



Health-Related Quality of Life (HRQoL) in Tuberculosis Patients: a Cross-Sectional Study Using the EuroQoL EQ-5D-3L Scale

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Abstract

The measurement of health-related quality of life (HRQoL) of pulmonary tuberculosis (TB) patients is important since TB significantly affects the patient's health and sufferings worldwide. HRQoL indicates the consciousness of patients regarding their physical and mental health. It is, therefore, very relevant in comprehending and measuring the exact impact of the disease state. The current study assessed the HRQoL of TB patients and the correlation between the EQ-5D index score and visual analogue scale (VAS) score. A prospective, cross-sectional study was conducted in February–March, 2022, at Rawalpindi Leprosy Hospital. A total of 400 patients with TB were included in the study. HRQoL was measured by using a validated Urdu version of EuroQoL 5 dimensions 3 level (EQ-5D-3L) and visual analogue scale (EQ-VAS). The overall mean score of EQ-5D and the visual analogue scale (VAS) score were (0.56 ± 0.43) and (65.56 ± 17.02) , respectively. The correlation coefficient of $r = 0.521$ between VAS and EQ-5D indicates that our results are statistically significant. Multivariate linear regression analysis implied that gender and education have a significant impact on the patient quality of life. The current study indicated that tuberculosis negatively affects the mental health, social function, and emotional aspects of the patient's quality of life. The HRQoL data from this study could be used to design future interventions and help prescribers to gain insight into the factors in which patient's health-related quality of life can be improved.

Keywords Tuberculosis · Health-related quality of life · EQ-5D-3L · EQ-VAS · Health states

Key Points

1. Due to the long duration of treatment and use of several agents, tuberculosis can lead to poor health-related quality of life among patients.
2. People living with tuberculosis in Pakistan has extremely poor HRQoL compared to other countries.
3. Policymakers should design behavioral interventions to improve the HRQoL of tuberculosis patients.

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Background

Tuberculosis (TB) is a matter of concern for global public health [1, 2]. Regardless of advancements in the identification and management of TB, approximately 10 million people developed TB, and an estimated 1.4 million people died from TB globally in 2019 [3]. The prevalence of tuberculosis in Pakistan is alarmingly high, and it ranked 6th among the highest burden country in the world for tuberculosis cases. It was estimated that annually 1.5 million people suffer from tuberculosis in Pakistan [4]. TB is an infectious disease that can affect any organ in the human body [5]. In most cases, it affects the lungs, and whenever it affects the lungs, it is referred to as pulmonary tuberculosis (PTB). TB is a curable disease. Despite the availability of effective medication, TB remains a major health concern worldwide [6]. TB patients may undergo several psychological problems, including depression, fear, and anxiety, and socioeconomic issues, in addition to clinical problems because of societal

discrimination and extended 6-month period of treatment during the management of TB [3, 7].

Health-related quality of life (HRQoL) is the person's perception of HRQoL, showing comfort in the areas that are influenced by their health status [8, 9]. A prolonged treatment period for TB can have detrimental effects on the HRQoL of the patients. Low HRQoL is due to the symptoms of TB, side effects of medication therapy, societal stigma, economic costs, anxiety, and depression during the process of treatment [10, 11]. Thus, in addition to the treatment of TB, it is crucial to address the psychological and social problems of patients as well [6].

Pakistan is ranked 5th among 22 countries with the highest burden of TB and 27th among high multidrug-resistant (MDR) TB countries in the world, contributing about 60% of the total TB burden in the Eastern Mediterranean Region. Every year, approximately 510,000 new cases of tuberculosis are reported in the country [11, 12]. TB diagnosis and treatment in Pakistan have not been thoroughly researched. TB patients reported a lack of treatment services rather than a refusal to take medication [10]. In contrast, another study concludes that lack of adherence is mainly due to poor access to treatment and limited interaction between patients and clinicians [13]. It was reported that clinicians underestimate the effect of prolonged TB treatment on the physical and psychological domains of the patient. Therefore, a more accurate picture can be provided through measures of patients' perception of health [14]. HRQoL is an important metric for helping healthcare workers understand their patients' levels of satisfaction and illness. The HRQoL of TB patients undergoing treatment is critical for tracking the impact of drug therapy on disease progression. To the best of our knowledge, no research has been conducted to evaluate HRQoL and the factors that influence it in TB patients in Pakistan's Potohar region. Therefore, the present survey aimed to assess self-reported HRQoL of pulmonary TB patients in Rawalpindi, Pakistan, utilizing the EQ-5D-3L and EQ-VAS (Urdu version) to investigate the impact of TB on HRQoL of the patients.

