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Research Article

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Assesment of Health-Related Quality of Life in Post-Tuberculosis Lung Disease Patients: A Cross Sectional Comparative Study

Odinaka CV[1*], Onyedum CC[2], Udeh CF[2], Mbata GC[1], Eke COU[1], Nwosu NI[2], Nlewedim PA[2], Obiefuna AG[2], Chukwuka JC[2] and Agu FC[2]

[1]*Department of Internal Medicine, Federal Teaching Hospital, Owerri, Imo State, Nigeria*

[2]*Department of Internal Medicine, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu State, Nigeria*

[*]Corresponding Author

Odinaka Chinwendu, Department of Internal Medicine, Federal Teaching Hospital, Owerri, Imo State, Nigeria.

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Abstract

Background: *Tuberculosis is a disease of public health importance because of its high morbidity and mortality and also its communicable nature. Pulmonary tuberculosis is an airborne respiratory disease caused by Mycobacterium tuberculosis. It is one of the oldest diseases known to affect man and is a major cause of death globally. Patients treated for pulmonary tuberculosis and cured can come down with poor health-related quality of life and impaired lung function although this has not been extensively studied. This study assessed the quality of life of post-tuberculosis lung disease patients.*

Aim: *The study was done to assess health-related quality of life in post-tuberculosis lung disease patients.*

Methods: *This was a hospital based cross sectional comparative study of post-pulmonary tuberculosis patients attending Federal Teaching Hospital, Owerri, who had completed treatment for tuberculosis at the point of treatment completion down/up to 2 years previously. Interviewer based questionnaire was administered to study participant to obtain data regarding socio-demographics. Other relevant clinical data including health-related Quality of Life of participants were collected using St George's respiratory Questionnaire.*

All participants were subjected to spirometry procedure to measure the ventilatory function parameters using spirolab III. Data was analyzed using IBM SPSS statistics version 25.0. Chi-square was used to determine association between categorical variables. The independent student t-test was used to compare continuous data while one-way ANOVA test was used to compare mean lung volumes of participants across the patterns of lung function with post hoc analysis conducted as appropriate. The Holmes-Bonferonni method was used to correct the analysis for multiple testing. Spearman rank correlation analysis was conducted between the lung volumes and median values of the symptom, impact and activity domains of the St George's Respiratory Questionnaire. A two-sided level of significance of 5% was used in all the analyses.

Results: *Out of the 200 participants recruited, consisting of 100 post-tuberculosis lung disease patients (18 years and above) and 100 age-, sex- and height-matched apparently healthy controls; mean age: 48.0±15.2 for cases and 46.7±13.9 for controls. The most frequent respiratory symptom was cough and sputum production which was present in 56 (56%) and 51 (51%). Respiratory lung function impairment occurred in 71% of cases and 12% of the control. The SGRQ component score for symptoms was 17.1 (IQR 16.8-40.8) followed by impact 1.05 (IQR 0-30.26) and total components 7.48 (IQR 1.20-34.51) for post-TB individuals and none for controls, Also, the current health status were significantly lower in post-TB cases (p = <0.001) compared to controls.*

Conclusion: *Overall, health-related quality of life was significantly reduced across the symptom and impact domains in post-TB individuals compared to healthy controls, highlighting the significant impact of pulmonary tuberculosis on affected individuals even after successful treatment.*

Keywords: Tuberculosis, Post-tuberculosis, Quality of life, Lung function

Abbreviations: TB: Tuberculosis; PTB: Pulmonary Tuberculosis; BMI: Body Mass Index; QOL: Quality of Life; HRQOL: Health-Related Quality of Life; FEV1: Forced Expiratory Volume in one Second; FVC: Forced Vital Capacity; CI: Confidence Interval; WHO: World Health Organisation

1. Introduction

Tuberculosis disease is spread when people who are infected with tuberculosis expel bacteria into the air by coughing, sneezing, talking, and singing [1]. In the immunocompetent host, the alveolar macrophages ingest the M. tuberculosis organisms; whether or not the macrophages destroy the bacteria depends on the degree to which they are activated, the host genetic factors and resistance mechanisms in the bacteria [2]. When innate macrophage microbicidal activity is inadequate to destroy the initial few bacteria of the droplet nucleus, they replicate doubling every 24 hours until the macrophage bursts to release its bacterial progeny. The bacilli spread from the initial lesion via lymphatic or circulatory systems to other parts of the body [2,3,4,6]. It is during this stage of infection that seeding to lung apices occur which is critical to the later development of pulmonary tuberculosis.

Pulmonary tuberculosis is an important risk factor for chronic respiratory diseases because of lasting lung damage [4,5,7]. Post-tuberculosis sequelae add substantially to the overall disease burden caused by tuberculosis and associated adverse patient outcomes including poor health related quality of life as well as increased lung function reduction after completion of treatment [10,12,13,15].

