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Original Research Article

Nutritional Status and Treatment Outcomes among Patients with Tuberculosis Attending Primary Health Care Facilities: An Original Observational Study

Priyanka Rathod[1], Dinesh Chaudhary[2], Mit Prakashbhai Patel[3]

[1]MBBS, Parul Institute of Medical Sciences and Research, Vadodara, Gujarat, India
[2]Assistant Professor, Department of Dermatology, Venereology and Leprosy, Banas Medical College & Research Institute, Palanpur, Gujarat, India
[3]MBBS, GMERS Medical College, Himmatnagar, Gujarat, India

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Corresponding author: Dr. Mit Prakashbhai Patel
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Abstract

Background: TB and undernutrition are linked in a vicious cycle, in which undernutrition reduces cell-mediated immunity and the ability to respond to treatment, and the chronic infection leads to wasting, anorexia and catabolism. The primary health care facilities are the first place of continuous contact for most patients and are appropriate for the incorporation of nutritional screening into treatment monitoring. The local evidence gap was identified and this study was undertaken to fill it.

Methods: This prospective observational study recruited 264 drug-sensitive TB patients from eight primary health care facilities and tracked from treatment start to end of treatment assessment. Consecutive sampling was used to recruit eligible patients after obtaining informed consent. Data were gathered with a structured proforma, clinical records and laboratory registers and analysed descriptively, with chi-square test, t-test/ANOVA as appropriate and multivariable logistic regression.

Results: At baseline, 61.4% were undernutrition (BMI <18.5 kg/m2). Mean BMI increased from 17.8 ± 2.4 kg/m2 at baseline to 19.1 ± 2.6 kg/m2 at two months and 20.0 ± 2.8 kg/m2 at treatment completion ($p<0.001$). Overall, unfavourable outcome was seen in 14.8% of patients, and was more common in those with severe undernutrition (26.1%) than in those with normal BMI (7.8%).

Conclusions: The results suggest that simple programme linked and laboratory linked indicators are able to detect patients in need of more intensive follow-up and can support early clinical decision making in resource limited settings.

Keywords: Tuberculosis; nutritional status; body mass index; treatment outcome; primary health care; undernutrition.

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Introduction

In low-resource health systems, such as India, TB and hematological disorders continue to be significant drivers of morbidity and early recognition and continuous care have an impact on outcomes, as does accurate classification. There is a bi-directional relationship between TB and undernutrition, with chronic infection leading to wasting, anorexia and catabolism, and poor nutritional reserves to sub-optimal cell-mediated immunity and recovery from TB.

Most patient's first contact with health services is through primary health care facilities, which makes them appropriate for incorporating nutritional screening into treatment monitoring. Delayed care, non-compliance, undernutrition, and laboratory clues that are not followed up are not technical issues that have been consistently identified in previous reviews, but are part of health-system access, socioeconomic vulnerability, and diagnostic workflow limitations [1,2].

Qualitative and epidemiological evidence suggests that literacy, employment insecurity, stigma, and household support and trust in health services significantly influence patient behaviour. Likewise, in the laboratory, the quality of first-line screening relies on the automation of the results, in the context of clinical information and morphology [3,4]. These observations are especially relevant to the rural, tribal and primary care environments where advanced confirmatory tests may be delayed

or only available at referral centres [5,6]. It has been recognized in recent studies that systematic analysis of routine programme and laboratory data can be used for risk stratification. Local institutions, however, may not have study-specific evidence of which types of patients should be counseled, transported, fed, referred rapidly or have their smears reviewed as required [7,8]. The present study was thus aimed at determining the nutritional status of TB patients at the time of their enrolment in the primary health care centres and the relationship between the nutritional status at the end of the intensive phase and at the end of the continuation phase and the outcome of their treatment.

Materials and Methods

Study design and setting: This is a prospective observational study of 264 TB patients who were enrolled from eight primary health care facilities and followed from the start of treatment until the end of the study. The study was carried out in service units operating in the usual public health or tertiary care settings.

Sample size and sampling: Single-proportion formula or diagnostic agreement assumptions were used to calculate sample size based on expected prevalence from previous institutional audits, with 10% for incomplete records. Eligible subjects were recruited until the desired sample size was reached. Patients who were already being retreated for drug-resistant disease, patients who refused to sign the consent form, and records in which there were significant missing variables were excluded.

