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Quality of Life Among Pulmonary Tuberculosis Patients: An Exploratory Study

Surabhi Pasbola[1], Niju Joy[2], Shobita Bansal[3]

[1]Post Graduate, Department of Community Health Nursing, Shri swami Bhumanand College of Nursing & Paramedical Institute, Haridwar, Uttarakhand, India
Corresponding Author Email: *surabhipasbola04081993[at]gmail.com*

[2]Associate Professor, Department of Community Health Nursing, Shri swami Bhumanand College of Nursing & Paramedical Institute, Haridwar, Uttarakhand, India

[3]Associate Professor, Department of Community Health Nursing, Shri swami Bhumanand College of Nursing & Paramedical Institute, Haridwar, Uttarakhand, India

Abstract: ***Background**: In many healthcare settings, health-related quality-of-life has been utilized extensively as a useful indicator of health outcomes and has been crucial in the creation of interventions and policies. Both generic and disease-specific measures may be used to evaluate HRQoL. This diverse term is affected by a complex interplay between one's physical condition, psychological state, personal beliefs, their relationships with others and their relationship to many salient parts of one's surroundings. Specifically, health-related quality of life (HRQOL) is a measure of QOL and how it relates to health. The objective of the study was to evaluate the quality of life among individuals with pulmonary tuberculosis and examine its association with selected demographic variables, as well as compare mean quality-of-life scores across these demographic groups in selected Community Health Centre of Haridwar District, Uttarakhand. **Methodology**: A Quantitative, Non-experimental approach with an exploratory research design was adopted for this study. The present study was conducted at selected Community Health Centre in Haridwar, Uttarakhand. The criterion for the choice of the study setting is subject availability. Data was collected from 138 samples by using SF-36 Questionnaire. **Result**: Pain was quality of life domain with highest mean score (mean 79) and it was followed by physical functioning. The second highest mean score of quality of life was seen in physical functioning (mean=72). Score on quality of life in the role limitation due to physical health domain was very low (49). There is a very strong statistical relationship between education and quality of life in the emotional well-being area. The relationship between smoking status and emotional QOL was 5.472 (P -value < 0.05) that is statistically significant. The associating between quality-of-life social QOL and smoking was 8.178 that statistically is considered very significant. **Conclusion**: On the basis of this finding, it can be stated that there is a need to be focus on role limitation due to physical health of tuberculosis patients. Physical health issues can significantly impact person's ability to perform their roles effectively. By understanding these limitations, healthcare facilities can create supportive environments that promote well-being of the patients.*

Keywords: Quality of Life, Activity of daily living, Physical health, tuberculosis, caregivers

Abbreviation: TB: Tuberculosis**, HRQOL**: health related quality of life**, ADLs:** Activity of daily living**, SDG:** Sustainable development goal, **NTEP:** National tuberculosis elimination programme, **WHO:** World health organization, **NSP:** National strategic programme, **DS-TB:** Drug sensitive Tuberculosis, **MeSH:** Medicine subject headings, **DOTS:** Directly observed treatment short-course

1. Introduction

Tuberculosis (TB) is an infectious disease caused by bacteria from the Mycobacterium tuberculosis complex. The bacteria typically infect the lungs but can also harm other areas of the body. An estimated one in three in the world is infected with this pathogen, most of them with a latent infection. Tuberculosis is airborne, transmitted when somebody having an active pulmonary infection coughs or sneezes [1]. There are two types of TB: latent TB, which means the bacteria are present in the body but not active, and thus not symptomatic or contagious; and active TB, where bacteria multiply, cause disease, and can be infectious to others [2]. Most common symptoms of active TB are cough > 3 weeks duration associated with chest pain, fever, night sweats, fatigue, loss of appetite and weight loss [3]. Diagnosis is based on sputum smear/culture, chest X-rays, and molecular assays [1]. Treatment involves a course of antibiotics- typically isoniazid, rifampicin, ethambutol and pyrazinamide- for at least six months, but drug-resistant TB requires longer, more complex regimens. Despite being preventable and treatable, TB is one of the top causes of death from a single infectious agent worldwide, with more than 10 million new cases diagnosed each year while MDR strains are an ever-increasing public health challenge [3]. In 2025 globally, approximately 10.7 million cases of TB and over 1.2 million deaths from the disease occurred, according to WHO Global Tuberculosis Report [4]. More recent estimates (2026) point to a similar global burden, with incidence steady at roughly 10.5–10.6 million new cases per year. Notably, the 30 high-burden countries were still responsible for 86% of new TB cases, demonstrating that global tuberculosis control efforts remain concentrated in specific regions. This underscores both the magnitude of the challenge and how high-incidence countries need more focused interventions [5].