According to WHO (1999), Health-related quality of life (HRQoL) was defined as individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns [19, 20].

Health-related quality of life measures the physical, social, psychosocial and environmental functional status of an individual [20-22]. It is a multi-faceted concept that reflects how a person's health impacts their physical, mental, and social well-being and their ability to function in daily life [19,20]. Chronic diseases such as pulmonary tuberculosis have a strong influence on both physical health and quality of life which collectively make up the health-related quality of life [23,25,26]. Pulmonary tuberculosis is a challenging public health problem associated with poor health related quality of life [12,19,31]. A patient's quality of life is an important measure of effective treatment particularly for PTB [28,29,32,34].

Irreparable lung damage visible as scarring, fibrosis, cavitation, or other types of damage on radiological imaging may occur following pulmonary tuberculosis which may impact on health-related quality of life [13,37,38]. Data on the quality of life of post-TB lung disease patients are limited. This study evaluated patients who have completed treatment for pulmonary tuberculosis for assessment of health-related quality of life with a view to identifying individuals who might require further respiratory function evaluation as part of their post treatment monitoring program.

2. Methods

2.1 Study Design

This was a hospital based cross sectional comparative study that spanned over a period of 7 months that assessed the health-related quality of life of patients treated and cured for pulmonary tuberculosis compared with apparently healthy control who have not been previously treated for PTB. Socio-demographic information included age, gender, marital status, occupation, tribe, level of education and religion. Detailed history was obtained from the participants by the researcher about participants' medical history, and quality of life using St Georges' respiratory questionnaire. Physical examination was carried out by the researcher including general and systemic examinations.

2.2 Inclusion Criteria

For the post-TB patients

1. Patients who gave written informed consent
2. Patients aged 18 years and above
3. Patients who had completed TB treatment and certified cured at six months of treatment completion up to two years.

For the controls

1. Persons who gave written informed consent
2. Persons with no historical evidence of lung disease
3. Persons aged 18 years and above who had not been previously treated for TB

2.3 Exclusion Criteria (For Both Cases and Controls)

1. Persons with active pulmonary tuberculosis
2. Persons with massive haemoptysis and those whose spirometry results fail to meet acceptability and repeatability criteria
3. Individuals with recent myocardial infarction, recent thoracic, abdominal or eye surgery, spine or chest deformities eg kyphoscoliosis, pectus deformities
4. Individuals with pre-existing bronchial asthma, chronic obstructive lung disease, interstitial lung disease, congestive cardiac failure, stroke or neuromuscular disease
5. Individuals with elevated blood pressure ≥ 180/100mmHg and those on long term treatment with drugs eg Bleomycin, Methotrexate, Amiodarone.

2.4 Data Analysis

Data were analysed using the IBM Statistical Package for Social Science (SPSS) version 25.0. Results were expressed as mean ± standard deviation at 95% confidence interval (CI).

Categorical variables (such as gender, symptoms, etc) were expressed as percentages. The independent Student t-test was used to compare continuous data while one-way ANOVA test was used to compare mean lung volumes of participants across the patterns of lung function with post hoc analysis conducted as

appropriate. The Holmes-Bonferonni method was used to correct the analysis for multiple testing. Spearman rank correlation analysis was conducted between the lung volumes and median values of the symptom, impact and activity domains of the St George's Respiratory Questionnaire. A P value of less than 0.05 was considered statistically significant.

3. Results

One hundred post-TB individuals (54 females and 46 males) and 100 controls (56 females and 44 males) were recruited for this study. There was no statistically significant difference in mean age for cases (48.0±15.2 years) relative to the controls (46.7±13.9 years, t=0.660; p=0.510). Of the 100 cases, 9 (9%) had no formal education, 39 (39%) had only primary education, 36(36%) had secondary education while 16 (16%) had up to tertiary education. This was statistically significant (p<0.001) when compared with that of controls. The predominant comorbidity was HIV in the cases 19 (19%) compared to the control group 6 (6%) and this was statistically significant (p=0.005) (Table 1). Thirty-nine (39%) of the cases had been previously treated for tuberculosis.

