TB patients having diabetes mellitus, 9% having hypertension, 2% having HIV, and 5% having both diabetes mellitus and hypertension [25]. Based on data from the International Diabetes Federation, in the next 2 decades there will be an increase in the prevalence of diabetes mellitus by 50-55%, especially on the African continent [26]. The risk of developing TB in patients with diabetes mellitus is about 3 times higher than that of non-diabetes mellitus patients [27].

Based on the length of treatment of pulmonary TB patients in this study, 59 respondents (58.4%) were dominated by the advanced phase (>2 months). This is in line with research conducted in Makassar to 100 respondents obtained advanced phase pulmonary TB patients (>2 months) as many as 77.2% [10]. However, this study is different from research conducted in Greater Accra, Ghana where the study found more patients with early phase pulmonary TB (0-2 months) of 161 respondents with a percentage of women 61 (61%) and men 100 (66.7%) [28].

Based on the research conducted, the dominance of respondents with pulmonary TB patients was at a moderate level of compliance (47.5%), followed by high compliance (40.6%). This percentage is far from respondents with low compliance (11.9%). This is in line with research conducted in West Java, Indonesia to 100 pulmonary TB patients obtained respondents with moderate compliance (46.6%), high compliance (41.4%) and low compliance (12.1%) [11]. Meanwhile, according to research conducted in Gandaki Province, Nepal to 180 pulmonary TB patients, high compliance (46.1%), moderate compliance (33.3%) and low compliance

(20.6%) were obtained [29]. Research conducted in Dalian, Northeast China on 564 patients found that patients with high compliance were 236 (41.84%), moderate compliance 183 (32.45%) and low compliance 145 (25.71%) [30]. A study conducted in Denpasar, Bali, Indonesia, involving 50 pulmonary TB patients, 76% of patients had high adherence, 24% had moderate adherence, and 0% had low adherence [31]. Based on the results of this study, patient adherence to tuberculosis treatment worldwide is still considered good, as it remains within the range of high to moderate adherence. The level of treatment adherence can be influenced by various factors other than the pulmonary TB patients themselves. Some of the factors are health system factors, environmental factors, therapeutic factors, family support factors and socio-economic factors. In addition, there is also the factor of medication supervision tuberculosis, be it a wife, husband, child, or person around who can monitor pulmonary TB patients during the treatment period [32].

WHOQOL-BREF in assessing the quality of life of pulmonary TB patients. Based on research conducted by researchers, the overall obtained general QOL (68.3%), physical domain quality of life (68.3%), psychological domain quality of life (70.3%), social relationship domain quality of life (63.4%), and environmental domain quality of life (87.1%) are in good condition. This is in line with research conducted in Gandaki Province, Nepal for 180 pulmonary TB patients, which obtained general QOL (79.7%), general health (79.7%), physical domain quality of life (68.5%), psychological domain quality of life (79%), social relationship domain quality of life (65.7%), and environmental domain quality of life (68.5%) in good condition [29]. Furthermore, research conducted in Makassar, Indonesia also found an improvement in quality of life [10]. This was reinforced by research conducted in Samarinda, Indonesia, which found that the overall quality of life of pulmonary TB patients was good [17]. However, in contrast to research conducted by Sinaga in Medan, Indonesia, to 100 respondents, it was found that good quality of life was only obtained from the psychological domain (50%) and social domain (50%) [16]. Based on these results, it can be concluded that respondents of pulmonary TB patients whose quality of life is good can still enjoy their current life by being able to accept, take meaning, and continue to be enthusiastic about all forms of their current life. The quality of life observed in this study was generally consistent with findings from previous studies. This similarity may reflect comparable treatment programs and patient support systems that help patients adapt to the disease and maintain their daily functioning. However, studies reporting lower quality-of-life scores may have included patients with more severe symptoms, a higher prevalence of comorbidities, or poorer socioeconomic conditions, all of which can negatively affect quality of life. While in studies whose physical domain quality of life is poor, it can be caused by the severity of the disease, the duration of symptoms and the presence of comorbid diseases [25].

Based on bivariate analysis, the p -value <0.05 means that there is a significant association between treatment adherence with general QOL and physical domain quality of life. Then in the environmental domain quality of life, the p -value <0.001 was obtained, which means that there is a significant association between treatment adherence and the environmental domain quality of life of pulmonary TB patients. However, in the psychological domain quality of life and social relationship domain, the p -value > 0.05 was obtained, which means that treatment adherence was not associated with quality of life in the psychological and social relationship domains. This may indicate that improvements in these domains are influenced by factors beyond medication adherence alone. Psychological well-being and social functioning may be more strongly affected by emotional support, mental health status, perceived stigma, and interpersonal relationships, which were not assessed in the present study.

