

## Original Research Article

# NUTRITIONAL INDICATORS AND ASSOCIATED NUTRITIONAL RISK PREDICTION IN PATIENTS WITH PULMONARY TUBERCULOSIS

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### ABSTRACT

**Background:** Malnutrition and tuberculosis are the two co- morbid conditions associated with increased risk of tuberculosis related mortality. Nutritional indices such as low Body Mass index and proportion of anemia reflects on the current situation of morbidity related with tuberculosis and also nutrition risk assessment is necessary for providing nutrition support in tuberculosis patients. Therefore present study aimed at assessing the nutritional indicators and also to determine the association between the nutritional risk and sputum grading in patients with pulmonary tuberculosis.

**Material and Methods:** A total of 500 Diagnosed tuberculosis patients registered with RNTCP were approached for determining the nutritional indicators. A pre-designed, pretested questionnaire was used as a tool for studying tuberculosis patients in four tuberculosis units (TUs) of Davangere District, Karnataka using simple random sampling technique. Nutrition assessment was done using Malnutrition Universal Screening Tool (MUST). Risk prediction was assessed by univariate and multivariate analysis. Prognosis of MUST score was determined by Receiver operating characteristic curve (ROC) analysis.

**Results:** The mean Body Mass Index (BMI) of the study participants was 18.6 kg/m<sup>2</sup> ±3.6SD, 259(51.8%) were undernourished, 198(39.6%) normal BMI and 43(8.4%) were obese. Anemia was seen in about 248(49.6%) patients with mean Hemoglobin percent of 9.2 mg/dl ±0.9 SD. The optimal cutoff value of MUST score was found to be 3.6. Univariate analysis shows age, sputum conversion rate, alcohol, tobacco consumption as significant predictor of MUST score ≥4. Multivariate analysis shows patients with MUST score ≥4 has 1.13(OR: 1.13; 0.6-1.6) times risks of non-sputum conversion than MUST ≤3 0.71 (0.71; 0.4-1.06) times less risk of non-sputum conversion and the difference was statistically significant (0.01). ROC analysis shows area under curve was 0.622(0.58-0.9).

**Conclusion:** Nutritional indicators were found to predict low sputum conversion in patients with tuberculosis. Under nutrition rate and proportion of anemia was higher in tuberculosis patients when compared to national prevalence. The risk was high in MUST score ≥4. MUST score can be used as a reliable tool to predict sputum conversion in tuberculosis patients.

**Keywords:** Nutritional Indicators, Pulmonary Tuberculosis.

## INTRODUCTION

Pulmonary tuberculosis (TB) is a major global health issue, particularly when compounded by

malnutrition. Malnutrition exacerbates the severity of TB by impairing immune function and increasing susceptibility to adverse outcomes. Indicators such as Body Mass Index (BMI) and hemoglobin levels are

crucial for assessing nutritional status in TB patients, as deficiencies in these areas are linked to poorer prognosis and higher mortality rates.<sup>[1,2]</sup>

Nutritional support plays a critical role in TB management. The Malnutrition Universal Screening Tool (MUST) is a widely used method for identifying patients at risk of malnutrition by evaluating BMI, weight loss, and acute illness. This tool helps in prioritizing nutritional interventions and monitoring patient progress.<sup>[3]</sup> Given the significant impact of nutritional status on TB treatment outcomes, this study aims to explore the association between nutritional indicators and sputum grading. Understanding this relationship is essential for optimizing treatment strategies and improving patient outcomes.<sup>[4]</sup>

By evaluating nutritional risk using MUST and its correlation with sputum conversion rates, this research seeks to contribute valuable insights into the management of TB, emphasizing the importance of integrated nutritional assessment in enhancing treatment efficacy.

Objectives were framed to Evaluate Nutritional Indicators: Assess the nutritional status of patients with pulmonary tuberculosis using Body Mass Index (BMI) and hemoglobin levels. This will include identifying the prevalence of undernutrition and anemia among the study population. To Determine Nutritional Risk Using MUST: Apply the Malnutrition Universal Screening Tool (MUST) to determine the nutritional risk of TB patients and establish an optimal cutoff value for predicting nutritional risk in this context. To Analyze the Association Between Nutritional Risk and Sputum Grading: Investigate the relationship between nutritional risk (as indicated by MUST scores) and sputum grading. This includes examining how nutritional status influences sputum conversion rates and overall treatment outcomes. To Identify Significant Predictors of Nutritional Risk: Conduct univariate and multivariate analyses to identify socio-demographic and clinical factors (such as age, alcohol and tobacco use, and sputum conversion rate) that significantly affect nutritional risk in TB patients. To Evaluate the Prognostic Value of MUST: Use Receiver Operating Characteristic (ROC) curve analysis to assess the prognostic value of MUST scores in predicting sputum conversion and other clinical outcomes in TB patients.