Table 1: Distribution of sociodemographic characteristics of study participants

	Cases n = 100, (%)	**Control n = 100, (%)**	**Chi-square (*p-value*)**
Gender			
Female	54 (54.0)	56 (56.0)	0.08 (*0.776*)
Male	46 (46.0)	44 (44.0)	
Mean age ± SD (years)	48.0 ±15.2	46.7 ± 13.9	0.660 (*0.510*) [t]
Age groups (in years)			
<25	8 (8.0)	6 (6.0)	1.97 (*0.894*)
25 – 34	11 (11.0)	14 (14.0)	
35 – 44	18 (18.0)	24 (24.0)	
45 – 54	31 (31.0)	28 (28.0)	
55 – 64	18 (18.0)	15 (15.0)	
≥65	14 (14.0)	13 (13.0)	
Education			
No formal education	9 (9.0)	0 (0)	39.54 *(<0.001)*
Primary	39 (39.0)	25 (25.0)	
Secondary	36 (36.0)	19 (19.0)	
Tertiary	16 (16.0)	56 (56.0)	
Marital status			
Single	24 (24.0)	25 (25.0)	3.81 (*0.432)*
Married	47 (47.0)	49 (49.0)	
Divorced	5 (5.0)	1 (1.0)	
Separated	1 (1.0)	0 (0)	
Widowed	23 (23.0)	25 (25.0)	
Smoking	8 (8.0)	2 (2.0)	3.79 (*0.052*)
Alcohol	16 (16.0)	0 (0)	17.39 (*<0.001*)
Comorbidities			
Diabetes	1 (1.0)	1 (1.0)	0 (*1.000*)
Hypertension	5 (5.0)	1 (1.0)	2.75 (*0.097*)
HIV	19 (19.0)	6 (6.0)	7.73 (*0.005*)

[t] independent Student-t test

Those who had been previously treated for tuberculosis more than once had significant cough (p=0.003), sputum production (p=0.004), breathlessness (p=0.013), chest pain (p=0.009) and haemoptysis (p=0.034) as shown in table 2.

Table 2: Association of sociodemographic characteristics with respiratory symptoms in post TB study participants

