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April 13, 2022
Date

Association between changes in body mass index and self-reported quality of life among patients successfully treated for tuberculosis disease in Tbilisi, Georgia

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Association between changes in body mass index and self-reported quality of life among patients successfully treated for tuberculosis disease in Tbilisi, Georgia

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Abstract

Association between changes in body mass index and self-reported quality of life among patients successfully treated for tuberculosis disease in Tbilisi, Georgia

By Kameela P. Noah

Objective: We aimed to estimate the association between changes in body mass index (BMI) during tuberculosis (TB) treatment with quality of life (QoL) at TB treatment completion.

Methods: We conducted a cross-sectional analysis using data from the Pulmonary Impairment after Tuberculosis Treatment (PITT) study. The PITT study was a cohort study conducted from 2019 to 2022 at the National Center for Tuberculosis and Lung Disease (NCTLD), Tbilisi, Georgia. Newly diagnosed adult (≥16 years) pulmonary TB patients with laboratory-confirmed TB who had BMI recorded at treatment initiation and completion were eligible for analyses. Weight gain was defined as ≥5% increase in BMI from the date of TB treatment initiation to date of completion. The 20-Item Short Form Survey (SF-20) was used to measure quality of life at treatment completion. Patients were defined to have high quality of life if physical (PCS) or mental composite scores (MCS) fell within the highest quartile. Crude and adjusted logistic regression models were used to estimate odds of high QoL.

Results: Among 124 eligible patients enrolled in PITT study, 119 (96.0%) were included in this study. Of these, 67 (56.3%) had ≥5% BMI increase. Among patients who experienced ≥5% BMI increase, 25% (13/52) had high PCS vs. 21% (14/67) among those with no BMI increase. The adjusted odds of reporting high PCS among patients who experienced ≥5% BMI increase were similar compared to those without BMI increase (aOR 1.5; 95% CI 0.6 – 4.0). Among patients who experienced ≥5% BMI increase, 23% (12/52) had high MCS vs. 25% (17/67) among those with no BMI increase. The adjusted odds of reporting higher MCS among patients who experienced ≥5% BMI increase was similar compared to those without BMI increase (aOR 0.9; 95% CI 0.4 – 2.0).

Conclusions: Compared to those with no BMI increase from the beginning to end of TB treatment, patients who had substantial BMI gain had similar odds of reporting high physical or mental QoL at the end of TB treatment.

Policy Implications: Weight gain, measured by increases in BMI from treatment initiation to completion, may not predict QoL at end of TB treatment.

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Introduction

Global Burden of Tuberculosis

Tuberculosis (TB) is a significant global health problem, creating high mortality and morbidity for both the newly diagnosed and survivors. A recent modelling analysis estimated that there were approximately 155 million survivors of TB in 2020.[1, 2] An estimated 122 million disability-adjusted life years (DALYs) are attributed to incident TB disease, and 58 million DALYs are attributed to post-TB sequalae.[1] Post-TB sequalae that hinder survivors' quality of life, like pulmonary impairment, are responsible for 47% of the total disease burden.[1] Despite the large contribution of post-TB sequalae to the overall disease burden, the health of patients after TB is not often considered in public health efforts. Global efforts to reduce the burden of TB have centered on prevention to reduce incidence and mortality.[3] Assessing the quality of life of patients who have completed treatment may provide insight into how to reduce the disease burden of TB over a person's lifetime.

Tuberculosis and Quality of Life

Quality of life is a measure of the multidimensional perception of an individual's and group's mental, physical, and social wellbeing.[4, 5] Quality of life can be reflective of general health, guide disease management evaluation, and assess the impact of TB on individuals' health.[6] Assessing the quality of life of patients post-TB treatment is an important indicator of the success of treatment and prevention programs.[6] Classical biological and clinical measures of successful TB treatment completion (e.g., sputum culture conversion) fail to capture patients' perceptions of day-to-day physical function and mental health.[6] There is no clear guidance on how patients should be followed after TB treatment completion. Measuring quality of life at the

end of treatment may provide a snapshot of patients' health and mental wellbeing, informing clinicians and public health officials how to determine if post-TB follow-up is necessary.

Current literature assessing TB and quality of life is not comprehensive. Most existing studies looking at the relationship between TB and quality of life have used cross-sectional designs and general, non-TB specific survey instruments. For example, the World Health Organization Quality of Life (WHOQOL) instrument developed by the World Health Organization and the 36-Item Short Form Health Survey (SF-36) created for the Medical Outcomes Study, are two of the most used to assess quality of life in newly diagnosed TB patients.[5-8] Moreover, many studies on this subject measure quality of life at diagnosis, but rarely at treatment completion. In the 30 studies included in a recent review of quality of life and TB, 16 collected data longitudinally through treatment completion, and none looked at quality of life after treatment.[8] For instance, the 2012 cross-sectional study conducted in Canada by Bauer et al. assessed quality of life at treatment initiation and found patients newly diagnosed with TB disease had poor quality of life at the start of treatment.[9] The relationship between TB and post-TB quality of life is not well understood; little research has examined factors associated with high quality of life beyond TB diagnosis, especially not after treatment completion.

Measuring quality of life after treatment completion can reveal gaps in treatment regarding the long-term physical, emotional, and social health of TB patients. Research has demonstrated that quality of life in TB patients remains lower than the general population. A recent review reports found even after TB patients successfully completed treatment and were microbiologically cured, their quality of life remained worse than the general population.[10] In an additional review of TB-quality of life, Aggarwal explains, "From a programmatic perspective, one must deviate from the traditional indicators of disease severity and treatment response to

capture the overall health status, with a greater emphasis on patient's, rather than clinician's, perspective of disease."[6] Quality of life assessed after treatment has the potential to redefine treatment success beyond traditional biological/clinical indicators and incorporate patients' ability to function day-to-day.[6] For instance, measuring quality of life after treatment may offer the opportunity to identify how the stigma surrounding TB affects quality of life even after curing disease.[6] Finding modifiable factors associated with high quality of life after treatment can inform patient-oriented care to improve the wellbeing of TB survivors.

Tuberculosis and Body Mass Index

Many studies have investigated the relationship between TB and body mass index (BMI), as weight loss is a common symptom of active disease and low BMI is associated with TB incidence. Previous studies concluded that weight loss during treatment is associated with poor clinical outcomes, like treatment failure and mortality.[11] This is likely due to the relationship between malnutrition and TB.[12] Conversely, weight gain among patients with M/XDR TB disease during the first three months of treatment is associated with improved clinical outcomes, like culture conversion.[13] A 2016 retrospective cohort study conducted from 2010 to 2014 in the United States reported weight gain, defined as a 5% increase in body weight, significantly increased with treatment duration.[14] Additionally, weight gain was predicted by age, treatment duration, and whether patients were underweight at diagnosis.[14] It is possible weight gain is associated with favorable clinical outcomes because it is reflective of improved nutrition.[14] However, it is unknown if an increase in weight gain during TB treatment is a predictor of improved quality of life after treatment.

Study Objective and Aims

Though clinical outcomes have been considered (culture conversion, pulmonary function, inflammatory response) as measures of treatment success, studies appraising quality of life as another measure of success after TB treatment completion are rare. Thus, the purpose of this study was to a) describe the distributions of physical, emotional, social function, health perceptions, role function, and pain quality of life domains measured by the 20-Item Short Form Survey among TB patients after treatment completion, b) explore if changes in BMI (from treatment initiation to completion) are predictive of high quality of life at treatment completion, and c) determine if changes in BMI (from the beginning to the end of TB treatment) are associated with smoking status at treatment completion.