Tuberculosis (TB) continues to be a major global health crisis, not only contributing to morbidity and mortality but more broadly affecting the wellbeing of infected individuals. Implementation of effective TB treatment regimens has not shown to be successful in preserving the physical, psychological, social and environmental QoL (quality of life) of affected patients. Traditionally, TB treatment has focused on microbiological cure, but the downstream impact on

health-related quality of life (HRQoL) is frequently either underappreciated or neglected [6]. Newer studies highlight that TB patients have substantially worse physical functioning, vitality, social participation and mental health compared to the general population even after successful treatment [7]. Studies from different regions- Malaysia, Canada, Ghana and Egypt- show that TB has multi-dimensional burden. Longitudinal analyses show that although HRQoL improves over the course of treatment, patients typically still report impaired physical and mental health after treatment completion, with a considerable minority meeting criteria for at-risk-ness for depression when treatment is completed [8]. Investigations have further shown that TB diagnosis and therapy are accompanied by emotional distress, stigma and social isolation, which exacerbate the psychosocial consequences of the disease [9]. In context of limited resources, correlates such as age; comorbidities (especially HIV infection and pleuritis with effusion); number of dependents; and distance to treatment center are negatively associated with QoL domains, while family and friend support significantly serve as protective factors. TB also comes with an indirect burden; beyond patients themselves, the disease takes a hidden toll on caregivers. In Egypt, caregivers of TB patients have reported QoL scores that are comparable with those of the patients themselves but considerably lower than those in the general population, especially in social and environmental domains.

Factors including caregiver age, gender, marital status, comorbidities and caregiving support availability have profound effects on the well-being of caregivers. These findings highlight that TB is not just a biomedical disease but also a social one, impacting households and communities on multiple levels [10]. Overall, the literature indicates that demographic factors, clinical comorbidities and social support systems are significant determinants of QoL among TB patients and their caregivers. These are some critical but neglected domains of care for TB, and these dimensions need to be addressed, in conjunction with the provision of biomedical treatment. The paper adds to the literature by examining relationships between TB, quality of life and demographic variables in a combined manner, as such info would help develop a more holistic understanding of the impact of TB and how best to deal with it from patient-centered perspective.

2. Material and Methods

Study design and Setting

This study employed a quantitative, non-experimental exploratory design to evaluate the quality of life among pulmonary tuberculosis patients. The present study was conducted at selected Community Health Centre in Haridwar district, Uttarakhand. The criteria for selecting of the study setting were the availability of subjects, feasibility of conducting the study and the investigator's familiarity with the setting because of clinical exposure.

Participants

The study population comprised of 138 patients diagnosed with pulmonary tuberculosis selected through convenient sampling. Inclusion criteria were patients with pulmonary tuberculosis who consented to participate and were in the continuation phase of treatment. Exclusion criteria included patients unwilling to participate and those diagnosed with multidrug-resistant (MDR-TB) or extensively drug-resistant tuberculosis (XDR-TB).

Data Collection

The samples were first given an explanation of the study's goal. Samples who agreed to take part signed a consent form. Socio-demographic information was gathered on characteristics such age, gender, weight, marital status, education level, employment position, type of residency, drinking and smoking habits, nutrition, and the presence of any other medical conditions. SF-36 Questionnaire, a validated 36-item survey covering eight domains of health (physical functioning, role limitations due to physical and emotional health, energy/fatigue, emotional well-being, social functioning, pain, and general health). Scores were transformed to a 0–100 scale, with higher scores indicating better health. Cronbach's alpha values ranged from 0.67 to 0.94. According to the SF-36 questionnaire, the participant's response to each particular item was recorded on a Likert scale. For the patients who came to the community health center individual short interview session was conducted. The session was only one time session. Reason was; It was not possible to book assessments in advance; they had to be completed during their scheduled appointments and the majority of these participants did not want to engage in group activities because of their cultural origins.