Symptoms	Cough n = 56, %	χ^2 (p-value)	Sputum n = 51, %	χ^2 (p-value)	Breathlessness n=34, %	χ^2 (p-value)	Chest pain n=31, %	χ^2 (p-value)	Wheezing n=13, %	χ^2 (p-value)	Haemoptysis n=10, %	χ^2 (p-value)
Gender												
Male	29 (51.8)	1.72	25 (49.0)	0.38	20 (58.8)	3.41	14 (45.2)	0.01	4 (30.8)	1.40	7 (70.0)	2.58
Female	27 (48.2)	(0.190)	26 (51.0).	(0.537)	14 (41.2)	(0.065)	17 (54.8)	(0.910)	9 (69.2)	(0.237)	3 (30.0)	(0.108)
Odds Ratio (95% CI)	1.71 (0.77 – 3.80)		1.28 (0.58 – 2.82)		2.20 (0.95 – 5.11)		0.95 (0.41 – 2.23)		0.48 (0.14 – 1.66)		3.05 (0.74 – 12.57)	
Age group												
≤48 years	26 (46.4)	1.58	24 (47.1)	1.02	16 (47.1)	0.50	14 (45.2)	0.84	7 (53.8)	0.02	2 (20.0)	4.56
>48 years	30 (53.6)	(0.208)	27 (52.9)	(0.313)	18 (52.9)	(0.478)	17 (54.8)	(0.359)	6 (46.2)	(0.886)	8 (80.0)	(0.033)
Odds Ratio (95% CI)	0.60 (0.27 – 1.33)		0.67 (0.30 – 1.47)		0.74 (0.32 – 1.70)		0.67 (0.29 – 1.57)		1.09 (0.34 – 3.51)		020 (0.04 – 0.99)	
Level of education												
Up to primary	32 (57.1)	4.26	27 (52.9)	1.02	22 (64.7)	5.76	20 (64.5)	4.91	7 (53.8)	0.21	5 (50.0)	0.02
At least secondary	24 (42.9)	(0.039)	24 (47.1)	(0.313)	12 (35.3)	(0.016)	11 (35.5)	(0.027)	6 (46.2)	(0.651)	5 (50.0)	(0.894)
Odds Ratio (95% CI)	2.33 (1.04 – 5.24)		1.50 (0.68 – 3.30)		2.82 (1.19 – 6.67)		2.66 (1.11 – 6.41)		1.31 (0.41 – 4.22)		1.09 (0.30 – 4.03)	
Marital status												
Currently married	22 (39.3)	3.04	18 (35.3)	5.73	16 (47.1)	0.00	14 (45.2)	0.06	4 (30.8)	1.58	3 (30.0)	1.29
Not currently married	34 (60.7)	(0.081)	33 (64.7)	(0.017)	18 (52.9)	(0.993)	17 (54.8)	(0.805)	9 (69.2)	(0.209)	7 (70.0)	(0.256)
Odds Ratio (95% CI)	0.49 (0.22 – 1.10)		0.38 (0.17 – 0.84)		1.00 (0.44 – 2.30)		0.90 (0.38 – 2.11)		0.45 (0.13 – 1.59)		0.45 (0.11 – 1.84)	
Body Mass Index												
Not overweight/obese	43 (76.8)	0.22	41 (80.4)	1.61	30 (88.2)	4.81	24 (77.4)	0.14	10 (76.9)	0.03	6 (60.0)	1.33
Overweight/obese	13 (23.2)	(0.642)	10 (19.6).	(0.204)	4 (11.8)	(0.028)	7 (22.6)	(0.708)	3 (23.1)	(0.864)	4 (40.0)	(0.248)
Odds Ratio (95% CI)	1.24 (0.50 – 3.08)		1.81 (0.72 – 4.55)		3.50 (1.09 – 11.24)		1.21 (0.45 – 3.29)		1.13 (0.28 – 4.84)		0.46 (0.12 – 1.77)	
Smoking												
Yes	6 (10.7)	1.27	4 (7.8)	0.00	2 (5.9)	0.31	4 (12.9)	1.47	1 (7.7)	0.00	1 (10.0)	0.06
No	50 (89.3)	(0.259)	47 (92.2).	(0.953)	32 (94.1)	(0.575)	27 (87.1)	(0.226)	12 (92.3)	(0.965)	9 (90.0)	(0.806)
Odds Ratio (95% CI)	2.52 (0.48 – 13.15)		0.96 (0.23 – 4.06)		0.63 (0.12 – 3.28)		2.41 (0.56 – 10.33)		0.95 (0.11 – 8.44)		1.32 (0.15 – 11.95)	
Alcohol												
Yes	13 (23.2)	4.93	11 (21.6)	2.40	7 (20.6)	0.81	5 (16.1)	0.00	3 (23.1)	0.56	2 (20.0)	0.13
No	43 (76.8)	(0.026)	40 (78.4).	(0.121)	27 (79.4)	(0.369)	26 (83.9)	(0.981)	10 (76.9)	(0.456)	8 (80.0)	(0.716)
Odds Ratio (95% CI)	4.13 (1.10 – 15.56)		2.42 (0.77 – 7.57)		1.64 (0.55 – 4.88)		1.01 (0.32 – 3.22)		1.71 (0.41 – 7.05)		1.36 (0.26 – 7.07)	
Comorbidities												
Present	11 (19.6)	1.33	10 (19.6)	1.10	7 (20.6)	0.33	9 (29.0)	0.62	1 (7.7)	2.18	2 (20.0)	0.10
Absent	45 (56)	(0.250)	41 (80.4)	(0.294)	27 (79.4)	(0.566)	22 (71.0)	(0.430)	12 (92.3)	(0.140)	8 (80.0)	(0.755)
Odds Ratio (95% CI)	0.58 (0.23 – 1.47)		0.61 (0.24 – 1.54)		0.75 (0.28 – 2.03)		1.47 (0.56 – 3.86)		0.23 (0.03 – 1.88)		0.77 (0.15 – 3.91)	
Previous tuberculosis treatment												
Yes	29 (51.8)	8.75	27 (52.9)	8.50	19 (55.9)	6.17	18 (58.1)	6.86	6 (46.2)	0.32	7 (70.0)	4.49
No	27 (48.2)	(0.003)	24 (47.1)	(0.004)	15 (44.1)	(0.013)	13 (41.9)	(0.009)	7 (53.8)	(0.571)	3 (30.0)	(0.034)
Odds Ratio (95% CI)	3.65 (1.52 – 8.79)		3.47 (1.48 – 8.13)		2.91 (1.24 – 6.86)		3.17 (1.32 – 7.62)		1.40 (0.43 – 4.53)		4.23 (1.02 – 17.49)	

χ^2 – Chi-square; CI – Confidence interval

The prevalence of lung function impairment was 71% among the post-TB cases compared to 12% in the controls; as shown in figure 1.