Methods

Study Designs and Settings

This descriptive, cross-sectional study was conducted at the outpatient department of Rawalpindi Leprosy Hospital, the oldest facility dedicated to the treatment of leprosy in Pakistan and particularly a treatment center for TB. The hospital was developed in 1965 by the Association of German Leprosy and Tuberculosis Relief Association. The hospital has 3 wards with a 97-bed facility providing diagnostic and treatment services for more than 100,000 patients per year.

Inclusion/Exclusion Criteria and Participants Characteristics

The following criteria were selected for inclusion in the study: the patient's age should be 16 or above, diagnosed with TB disease, and the patient can speak or write Urdu (the official language of Pakistan). In this study, only those TB patients were included who were receiving TB therapy. The examination was conducted during the treatment of TB. The patients had different schemes and duration of treatment. Patients were diagnosed through chest X-ray, sputum smear microscopy, and sputum for gene expert tests. Patients with the presence of MDR strains were also included in the study.

The patients with ages below 16 and the patients with comorbidities such as hypertension and diabetes, dementia, immigrants, and those unable to complete the survey were excluded from the study.

Sample Size and Sampling Technique

A simple random sampling technique was used to collect the data from the patients suffering from TB. All the TB patients who fulfilled the outlined criteria have equal chances of being enrolled in the study. The sample size was calculated by using the Rao soft calculator, and the required sample size by this software came out to be 377. The 377-sample size was generated by taking 20,000 TB patients with a 95% confidence interval and a 5% margin of error. We adjusted the sample size by using the following formula: $n = n / (1 - d)$, where $n = 384$ and $d = 5\%$. The required sample size by this formula came out to be 397. For the prevention of any error or missing rate, we approached 400 TB patients at the Rawalpindi Leprosy Hospital.

Study Instrument and Data Collection Procedure

The EuroQoL health-related quality of life scale (EQ-5D-3L) and visual analogue scale (VAS) were calculated to measure the HRQoL of TB patients. The protocol of the study was registered with the EuRoQoL registration foundation (registration ID: 46,800) [9], and we got the validated Urdu version of the EQ-5D-3L questionnaire. The 5 health domains were assessed by EQ-5D: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension had three levels, viz., no problem, some or moderate, problems, and extreme problems corresponding to levels 1, 2, and 3, respectively [15]. The participant's health state was described in 243 different health states. These health states' score ranges from 1 to -0.594 , where 1 indicates the best health state (1111) and -0.594 for the worse health state (3333). The visual analogue scale (EQ-VAS) was also included in EQ-5D-3L. The visual analogue scale

(EQ-VAS) is a calibrated line, and it determined the respondent's self-rated status of health on a graduated (0–100) scale, where 0 indicates feeble health and 100 for the good health of patients [16]. The EQ-5D-3L and VAS are being used for many years for determining the HRQoL of different diseases such as tuberculosis [11], hypertension [17], liver disease [18], HIV/AIDS [9], diabetes [19], and cancer [20].

The data was collected for a period of 2 months (February 2022–March 2022) by using the designed questionnaire which accesses the HRQoL of the patients suffering from TB. The internal consistency and reliability of the questionnaire were validated by using Cronbach's alpha, and it came out to be 0.809. The 0.809 value of Cronbach indicates that our questionnaire was highly reliable. The questionnaire consisted of 2 parts [16]. The first part comprised sociodemographic characteristics of the patients' (age, gender, marital status, level of education, occupation, and locality of the patients) parameters. The information obtained from the patient was also confirmed by the patient's medical record. The second part comprised of EuroQoL HRQoL scale (EQ-5D-3L) and a visual analogue scale (VAS). The study participants were requested to self-assess their health states and rate their health score by using the EuroQoL HRQoL scale (EQ-5D-3L) and visual analogue scale (VAS). The investigator ensures that all the participants understand the nature and purpose of the study. If the participants face any difficulty related to understanding the question, then the investigator assists the patients and makes sure that the patient understands the question. The participants were encouraged to fill all the questions in chronological order and instructed to not skip any question. The patients completed the questionnaire in 20–30 min.

Statistical Analysis

The data was compiled in MS Excel and then analyzed by using the Statistical Package for Social Sciences (SPSS) software version 21.0. The Shapiro–Wilk test was used to determine normality. There was a normal distribution of data; therefore, parametric tests were applied on the collected data. Descriptive and inferential statistics were applied to summarize the characteristics of the data set and to make predictions about a larger population based on the representative sample, respectively.

