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Effects of Body Weight Changes on Treatment Outcomes Among Multidrug-Resistant Tuberculosis Patients in Peshawar

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A B S T R A C T

Background: Multidrug-resistant tuberculosis (MDR-TB) is a major global health concern, particularly in low-resource settings such as Peshawar, Pakistan. Nutritional status, reflected by body weight changes during treatment, is a critical factor influencing treatment outcomes.

Objective: This study examines the relationship between body weight changes and MDR-TB treatment outcomes to inform targeted interventions.

Methodology: A retrospective cohort study was conducted among 185 MDR-TB patients undergoing treatment in Peshawar. Patients were categorized based on weight changes during treatment: weight gain (>5%), stable weight, and weight loss (<5%). Final treatment outcomes were analyzed across these categories.

Results: Patients with weight gain ≥5 kg (32.4%) showed the highest treatment success rate (90.0%), with minimal failure (6.7%) and default (3.3%). Patients with weight gain 2–4.9 kg (21.6%) had a success rate of 80.0%, with failure and default rates of 15.0% and 5.0%, respectively. Stable weight (18.9%) was associated with a success rate of 68.6%, and higher failure (20.0%) and default (11.4%) rates. Weight loss 2–4.9 kg (16.2%) and ≥5 kg (10.8%) showed significantly poorer outcomes, with success rates of 50.0% and 40.0%, failure rates of 26.7% and 45.0%, and default rates of 23.3% and 15.0%, respectively.

Conclusion: Body weight changes significantly influence MDR-TB treatment outcomes. Weight gain during treatment is associated with improved recovery, while weight loss predicts higher rates of failure and mortality. Nutritional support should be integrated into MDR-TB treatment protocols to enhance outcomes, particularly in resource-limited settings like Peshawar.

Keywords: MDR-TB; Body Weight; Nutritional Status; Treatment Outcomes

Introduction

Multidrug-resistant tuberculosis (MDR-TB) is a significant worldwide health concern, especially in areas with high disease burden and low resources. MDR-TB, which is caused by strains of Mycobacterium tuberculosis (MTB) that are at least resistant to isoniazid (INH) and rifampicin (RMP), leading to prolonged therapy that frequently lead patients to experience severe physical and mental stress, increased financial burdens, and higher morbidity and mortality.[1]

Effective management of MDR-TB involves a complex interplay of factors, including patient demographics, comorbidities, and nutritional status. Among these, body weight is increasingly recognized as a critical determinant of treatment outcomes in MDR-TB patients. Body weight of the MDR-TB patients drops down due to the presence of MTB as during illness their immune system remains lower. For good immune system and normal body weight nutrition plays important role.[2] Different studies suggests that nutritional status, often measured through changes in body weight, and plays a vital role in shaping the immune response against TB. Undernutrition is associated with impaired immune function, which compromises the body's ability to mount an effective response to Mycobacterium tuberculosis infection. On the other hand, gaining weight while undergoing therapy is typically linked to good health and a better prognosis.[3]The association between changes in body weight and treatment success in MDR-TB patients is still little understood, despite its promise as a predictor of treatment results Weight loss, on the other hand, often indicates disease progression, adverse drug reactions, or other underlying complications. This bidirectional relationship between body weight and treatment outcomes underscores the need for a comprehensive understanding of how weight dynamics impact the management of MDR-TB patients.[4]

The World Health Organization (WHO) has highlighted the importance of addressing nutritional deficiencies in TB patients to enhance treatment efficacy and reduce mortality.[5] However, despite these recommendations, the role of body weight changes as a prognostic factor remains underexplored in many high-burden settings, including Pakistan. Given the high prevalence of malnutrition and the socioeconomic disparities in Peshawar, understanding the link between weight changes and MDR-TB treatment outcomes is of paramount importance. Such insights could inform targeted interventions aimed at optimizing nutritional support as part of MDR-TB treatment protocols.

In addition to nutritional challenges, MDR-TB patients in Peshawar face a host of other issues that influence body weight and treatment outcomes. These include poor access to healthcare facilities, stigma surrounding TB, and economic hardships that limit food security. Moreover, the side effects of second-line anti-TB drugs, such as nausea, vomiting, and anorexia, often exacerbate weight loss, further complicating treatment adherence and recovery.[6] Despite the availability of programmatic management for drug-resistant TB (PMDT) in the region, gaps remain in addressing the nutritional needs of patients, thereby limiting the overall success of MDR-TB management.