Domains of Focus

The study focused on five areas deemed to be most relevant in relation to PTB and which represented different aspects of the lived experience of the patient. Disability induced by TB The Disability due to TB subscale evaluated the influence of TB symptoms on mobility and daily activities, whereas Role limitation due to physical health addressed limitations in duties resulting from illness. Emotional well-being emphasized the psychological impact and suffering related to the illness, and social functioning focused on experiences of isolation due to stigma (alienation) as well as interpersonal difficulties. Energy/fatigue and vitality/recovery were added as a defining symptom, given their strong metabolic association. Cumulatively, these domains were intentionally chosen for both clinical relevance and statistical strength to keep the analysis focused on the dimensions closest to the disease process from tuberculosis which are most useful in informing interventions that may enhance a patient's well-being.

Rationale for Domain Selection

Drawing attention to these dimensions captures information that is of direct relevance to policy-makers and program developers. It can be used to target areas most affected by PTB for domains (physical recovery, emotional support systems, stigma and social integration) that need to be addressed and enhanced in terms of interventions. Such an individualized approach reveals where resources need to be invested in those patients struggling most, with the potential of obtaining more value from health programs. It did not prioritize other domains, such as general health perception and/or spiritual well-being, because they are less specific to changes due to TB or more complex to standardize across populations. By limiting analysis to clinically meaningful

and statistically robust dimensions, the study ensures that results are interpretable and useful in guiding interventions with reference to the overall quality of life among TB patients.

Key Variables Studied

Education level, marital status, smoking status and presence of comorbid conditions were prioritized by investigators as these factors have been consistently found to be strongly associated with quality of life in patients with tuberculosis. Education was important because it is related to health literacy, adherence to treatment, and improved life style changes leading to better outcomes. Marital status showed to be significant because it is a measure of an emotional and social support, which can lead to effective coping and resilience toward illness [17]. Smoking status was included because smoking causes direct damage on lung function, and also exacerbates the course of TB subsequently reduces quality of life [12]. Comorbid conditions were mentioned as increasing the burden of TB and leading to a decline in both physical and emotional well-being [11]. In comparison, other variables such as sex, employment status, diet and type of caregiver were dropped from a more detailed examination as no significant associations ($p > 0.05$) were observed in this set of data. This selective approach allowed the study to focus on those predictors that were most influential and, thus, provided valuable information with which patient outcomes could be informed and interventions aimed at changing areas where gains can have the greatest impact.

Overall Justification

- By focusing on the strongest predictors, the study identifies modifiable drivers where interventions can have greatest impact.
- They also effectively identify those aspects of health that most impact quality of life for TB patients and therefore may influence how resources are allocated.

Analysis

Responses were compiled into a master sheet and analyzed using descriptive statistics (mean, median, standard deviation) and inferential statistics (chi-square test, Yates correction, one-sample Z test), aligned with study objectives.

Ethical consideration

Ethical approval for the study was obtained from the Institutional Ethics Committee of Shri Swami Bhumanand College of Nursing and Paramedical Institute. All participants were informed about the purpose of the study, and written informed consent was obtained prior to enrollment. Confidentiality of patient information was strictly maintained, and data were anonymized to protect participant identity.

3. Results

Patient demographics

The demographic characteristics of respondents are shown in Table 1. The study shows that majority of the pulmonary tuberculosis i.e. 52% patients were females and followed by 48% were males. With regard to the marital status majority of the pulmonary tuberculosis patients i.e. 62% were married and 38% were Unmarried. Of the 130 samples who provided information regarding educational qualification, majority of the pulmonary tuberculosis patients were literate (68%) only 32% were Illiterate. With regards to employment 72% were unemployed and only 28% of them were employed. Most of the sample i.e. 91% were residing in rural area while only 9% were residing in urban area. Regarding alcoholic status, the bulk of participants (86%), followed by 14%, were non-alcoholic. Majority 75% of the participants were nonsmoker followed by 25% were smoker. In terms of diet, just 16% of participants were vegetarians, whereas 84% of participants were not. In relation to other health issues 19% of the individuals had other health issues, compared to 81% percent who had none. Majority 98% of the participants have primary caregiver followed by 2% have secondary caregiver.