Descriptive statistics were used to summarize and describe the demographic information and disease-related characteristics of TB patients. The categorical variables were represented in percentages and frequencies, while the continuous variables were described in the means and standard deviations. The mentioned 5 health domains of HRQoL were described as no problems, some problems, and severe problems. For the Pakistani population, EQ-5D preference utility score data were not available for

each state of health. Therefore, the HRQoL index value was calculated by using the time trade-off (TTO) tariff method from the representative sample of the UK population [18, 21]. The chi-square test was used to measure the level of association between study variables. Pearson correlation test was applied to determine any correlation between health-related quality of life (HRQoL) and the visual analogue scale (VAS). Independent sample *t*-tests and ANOVA were applied to determine the statistically significant differences in HRQoL (EQ-5D and EQ-VAS scores) related to the characteristics of TB patients. For regression analysis, only those variables include that show significant variation in HRQoL in univariate analysis. The significant predictor of HRQoL of TB patients was determined by applying a multivariable regression model. Moreover, the impact of two or more independent factors on the dependent variable was predicted using multiple regression analysis. A *P* value of < 0.05 was considered significant at a 95% confidence interval.

Ethical Considerations

This study was ethically approved by the institutional review board (IRB) of Rawalpindi Leprosy Hospital (approval no. RLH-097–2022). The objective and purpose of the study were verbally explained by the principal investigator to the patients. Informed consent was obtained from the patients. The patients were assured that their health information should be kept confidential and disclosed only to the research team. Data were collected after they signed the consent form. The patient's involvement in the study was fully voluntary and without remuneration. All the participants filled out the questionnaire and participated in the study. The study was accomplished according to ethical principles as described in the Helsinki Declaration of 1964, which was revised in 2013 [22], and also follows the rules and regulations of Pakistan for research that involves the human subject.

Results

Sociodemographic

Of the 400 patients, 154 (38.5%) were between the age of 21 and 30 years, and 48 (12%) were above 60 years of age. The mean age was 38.93 ± 16.740 years. Among the patients, 201 (50.3%) were females, and 199 (49.8%) were males. Regarding marital status, 255 (63.8%) were married, 124 (31.0%) were unmarried, and 21 (5.3%) females were widows. Regarding the level of education, 123 (30.8%) were

Table 1 Sociodemographic characteristics of patients ($n=400$)

Variable	Frequency (n)	Percentage (%)
Age (years)		
21–30	154	38.5
31–40	85	21.3
41–50	68	17.0
51–60	45	11.3
> 60	48	12.0
Gender		
Male	199	49.8
Female	201	50.3
Marital status		
Married	255	63.8
Unmarried	124	31.0
Widows	21	5.3
Level of education		
Illiterate	123	30.8
Primary	38	9.5
Middle	48	12.0
Matric	69	17.3
Intermediate	67	16.8
Graduate	47	11.8
Postgraduate	8	2.0
Occupation		
Employed	140	35.0
Unemployed	99	24.75
House worker/wife	161	40.25
Locality		
Urban	284	71.0
Rural	116	29.0

illiterate, and 8 (2%) were postgraduate. Among the patients, 140 (35%) were employed, 99 (24.75%) were unemployed, and 161 (40.25%) females were housewives. Regarding the locality, 284 (71%) of the patients were from urban areas, whereas 116 (29%) were from rural areas (Table 1).

Health-Related Quality of Life

Regarding mobility, 206 (51.5%) patients responded that they had no problem while walking, 138 (34.5%) patients had some problems in walking, and 56 (14%) were confined to bed. Regarding self-care, 272 (68%) patients could take care of themselves, and 92 (23%) patients had some problem while washing or dressing, whereas 36 (9%) were unable to wash or dress. Regarding usual activities, 239 (59.8%) patients could perform their usual activities without any problem, whereas 114 (28.5%) had some problem with performing their daily activities, and 47 (18%) patients were unable to perform their usual activities. Regarding the dimension of pain/discomfort, 145 (36.3%) had no pain, and 190 (47.5%) had moderate pain, whereas 65 (16.3%) patients had extreme pain or discomfort because of the disease. Regarding anxiety/depression, 220 (55%) patients had no anxiety or depression because of the disease, and 135 (33.8%) had some sort of depression because of the disease, whereas 45 (11.3%) were extremely anxious or depressed because of this disease (Table 2).