Methods

Study Design and Setting

We conducted a cross-sectional analysis nested within a prospective cohort study entitled "Pulmonary Impairment after Tuberculosis Treatment (PITT)", which was conducted at the National Center for Tuberculosis and Lung Disease (NCTLD) in Tbilisi, Georgia, from 2019 – 2022. Patients in the PITT study were enrolled on the date of TB treatment completion. Eligible participants for this study included patients aged 16 years or older who successfully completed treatment for pulmonary TB disease and had BMI measures at treatment initiation and completion (Figure 1). Pulmonary TB was laboratory confirmed (by a positive *Mycobacterium tuberculosis* culture, or sputum-smear, and/or rapid molecular diagnostic test result). Participants with previous history of TB treatment, prior lung surgery, lung cancer history, or a positive HIV test were excluded from the cross-sectional analysis. Additionally, patients who had extrapulmonary disease only or who had poor TB treatment outcomes were excluded from analyses.

Study Measures and Definitions

The primary exposure was an increase in BMI, defined as at least 5% increase in BMI from date of TB treatment initiation to date of TB treatment completion. The primary exposure was expressed as two-level categorical variable (no substantial increase in BMI vs. ≥ 5% BMI increase). Additionally, a two-level binary variable, reflecting any change in BMI category from the beginning of treatment to completion, was created. To better characterize relative changes in BMI from date of treatment initiation to date of treatment completion, we also created a three-level categorical variable (i.e., no substantial change, increase by ≥5%, decrease by ≥5%), as well as a four-level quartile categorical variable.

The primary outcome of this study was quality of life measured by the 20-Item Short Form Survey, or SF-20. The SF-20 is a standardized instrument developed for the Medical Outcomes Study by RAND, a longitudinal study of patients with chronic conditions.[15] The SF-20 was designed to minimize respondent burden while maintaining precision standards for group comparisons of multiple health domains.[15] The twenty-question survey divides quality of life into six domains: physical functioning, emotional wellbeing, role functioning, social functioning, health perceptions, and pain. The domains are scored from 0 to 100, with a higher score representing a higher quality of life. However, the pain category has a reverse scoring scheme; with a score of 100 reflects a high level of pain, and poorer quality of life.[15]

Three composite scores were created for additional interpretation of quality of life scores; the Total Composite Score, Physical Composite Score, and Mental Composite Score. The Total Composite Score represents the totality of a patients' physical and mental health components. The Total Composite Score summed the scores across all six SF-20 domains. The Physical Composite Score and Mental Composite Score were developed to explore how physical and

mental health domains contribute to the total composite score.[15] The Physical Composite Score is a summary measure of the physical wellbeing of a patient; it reflects patients' quality of life as it relates to physical function and pain.[16] The Physical Composite Score was the sum of the physical functioning, health perceptions, and pain domain scores of the SF-20. The Mental Composite Score reflects the mental health component of patients' quality of life.[16] The Mental Composite Score summed the scores of the emotional wellbeing, role functioning, and social functioning domains. For the simplicity of the physical composite score and total composite score, the reversed pain scoring scheme was used. The physical and mental composite scores range from 0 to 300, with a score of 300 representing the best quality of life measure. The total composite score ranges from 0 to 600, with 600 reflecting the highest quality of life. A high physical, mental, or total composite score was defined as having a score in the fourth quartile. Low physical, mental, or total composite scores were defined as scores that fell beneath the fourth quartile.

Patients' demographic characteristics including gender, age group (16 – 45 years, over 45 years), diabetes status, self-reported smoking status, BMI category at the end of TB treatment (underweight [BMI < 18.5 kg/m^2], normal [BMI 18.5 - 25 kg/m^2], overweight/obese [BMI >25 kg/m^2]), and lung severity were collected at study enrollment (i.e., end of TB treatment). Detailed treatment information and patients' clinical characteristics including drug resistance type, whether they were underweight (i.e., BMI <18.5 kg/m^2) at treatment initiation, and the presence of cavitary disease at TB treatment initiation were collected from patients' medical chart. Drug resistance type was determined by a phenotypic drug sensitivity test at TB diagnosis and were classified as drug-sensitive (i.e., including isoniazid [INH]-monoresistant TB) and multidrug/extensively drug-resistant TB (M/XDR TB). Cavitary disease was defined as the

presence of cavitary lesions on the chest X-ray image obtained at the beginning of TB treatment. Self-reported smoking status was collected at the end of TB treatment by using a study questionnaire (classified as being a current/former smoker vs. never smoked). Lung severity was determined by chest computed tomography performed at the end of TB treatment. To determine lung severity, we scored the degree of impairments on the five lung lobes (ranged from 0 – 20). We then classified lung severity as mild (total severity score 0 – 10), and moderate + severe (total severity score 11 – 20).

Statistical Analyses

Chi-squared tests were used to examine patient demographic and clinical characteristics associated with ≥5% relative increase in BMI from TB treatment initiation to completion. For demographic or clinical characteristics of limited sample size, Fisher's exact tests were used to assess the association between these characteristics and a ≥5% relative increase in BMI from treatment start to finish. Kruskal-Wallis and Wilcoxon rank sum tests were used to analyze the differences in median SF-20 scores and composite scores across relative changes in BMI measured from date of TB treatment initiation to date of treatment completion, as well as across different patient demographic and clinical characteristics. Logistic regression models were used to estimate the association between ≥5% relative changes in BMI from date of treatment initiation to date of completion and SF-20 composite scores expressed in odds ratios (OR) and 95% confidence intervals (95% CI). Two adjusted logistic regression models were performed to account for the effect of potential confounders. Covariates included in the multivariable models were selected after assessing results of bivariate analyses and established confounders from published literature. To assess the association between relative changes in BMI from TB treatment initiation to treatment completion and smoking status (current/former smoker vs. never

smoker), Chi-Square and Fisher's Exact tests were used. Since there was only a small proportion of data was missing (<5%), complete case analyses (i.e., only including study participants with complete information on the variables of interest) were performed. All statistical analyses were performed using SAS version 9.4 (Cary, NC) and a two-sided p-value <0.05 considered significant in all analyses.

Ethical Considerations

This study was reviewed and approved by the ethics committee at NCTLD and Institutional Review Board at Emory University. Informed consent was obtained from all participants prior to completing any study procedures.

Results

Study Populations

During the study period 215 patients were screened at the National Center for Tuberculosis and Lung Disease in Tbilisi, Georgia (Figure 1). Seventy-five patients were ineligible due to exclusion criteria, sponsor decision, or participant refusal. One-hundred forty patients were enrolled, of which 119 had available BMI data at treatment initiation and completion and were considered eligible for cross-sectional analyses. Patients with missing smoking data at treatment completion were excluded from the cross-sectional analysis of relative change in BMI from treatment start to finish by smoking status (N = 118).

Patient Characteristics

Among those included in final analyses, 53 (43.7%) patients reported a ≥5% increase in BMI from TB treatment initiation to treatment completion (Table 1). Nearly a quarter of patients

in our cohort (22/119, 22.7%) experienced a change in BMI category from treatment beginning to completion (Table 2). By the end of TB treatment, most participants in the cohort (62.2%) had BMI within a normal range (BMI 18.5 – 25 kg/m^2). The median percentile increase in BMI from treatment initiation to completion was 4.35% (IQR 0%, 9.43%)(Table 4).

Most patients were male (58.0%) and were aged 16 to 45 years (69.8%) at the end of TB treatment (Table 1). Most patients had drug-sensitive TB disease (76.5%) and the proportion of diabetes at the end of TB treatment was 9.8%. At treatment initiation, 24.4% of participants were underweight and 22.7% had cavitary disease. The proportion of patients who self-reported as a current or former smoker was 43.2%. A small proportion of participants (6.7%) had moderate to severe lung severity, determined by chest computed tomography, at the end of treatment.

Distribution of Quality of Life at Treatment Completion

The median SF-20 measures of quality of life were high among patients who successfully completed TB treatment. For instance, the median SF-20 score for physical health of all the cohort was 100 (IQR 91.7, 100) (Supplemental Table 1). The median health perceptions score of all patients included in analysis was 70.0 (IQR 60.0, 80.0). The median score for pain was 0 (IQR 0, 20.0). The median score for social function was high, at 100 (IQR 100, 100). Patients had a high median emotional health score of 76.0 (IQR 64.0, 84.0) and a high median role-function score of 100 (IQR 100, 100). The median of Total Composite Scores was 522 (IQR 474, 553) at treatment completion (Table 2). The median of Mental and Physical Composite Score, respectively, were 266 (IQR 235, 276) and 260 (IQR 232, 280) at treatment completion.