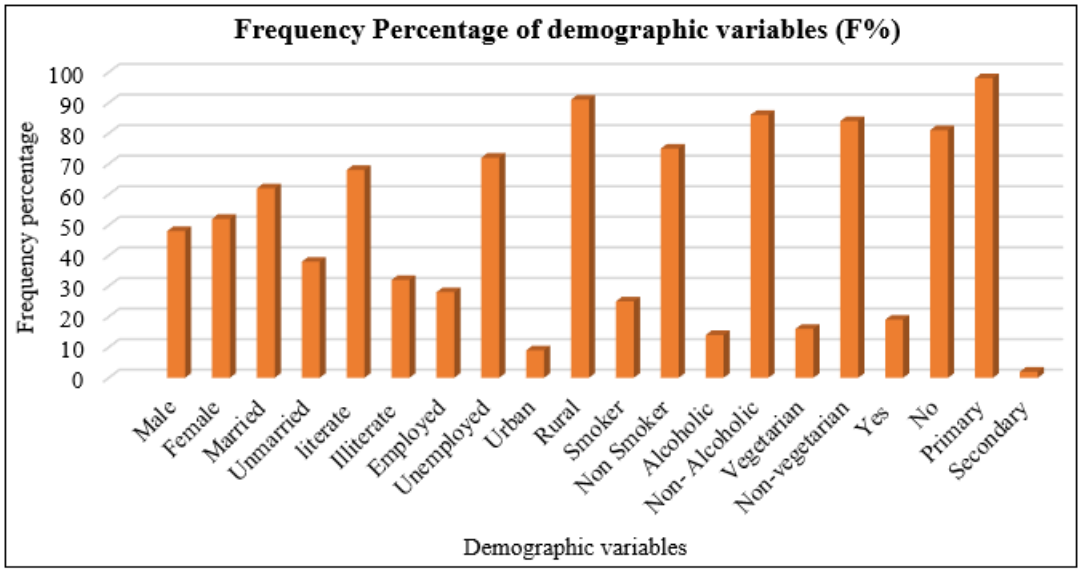

Figure 1: Frequency percentage of demographic variables of tuberculosis patients

Overall Quality of life domain Score of Tuberculosis patients

The SF-36 results show that pain well-being had the highest mean score (79), while role limitations due to physical health were lowest (49). Physical well-being averaged 72, with better outcomes among literates, employed, and those without other health problems, but markedly lower among patients with comorbidities or secondary caregivers. Emotional well-being (65) and social functioning (68) were moderate, though both dropped significantly in smokers, illiterates, and those with additional health issues. Energy/fatigue (60) was reduced in illiterates, smokers, and urban residents, while general health scored lowest overall (53), particularly among smokers, alcoholics, literates, and those with secondary caregivers. Overall, the data highlight that comorbidities, illiteracy, smoking, and reliance on secondary caregivers consistently lowered well-being across domains, whereas literacy, employment, and absence of health problems were associated with higher scores.

Table 1: Overall mean well-being scores of pulmonary tuberculosis patient

S.no.	QOL Domain	Mean well-being score
1	Physical Functioning	72
2	Role limitations due to physical health	49
3	Role Limitations due to emotional health	52
4	Energy /Fatigue	60
5	Emotional well being	65
6	Social functioning	68
7	Pain	79
8	General health	53

Association of Quality-of-Life among pulmonary tuberculosis patient with selected demographic variable