EQ-5D Health Scores

The EQ-5D index score shows a significant difference between different groups of age ($P=0.000$), marital status ($P=0.013$), level of education ($P<0.05$, $P=0.000$), and different groups of occupation, whereas the EQ-5D score has

Table 2 Responses to EQ-5D questionnaire

Dimension	Description	Frequency	(%)
Mobility	I have no problems in walking about	206	51.5
	I have some problems in walking about	138	34.5
	I am confined to bed	56	14.0
Self-care	I have no problems with self-care	272	68.0
	I have some problems washing or dressing myself	92	23.0
	I am unable to wash or dress myself	36	9.0
Usual activities	I have no problems with performing my usual activities	239	59.8
	I have some problems with performing my usual activities	114	28.5
	I am unable to perform my usual activities	47	11.8
Pain/discomfort	I have no pain or discomfort	145	36.3
	I have moderate pain or discomfort	190	47.5
	I have extreme pain or discomfort	65	16.3
Anxiety/depression	I am not anxious or depressed	220	55.0
	I am moderately anxious or depressed	135	33.8
	I am extremely anxious or depressed	45	11.3

an insignificant difference ($P > 0.05$) between the gender group and related to the locality.

Similarly, the VAS score has significant differences related to the different groups of occupation, levels of education, and insignificant differences ($P < 0.05$) for the gender group and locality group. In contrast to the EQ-5D index score, the VAS score indicates an insignificant difference regarding marital status ($P = 0.177$) and between the different groups of age ($P = 0.094$) (Table 3).

EQ-5D Health States

Ninety-six different EQ-5D states of health were mentioned by patients with TB. The results showed that 82 (20.5%) patients had a health state of 11,111, 32 (8.0%) patients had a health state of 11,121, and 35 (8.8%) patients had a health state of 11,122. The EQ-5D states of health with maximum frequencies were included (Table 4).

Table 4 EQ-5D health states

Health state	Frequency	%
11,111	82	20.5
11,112	12	3.0
11,121	32	8.0
11,122	35	8.8
21,121	13	3.3
21,122	12	3.0
22,221	10	2.5
22,222	19	4.8
33,333	15	3.8

Table 3 EQ-5D health scores

Description	n	Mean EQ-5D Score	S.D	P value	Mean EQ-VAS	S.D	P value
Age** (years)							
21–30	154	0.6374	0.3943	0.000	67.52	18.548	0.094
31–40	85	0.6069	0.3602		65.41	16.551	
41–50	68	0.5503	0.4060		66.69	14.548	
51–60	45	0.3945	0.4978		63.00	16.251	
> 60	48	0.3689	0.5054		60.31	15.892	
Gender*							
Male	199	0.5545	0.4323	0.924	65.42	16.408	0.870
Female	201	0.5586	0.4226		65.70	17.650	
Marital status**							
Married	255	0.5346	0.4362	0.013	64.67	16.818	0.177
Unmarried	124	0.6331	0.3770		67.85	17.457	
Widow	21	0.3721	0.5175		62.86	16.246	
Education**							
Illiterate	123	0.4420	0.4504	0.000	61.59	16.978	0.001
Primary	38	0.4223	0.4633		61.71	19.322	
Middle	48	0.6031	0.4318		65.73	19.074	
Matric	69	0.6509	0.3789		66.38	15.809	
Inter	67	0.6913	0.3615		71.19	13.515	
Graduate	47	0.6188	0.3713		70.91	16.064	
Postgraduate	8	0.3695	0.5157		58.13	17.513	
Occupation**							
Employed	140	0.6079	0.4008	0.000	67.43	16.154	0.001
Unemployed	99	0.5319	0.4356		64.37	17.016	
House worker/wife	161	0.5272	0.4419		64.66	17.714	
Location*							
Urban	284	0.5739	0.4270	0.203	66.58	17.005	0.059
Rural	116	0.5140	0.4256		63.04	16.874	

*Independent sample t-test, **ANOVA

Table 5 Correlation between EQ-5D index and VAS scores

Pearson correlation	EQ-5D index score	VAS score
Correlation coefficient	1	0.521
Sig. (2-tailed) *	-	0.000
N	400	400

Correlation Between EQ-5D Index and VAS Scores

The correlation between the EQ-5D index score and VAS was measured by using Pearson's correlation. The range of correlation values is between +1 and -1. The coefficient of correlation was $r=0.521$ ($P=0.000$) which indicated a statistically significant and moderate linear relationship (Table 5).