Association between Relative Changes in Body Mass Index and Quality of Life

The score distributions of the SF-20's six domains were similar among study participants who experienced a ≥5% increase in BMI from treatment initiation to completion vs. those who had no substantial increase in BMI (Table 2). The similarity of the SF-20 domains across the change in BMI variables was consistent, except for the role function domain at the three-level categorical variable (non-substantial BMI change, increased by ≥5%, decreased by ≥5%). Although the median role function score among patients whose BMI increased by ≥5% (100, IQR 100, 100) was similar to those with a non-substantial BMI change (100, IQR 100, 100), the median role function of patients whose BMI decreased by ≥5% (37.5, IQR 0, 75.0) was significantly lower than those who had a non-substantial BMI change (median difference=62.5, p-value 0.045).

Total Composite Score

The distributions of total composite score were similar among study participants who experienced a ≥5% increase in BMI from treatment initiation to completion vs. no substantial increase in BMI (median difference 1.0, p-value 0.927) (Table 3). Study participants who experienced ≥5% BMI increase had a similar proportion of high total composite scores (25.0%, 13/52) compared to those who had no substantial increase (23.9%, 16/67) (OR 1.1 95% CI 0.5, 2.5) (Table 4). The odds of reporting high total composite scores among patients who experienced ≥5% BMI increase was 1.1 (aOR_1 95% CI 0.5 - 2.5) times the odds of those with no substantial increase in BMI after adjusting for age and sex (Table 5). Similarly, the odds of reporting high total composite scores among patients who had ≥5% increase in BMI was 1.2 (aOR_2 95% CI 0.5 - 2.8) times the odds of those with no substantial increase in BMI after adjusted for age, sex, and smoking status at treatment completion.

Physical Composite Score

The physical composite score distributions were similar among study participants who experienced a ≥5% increase in BMI from treatment initiation to completion vs. no substantial increase in BMI (median difference 5.0, p-value 0.927) (Table 3). Study participants who experienced ≥5% BMI increase had a similar proportion of high physical composite scores (25.0%, 13/52) compared to those who had no substantial increase in BMI (20.9%, 14/67) (OR 1.3 95% CI 0.5, 3.0) (Table 4). The odds of reporting high physical composite scores among patients who experienced ≥5% BMI increase was 1.3 (aOR_1 95% CI 0.5 - 3.0) times the odds of those with no substantial increase in BMI after adjusting for age and sex (Table 5). Similarly, the odds of reporting high physical composite scores among patients who had ≥5% increase in BMI was 1.5 (aOR_2 95% CI 0.6 - 4.0) times the odds of those with no substantial increase in BMI after adjusted for age, sex, and smoking status at treatment completion.

Mental Composite Score

The mental composite score distributions were similar among study participants who experienced a ≥5% increase in BMI from treatment initiation to completion vs. no substantial increase in BMI (median difference -2.0, p-value 0.864) (Table 3). Study participants who experienced ≥5% BMI increase had a similar proportion of high mental composite scores (23.1%, 12/52) compared to those who had no substantial increase in BMI (25.4%, 17/67) (OR 0.9 95% CI 0.4, 2.1) (Table 4). The odds of reporting high mental composite scores among patients who experienced ≥5% BMI increase was 0.9 (aOR_1 95% CI 0.4 - 2.0) times the odds of those with no substantial increase in BMI after adjusting for age and sex (Table 5). Similarly, the odds of reporting high mental composite scores among patients who had ≥5% increase in BMI

was 0.9 (aOR_2 95% CI 0.4 - 2.0) times the odds of those with no substantial increase in BMI after adjusted for age, sex, and smoking status at treatment completion.

Smoking Status and Changes in Body Mass Index at Treatment Completion

We conducted an exploratory analysis to examine whether smoking status was associated with change in BMI from treatment initiation to treatment completion. Of the 118 patients included in analysis, the proportion of patients who experienced ≥5% relative increase in BMI was 35.3% among current vs. former smoker vs. 50.8% among those who never smoked (p-value 0.09) (Supplemental Table 3).

Discussion

Overall, we found high self-reported quality of life scores measured by the SF-20 at the end of TB treatment. Importantly, in this cohort of 119 successfully treated TB patients, we found nearly half had a substantial increase in BMI from treatment initiation to treatment completion. Although non-significant, we reported a moderately increased odds of reporting high physical quality of life among patients with a substantial increase in BMI compared to those without a substantial change in BMI after adjusting for potential confounders. Interestingly, after adjusting for potential confounders, the odds of reporting high mental quality of life was slightly lower among patients with a substantial increase in BMI compared to those without a BMI. Overall, our results suggest quality of life does not differ by patients' change in BMI from treatment initiation to completion.

A large proportion of patients in our study experienced weight gain, measured by BMI increase, by the end of TB treatment. Our results are consistent with previous studies that demonstrated patients gain weight over the course of TB treatment. A retrospective cohort study

conducted in the United States from 2010 to 2014 found over half of TB patients' weight increased 5% from treatment initiation to completion (62.4%, p-value < 0.001).[14] Furthermore, the U.S. study found weight increased linearly from treatment initiation to completion among patients whose weight increased by 5% ($\beta = 1.67$, $R^2 = 0.931$, p-value < 0.001).[14]

Our findings of high quality of life at the end of TB treatment are inconsistent with preexisting research. For example, a prospective cohort study of 1,034 patients conducted in 2013 in a North Indian city demonstrated quality of life, measured by mean World Health Organization Quality of Life (WHOQOL-BREF) survey scores, was higher at treatment completion compared to the intensive and continuation TB treatment phases (mean 80.0, SD 12.9, 95% CI [79.1, 80.0], p-value < 0.05).[18] Like the SF-20, the WHOQOL-BREF quality of life scores range from 0 to 100, with a higher score reflecting better quality of life.[18]

Compared to those with no substantial BMI change from the beginning to the end of TB treatment, individuals with ≥5% increase in BMI non-significantly trended toward having higher odds of reporting high physical composite score but lower odds of reporting high mental composite score in our cohort. To our knowledge, there is no other study assessing the relationship between BMI increase and quality of life at the end of TB treatment. Other studies have assessed the association of factors, besides weight gain, with TB-quality of life. Given we did not collect quality of life data at baseline, it is impossible to know whether patients in our study may have worse or improved quality of life by treatment completion. Larger prospective studies to evaluate whether changes in BMI during TB treatment is associated with improved quality of life from the beginning to the end of TB treatment are still warranted.

Plausible mechanisms for improved physical quality of life resulting from weight gain are likely linked to improvements in nutrition during TB treatment. Weight gain is reflective of

improvements in nutrition that combat the wasting indicative of TB.[12] The reversal of wasting may lead to higher physical quality of life. The patients in our study had relatively mild disease and a reasonable median treatment time of 6 months for drug-susceptible TB cases, and 9 months for M/XDR TB cases. The typical duration of treatment may indicate uncomplicated clinical manifestations of TB disease, which could explain the high median quality of life scores at the end of TB treatment that we are observing in our cohort.

Interestingly, patients in our study experiencing weight gain from treatment initiation to completion reported lower median mental quality of life. It has been documented that the association of TB with poor mental health could persist beyond treatment completion.[19] A recent review of 40 studies describing mental health and TB, found the pooled prevalence of depression among those living with TB to be 25% (95% CI 14%, 39%).[19] Of note, some patients in our study were treated for TB during the COVID-19 pandemic. Georgia initiated strict measures to stop the spread of the virus, including stay-at-home orders and the cancellation of large, public events.[20] It is plausible that some TB patients in our cohort may have had low mental quality of life due to stressful obstacles threatening treatment completion, like the stay-at-home mandate.