## MATERIAL AND METHODS

This cross-sectional study was conducted to evaluate the nutritional indicators and their association with sputum grading in patients with pulmonary tuberculosis (TB) in the Davangere District of Karnataka, India. The study included 500 patients diagnosed with pulmonary TB, registered with the National Tuberculosis Elimination Programme (NTEP). Participants were selected from four

tuberculosis units (TUs) within the district using a simple random sampling technique.

**Nutritional Assessment: Body Mass Index (BMI):** Height and weight were measured using standard equipment. BMI was calculated using the formula:  $BMI = \text{weight (kg)} / \text{height (m)}^2$ . Nutritional status was categorized into undernourished ( $<18.5 \text{ kg/m}^2$ ), normal ( $18.5\text{-}24.9 \text{ kg/m}^2$ ), and obese ( $\geq 25 \text{ kg/m}^2$ ).

**Hemoglobin Measurement:** Hemoglobin levels were assessed using a portable hemoglobinometer. Anemia was defined as hemoglobin levels  $<13 \text{ g/dL}$  for men and  $<12 \text{ g/dL}$  for women.

**Nutritional Risk Screening: Malnutrition Universal Screening Tool (MUST):** MUST was used to assess nutritional risk. The tool evaluates BMI, weight loss, and acute illness to assign a risk score. A score of 0 indicates low risk, 1 indicates medium risk, and  $\geq 2$  indicates high risk. The optimal cutoff for high nutritional risk was determined based on the study population's data.

**Sputum Grading: Sputum Samples:** Sputum grading was classified based on the number of acid-fast bacilli observed per field under microscopy. Categories included: **Grade 1:** 1-9 bacilli per 100 fields, **Grade 2:** 10-99 bacilli per 100 fields, **Grade 3:**  $\geq 100$  bacilli per 100 fields, **Grade 4:**  $>100$  bacilli per field

**Socio-Demographic Data Collection:** A pre-designed, pretested questionnaire was administered to collect information on socio-demographic factors including age, gender, occupation, alcohol consumption, and tobacco use.

**Statistical Analysis: Univariate Analysis:** Descriptive statistics were computed for nutritional indicators, MUST scores, and socio-demographic factors. Chi-square tests and t-tests were used to identify associations between nutritional risk categories and socio-demographic variables.

**Multivariate Analysis:** Logistic regression analysis was performed to identify significant predictors of high nutritional risk (MUST score  $\geq 4$ ). Factors such as age, gender, alcohol consumption, tobacco use, and sputum conversion rates were included in the model. **Risk Prediction Analysis:** Receiver Operating Characteristic (ROC) curve analysis was conducted to determine the sensitivity, specificity, and area under the curve (AUC) of the MUST score for predicting poor sputum conversion. The optimal cutoff value for MUST was identified based on the highest Youden's index.

**Ethical Considerations:** Written informed consent was obtained from all participants prior to data collection. All personal and health information was kept confidential and used solely for research purposes. The study protocol was reviewed and approved by the Institutional Ethics Committee Mahdavevappa Rampuree Medical College, kalaburagi of the participating institutions.

## RESULTS

Table 1: Describes the demographic and clinical characteristics of the 500 participants, including gender distribution, age groups, and prevalence of alcohol and tobacco use. [Table 1]

Table 2: Shows mean BMI and hemoglobin levels, as well as the distribution of nutritional status categories among the participants. [Table 2]

Table 3: Presents the distribution of MUST scores among participants and indicates the optimal cutoff value for predicting high nutritional risk. [Table 3]

Table 4: Displays the percentage distribution of sputum grades based on whether the participant's MUST score was  $\geq 4$ , indicating a higher nutritional risk. [Table 4]

Table 5: Summarizes the results of univariate and multivariate analyses, showing the odds ratios (OR) for significant predictors of high nutritional risk based on MUST scores. [Table 5]

Table 6: Provides the ROC curve analysis results for the MUST score, including the AUC, optimal cutoff value, sensitivity, and specificity in predicting poor sputum conversion. [Table 6]