The Multivariate Linear Regression Model

The multiple regression table shows the impact of independent variables on health index scores. The table shows that all independent variables have an insignificant impact on the dependent variable except gender and education. Gender has a positive and significant impact on health index score ($P<0.05$), and education also has a positive and significant impact on health index score ($P<0.05$) (Table 6).

The multiple regression table shows the impact of independent variables on the VAS score. The table shows that all independent variables have an insignificant impact on the dependent variable except education. Education has a positive and significant impact on VAS ($P<0.05$) (Table 7).

Discussion

Tuberculosis is a major public health concern around the world. The prolonged therapy and infectious nature of the disease are the reasons for social, physical, and mental

Table 6 Multiple regression model (index score and demographic variables; coefficients matrix)

Variables	β coefficient	95% confidence interval		<i>P</i> value
		Lower bound	Upper bound	
(Constant)		0.445	0.929	0.000
Age	-0.220	-0.099	-0.035	0.000
Gender	0.056	-0.074	0.169	0.440
Marital status	-0.041	-0.104	0.045	0.434
Education	0.122	0.004	0.052	0.023
Occupation	-0.104	-0.123	0.021	0.162
Locality	0.012	-0.082	0.104	0.817

Dependent Variable: Health Index score

Model statistics: $R^2=0.081$; $F=5.751$; $P=0.000$

Table 7 Multiple regression model (VAS score and demographic variables; coefficients matrix)

Variables	β coefficient	95% confidence interval		<i>P</i> value
		Lower bound	Upper bound	
(Constant)		55.780	75.404	0.000
Age	-0.082	-2.289	0.296	0.130
Gender	0.045	-3.384	6.466	0.539
Marital status	0.020	-2.450	3.601	0.709
Education	0.149	0.378	2.327	0.007
Occupation	-0.073	-4.357	1.487	0.335
Locality	-0.046	-5.498	2.047	0.369

Dependent variable: VAS score

Model statistics: $R^2=0.050$; $F=3.429$; $P=0.003$

distress and the poor health quality of TB patients. Unfortunately, a few studies have been conducted in Pakistan to access the impact of disease burden and its prolonged therapy on the HRQoL of patients with TB [2]. The current study was conducted to assess the HRQoL of TB patients at the Rawalpindi Leprosy Hospital's outpatient department (OPD).

The mean EQ-5D score for TB patients was 0.56 ± 0.43 , while the mean EQ-VAS score was 65.56 ± 17.02 . EQ and VAS scores in our study are better than the other study conducted in Pakistan in 2018, which reported a 0.43 score on EQ-5D and a 54.73 score on the VAS [11]. A study conducted in Sri Lanka reported that the mean EQ-VAS score of TB patients at the start of therapy was 59.64 and this mean EQ-VAS score was lower than our study score. But in the Sri Lankan study, the mean EQ-VAS score increased to 78 scores at the end of the 2-month therapy (intensive phase) and increased to 83.4 after 6 months of therapy [6]. The results of our study indicate that most of the patients suffering from TB showed some/moderate problems in the domains of mobility, pain/discomfort, and anxiety/depression which leads to poor HRQoL in TB patients. The prior studies also reported that the physical and psychological domains of HRQoL were affected by TB. These studies mentioned that the social and mental health of people are equally valuable and affected in chronic disease patients along with physical health and these factors attribute to the poor health-related quality of life of TB patients [14, 23, 24]. The result of this study is consistent with the earlier studies conducted in different countries, and these studies concluded that patients' QoL was affected by prolonged TB therapy. The extended duration of TB therapy, the complex drug combination, the adverse drug effects, and the fear of losing the job decrease the health-related quality of life of TB patients. These studies also mention that TB patients have lower HRQoL compared to healthy individuals [25–27]. The poor HRQoL in TB patients might be due to lack of knowledge, loss of income, stigma, and lack of social support, drug side effects, and long treatment duration emerged as important barriers to treatment adherence [28, 29]. A case-control study