This study was subject to limitations. First, our results may not be generalizable to TB patients in countries that are not part of the former Soviet Union, have different histories of TB burden (high burden), or who struggle to access TB treatment. Second, our sample was small. It is possible the small sample size capped detectable differences in the six SF-20 domains and composite scores and limited the observation of a significant association of increase in BMI with quality of life. Furthermore, the small size of our sample may have impaired detections of statistical significance when identifying confounders in the bivariate analyses. Third, patients in our study reported relatively mild disease and all were successfully treated for TB. Further

efforts to study the distribution of quality of life and the association between increase in BMI and quality of life stratified by treatment outcomes (success vs. failure) are needed. Fourth, it is also possible TB patients feel marked improvements in their health at treatment success compared to diagnosis and report higher scores than what is accurate. We did not collect quality of life data at treatment initiation, so we cannot determine if improvements in quality of life from beginning to end of TB treatment were made. Last, our study did not capture unmeasured confounders that could distort the association of changes in BMI with quality of life. For instance, unmeasured changes in stress or emotional health due to the COVID-19 pandemic during treatment may have affected how changes in BMI were associated with quality of life. However, our study was the first to report quality of life after successful TB treatment. Our study was a first step towards understanding the quality of life of TB survivors.

Conclusion

Previous studies assessing health-related quality of life among TB patients have not considered weight gain as a predictor of post-TB quality of life. Although non-significant, our cross-sectional analysis suggests patients who experienced weight gain from TB treatment initiation to completion may have moderately increased odds of a high physical composite score than those with no substantial weight gain. Additionally, compared to those with no substantial weight gain during TB treatment, we reported slightly lower odds of having high mental health at treatment completion among those who experienced weight gain. Future studies with larger sample size and the collection of BMI and quality of life data at multiple treatment timepoints (i.e., from TB treatment initiation to treatment end), are still warranted to understand the effect of weight gain on physical and mental well-being of TB patients during and after treatment.

Public Health Significance

Our findings suggest that TB patients' quality of life at treatment completion is not significantly associated with weight gain during treatment. Future studies that include patients with poor TB treatment outcomes and longitudinal analyses of quality of life from the beginning of, during, and post-TB treatment are still warranted to provide a more complete understanding of quality of life among TB patients. Recording BMI throughout TB treatment may provide a simple and affordable measure of patient physical well-being during and after TB treatment. Additionally, interventions to improve post-treatment the emotional wellbeing of TB patients should be considered.

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Tables and Figures

Figure 1. Study flow diagram

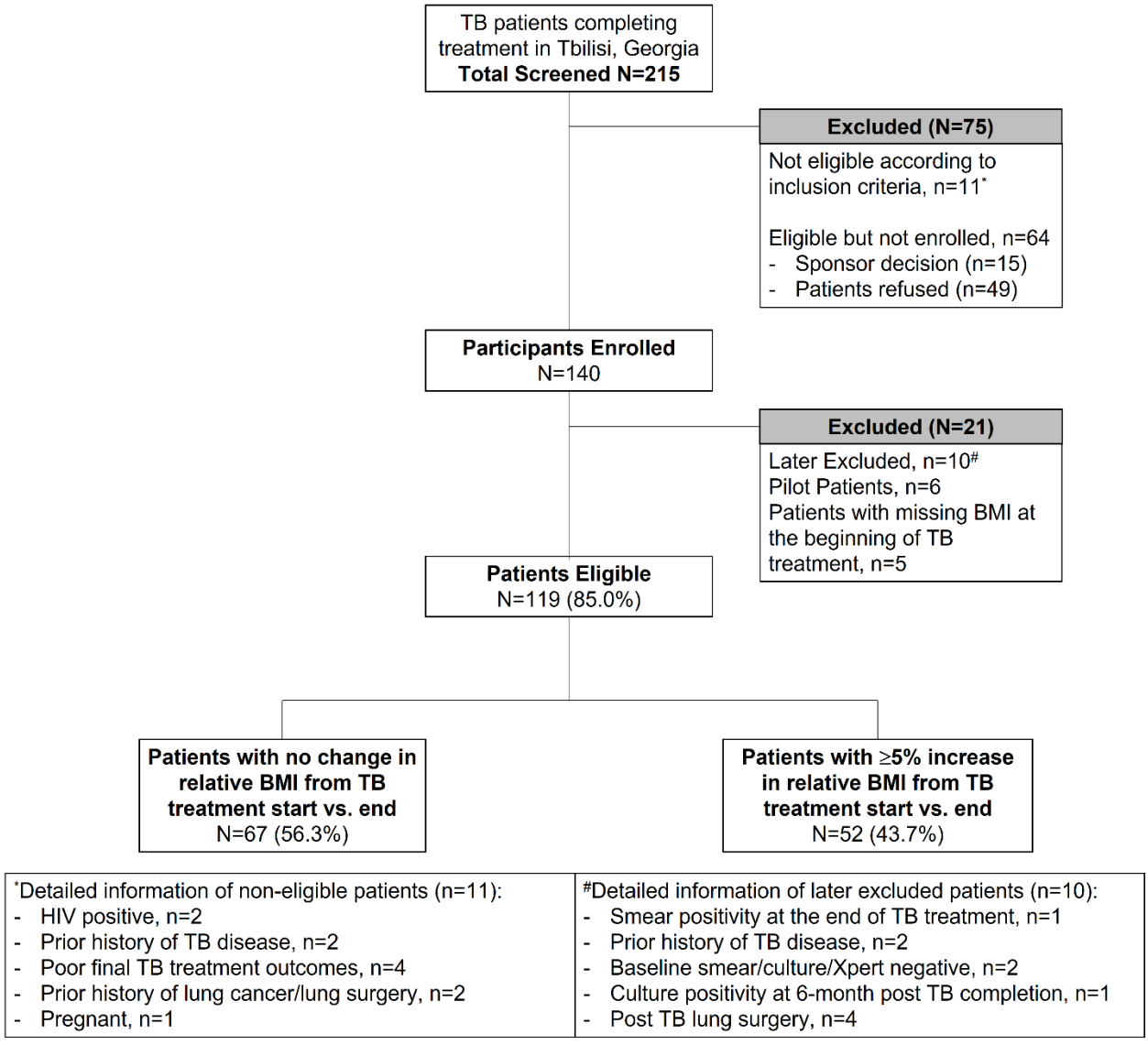

Table 1. Factors associated with increase in BMI during TB treatment among patients successfully treated for TB disease in the country of Georgia, 2019 – 2022 (N=119)

Characteristics	Total N=119*	Increased BMI by 5%		p-values†
		No	Yes	
	N (%)	N (%)=67 (56.3%)	N (%)=52 (43.7%)	
Basic demographic information				
Age group				
16 – 45	83 (69.8%)	46 (55.4)	37 (44.6)	0.769
46 +	36 (30.3%)	21 (58.3)	15 (41.7)	
Sex				
Female	50 (42.0%)	29 (58.0%)	21 (42.0%)	0.751
Male	69 (58.0%)	38 (55.1%)	31 (44.9%)	
Participant characteristics at start of tuberculosis treatment				
Tuberculosis Type				
DSTB	91 (76.5%)	54 (59.3%)	37 (40.7%)	0.228
M/XDR	28 (23.5%)	13 (46.4%)	15 (53.6%)	
Diabetes Status				
Non-diabetic	108 (90.8%)	63 (58.3%)	45 (41.7%)	0.208‡
Diabetic	11 (9.2%)	4 (36.4%)	7 (63.6%)	
Underweight at TB treatment initiation**				
Not underweight	90 (75.6%)	57 (63.3%)	33 (36.7%)	**0.006**
Underweight	29 (24.4%)	10 (34.5%)	19 (65.5%)	
Cavitary Disease				
No	92 (77.3%)	52 (56.5%)	40 (43.5%)	0.929
Yes	27 (22.7%)	15 (55.6%)	12 (44.4%)	
Participant characteristics at the end of tuberculosis treatment				
Smoking Status				
Never Smoker	67 (56.8%)	33 (49.3%)	34 (50.8%)	0.094
Current or former smoker	51 (43.2%)	33 (64.7%)	18 (35.3%)	
BMI category at TB treatment completion				
Underweight	14 (11.8%)	10 (71.4%)	4 (28.6%)	0.477
Normal	74 (62.2%)	40 (54.1%)	34 (46.0%)	
Overweight	31 (26.1%)	17 (54.8%)	14 (45.2%)	
Lung Severity at TB treatment completion				
Mild	111 (93.3%)	64 (57.7%)	47 (42.3%)	0.295‡
Moderate + Severe	8 (6.7%)	3 (37.5%)	5 (62.5%)	

*11 participants had missing BMI at TB treatment initiation

**Patients were classified as underweight if BMI < 18.5 kg/m^2. Patients with BMI over 18.5 kg/m^2 were not considered underweight.