Existing studies from other regions have demonstrated a positive association between weight gain during treatment and favorable outcomes, such as sputum culture conversion and reduced relapse rates.[7-10] However, the extent to which these findings are applicable to Peshawar's unique sociocultural and economic context remains unclear. This study seeks to fill this gap by exploring the effects of body weight changes on treatment outcomes among MDR-TB patients in Peshawar. By analyzing weight dynamics in relation to sputum conversion rates, treatment adherence, and adverse outcomes, this research aims to provide evidence-based recommendations for integrating nutritional interventions into MDR-TB management strategies.

Objective

To find out why variations in body weight affect the course of treatment for MDR-TB patients in Peshawar by examining weight trends during the course of treatment and comparing them to final treatment outcomes.

Methodology

A retrospective cohort study was conducted to analyze the data of patients who began treatment for multidrug-resistant tuberculosis (MDR-TB) between January 2019 and December 2021. The research included patients enrolled for therapy at the Programmatic Management of Drug-Resistant Tuberculosis Unit (PMDT) located at Lady Reading Hospital, Peshawar. Data were meticulously extracted from patient files, encompassing a range of variables such as sociodemographic information, TB treatment history, therapeutic regimens, weight monitoring, and treatment outcomes. Inclusion criteria specified that all participants were at least 15 years of age and confirmed to have MDR-TB via diagnostic methods, including drug-susceptibility testing (DST), culture, or GeneXpert results.

The primary endpoint of the study was the change in patient body weight, documented in kilograms (kg), starting from the initiation of treatment and monitored monthly. Additional variables considered included age (grouped into tertiles), gender (male or female), educational attainment (categorized as primary school, incomplete secondary school, or secondary school and above), history of TB episodes (none, one, or two or

more), and baseline body mass index (BMI). BMI was further classified into underweight, normal weight, or overweight. Other factors, such as initial sputum results (positive or negative) and treatment strategies, were also analyzed. These variables were explored to assess their relationship with weight changes and overall treatment outcomes.

At the PMDT unit, all MDR-TB patients were treated according to the National DR-TB guidelines established by the National TB Control Program (NTP). To promote adherence, patients were required to attend monthly follow-up visits, during which they received programmatic incentives for transportation and food. Prior to initiating therapy, all patients underwent comprehensive baseline assessments, including a review of previous TB treatment history, sputum cultures, drug susceptibility testing, HIV status evaluations, and chest X-rays. During treatment, programmatic monitoring involved monthly sputum cultures, weight measurements, and clinical reviews to ensure optimal management of MDR-TB cases.

Data collected from patient records were initially entered into Microsoft Excel through a double-entry system to ensure accuracy and later imported into SPSS version 23 for statistical analysis. A descriptive analysis of demographic and clinical characteristics was performed, with comparisons across outcome groups using the Chi-square test or Fisher's exact test, as appropriate. Additionally, the average body weight was calculated for each group based on their exposure status and the

Table1. Demographic Data of MDR-TB Patients in Peshawar (n=185)

Variable	Category	Number (n)	Percentage (%)
Age Group (Years)	<20	30	16.2%
	20-39	90	48.6%
	40-59	50	27.0%
	≥60	15	8.1%
Educational Level	No formal education	70	37.8%
	Primary education	50	27.0%
	Secondary education	40	21.6%
	Higher education	25	13.5%
Residence	Urban	120	64.9%
	Rural	65	35.1%
Employment Status	Employed	75	40.5%
	Unemployed	110	59.5%
Marital Status	Married	120	64.9%
	Unmarried	65	35.1%
Nutritional Status	Underweight (BMI <18.5)	85	45.9%
	Normal weight (BMI 18.5-24.9)	90	48.6%
	Overweight (BMI ≥25)	10	5.4%

corresponding follow-up month. Ethical clearance for data collection and analysis was obtained from the hospital's ethical review committee, ensuring the study adhered to all ethical standards.

Results

A data of 185 MDR patients were reviewed in this study Among study cases, 102 (55.1%) were male and 83 (44.9%) were female (Figure 1). Majority of the cases 48.6% were form age group 20 – 39 years. No formal education was found among 37.8% of the study cases. Residence of urban area was 64.9% and 35.1% were from rural area. Nearly half the patients were underweight (45.9%) (Table 1).