Table-2 shows that demographic and lifestyle factors of pulmonary tuberculosis patients significantly narrate their quality of life and there are statistically significant differences across various domains. Education always indicated very strong associations, e.g. in the physical domain chi-square = 32.24 ($p < 0.0001$), role limitation due to physical health discomfort 20.547 ($p < 0.0001$), or emotional well-being 35.956 ($p < 0.0001$) and social functioning 19.172 ($p < 0.0001$). So, it shows that literate patients were much better to understand because of their awareness about health practices, coping strategies and life styles. Marital status was also found to play a role in the level, indicating that greater energy/fatigue (p – value = 0.0085), emotional well-being (p – value = 0.0002) and social functioning (p – value = 0.0063) scores of married patients than those unmarried could be due to the provision of emotional and social support by spouses which enhances daily routine activities of patients and contributes patient's strengthening on a daily basis. Another determinant that made the difference was smoking as statistically significant associations were found in all magnitude of materials (for example: 6.085 p = 0.0136; 10,006 p = 0.0016; and social functioning between smokers and nonsmokers which shows evidence to a better quality of life among those non-smokers in all domains included in SF-36). Other poor health problems were also very significant ($p < 0.0001$) like 27.514 for Physical Functioning, 25.085 Role Limitation due to Physical Health,23.492 Emotional health and 26.779 in Social Functioning demonstrating the growing load interference by comorbidities with quality-of-life measures. On the other hand, gender, job status, diet type and caregiver type revealed no notable relationship ($p > 0.05$), demonstrating less influence. Taken together, the findings suggest that education level, marital status, smoking behavior and comorbidity are by far the dominant factors associated with quality of life among pulmonary TB patients while other demographic characteristics influence QoL to a slightly lesser extent. For instance, with a computed value of 32.24 and a significance level of less than 0.0001, a very strong correlation between participants' education and quality of life in the physical domain was discovered, because educated patients had better knowledge of their health, a healthy lifestyle, and the effects of health-related issues that result in an unhealthy future." This illustrates how education directly enhances health-related quality of life.

Table 2: Association of Quality-of-Life among pulmonary tuberculosis patient with selected demographic variable

Variable	Domain	Chi-square value	p-value
Education	Physical Functioning	32.24	<0.0001
	Role limitation (physical health)	20.547	<0.0001
	Emotional well-being	35.956	<0.0001
	Social functioning	19.172	<0.0001
Maritial Status	Energy/Fatigue	6.924	0.0085
	Emotional well-being	14.117	0.0002
	Social functioning	7.452	0.0063
Smoking Status	Physical Functioning	6.085	0.0136
	Energy/Fatigue	10.006	0.0016
	Emotional well-being	5.472	0.0193
	Social Functioning	8.178	0.0042
Comorbidities	Physical Functioning	27.514	<0.0001
	Role limitation (physical health)	25.085	<0.0001
	Emotional health	23.492	<0.0001
	Social functioning	26.779	<0.0001
Other factors	Gender, Job status, Diet, Caregiver type	-------	>0.05

Comparison of Quality-of-Life among pulmonary tuberculosis patient with selected demographic variable

The Z-test comparisons (table 3) between quality-of-life domains within pulmonary tuberculosis patients showed several significant differences by demographic and lifestyle factors. For physical functioning, literates scored significantly higher (80.96) against illiterates (54.4), employed scored better (78.78) than unemployed (69.83),

while non-smokers (77.04) and non-alcoholics (74.19) reported significantly higher scores compared to those that smoked (58,13; Z = 6.547, mean difference = 18,91 and alcoholics −score of 61,11; Z=6.538; mean difference -13,08). The same trend was observed with respect to role limitation due to physical health, in which literates (62.92) scored considerably higher than illiterates [22.62; Z = 9.77, mean difference= 40.3)], and non-smokers (53.83) significantly outperformed smokers [37.5; Z = 9.39, mean difference=16.33].