Characteristics	Total N=119*	Increased BMI by 5%		p-values†
		No	Yes	
	N (%)	N (%)=67 (56.3%)	N (%)=52 (43.7%)	

***Underweight if BMI < 18.5 kg/m^2, normal 18.5 kg/m^2 ≤ BMI ≤ 25 kg/m^2, overweight/obese 25 kg/m^2 ≤ BMI ≤ 30 kg/m^2

†p-values obtained from chi-square tests

‡p-values obtained from Fisher's exact tests

Abbreviations:
BMI – body mass index; DSTB – drug-susceptible tuberculosis; M/XDR – multi/extensively drug resistant tuberculosis; TB – tuberculosis

Bold indicates that the findings are significant at α=0.05

Table 2. Treatment completion 20-Item Short Form Survey (SF-20) scores by change in BMI among patients successfully treated for TB disease in the country of Georgia, 2019 – 2022 (N=119)

Change of BMI during TB treatment	Total N=119 n (%)	Physical median (IQR)	Emotional median (IQR)	Role median (IQR)	Social median (IQR)	Health Perceptions median (IQR)	Pain median (IQR)
Number of items	20	6	5	2	1	5	1
Theoretical score range		0-100	0-100	0-100	0-100	0-100	100-0
Median (IQR) of all Cohort		100 (91.7 – 100)	76.0 (64.0 – 84.0)	100 (100 – 100)	100 (100 – 100)	70.0 (60.0 – 80.0)	0 (0 – 20.0)
Change in BMI Category							
Any change in BMI category							
No	92 (77.3%)	100 (91.7 - 100)	76.0 (66.0 - 84.0)	100 (100 - 100)	100 (100 - 100)	70.0 (60.0 - 80.0)	0 (0 - 20.0)
Yes	27 (22.7%)	100 (91.7 - 100)	72.0 (60.0 - 84.0)	100 (75.0 - 100)	100 (100 - 100)	75.0 (60.0 - 85.0)	0 (0 - 20.0)
p-value*		0.159	0.721	1.000	0.561	0.229	0.829
Relative Change in BMI							
Relative Change in BMI#							
Non-substantial change (-5% < *x* <5%)	65 (54.6%)	100 (91.7, 100)	76.0 (60.0, 84.0)	100 (100, 100)	100 (100, 100)	70.0 (60.0 - 80.0)	0 (0 - 20.0)
Increased by ≥5%	52 (43.7%)	100 (91.7, 100)	76.0 (66.0, 80.0)	100 (100, 100)	100 (100, 100)	70.0 (60.0 - 85.0)	0 (0 - 20.0)
Decreased by ≥5%	2 (1.7%)	83.3 (66.7, 100)	62.0 (40.0, 84.0)	37.5 (0, 75.0)	100 (100, 100)	65.0 (50.0 - 80.0)	20.0 (0 - 40.0)
P-value†		0.612	0.898	**0.045**	0.785	0.849	0.708
≥5% Increase in Relative BMI Change							
No	67 (56.3%)	100 (91.7, 100)	76.0 (60.0, 84.0)	100 (75.0, 100)	100 (100, 100)	70.0 (60.0 - 80.0)	0 (0 - 20.0)
Yes	52 (43.7%)	100 (91.7, 100)	76.0 (66.0, 80.0)	100 (100, 100)	100 (100, 100)	70.0 (60.0 - 85.0)	0 (0 - 20.0)
P-value*		0.749	0.904	0.512	0.991	0.628	0.678
Relative BMI Change in Quartile#							
Quartile 1 (≤0)	31 (26.1%)	100 (91.7, 100)	76.0 (56.0, 84.0)	100 (50.0, 100)	100 (100, 100)	70.0 (60.0 - 80.0)	0 (0 - 20.0)
Quartile 2 (0.01 - 4.35%)	29 (24.4%)	100 (91.7, 100)	76.0 (68.0, 84.0)	100 (100, 100)	100 (100, 100)	70.0 (60.0 - 80.0)	0 (0 - 0)
Quartile 3 (4.36 - 9.43%)	28 (23.5%)	100 (95.8, 100)	76.0 (64.0, 80.0)	100 (75.0, 100)	100 (90.0, 100)	70.0 (60.0 - 82.5)	0 (0 - 20.0)
Quartile 4 (> 9.43%)	31 (26.1%)	100 (91.7, 100)	72.0 (64.0, 84.0)	100 (100, 100)	100 (100, 100)	75.0 (60.0 - 85.0)	0 (0 - 20.0)
P-value†		0.531	0.968	0.408	0.784	0.822	0.355

Change of BMI during TB treatment	**Total N=119 n (%)**	**Physical median (IQR)**	**Emotional median (IQR)**	**Role median (IQR)**	**Social median (IQR)**	**Health Perceptions median (IQR)**	**Pain median (IQR)**
Number of items	20	6	5	2	1	5	1
Theoretical score range		0-100	0-100	0-100	0-100	0-100	100-0
Median (IQR) of all Cohort		100 (91.7 – 100)	76.0 (64.0 – 84.0)	100 (100 – 100)	100 (100 – 100)	70.0 (60.0 – 80.0)	0 (0 – 20.0)
High relative BMI Change (x > 9.43%)[#]							
No	88 (74.0%)	100 (91.7, 100)	76.0 (60.0, 80.0)	100 (75.0, 100)	100 (100, 100)	70.0 (60.0, 80.0)	0 (0, 20.0)
Yes	31 (26.1%)	100 (91.7, 100)	72.0 (64.0, 84.0)	100 (100, 100)	100 (100, 100)	75.0 (60.0, 85.0)	0 (0, 20.0)
p-value[*]		0.118	0.809	0.153	0.500	0.267	0.938

[#]With x=relative BMI change presented in %

[*]p-values obtained from Wilcoxon rank-sum tests

[†]P-values obtained from Kruskal-Wallis test

Abbreviations:

BMI – body mass index; IQR – interquartile range

Bold indicates that the findings are significant at α=0.05

Table 3. Total composite 20-Item Short Form Survey (SF-20) scores by change in BMI from treatment initiation to completion among patients successfully treated for TB disease in the country of Georgia, 2019 – 2022 (N=119)