Study from Primary Health Care in Labuan Bajo, Indonesia, also found a significant correlation between compliance in taking medication and the quality of life of tuberculosis patients [33]. Adherence affects the success of treatment to 100% completion. Pulmonary TB patients must be compliant in undergoing treatment in order to achieve recovery and good general QOL. If patients are not compliant in taking medication, then treatment becomes ineffective and will have an impact on a much longer treatment period [34]. Research conducted in the Greater Accra region, Ghana, West Africa to 250 respondents of pulmonary TB patients where the quality of life seen from the health of pulmonary TB patients is worse than healthy people and will be much worse if not adherent in treatment [28]. According to the WHO, the average level of patient compliance with chronic diseases in developed countries is only 50%, and in developing countries the number

is even lower. This may be due to several barriers, including limited access to healthcare services, financial difficulties, long treatment duration, medication side effects, inadequate health literacy, and insufficient family or social support, all of which can reduce patients' motivation and ability to adhere to treatment [34].

Research conducted in Nepal on 180 pulmonary TB patients where the quality of life in the physical domain is better (68.5%) and the environmental domain is better (68.5%) in patients who adhere to taking medication [29]. However, in a study conducted by Diandra in Medan, Indonesia, it was found that poor quality of life occurred in the physical domain and environmental domain of pulmonary TB patients, namely in the physical domain by 55% and the environmental domain by 51% [25]. This difference occurs due to several factors including pulmonary TB patients generally sweating at night this can interfere with sleep cycle time [35]. In addition, side effects of the drugs include itching and joint pain [36]. Some pulmonary TB patients feel that they can still do and fulfil their activities and feel safe and not constrained by information or finances. On the other hand, there are also pulmonary TB patients who feel that their illness prevents them from doing their usual activities, so this will be a problem that affects the patient's finances, recreation, and sense of security. Although treatment is free at the polyclinic, transportation costs can be an issue [37].

Based on the observations of researchers in the field, pulmonary TB patients at the TB-DOTS Polyclinic of Prof. dr. Chairuddin P. Lubis Universitas Sumatera Utara Hospital felt that there was no psychological disturbance either for those who were compliant with taking medication or those who were not compliant. This can occur due to the factor of self-ability to accept the condition of the disease being suffered and strive to undergo treatment without having to think about the disease for the sake of recovery to be achieved. However, this result is different from research in Nepal where pulmonary TB patients have a better psychological domain quality of life in patients who adhere to taking medication (79%) [29]. This can happen because when patients come for treatment, they are underweight, have no appetite, coughing which can affect their level of confidence in their psychology.

Then seen from the environmental domain of quality of life, from the data obtained by researchers in the field, that pulmonary TB patients while undergoing treatment have a fear of being avoided from the environment both from the family environment and the surrounding environment. However, that feeling turned out to be erased by seeing that there was always support from the family to remain enthusiastic in undergoing treatment, still being able to have sexual intercourse with certain restrictions, and always wearing masks to maintain contact with others. Thus, social relationships in high, medium, and low adherence can also be good, although with a smaller frequency than in high adherence. However, in other areas it can be found that there are still many areas that consider TB disease to be full of stigma, one of which is in a study conducted in Tabuk, Saudi Arabia, more than 2/3 of the population has a positive attitude but with a different view of knowledge and practice, many of them will avoid someone if they have tuberculosis [38]. Research in Ghana, West Africa found that TB is a disease caused by poverty and low caste, and is considered a punishment from God [39]. Therefore, communication, education, and motivation are needed for both TB patients and people in the area. Stigma greatly affects the psychological quality of life of TB patients.

Since this study found an association between treatment adherence and quality of life, efforts to improve adherence should be prioritized. Family support, encouragement from the social environment, and regular counselling by healthcare workers may help patients' complete treatment and potentially achieve better quality of life outcomes.

This study has limitations where this study is not generalized to all TB patients because the study was only conducted in one hospital, did not study the Multi Drug Resistant (MDR) TB patients, and only have one independent variable, namely treatment adherence level. In addition, this is a cross-sectional study, so that the condition of the patients before and after treatment was not known.

Nevertheless, the results obtained in this study can be a reference for effective treatment management of pulmonary TB patients in the future. Seeing the association between treatment adherence and quality of life of pulmonary TB patients can guide and design strategies for the management of pulmonary TB patients for a better quality of life and help reduce the number of pulmonary TB cases in the world.

5. Conclusion

There is an association between medication adherence and general quality of life (QOL), physical domain, and environmental domain quality of life. However, there is no association between treatment adherence and quality of life in the psychological domain and environmental domain. This research can be a reference in the management of TB patients in primary health care, hospitals and other TB service facilities, regarding the importance of treatment adherence which can be related to the quality of life of TB patients. Further studies with a cohort design, more research sites, and more variables are needed to improve TB management.

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Conflict of Interest Statement

The author declares that there is no conflict of interest in this research.

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