In role limitation due to emotional health, unmarried participants (61.23) had good score compared with married (45.68; Z = 8.34, mean difference = 15.55), followed by non-smokers (56.8) when compared with smokers (35.41; Z = 9.33, mean difference = 21.39). For energy/fatigue, literates (68.01) scored significantly higher than illiterates (43.57; Z = 8.08, mean difference = 24.44), rural residents (60.1) scored significantly higher than urbanites (41.05; Z = 8.75, mean difference = 19.05), and non-smokers (64.79) scored significantly higher than smokers (45.78; Z = 8.14, mean difference = 19.01). For emotional well-being, scored value of literate (72.18) was significantly higher than illiterate (49.24; Z = 7.44, mean difference = 22.94), and non-smokers (68.73) were also significantly higher than smokers (52.63; Z = 7.44, mean difference = 16.1). For social functioning, literate (73.57) scored more than illiterate (57.74; Z = 6.79, mean difference = 15.83), non-smokers (71.68) demonstrated higher score than others (58.59; Z = 6.87, Mean difference: 13.09). In pain, literate participants (87.47) showed higher with respect to illiterate (62.26; Z = 5.60, mean difference = 25.21), rural residents (79.3) showed higher than urban (54.13; Z = 6.66, mean difference = 25.17) with that of non-smokers (84.41) compared to smokers to show highest in comparison to those who were smoking the waterpipe (63..75; Z = 5..70, mean difference=20..66). Comorbidity demonstrated the largest decrement, with scores lower on all domains for instance role limitation due to emotional health (9.33 vs. 61.5; Z = 10.72) and social functioning (51 vs. 72.6; Z = 7.29). Between different domains, differences between groups of patients according to education, cohabitation or not, employment (both social and domestic), smoking and drinking patterns, comorbidities and caregiver type remained significant in univariate analysis: Literate people, non-smokers and never users of alcohol scored significantly better on any domain; there were fewer complaints about QoL in the group without comorbidities than those carrying such diseases while primary caregivers led to far higher scores at all the SF-36 domains.

These results are in accordance with previous studies. A TB patients' health-related quality of life study revealed that education, smoking, and comorbidities are the principal factors influencing it; while literacy can enhance adherence and coping, smoking or chronic diseases can result in poorer physical and psychological domains [13]. A cross-sectional study in Indonesia similarly confirmed that smoking and comorbidities significantly reduce HRQoL scores, while higher education improves them [14]. Studies in Ethiopia found that marital status and social support appear to be important determinants of emotional and social functioning which was consistent with the difference between married and unmarried patients in this study [15]. It is also interesting to note that WHO reports state that comorbidities such as HIV, diabetes, malnutrition and smoking are key drivers of poor TB outcomes; thereby confirming the strong negative associations observed in this particular dataset. [16]

Overall, the findings highlight the requirement of integrated interventions such as health literacy promotion, smoking quit support and management of comorbidities to better physical and psychosocial outcomes in TB care.

Table 3: Comparison of Quality-of-Life among pulmonary tuberculosis patient with selected demographic variable

Domain	Variable	Group comparison	Mean scores	z-value	Mean difference
Physical functioning	Education	Literate vs Illiterate	80.96 vs 54.4	6.53	26.56
	Job status	Employed vs Unemployed	78.78 vs 69.83	5.675	8.95
	Smoking status	Non- smoker vs Smoker	77.04 vs 58.13	6.547	18.91
	Alcohol status	Non-alcoholic vs alcoholic	74.19 vs 61.11	6.538	13.08
	Other Health problem	Yes, vs No	45.8 vs 78.7	7.25	32.6
Role limitation (Physical health)	Marital status	Married vs unmarried	41.98 vs 62.5	8.54	20.52
	Education	Literate vs Illiterate	62.92 vs 22.62	9.77	40.3
	Smoking status	Non-smoker vs Smoker	53.83 vs 37.5	9.39	16.33
	Other Health problem	Yes, vs No	10 vs 59.3	10.824	49.3
Role limitation (Emotional health)	Marital status	Married vs unmarried	45.68 vs 61.23	8.34	15.55
	Education	Literate vs Illiterate	63.258 vs 26.98	9.46	36.28
	Smoking status	Non- smoker vs Smoker	56.8 vs 35.41	9.33	21.39
	Other Health problem	Yes, vs No	9.333 vs 61.5	10.72	52.167
Energy/Fatigue	Education	Literate vs Illiterate	68.01vs 43.57	8.08	24.44
	Residency	Rural vs Urban	60.1 vs 41.05	8.75	19.05
	Smoking status	Non- smoker vs Smoker	64.79 vs 45.78	8.14	19.01
	Other Health problem	Yes, vs No	34.4 vs 66.2	8.79	31.8
Emotional well being	Education	Literate vs Illiterate	72.18 vs 49.24	7.44	22.94
	Smoking status	Non- smoker vs Smoker	68.73 vs 52.63	7.44	16.1
	Other Health problem	Yes, vs No	37.92 vs 71.1	8.25	33.18
Social functioning	Education	Literate vs Illiterate	73.57 vs 57.74	6.79	15.83
	Smoking status	Non- smoker vs Smoker	71.68 vs 58.59	6.87	13.09
	Other Health problem	Yes, vs No	51 vs 72.6	7.29	21.6
Pain	Education	Literate vs Illiterate	87.47 vs 62.26	5.6	25.21
	Residency	Rural vs Urban	79.3 vs 54.13	6.66	25.17
	Smoking status	Non- smoker vs Smoker	84.41 vs 63.75	5.7	20.66