Change of BMI during TB treatment	Total N=119 n (%)	Physical Components Score Median (IQR)	Mental Components Score Median (IQR)	Total Composite Score median (IQR)
Number of items	20	3	3	6
Theoretical score range		0 - 300	0 - 300	0-600
Median (IQR) of all Cohort		260 (232 – 280)	268 (242 – 276)	525 (475 - 557)
Change in BMI Category				
Any change in BMI category				
No	92 (77.3%)	260 (235 – 280)	268 (241 – 276)	525 (477 – 556)
Yes	27 (22.7%)	270 (232 – 285)	263 (248 – 280)	528 (454 – 562)
p-value*		0.901	0.889	0.882
Relative Change in BMI				
Relative Change in BMI#				
Non-substantial change (-5% < *x* <5%)	65 (54.6%)	260 (235 - 280)	268 (234 – 280)	525 (475 – 556)
Increased by ≥5%	52 (43.7%)	265 (231 – 283)	266 (248 – 276)	526 (474 – 558)
Decreased by ≥5%	2 (1.7%)	228 (177 – 280)	200 (140 – 259)	428 (317 – 539)
P-value†		0.865	0.318	0.710
≥5% Increase in Relative BMI Change				
No	67 (56.3%)	260 (235 – 280)	268 (230 – 280)	525 (475 – 556)
Yes	52 (43.7%)	265 (231 – 283)	266 (248 – 276)	526 (474 – 558)
P-value*		0.976	0.864	0.927
Relative BMI Change in Quartile#				
Quartile 1 (≤0)	31 (26.1%)	250 (235 – 280)	260 (220 – 280)	508 (459 – 545)
Quartile 2 (0.01 - 4.35%)	29 (24.4%)	265 (245 – 280)	268 (244 – 276)	532 (478 – 560)
Quartile 3 (4.36 - 9.43%)	28 (23.5%)	266 (228 – 283)	266 (236 – 276)	524 (478 – 561)
Quartile 4 (> 9.43%)	31 (26.1%)	262 (230 – 280)	268 (256 – 284)	524 (464 – 557)
P-value†		0.729	0.771	0.813
High relative BMI Change (x > 9.43)#				
No	88 (74.0%)	260.0 (235.0, 280.0)	264.0 (230.0, 276.0)	518.3 (473.7, 553.0)

Change of BMI during TB treatment	**Total N=119 n (%)**	**Physical Components Score Median (IQR)**	**Mental Components Score Median (IQR)**	**Total Composite Score median (IQR)**
Number of items	20	3	3	6
Theoretical score range		0 - 300	0 - 300	0-600
Median (IQR) of all Cohort		260 (232 – 280)	268 (242 – 276)	525 (475 - 557)
Yes	31 (26.1%)	261.7 (230.0, 280.0)	268.0 (256.0, 284.0)	524.0 (463.7, 557.0)
p-value*		0.961	0.377	0.741

[#]With x=relative BMI change presented in %
*p-values obtained from Wilcoxon rank-sum tests
[†]P-values obtained from Kruskal-Wallis test
Abbreviations:
BMI – body mass index; IQR – interquartile range
Bold indicates that the findings are significant at α=0.05

Table 4. Logistic regression analyses to evaluate the effect of changes in body mass index from tuberculosis treatment initiation to completion on high quality of life measured by 20-Item Short Form Survey composite scores, among patients successfully treated for TB disease in the country of Georgia, 2019 – 2022 (N=119)

Patients' Characteristics	Odds Ratio (95% Confidence Interval)*					
	High Physical Component Score* (PCS) n (%) = 27 (22.7%)		High Mental Component Score (MCS) n (%) = 29 (24.4%)		High Total Composite Score (TCS) n (%) = 29 (24.4%)	
	n/Total (%)	Crude OR	n/Total (%)	Crude OR	n/Total (%)	Crude OR
Change in BMI Category						
No	20/92 (21.7)	Ref	21/92 (22.8)	Ref	21/92 (22.8)	Ref
Yes	7/27 (25.9)	1.3 (0.4, 3.3)	8/27 (29.6)	1.4 (0.5, 3.6)	8/27 (29.6)	1.4 (0.5, 3.6)
≥5% Increase in Relative BMI Change						
No	14/67 (20.9)	Ref	17/67 (25.4)	Ref	16/67 (23.9)	Ref
Yes	13/52 (25.0)	1.3 (0.5, 3.0)	12/52 (23.1)	0.9 (0.4, 2.1)	13/52 (25.0)	1.1 (0.5, 2.5)
Relative BMI Change in Quartile#						
Quartile 1 (≤0)	6/31 (19.4)	Ref	8/31 (25.8)	Ref	6/31 (19.4)	Ref
Quartile 2 (0.01 - 4.35%)	7/29 (24.1)	1.3 (0.4, 4.7)	7/29 (24.1)	0.9 (0.3, 3.0)	8/29 (27.6)	1.6 (0.5, 5.5)
Quartile 3 (4.36 - 9.43%)	7/28 (25.0)	1.4 (0.4, 2.9)	6/28 (21.4)	0.8 (0.2, 2.6)	8/28 (28.6)	1.7 (0.5, 5.8)
Quartile 4 (> 9.43%)	7/31 (22.6)	1.2 (0.4, 4.3)	8/31 (25.8)	1.0 (0.3, 3.2)	7/31 (22.6)	1.2 (0.4, 4.3)
High relative BMI Change (x > 9.43%)#						
No	20/88 (22.7)	Ref	21/88 (23.9)	Ref	22/88 (25.0)	Ref
Yes	7/31 (22.6)	1.0 (0.4, 2.6)	8/31 (25.8)	1.1 (0.4, 2.8)	7/31 (22.6)	0.88 (0.3, 2.2)

*High Physical, Mental, and Total Composite scores are defined as falling within the fourth quartile.
#With x=relative BMI change presented in %
Abbreviations:
BMI – body mass index; IQR – interquartile range; Ref – Reference group
Bold indicates that the findings are significant at α=0.05

Table 5. Multivariable logistic regression analyses to evaluate the effect of changes in BMI during TB treatment on high quality of life measured by 20-Item Short Form Survey (SF-20) composite scores, among patients successfully treated for TB disease in the country of Georgia, 2019 – 2022 (N=119)

Patients' Characteristics	Adjusted Odds Ratio (95% Confidence Interval)					
	High Physical Component Score* (PCS) n (%) = 27 (22.7%)		High Mental Component Score (MCS) n (%) = 29 (24.4%)		High Total Composite Score (TCS) n (%) = 29 (24.4%)	
	Model 1* aOR (95%CI)	Model 2† aOR (95%CI)	Model 1* aOR (95%CI)	Model 2† aOR (95%CI)	Model 1* aOR (95%CI)	Model 2† aOR (95%CI)
Change in BMI Category						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.3 (0.4, 3.4)	1.3 (0.5, 3.7)	1.3 (0.5, 3.4)	1.3 (0.5, 3.5)	1.5 (0.5, 3.8)	1.5 (0.6, 4.0)
5% Increase in Relative BMI Change						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.3 (0.5, 3.0)	1.5 (0.6, 4.0)	0.9 (0.4, 2.0)	0.9 (0.4, 2.0)	1.1 (0.5, 2.5)	1.2 (0.5, 2.8)
Relative BMI Change in Quartile#						
Quartile 1 (≤0)	Ref	Ref	Ref	Ref	Ref	Ref
Quartile 2 (0.01 - 4.35%)	1.4 (0.4, 4.9)	1.3 (0.4, 4.9)	0.8 (0.3, 2.8)	0.8 (0.2, 2.7)	1.6 (0.5, 5.7)	1.6 (0.5, 5.7)
Quartile 3 (4.36 - 9.43%)	1.5 (0.4, 5.4)	1.6 (0.4, 6.1)	0.7 (0.2, 2.3)	0.7 (0.2, 2.7)	1.8 (0.5, 6.3)	1.9 (0.5, 6.9)
Quartile 4 (> 9.43%)	1.2 (0.4, 4.3)	1.2 (0.4, 4.5)	0.9 (0.3, 3.0)	0.9 (0.3, 3.0)	1.2 (0.4, 4.4)	1.3 (0.4, 4.5)
High relative BMI Change (> 9.43%)#						
No	Ref	Ref	Ref	Ref	Ref	Ref
Yes	1.0 (0.3, 2.5)	1.0 (0.3, 2.5)	1.1 (0.4, 2.8)	1.1 (0.4, 2.8)	0.9 (0.3, 2.2)	0.9 (0.3, 2.2)

*High Physical, Mental, and Total Composite scores fall within the fourth quartile.
#With x=relative BMI change presented in %
*Model 1 was adjusted for age and gender
†Model 2 was adjusted for age, gender, and smoking status
Abbreviations:
BMI – body mass index; IQR – interquartile range; Ref – Reference group
Bold indicates that the findings are significant at α=0.05

Supplemental Table 1. 20-Item Short Form Survey scores by patient characteristics at baseline and treatment completion among patients successfully treated for TB disease in the country of Georgia, 2019 – 2022 (N=119)