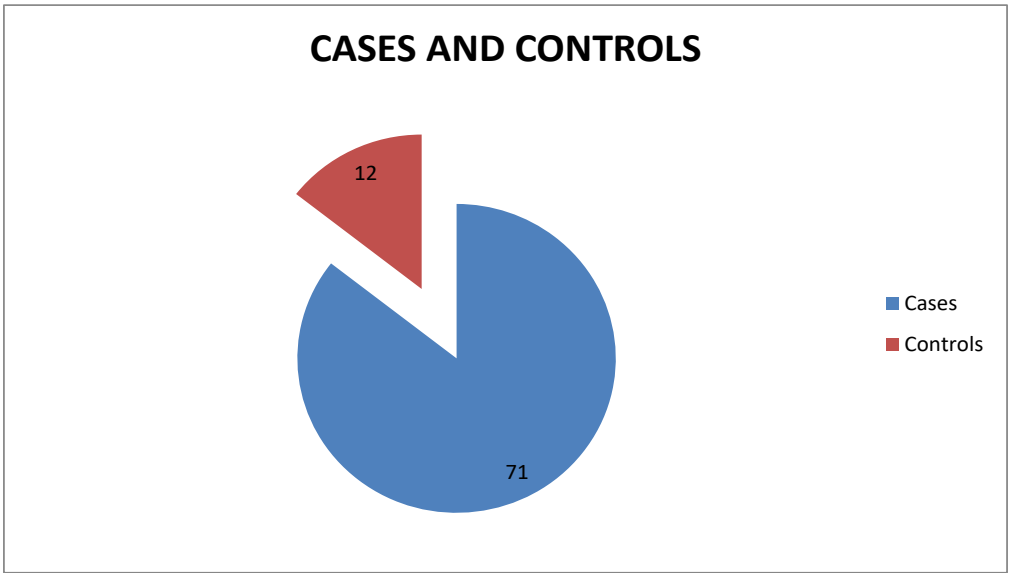

Figure 1: Prevalence of abnormal spirometry in study participants

The mean FEV1 among the post-TB cases was 1.93 ± 0.73L (median z-score -2.06) comparatively lower to that of the control group with mean FEV_1 of 2.40 ± 0.64L (median z-score -0.7) and the difference was statistically significant (t -4.79, p<0.001). Similarly, the mean FVC among the post-TB cases was 2.72 ± 0.87L (median z-score -2.27) which was lower compared to the control group with mean FVC of 3.12 ± 0.88L (median z-score -0.31) and the difference was statistically significant (t -3.22, p=0.001). Also the mean FEV_1/FVC of 69 ± 12.4 among the post-TB cases (t -5.62, p<0.001), mean FEF25-75 of 1.57 ± 0.83 (t -4.67, p<0.001) and mean PEFR of 4.66 ± 1.92 (t -5.34, p<0.001) were statistically significantly lower in the post-TB cases compared to the control group (Table 3). Obstructive ventilatory pattern was the predominant pattern followed by restrictive and mixed patterns (Table 4).

Table 3: Lung function indices of study participants with their z-scores

	Cases ***n = 100*** **mean ± SD**	**Control** ***n = 100*** **mean ± SD**	**Student t** (*p-value*)
FEV_1 (litres)	1.93 ± 0.73	2.40 ± 0.64	-4.79 (*<0.001*)
FEV_1 z-score	-2.06 (-2.80 – -0.55) †	-0.71 (-0.96 – -0.27) †	2769 (*<0.001*) ‡
FVC (litres)	2.72 ± 0.87	3.12 ± 0.88	-3.22 (*0.001*)
FVC z-score	-2.27 (-2.30 – -0.24) †	-0.31 (-0.84 – -0.26) †	3417 (*<0.001*) ‡
FEV_1/FVC (%)	69.5 ± 12.4	77.7 ± 7.9	-5.62 (*<0.001*)
FEV_1/FVC z-score	-1.38 (-2.33 – -0.94) †	-1.34 (-1.38 – -1.21) †	4137 (*0.035*) ‡
FEF_{25-75} (l/sec)	1.57 ± 0.83	2.09 ± 0.75	-4.67 (*<0.001*)
PEFR (l/sec)	4.66 ± 1.92	6.16 ± 2.04	-5.34 (<0.001)

† median (interquartile ranges), ‡ Mann-Whitney U test

Table 4: Distribution of lung function abnormalities in study participants

Lung Function Pattern	**Cases (n, %)**	**Control (n, %)**	**Chi-square (p-value)**
Normal	29 (29.0)	88 (88.0)	73.10 (<0.001)
Obstructive	29 (29.0)	8 (8.0)	
Restrictive	28 (28.0)	3 (3.0)	
Mixed	14 (14.0)	1 (1.0)	
Total	**100 (100.0)**	**100 (100.0)**	

The FEV_1 (p<0.001), FVC (p=0.002), FEF25-75 (p<0.001) and FEV_1/FVC (p<0.001) of the post-TB individuals were significantly reduced across the patterns of lung function impairment as shown in Table 5.

On the average, the mean FEV1 values were about 720ml lower in those with restrictive lung pattern compared to those with a normal pattern (95% CI: 250 to 1,180ml) and 990ml (95%CI: 430 to 1,560ml) lower in those with a mixed pattern compared to the normal. The difference between the mean FEV_1 in those with a normal pattern and those with an obstructive pattern was no longer significant after adjusting for multiple testing by the Bonferroni method (p=0.112). There was no significant difference in mean FEV1 values between those with obstructive, restrictive and mixed patterns (Table 6).

The mean FVC was 770ml higher (95%CI: 180 to 1340ml) in the normal pattern than in those with a restrictive pattern and 710ml higher (95%CI: 10 to 1,430ml) than in those with a mixed pattern. There was no significant difference in the mean FVC values between those with a normal and an obstructive pattern, or between those with obstructive, restrictive and mixed patterns (p>0.05) (Table 6).