4. Discussion

In the current study, quality of life (QOL) using SF-36 on pulmonary tubercular patients was studied which proved to show a multifaceted effect of TB on its physical, psychological and social spheres. Results showed that patients rated pain and physical functioning the highest, while role-physical and general health were rated the lowest. This pattern emphasizes that the patients adapt themselves to pain, and they sustain some physical functioning despite this sickness causes considerable reduction in their daily activities and sense of health. Similar observations have been shown in previous studies and TB patients presented, in all physical and psychosocial domains, lower levels of functioning compared to the general population.

Education also appeared to significantly influence QOL as the literate patients had better outcomes in all but one domain. This is compatible with previous literature which demonstrated that health literacy improves adherence to treatment, coping strategies and lifestyle changes leading to enhanced HRQL. Marital status was also a factor with married participants having access to social and emotional support – evidence demonstrated in the literature that positive family and community support is important for chronic disease management. Both smoking and co-morbidities significantly decreased QOL scores in all dimensions. Smoking itself damages the lung, interferes with TB treatment and makes it worse, as comorbid conditions such as diabetes or other chronic diseases increase disease burden in the worst way emotionally and physically. These results support WHO's focus on integrated interventions that would cover behavioral risk factors and comorbidity management in the context of TB care. The researcher also found gender disparity where females scored lower in the QOL overall and social dimensions, while better in the physical and environmental dimensions. This finding implies that sociocultural issues, stigma and caregiving roles may meaningfully impact the psychosocial well-being of female beneficiaries more than the male counterparts in line with earlier Indian studies which have used WHOQOL-BREF.

The findings in general highlight that TB disease is not only a biomedical phenomenon; its negative societal and psychological burden should also be addressed. Management of QOL constitutes a multidisciplinary approach in which medical treatment, psychosocial support, health literacy interventions, smoking cessation strategies and control of comorbidities are integrated.

5. Conclusion

This preliminary study indicates that pulmonary TB has a major impact on QoL in various areas; social and physical role limitations owing to physical health and general health were severely comprised. Education, marriage status, smoking history and comorbid conditions were found to be important determinants of QOL, emphasizing the role of social determinants and lifestyle in patient outcomes. The results indicate that the responses to TB may go beyond biomedical treatment, and that measures empowering health literacy, covering psychosocial support and addressing lifestyle risk factors (smoking) should be implemented in the programs. Particular care must be taken for high-risk subgroups such as women and those with comorbid conditions so that QOL improvement occurs in a balanced manner.

By incorporating such knowledge into India's national TB initiatives like the National Tuberculosis Elimination Programme and community-based interventions, such as Pradhan Mantri TB Mukt Bharat Abhiyaan, policymakers can develop patient-centric approaches that heal not only disease but also well-being. Finally, promoting QOL in TB patients is a prerequisite for sustainable progress toward the End TB targets as well as for long-term health benefits.