Patients' Characteristics	**Total N=119* n (%)**	**Physical** ***median (IQR)***	**Health Perceptions** ***median (IQR)***	**Pain** ***median (IQR)***
Number of items	20	6	5	1
Theoretical score range		0-100	0-100	100-0
Median (IQR) of all cohort		100 (91.7 – 100)	70.0 (60.0 – 80.0)	0 (0 – 20.0)
Basic demographic information				
Age group				
16 – 45	83 (69.8%)	100 (91.7 - 100)	70.0 (60.0 - 85.0)	0 (0 - 20.0)
46 +	36 (30.3%)	100 (83.3 - 100)	65.0 (57.5 - 80.0)	0 (0 - 20.0)
p-values*		**0.021**	0.250	0.587
Sex				
Female	50 (42.0%)	100 (91.7 - 100)	72.5 (60.0, 90.0)	0 (0, 20.0)
Male	69 (58.0%)	100 (100 - 100)	70.0 (60.0, 80.0)	0 (0, 20.0)
p-values		0.236	0.166	0.132
Participant characteristics at the start of tuberculosis treatment				
Tuberculosis Type				
DSTB	91 (76.5%)	100 (91.7 - 100)	75.0 (60.0, 85.0)	0 (0, 20.0)
M/XDR	28 (23.5%)	100 (91.7 - 100)	60.0 (45.0, 77.5)	0 (0, 20.0)
p-values		0.424	**0.004**	0.076
Diabetes Status				
Non-diabetic	108 (90.8%)	100 (91.7 - 100)	70.0 (60.0, 85.0)	0 (0, 20.0)
Diabetic	11 (9.24%)	91.7 (66.7 - 100)	70.0 (40.0, 75.0)	0 (0, 40.0)
p-values		**0.019**	0.310	0.215
Underweight at TB treatment initiation**				
Not underweight	90 (75.6%)	100 (91.7 – 100)	75.0 (60.0 – 80.0)	0 (0, 20.0)
Underweight	29 (24.4%)	100 (91.7 – 100)	70.0 (60.0 – 85.0)	0 (0, 20.0)
p-values		0.903	0.675	0.694
Cavitary Disease				
No	92 (77.3%)	100 (91.7 - 100)	70.0 (60.0 - 80.0)	0 (0, 20.0)
Yes	27 (22.7%	100 (100 – 100)	75.0 (55.0 - 85.0)	0 (0, 20.0)
p-values		**0.033**	0.949	0.863

Participant characteristics at the end of tuberculosis treatment								
Smoking Status								
Never Smoker	67 (56.8%)	100 (91.7, 100)	70.0 (60.0, 85.0)	0 (0, 20.0)	100 (100, 100)	70.0 (60.0, 85.0)	0 (0,	
Current smoker or former smoker	51 (43.2%)	100 (91.7, 100)	70.0 (55.0, 80.0)	0 (0, 20.0)	100 (100, 100)	70.0 (55.0, 80.0)	0 (0,	
p-values		0.781	0.304	0.921	0.338	0.563	0.36	
BMI category at TB treatment completion***								
Underweight	14 (11.8%)	100 (100 – 100)	65.0 (50.0 - 75.0)	0 (0, 20.0)				
Normal	74 (62.2%)	100 (91.7 - 100)	75.0 (60.0 - 85.0)	0 (0, 20.0)				
Overweight	31 (26.1%)	100 (91.7 - 100)	65.0 (60.0 - 75.0)	0 (0, 20.0)				
p-values		0.761	0.161	0.647				
Lung Severity								
Mild	111 (93.3%)	100 (91.7, 100)	70.0 (60.0, 85.0)	0 (0, 20.0)	100 (100, 100)	70.0 (60.0, 85.0)	0 (0, 2	
Moderate + Severe	8 (6.72%)	83.3 (66.7, 100)	60.0 (48.0, 72.5)	0 (0, 20.0)	100 (100, 100)	60.5 (40.0, 80.0)	0 (0, 4	
p-values †	1 (0.84%)	100 (100 - 100)	68.0 (68.0, 68.0)	0 (0, 0)	100 (100, 100)	60.0 (60.0, 60.0)	0 (0,	
		0.014	0.817	0.762	0.364	0.178	0.80	

Abbreviations:
BMI – body mass index; IQR – interquartile range
**Patients were classified as underweight if BMI < 18.5 kg/m^2. Patients with BMI over 18.5 kg/m^2 were not considered underweight.
***Underweight < 18.5 kg/m^2, normal 18.5 kg/m^2 ≤ x 25 kg/m^2, overweight/obese 25 kg/m^2 ≤ x ≤ 30 kg/m^2
*p-values obtained from Wilcoxon rank-sum tests.
†P-values obtained from Kruskal-Wallis test.
Bold indicates that the findings are significant at a=0.05.

Supplemental Table 1 Continued. 20-Item Short Form Survey scores by patient characteristics at baseline and treatment completion among patients successfully treated for TB disease in the country of Georgia, 2019 – 2022 (N=119)

Patients' Characteristics	**Total N=119* n (%)**	**Social** ***median (IQR)***	**Emotional** ***median (IQR)***	**Role** ***median (IQR)***
Number of items	20	1	5	2
Theoretical score range		0-100	0-100	0-100
Median (IQR) of all cohort		100 (100 – 100)	76.0 (64.0 – 84.0)	100 (100 – 100)
Basic demographic information				
Age group				
16 – 45	83 (69.8%)	100 (100 - 100)	76.0 (60.0 - 84.0)	100 (100 - 100)
46 +	36 (30.3%)	100 (100 - 100)	72.0 (68.0 - 80.0)	100 (75 - 100)
p-values*		0.966	0.928	0.595
Sex				
Female	50 (42.0%)	100 (100, 100)	72.0 (60.0, 80.0)	100 (100, 100)
Male	69 (58.0%)	100 (100, 100)	76.0 (68.0, 84.0)	100 (75.0, 100)
p-values		0.337	0.089	0.264
Participant characteristics at the start of tuberculosis treatment				
Tuberculosis Type				
DSTB	91 (76.5%)	100 (100, 100)	76.0 (68.0, 84.0)	100 (100, 100)
M/XDR	28 (23.5%)	100 (80.0, 100)	68.0 (60.0, 80.0)	100 (50.0, 100)
p-values		**0.016**	0.054	**0.012**
Diabetes Status				
Non-diabetic	108 (90.8%)	100 (100, 100)	76.0 (62.0, 82.0)	100 (100, 100)
Diabetic	11 (9.24%)	100 (100, 100)	72.0 (68.0, 88.0)	100 (75.0, 100)
p-values		0.353	0.658	0.424
Underweight at TB treatment initiation**				
Not underweight	90 (75.6%)	100 (100 – 100)	76.0 (64.0 – 84.0)	100 (100 – 100)
Underweight	29 (24.4%)	100 (100 – 100)	76.0 (60.0 - 80.0)	100 (75.0 – 100)
p-values		0.385	0.531	0.604

Patients' Characteristics	Total N=119* n (%)	Social *median (IQR)*	Emotional *median (IQR)*	Role *median (IQR)*
Number of items	20	1	5	2
Theoretical score range		0-100	0-100	0-100
Median (IQR) of all cohort		100 (100 – 100)	76.0 (64.0 – 84.0)	100 (100 – 100)
Cavitary Disease				
No	92 (77.3%)	100 (100 – 100)	76.0 (64.0 - 84.0)	100 (75.0 – 100)
Yes	27 (22.7%	100 (100 – 100)	72.0 (60.0 – 84.0)	100 (100 – 100)
p-values		0.651	0.519	0.071
Participant characteristics at the end of tuberculosis treatment				
Smoking Status				
Never Smoker	67 (56.8%)	100 (100, 100)	76.0 (68.0, 88.0)	100 (75.0, 100)
Current smoker or former smoker	51 (43.2%)	100 (100, 100)	76.0 (60.0, 84.0)	100 (100, 100)
p-values		0.061	0.564	0.141
BMI category at TB treatment completion***				
Underweight	14 (11.8%)	100 (100 – 100)	74.0 (60.0 - 80.0)	100 (50.0 - 100)
Normal	74 (62.2%)	100 (100 – 100)	76.0 (68.0 - 84.0)	100 (100 – 100)
Overweight	31 (26.1%)	100 (100 – 100)	72.0 (60.0 - 80.0)	100 (100 – 100)
p-values		0.994	0.313	0.448
Lung Severity				
Mild	111 (93.3%)	100 (100, 100)	76.0 (60.0, 84.0)	100 (75.0, 100)
Moderate + Severe	8 (6.7%)	100 (100, 100)	70.0 (68.0, 84.0)	100 (100, 100)
p-values †		0.158	0.894	0.525