conducted in India measured HRQoL scores on a WHO health-related quality of life tool, and they reported that TB patients have lower HRQoL compared to the control group [30]. The current study indicates that patient education and age group have a positive effect on the HRQoL, and these results are very similar to the study conducted in Thailand [31]. The education level leads to better HRQoL, and these results were also supported by the prior study [2]. The current study indicates that 33% of patients have moderate anxiety/depression levels, while 11% are extremely depressed patients, and these results are lower than the previous study conducted by Atif et al. which reported that 67% of patients have depression at the start of the treatment and 23% patients still have depression at the end of the treatment [10]. A study conducted in Yemen observed poor QoL in TB patients, with a significant likelihood of depression, and these findings are consistent with the present study. Hospitalization, social stigma, and difficulty in maintaining family life are some of the factors that contribute to anxiety or depression in tuberculosis patients [23, 32]. In another study, about half of the assessed patients indicated bad or very bad general HRQoL [33]. The previous study conducted to assess HRQoL on both inpatient and outpatient reported that the inpatients ($n=197$) displayed lower HRQoL scores compared to outpatients [34]. Similarly, a study was conducted in Eritrea to assess HRQoL among rifampicin/multidrug-resistant TB (RR/MDR-TB) in comparison to drug-susceptible TB (DS-TB) patients. HRQoL was impaired in both groups, but RR/MDR-TB patients had a worse HRQoL [35]. The HRQoL was diminished in the TB patients [36]. The previous studies reported that HRQoL was poor in TB patients, but after treatment progression, both EQ-5D health utility and EQ-VAS scores were increased [11, 37, 38]

Evidence suggests that improved awareness regarding TB leads to better treatment outcomes and better control over the spread of TB [12]. It has been found that healthcare programs that include holistic assessment of social and psychological aspects of treatment in physical disorders are more likely to be successful [39]. The presence of a pharmacist in an inpatient setting has contributed to the prevention and resolution of problems related to the pharmacotherapeutic management of TB. Pharmacists can position themselves as major players in the therapeutic management of TB inpatients in resource-limited settings [40]. HRQoL was significantly improved in the interventional group that comprised the pharmacist-led interventional program which advocates the vital role of pharmacists in patients' education and a better healthcare system in Pakistan [41].

Clinical Implications

This study has practical implications as its findings highlight the current status of HRQoL among TB patients in Pakistan. The prescriber will be able to gain insight into possible factors that may influence HRQoL among TB patients as a

result of the current analysis. In addition, it will be helpful for designing interventions aimed at improving HRQoL in tuberculosis patients. The current study suggests that specialized centers and programs should be developed to provide TB patients with awareness about healthy activities and enhance their life status.

The HRQoL of TB patients during and after therapy will need to be measured in future studies. As in the present study, the HRQoL of TB patients was measured during the treatment, but not after the treatment was completed. The HRQoL level was certainly better after the treatment compared to during the treatment. The other suggestion is that researchers should conduct further studies in the future to evaluate the HRQoL of TB patients who have comorbidities.

Strengths and Limitations of the Study

The strength of the study was that the investigators make sure that patients understand all the questions so that we can get a more accurate finding of HRQoL level. Moreover, a generic and disease-specific validated questionnaire EuRoQoL EQ-5D VAS was used to measure the HRQoL of the TB patients.

The study also has some limitations. This study was conducted in one city in Pakistan, and the results may not be generalizable to the whole areas and population of the country. Time and financial constraints were also faced during the conduction of the study.

Conclusion

The study participants showed poor EQ-5D index and VAS scores which indicate poor HRQoL in TB patients. VAS score and the EQ-5D index showed a moderate and statistically significant linear relationship. The poor HRQoL among TB patients in Pakistan raises serious concerns, and the finding of this study suggests that the management of TB patients should focus on strategies addressing HRQoL problems. Health education programs and interventions involving pharmacists should also be provided especially in rural areas.

Abbreviations *HRQoL*: Health-related quality of life; *TB*: Tuberculosis; *VAS*: Visual analogue scale

Author Contribution MA conceptualize the idea, MA, MA1, MR, SF, IS, AHA, SUN, AA, AF designed the study. AA, MA1, MR, SF, IS, AHA, SUN, AA, AF collected the data, MA, AA, AF, MA1 analyzed the data, MA, MR generated the tables, MA, MA1, SF, AF written the

first draft of manuscript subsequently edited by AA, AF, IS and SUN. All authors MA, MA1, MR, SF, IS, AHA, SUN, AA, AF approved the final version of the manuscript and are accountable for all aspects of the work. All authors read and approved the final manuscript.

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Data Availability Raw data used in the statistical analysis of this paper can be requested from the corresponding author (MA) on reasonable request.

Code Availability Code availability is available upon reasonable request from the corresponding author.

Declarations

Ethics Approval and Consent to Participate This study was ethically approved by the Institutional review board (IRB) of Rawalpindi Leprosy Hospital (approval no. RLH-097–2022). Written informed consent was taken from all participants.

Consent for Publication Not applicable.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Competing Interests The authors declare no competing interests.

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