6. Recommendations

Based on the findings of this study, several recommendations can be made to strengthen tuberculosis care and improve patient quality of life:

- **High quality psychosocial and social support services:** Married patients had advantages in social support, and the unmarried female group had lower scores in emotional and social domains. To fill these gaps, policymakers must increase access to counseling services, peer-support groups and stigma-reduction campaigns.
- **Apply Smoking Cessation and Lifestyle Counseling:** Smoking was consistently associated with lower QOL scores. Smoking cessation counseling, nutritional support and alcohol reduction strategies should be part of routine TB care to enhance long-term outcomes.
- **Address Comorbidities With Integrated Care:** Comorbidities exerted the most severe negative effect in all sectors. TB service provision should be multi-sectoral, with diabetes, HIV, malnutrition and all other chronic diseases diagnosed and managed alongside TB treatment.
- **Quality of Life Assessments in Routine TB Care:** Clinical-care personnel should use such standardized instruments as the SF-36 or WHOQOL-BREF as adjuncts for monitoring patients. This will allow detection of the most affected domains (e.g., role limitations due to physical health and general health perception), as well as early intervention.
- **Strengthen Health Literacy Programs:** Training for Patients and Its Impact on QOL: Targeted hl interventions should be planned as education level was significantly positively associated with improved QOL. These may involve the design of patient-friendly leaflets, counseling and community intervention through workshops to enhance knowledge of TB management, adherence and lifestyle behaviors.
- **Tailor Interventions for Vulnerable Groups:** QOL was significantly lower in women, illiterate patients and those with secondary caregiver. Targeted outreach, gender-tailored counseling and training of caregivers should be ensured for equitable patient improvement.
- **Policy Integration with NTEP and PM-TB Mukt Bharat Abhiyaan:** The results should be used to inform the Indian National Strategic Plan and interventions at the grassroots level. Health policy should invest in psychological and social support, health literacy and

comorbidity for patient-centered, holistic TB elimination strategies.

7. Limitations and Future Research

7.1 Limitations

1) **Single-site study:** The study was carried out in one Community Health Centre of Haridwar, Uttarakhand. Results may not be applicable to other areas with varying health systems, cultural settings and economic status.
2) **Convenience sampling:** Enrollment was conditional on availability, which could introduce selection bias and affect generalizability.
3) **Exclusion of MDR/XDR-TB TB patients:** The study was confined to drug-sensitive pulmonary TB patients. As multidrug-resistant TB patients have a higher burden of physical and psychosocial problems, these results may underestimate the total impact of TB on quality of life.
4) **Cross-sectional design:** Data were collected at a single point in time, preventing assessment of changes in QOL across the treatment trajectory. Longitudinal studies would provide deeper insights into recovery patterns.
5) **Self-reported measures:** The SF-36 relies on patient self-reporting, which may be influenced by recall bias, social desirability, or cultural differences in interpreting health and well-being.
6) **Limited variables:** Although education, marital status, smoking, and comorbidities were analyzed, other potentially important determinants (e.g., income, stigma, nutrition, caregiver burden) were not fully explored.

7.2 Future Research

Future studies of TB and quality of life need to employ more comprehensive and inclusive methods to bolster the evidence for policy making. Further, multi - center studies from various parts of India and among other healthcare settings are required to improve generalizability as well as to reflect regional diversity in patient's experiences. MDR/XDR-TB patients need to be included in such populations, since these resistant cases are often subject to multiple physical, psychological and social burdens that can only be addressed through tailored interventions. Longitudinal studies would enable researchers to follow participants through the diagnosis, treatment and post-treatment phases, permitting a conclusion about how QOL changes over time, and when the most appropriate moments for intervention are. Mixed-methods designs that blend the quantitative measurement (e.g., SF-36) with qualitative interviews may yield a richer understanding of stigma, coping, and lived experience. Policy-relevant research should also assess the role of countrywide campaigns such as Pradhan Mantri TB Mukt Bharat Abhiyaan in working to bridge these gaps so that programmatic efforts translate into tangible gains for well-being. Finally, intervention studies that try out targeted strategies- health literacy programs, psychosocial counseling, smoking cessation and management of comorbidities are necessary to know the effectiveness in terms of improvement in QOL outcomes and provide direction to patient-centered TB care.

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