Similarly, the mean FEF_{25-75} was significant only between those with a normal lung function pattern and those with obstructive, restrictive and mixed patterns; there were no statistically significant differences in the mean FEF_{25-75} between those with obstructive, restrictive or mixed patterns. Those with a normal pattern had a higher mean FEF25-75 value compared to those with an obstructive pattern (0.67l/s, 95%CI: 0.13 to 1.21l/s), those with a restrictive pattern (0.68l/s, 95%CI: 0.16 to 1.21l/s) and those with a mixed pattern (1.09l/s, 95%CI: 0.44 to 1.73l/s) (Table 6).

The mean FEV_1/FVC of the cases differed between those with normal and obstructive and mixed patterns, but not in those with normal and restrictive patterns. Also, the mean FEV_1/FVC values of the cases were different between those with obstructive and

restrictive patterns and between those with restrictive and mixed patterns. On the average, the mean FEV_1/FVC ratio was 14.8 percentage points (95%CI: 8.6 to 21.0%) higher in those with normal patterns than in those with obstructive patterns and 21.6 percentage points (95%CI: 13.8 to 29.3%) higher than in those with mixed patterns. While it was lower in those with a normal pattern compared to those with a restrictive pattern, this was not statistically significant (-0.6%, 95%CI: -6.9 to 5.6%). For those with a restrictive pattern, the mean ratio was also higher than in those with an obstructive pattern by 15.4 percentage points (95%CI: 9.1 to 21.7%) as well as in those with a mixed pattern by 22.2 percentage points (95%CI: 14.4 to 29.9%) (Table 6). The Lung function patterns showed significant association in those with primary level of education (p=0.043) and underweight individuals (p=0.008) (table 7) while participants above 55 years of age had more of obstructive ventilatory pattern as shown in figure 3.

Table 5: Comparison of lung volumes of post-TB cases by pattern of lung function impairment

Pattern of lung function	FEV_1 (litres) mean±SD	FVC (litres) mean±SD	FEF_{25-75} (l/sec) mean±SD	FEV_1/FVC (%) mean±SD
Normal (n = 29)	2.42 ± 0.83	3.10 ± 0.81	2.11 ± 0.92	76.3 ± 9.1
Obstructive (n = 29)	1.93 ± 0.49	2.89 ± 0.76	1.44 ± 0.78	61.8 ± 6.1
Restrictive (n = 28)	1.71 ± 0.62	2.32 ± 0.93	1.42 ± 0.54	77.3 ± 11.1
Mixed (n = 14)	1.43 ± 0.57	2.39 ± 0.74	1.02 ± 0.70	55.1 ± 7.6
F	9.462	5.356	7.965	33.54
p-value	<0.001	0.002	<0.001	<0.001

F: One-way analysis of variance (ANOVA) test

Table 6: Post-hoc analysis of lung volumes of cases across patterns of lung function impairment

	FEV_1 (l) Mean difference (95% CI)	FVC (l) Mean difference (95% CI)	FEF_{25-75} (l/s) Mean difference (95% CI)	FEV_1/FVC (%) Mean difference (95% CI)
Normal				
Obstructive	0.49 (0.03 to 0.95)	0.20 (-0.38 to 0.79)	*0.67 (0.13 to 1.21)*	*14.8 (8.6 to 21.0)*
Restrictive	*0.72 (0.25 to 1.18)*	*0.77 (0.18 to 1.34)*	*0.68 (0.14 to 1.22)*	-0.6 (-6.9 to 5.6)
Mixed	*0.99 (0.43 to 1.56)*	0.71 (-0.01 to 1.42)	*1.08 (0.42 to 1.75)*	*21.6 (13.8 to 29.3)*
Obstructive				
Normal	-0.49 (-0.95 to -0.03)	-0.20 (-0.79 to 0.38)	*-0.67 (-1.21 to -0.13)*	*-14.8 (-21.0 to -8.6)*
Restrictive	0.22 (-0.24 to 0.69)	0.57 (-0.02 to 1.15)	0.01 (-0.53 to 0.53)	*-15.4 (-21.7 to -9.1)*
Mixed	0.50 (-0.07 to 1.07)	0.50 (-0.22 to 1.23)	0.41 (-0.25 to 1.07)	6.8 (-0.9 to 14.5)
Restrictive				
Normal	-0.72 (-1.18 to -0.25)	*-0.77 (-1.36 to -0.18)*	*-0.68 (-1.22 to -0.14)*	0.6 (-5.6 to 6.9)
Obstructive	-0.22 (-0.69 to 0.24)	-0.57 (-1.15 to 0.02)	-0.01 (-0.55 to 0.53)	15.4 (9.1 to 21.7)
Mixed	0.28 (-0.29 to 0.85)	-0.06 (-0.79 to 0.66)	0.40 (-0.25 to 1.07)	*22.2 (14.4 to 29.9)*
Mixed				
Normal	*-0.99 (-1.56 to -0.43)*	*-0.71 (-1.42 to -0.01)*	*-1.08 (-1.75 to -0.42)*	*-21.6 (-29.3 to -13.8)*
Obstructive	-0.50 (-1.07 to 0.07)	-0.50 (-1.23 to 0.22)	-0.41 (-1.08 to 0.25)	-6.8 (-14.4 to 0.9)
Restrictive	-0.28 (-0.85 to 0.29)	0.06 (-0.66 to 0.79)	-0.40 (-1.07 to 0.26)	*-22.2 (-29.9 to -14.4)*