				100 (100, 100)	70.0 (60.0, 85.0)	0 (0,
				100 (100, 100)	70.0 (55.0, 80.0)	0 (0,
				0.338	0.563	0.36

Abbreviations:
BMI – body mass index; IQR – interquartile range
**Patients were classified as underweight if BMI < 18.5 kg/m^2. Patients with BMI over 18.5 kg/m^2 were not considered underweight.
***Underweight < 18.5 kg/m^2, normal 18.5 kg/m^2 ≤ x 25 kg/m^2, overweight/obese 25 kg/m^2 ≤ x ≤ 30 kg/m^2
*p-values obtained from Wilcoxon rank-sum tests.
†P-values obtained from Kruskal-Wallis test.
Bold indicates that the findings are significant at a=0.05.

Supplemental Table 2. Composite 20-Item Short Survey Form scores by patient characteristics at baseline and treatment completion among patients successfully treated for TB disease in the country of Georgia, 2019 – 2022 (N=119)

Patients' Characteristics	Total N=119 n (%)	Physical Composite median (IQR)	Mental Composite median (IQR)	Total Composite median (IQR)
Number of items	20	3	3	6
Theoretical score range		0 - 300	0 - 300	0 - 600
Median (IQR) of all cohort		260 (232 – 280)	266 (235 – 276)	522 (474 - 553)
Basic demographic information				
Age group				
16 – 45	83 (69.8%)	265 (235 – 280)	268 (244, 280)	529 (484, 557)
46 +	36 (30.3%)	255 (210 – 278)	268 (238, 274)	512 (458, 553)
p-values		0.136	0.649	0.187
Sex				
Female	50 (42.0%)	265 (235 – 285)	264 (251, 276)	530 (474, 560)
Male	69 (58.0%)	260 (232 – 280)	268 (240, 280)	516 (475, 551)
p-values		0.180	0.951	0.402
Participant characteristics at the start of tuberculosis treatment				
Tuberculosis Type				
DSTB	91 (76.5%)	265 (235 – 285)	272 (251 – 280)	530 (484 – 561)
M/XDR	28 (23.5%)	249 (207 – 273)	254 (194 – 266)	485 (417 – 530)
p-values		**0.029**	**0.002**	**0.002**
Diabetes Status				
Diabetic	108 (90.8%)	262 (233 – 280)	268 (243 – 278)	528 (478 –558)
Non-diabetic	11 (9.24%)	253 (173 – 275)	263 (240 – 272)	500 (433 – 539)
P-value		0.134	0.804	0.251
Underweight at TB treatment initiation**				
Underweight	29 (24.4%)	260 (228 – 280)	260 (230 – 280)	516 (454 – 551)
Not underweight	90 (75.6%)	262 (235 – 280)	268 (244 – 276)	527 (475 – 557)
p-values		0.735	0.675	0.776
Cavitary Disease				
No	92 (77.3%)	260 (232 – 280)	268 (235 – 276)	523 (473 – 552)
Yes	27 (22.7%	270 (235 – 280)	268 (248 – 284)	528 (481 – 562)

Patients' Characteristics	Total N=119 n (%)	Physical Composite median (IQR)	Mental Composite median (IQR)	Total Composite median (IQR)
Number of items	20	3	3	6
Theoretical score range		0 - 300	0 - 300	0 - 600
Median (IQR) of all cohort		260 (232 – 280)	266 (235 – 276)	522 (474 - 553)
p-values		0.578	0.642	0.509
Participant characteristics at the end of tuberculosis treatment				
Smoking Status				
Never smoker	67 (56.8%)	262 (245, 280)	266 (242, 276)	529 (474, 556)
Current smoker or former smoker	51 (43.2%)	260 (210, 280)	268 (244, 280)	518 (475, 560)
p-values*		0.362	0.442	0.601
BMI category at TB treatment completion***				
Underweight				
Normal	14 (11.8%)	253 (220 – 275)	258 (210 – 276)	505 (452 – 551)
Overweight	74 (62.2%)	268 (232 – 285)	268 (244 – 284)	530 (478 – 561)
p-values	31 (26.1%)	258 (232 – 272)	264 (252 – 276)	518 (472 – 539)
		0.371	0.310	0.306
Lung Severity				
Mild	111 (93.3%)	265 (235 – 280)	264 (240 – 276)	525 (475 – 560)
Moderate	7 (5.88%)	232 (207 – 260)	272 (268 – 284)	507 (532 – 418)
Severe	1 (0.84%)	260 (260 –260)	268 (268 – 268)	528 (528 – 528)
p-values*		0.141	0.580	0.654

Abbreviations:
BMI – body mass index; IQR – interquartile range
**Patients were classified as underweight if BMI < 18.5 kg/m^2. Patients with BMI over 18.5 kg/m^2 were not considered underweight.
***Underweight < 18.5 kg/m^2, normal 18.5 kg/m^2 ≤ x 25 kg/m^2, overweight/obese 25 kg/m^2 ≤ x ≤ 30 kg/m^2
*p-values obtained from Wilcoxon rank-sum tests.
†P-values obtained from Kruskal-Wallis test.
Bold indicates that the findings are significant at α=0.05.

Supplemental Table 3. Changes in BMI from treatment initiation to completion by smoking status among patients successfully treated for TB disease in the country of Georgia, 2019 – 2022 (N=118)

Change of BMI during TB treatment	Total N = 118*	Smoking Status		p-value[†]
		Never Smoker n(%)= 67 (56.8)	Current or Former Smoker n(%)= 51 (43.2)	
Any change in BMI category				
No	91 (77.1%)	50 (74.6)	41 (80.4)	0.464
Yes	27 (22.9%)	17 (25.4)	10 (19.6)	
Relative Change in BMI[#]				
Non-substantial change (-5% < *x* <5%)	64 (54.2%)	33 (49.3)	31 (60.8)	0.083[‡]
Increased by ≥5%	52 (44.1%)	34 (50.8)	18 (35.3)	
Decreased by ≥5%	2 (1.7%)	0 (0)	2 (3.9%)	
≥5% Increase in Relative BMI Change				
No	66 (55.9%)	33 (49.3)	33 (64.7)	0.094
Yes	52 (44.1%)	34 (50.8)	18 (35.3)	
Relative BMI Change in Quartile[#]				
Quartile 1 (≤0)	30 (25.4%)	16 (23.9)	14 (27.5)	0.830
Quartile 2 (0.01 - 4.35%)	29 (24.6%)	15 (22.4)	14 (27.5)	
Quartile 3 (4.36 - 9.43%)	28 (23.7%)	17 (25.4)	11 (21.6)	
Quartile 4 (> 9.43%)	31 (26.3%)	19 (28.4)	12 (23.5)	
High relative BMI Change (> 9.43)[#]				
No	87 (73.7%)	48 (71.6)	39 (76.5)	0.555
Yes	31 (26.3%)	19 (28.4)	12 (23.5)	

*11 patients had missing BMI at treatment initiation. 1 patient had missing smoking status at treatment initiation.
[#]With x=relative BMI change presented in %
[†]p-values obtained from Chi-square tests, unless otherwise indicated.
[‡] p-values obtained from Fisher's exact test.
Abbreviations:
BMI – body mass index