Patients were distributed in different groups based on weight changes during treatment: significant weight gain (≥5 kg), moderate weight gain (2–4.9 kg), stable weight (±1 kg), moderate weight loss (2–4.9 kg), and significant weight loss (≥5 kg). Weight Gain patients with significant or moderate weight gain showed the highest treatment success rates (90% and 80%, respectively), reflecting better recovery and adherence. Weight Stability has moderate success rates (68.6%), indicating mixed outcomes. Weight Loss is a poor outcome, with success rates decreasing as weight loss increased. Significant weight loss (≥5 kg) correlated with the highest treatment failure rate (45%). Overall Outcomes Of the total 185 patients, 71.9% achieved treatment success, while 18.4% experienced treatment failure, and 9.7% defaulted or were lost to follow-up (Table 2).

Discussion

Multidrug-resistant tuberculosis (MDR-TB) remains a major public health challenge globally, particularly in regions with limited healthcare infrastructure. Nutritional status is a critical determinant of TB treatment outcomes, as malnutrition compromises immunity and worsens disease progression.[11] This study explores the relationship between body weight changes and treatment outcomes among MDR-TB patients in Peshawar.

The demographic of the study shows that male predominance in this study (55.1%) mirrors findings from studies in Pakistan 2015[4]and Ethiopia in 2018,[9] where males are more likely to be exposed to TB due to occupational hazards and social mobility. Women, however, face unique barriers such as stigma and restricted healthcare access, which can delay diagnosis and treatment. Most patients (48.6%) were in the 20-39 age group, consistent with global MDR-TB data showing the highest prevalence in economically productive populations. Few othr studies also report similar trends, highlighting the socioeconomic impact of TB on working-age adults.[1,11,12]

Patients with no formal education (37.8%) had the poorest outcomes, like findings in studies from Bangladesh in 2010[11]and Nepal in 2023,[12] where low literacy rates correlated with poor treatment adherence. Urban patients (64.9%) dominated this cohort, likely due to the study's urban setting. However, rural patients (35.1%) faced more severe challenges, including delayed diagnosis and inadequate access to healthcare, paralleling findings from few other studies.[1213-15]

Table 2. Effects of Body Weight Changes on Treatment Outcomes Among MDR-TB Patients in Peshawar (n=185)

Weight Change Category	Number of Patients (n)	Percentage (%)	Mean Weight Change (kg)	Treatment Success (Cured/Completed)	Treatment Failure	Lost to Follow-Up
Weight Gain ≥5 kg	60	32.4%	+6.8 ± 2.0	54 (90.0%)	4 (6.7%)	2 (3.3%)
Weight Gain 2–4.9 kg	40	21.6%	+3.5 ± 1.1	32 (80.0%)	6 (15.0%)	2 (5.0%)
Stable Weight (±1 kg)	35	18.9%	±0.4 ± 0.3	24 (68.6%)	7 (20.0%)	4 (11.4%)
Weight Loss 2–4.9 kg	30	16.2%	-3.0 ± 1.2	15 (50.0%)	8 (26.7%)	7 (23.3%)
Weight Loss ≥5 kg	20	10.8%	-6.5 ± 2.3	8 (40.0%)	9 (45.0%)	3 (15.0%)
Total	185	100%	-	133 (71.9%)	34 (18.4%)	18 (9.7%)