values in italics are significant (p<0.05)

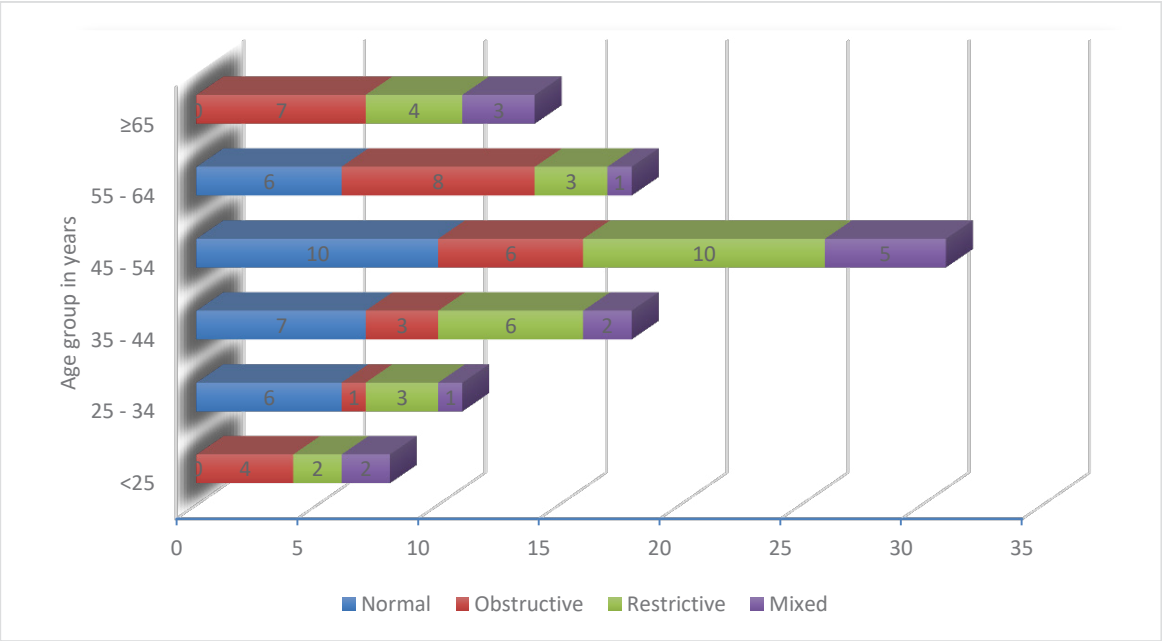

Figure 2: Distribution of lung function by age group in post-TB cases.

Table 7: Association of lung function patterns with sociodemographic factors in post TB individuals

Variable	Normal (n=29) N, %	Obstructive (n=29) N, %	Restrictive (n=28) N, %	Mixed (n=14) N, %	χ^2	*p-value*
Age						
≤48 years	18 (62.1)	11 (37.9)	16 (57.1)	7 (50.0)	3.80	*0.284*
>48 years	11 (37.9)	18 (62.1)	12 (42.9)	7 (50.0)		
Gender						
Male	10 (34.5)	12 (41.4)	15 (53.6)	8 (57.1)	3.47	*0.325*
Female	19 (65.5)	17 (58.6)	13 (46.4)	6 (42.9)		
Level of education						
≤Primary	13 (44.8)	18 (62.1)	8 (28.6)	9 (64.3)	8.14	*0.043*
≥Secondary	16 (55.2)	11 (37.9)	20 (71.4)	5 (35.7)		
Marital status						
Married	15 (51.7)	13 (44.8)	15 (53.6)	4 (28.6)	2.71	*0.439*
Not married	14 (48.3)	16 (55.2)	13 (46.4)	10 (71.4)		
Smoking						
Yes	1 (3.4)	3 (10.3)	3 (10.7)	1 (7.1)	1.33	*0.723*
No	28 (96.6)	26 (89.7)	25 (89.3)	13 (92.9)		
Comorbidities						
Present	9 (31.0)	5 (17.2)	8 (28.6)	2 (14.3)	2.56	*0.465*
Absent	20 (69.0)	24 (82.8)	20 (71.4)	12 (85.7)		
Previous TB treatment						
Yes	10 (34.5)	12 (41.4)	11 (39.3)	6 (42.9)	0.406	*0.939*
No	19 (65.5)	17 (58.6)	17 (60.7)	8 (57.1)		
BMI						
Normal/underweight	15 (51.7)	25 (86.2)	23 (82.1)	12 (85.7)	11.94	*0.008*
Overweight/obese	14 (48.3)	4 (13.8)	5 (17.9)	2 (14.3)		