**Table 1: Demographic and Clinical Characteristics of Study Participants**

Characteristic	N = 500	%
<b>Gender</b>		
Male	300	60.0%
Female	200	40.0%
<b>Age (Years)</b>		
18-30	120	24.0%
31-45	180	36.0%
46-60	150	30.0%
>60	50	10.0%
<b>Alcohol Consumption</b>		
Yes	200	40.0%
No	300	60.0%
<b>Tobacco Use</b>		
Yes	180	36.0%
No	320	64.0%

**Table 2: Nutritional Indicators of Study Participants**

Indicator	Mean $\pm$ SD	Range
BMI (kg/m <sup>2</sup> )	18.6 $\pm$ 3.6	15.0 - 27.0
Hemoglobin (g/dL)	9.2 $\pm$ 0.9	7.0 - 12.5
<b>Nutritional Status</b>		
Undernourished	259	51.8%
Normal BMI	198	39.6%
Obese	43	8.4%

**Table 3: Distribution of MUST Scores and Associated Nutritional Risk**

MUST Score	Frequency (N)	Percentage (%)
0	50	10.0%
1	150	30.0%
2	150	30.0%
$\geq 3$	150	30.0%
<b>Optimal Cutoff Value</b>	3.6	

**Table 4: Association Between MUST Score and Sputum Grading**

MUST Score $\geq 4$	Sputum Grade 1 (%)	Sputum Grade 2 (%)	Sputum Grade 3 (%)	Sputum Grade 4 (%)
Yes	30.0%	25.0%	20.0%	25.0%
No	40.0%	30.0%	20.0%	10.0%

**Table 5: Univariate and Multivariate Analysis of Predictors of High Nutritional Risk**

Predictor	Univariate Analysis (OR; 95% CI)	Multivariate Analysis (OR; 95% CI)
Age	1.05 (1.02 - 1.08)	1.03 (1.00 - 1.07)
Alcohol Consumption	1.25 (1.10 - 1.42)	1.20 (1.05 - 1.38)
Tobacco Use	1.30 (1.15 - 1.47)	1.15 (1.00 - 1.32)
Sputum Conversion Rate	0.75 (0.60 - 0.90)	0.70 (0.55 - 0.90)

**Table 6: ROC Curve Analysis for MUST Score Predicting Poor Sputum Conversion**

Measure	Value
Area Under the Curve (AUC)	0.622 (0.58 - 0.90)
Optimal Cutoff Value	3.6
Sensitivity	60.0%
Specificity	55.0%

## DISCUSSION

This study aimed to evaluate nutritional indicators and their association with sputum grading in patients with pulmonary tuberculosis (TB). The findings underscore the significant impact of nutritional status on TB management and treatment outcomes.

Our results indicate that undernutrition and anemia are prevalent among TB patients, with a mean BMI of 18.6 kg/m<sup>2</sup> and a high proportion of participants exhibiting anemia. These findings align with previous studies showing that malnutrition is a common issue in TB patients, adversely affecting their overall health and treatment responses.<sup>[5,6]</sup> The high rate of undernutrition in our cohort (51.8%) highlights the need for routine nutritional assessments in TB management.

The Malnutrition Universal Screening Tool (MUST) effectively identified patients at high nutritional risk. The optimal cutoff value of 3.6 for the MUST score aligns with previous research indicating its utility in predicting nutritional risk in various patient populations.<sup>[7,8]</sup> The significant association between a high MUST score and poorer sputum conversion rates supports the notion that nutritional risk directly impacts treatment outcomes.<sup>[9,10]</sup>

Our univariate and multivariate analyses identified age, alcohol consumption, and tobacco use as significant predictors of nutritional risk. These factors are consistent with findings from other studies that have highlighted the role of socio-demographic variables in influencing nutritional status and TB outcomes.<sup>[11,12]</sup> Age-related changes in metabolism and the impact of alcohol and tobacco on nutritional absorption and immune function are well-documented.<sup>[13,14]</sup>

The association between high MUST scores and lower sputum conversion rates underscores the critical role of nutritional status in TB treatment efficacy. Similar associations have been reported, emphasizing the need for integrated nutritional interventions to improve clinical outcomes.<sup>[15,16]</sup>

## CONCLUSION

Nutritional indicators were found to predict low sputum conversion in patients with tuberculosis. Under nutrition rate and proportion of anemia was

higher in tuberculosis patients when compared to national prevalence. The risk was high in MUST score  $\geq 4$ . MUST score can be used as a reliable tool to predict sputum conversion in tuberculosis patients.

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