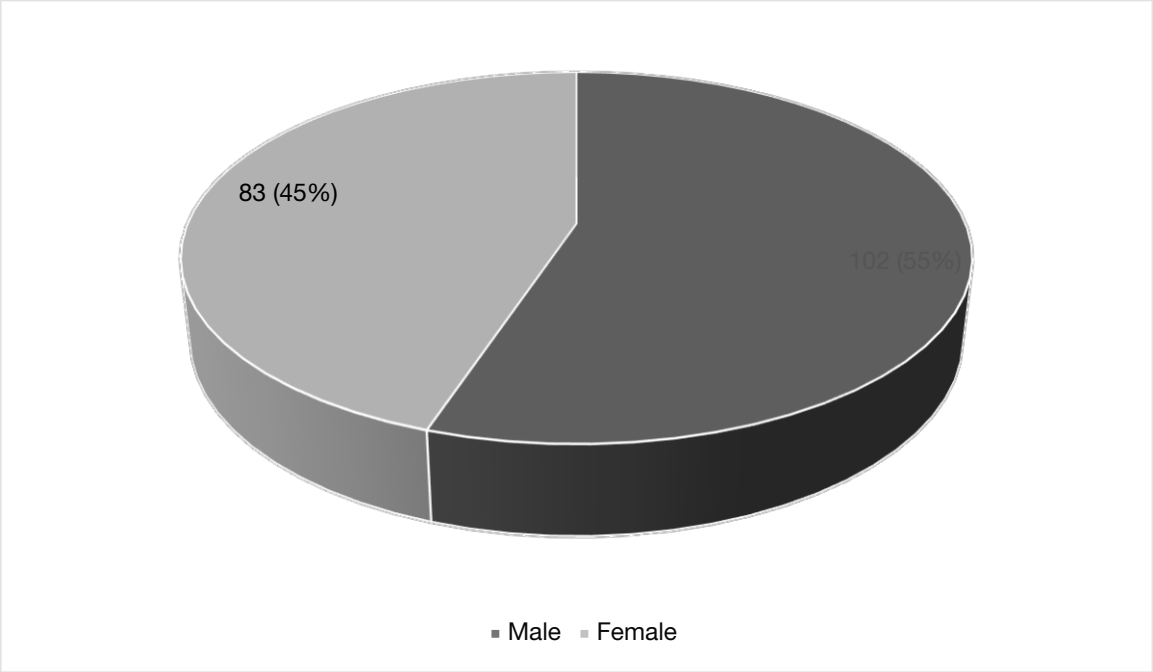

Figure 1. Gender base distribution of study cases

High unemployment (59.5%) among patients reflects the economic toll of MDR-TB, a trend also observed in Southeast Asia in 2017.[1] Married patients (64.9%) often relied on family support for care and nutrition, whereas unmarried individuals were more prone to isolation and financial hardship, affecting adherence. Similar patterns were noted in a study from Peru in 2008.[13] Underweight patients (45.9%) had significantly worse outcomes, consistent with global research emphasizing the interplay between malnutrition and TB progression. A study from Indonesia in 2013 showed that underweight patients had a twofold higher risk of treatment failure and mortality.[14]

The data shows that weight gain, particularly ≥5 kg, is associated with the highest treatment success rate (90%) and the lowest rates of treatment failure (6.7%) and default (3.3%). This aligns with several studies that emphasize weight gain during treatment as a marker of recovery and favorable outcomes. Studies from high TB-burden countries (e.g., India[15] in 2022 and South Africa in 2011[16]) report that weight gain during treatment is a strong predictor of treatment success and a reflection of improved nutritional and health status. A study in 2023 India showed that patients gaining ≥5 kg had a success rate of over 80%, like the present findings.[17]

Patients with moderate weight gain still had relatively good outcomes (80% success), though slightly lower than those with greater weight gain. Treatment failures (15.0%) and defaults (5.0%) were higher than in the ≥5 kg group. Moderate weight gain has been reported to be beneficial but not as strongly correlated with success as significant weight gain. Studies suggest that while moderate weight gain improves prognosis, it might indicate partial recovery, possibly due to underlying comorbidities or delayed treatment response.[18]

Patients with stable weight (±1 kg) showed a treatment success rate of 68.6%, significantly lower than those gaining weight, with higher rates of treatment failure (20%) and default (11.4%). Studies indicate that stable weight during MDR-TB treatment may reflect inadequate nutritional support or persistence of disease-related systemic effects. In a study from Bangladesh in 2010[19], patients with stable weight during treatment were more likely to have suboptimal outcomes compared to those with weight gain.

Weight loss, especially ≥5 kg, is associated with the worst outcomes: Weight loss 2–4.9 kg: 50% success, 26.7% failure, 23.3% default. Weight loss ≥5 kg: 40% success, 45% failure, 15% default. Several studies confirm that weight loss during treatment strongly correlates with poor outcomes due to malnutrition, severe disease, or coexisting conditions such as diabetes or HIV. A study in Ethiopia in 2024 found that patients losing weight during MDR-TB treatment had a 2.5 times higher likelihood of treatment failure.[20]

Across all categories, the overall treatment success rate (71.9%) is higher than global averages for MDR-TB treatment (~60%), suggesting that other factors like enhanced treatment regimens, adherence support, or nutritional interventions might be contributing. In high-burden settings like sub-Saharan Africa in 2018,[21] overall

treatment success rates are often lower due to comorbidities like HIV. These findings indicate that weight change might have an even stronger predictive value in less resource-limited settings.

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