χ^2 – Chi-square

The current health status of post-TB clients was statistically significantly lower than their healthy counterparts. Quality of life was lower across the symptom 17.1 (IQR 6.8-40.8) and impact 1.05 (IQR 0 – 30.26) domains in post-TB participants compared to controls who never had Pulmonary tuberculosis. This difference was statistically significant with p value < 0.001 as shown in table

8. Reduced lung volume indices (FEV_1, FEF_{25-75} and FEV_1/FVC) were associated with worsened health-related quality of life (table 9)

Table 8: Health status of cases and controls

Current health status	Cases N=100, %	Controls n=100, %	Total n=200, %	χ^2 *(p-value)*
Poor	10 (10.0)	0 (0.0)	10 (5.0)	27.60
Fair	29 (29.0)	10 (10.0)	39 (19.5%)	*(<0.001)*
Good	58 (58.0)	78 (78.0)	136 (68.0)	
Very Good	3 (3.0)	12 (12.0)	15 (7.5)	

χ^2 – Chi-square

Table 9: Spearman correlation coefficient of St. Georges Respiratory Questionnaire scores with lung volumes of cases

	Total	Symptom	Activity	Impact
FEV_1	-0.25*	-0.27**	-0.26*	-0.19
FVC	-0.14	-0.17	-0.13	-0.10
FEF_{25-75}	-0.29**	-0.24**	-0.34	-0.24*
FEV_1/FVC	-0.28**	-0.28	-0.24	-0.31**

* $p<0.05$, ** $p<0.01$

4. Discussion

This study showed that Health-related quality of life was significantly lower across the symptom and impact domains in post-TB patients than in the control group. Median symptom domain score was 17.1 for cases and none for control while median impact domain score was 1.05 for cases and none for control. This is similar with findings by Ozoh et al[12] and Ojuawo et al.19 who noted significant component score for symptom followed by activity and impact domains. In India, Kim et al6 also noted significant decline in HRQoL among post-TB individuals with jeopardised physical and mental health. This was similar to finding in this work which noted compromised current health status. This could be because, in addition to the impact of PTB on the patient's physical health and fitness, the infectious nature of the disease could cause the individual to be stigmatized in the society even after successful treatment causing significant psychological trauma.

The current health status of Post-tuberculosis individuals was significantly lower than the healthy controls. This can be explained by adverse health-related impact of the disease on patients as well as improved socioeconomic standards among the healthy controls. In this study, a greater percentage of the post-TB patients; 58% (58) had good overall quality of life perception compared to 10% (10) of them who had poor perception. This is similar to what was reported by Kastien-Hilka et al20 who found a significant improvement during the treatment course of TB relative to the beginning of TB treatment. These findings point to the favourable impact of successful treatment for tuberculosis on the patients.

5. Conclusion

There is diminished quality of life following treatment for pulmonary tuberculosis in Owerri. This underscores the need for incorporation of health-related quality of life assessment as an essential tool in the evaluation of post-tuberculosis lung disease.

Declarations

Ethics and Consent to Participate: The research was done in compliance with the Helsinki Declaration. The study was approved by the Ethics committee of the Federal Teaching Hospital, Owerri (FMC/OWR/HREC/VOL11./78). Informed consent to participate was obtained from all of the participants.

Consent for Publication: Not applicable.

Availability of Data and Materials: Data are available from the corresponding author upon reasonable request

Competing Interests: The authors declare no conflict of interests

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Contributions

All authors made meaningful contributions to the study

CV and CC– conceptualised the study and wrote the manuscript

NI and PA – assisted with interpretation of results, revised and supervised the writing of the manuscript

CF and AG– assisted with data collation

GC and COU- assisted with interpretation of results

JC and FC – assisted with data analysis

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Author information

Authors and Affiliations

Department of Internal Medicine, Federal Teaching Hospital, Owerri, Imo State, Nigeria

Odinaka CV, Mbata GC, Eke COU

Department of Internal Medicine, College of Medicine and Health Sciences, University of Nigeria Teaching Hospital, Enugu State, Nigeria

Onyedum CC, Udeh CF, Nwosu NI, Nlewedim PA, Obiefuna AG, Chukwuka JC, Agu FC

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