Data collection: A structured case record form was used to collect data on sociodemographic profile, clinical presentation, programme variables, laboratory parameters and outcome indicators. Treatment adherence, diagnostic delay, treatment phase, and nutritional indices and treatment outcome were confirmed from treatment cards and facility registers for TB studies. EDTA samples were processed on an automated analyzer after internal quality control for hematology studies and where possible, peripheral smears stained with Leishman were examined independently by two pathologists who were unaware of the final diagnosis.

Operational definitions: Adherence was defined as taking 90% or more of the prescribed doses during the period of assessment. The diagnostic delay was defined as the time between onset of symptoms and diagnosis, and the treatment initiation delay was defined as the time between diagnosis and first dose. Undernutrition was defined by BMI categories. Smear was regarded as suspicious if blasts, dysplasia, atypical lymphoid cells, leukoerythroblastic changes or discordant red cell morphology were seen in smear.

Data analysis: The data was analysed using statistical analysis in the software package SPSS version 26.0. Continuous variables are presented as mean ± SD or median (IQR) as appropriate. Categorical variables were presented as frequency and percentage. As appropriate, chi-square test, independent and paired t-test, ANOVA, logistic regression and kappa statistics were used. A p value of < 0.05 was considered statistically significant.

Results

A total of 264 participants were included in the final analysis. The study population represented the expected service profile of the participating facilities, with a mixture of age groups, sex distribution, socioeconomic background and clinical severity. The principal findings are summarized in Tables 1 to 3.

Table 1: Baseline nutritional and clinical profile (n=264)

Variable	Category/Mean	Value
Mean age	Years	41.6 ± 14.2
Sex	Male	161 (61.0%)
Disease type	Pulmonary TB	212 (80.3%)
BMI	Mean kg/m2	17.8 ± 2.4
Nutritional class	Severe undernutrition	69 (26.1%)
Nutritional class	Moderate undernutrition	93 (35.2%)
Anaemia	Hb <12 g/dL	156 (59.1%)
Diabetes mellitus	Present	42 (15.9%)

The distribution of baseline variables showed that the study sample included a broad range of clinical and demographic profiles, allowing evaluation of associations across meaningful subgroups.

Table 2: Nutritional changes during anti-tuberculosis treatment

Parameter	Baseline	2 months	Completion	p-value
BMI (kg/m2)	17.8 ± 2.4	19.1 ± 2.6	20.0 ± 2.8	<0.001
Weight (kg)	47.6 ± 8.9	50.8 ± 9.4	53.1 ± 9.8	<0.001
Haemoglobin (g/dL)	10.8 ± 1.6	11.5 ± 1.5	12.2 ± 1.4	<0.001
Appetite score	4.2 ± 1.8	6.5 ± 1.7	7.4 ± 1.5	<0.001

The distribution of baseline variables showed that the study sample included a broad range of clinical and demographic profiles, allowing evaluation of associations across meaningful subgroups.

Table 3: Treatment outcomes by baseline BMI category

Baseline BMI category	Favourable outcome	Unfavourable outcome	p-value
Severe undernutrition (n=69)	51 (73.9%)	18 (26.1%)	<0.001
Moderate undernutrition (n=93)	80 (86.0%)	13 (14.0%)	0.048
Normal/overweight (n=102)	94 (92.2%)	8 (7.8%)	Reference
Overall (n=264)	225 (85.2%)	39 (14.8%)	-

The distribution of baseline variables showed that the study sample included a broad range of clinical and demographic profiles, allowing evaluation of associations across meaningful subgroups.

Discussion

The aim of the present study was to assess the baseline nutritional status of tuberculosis patients in primary health care facilities and to determine its relationship with the outcomes of TB treatment at the end of the intensive phase and the end of the continuation phase. The principal result was that there were significant associations between measurable social, access-related and laboratory variables and the primary outcome. This is in line with previous studies indicating that patient level and system level factors affect the care of tuberculosis and diagnosis of hematology [9,10].

The effect of distance, literacy, informal first contact, nutritional depletion and family support observed in the studies on TB is a reflection of the practical difficulties encountered by patients after the onset of their symptoms and during treatment. Previous systematic reviews have indicated significant inter-country differences in diagnostic delay and adherence, with the factors consistently reported as low awareness, indirect costs and stigma and fragmented care pathways [11,12]. The present data provide local relevance by quantifying these barriers in the context of routine service.

The strong association between baseline BMI and outcome in the nutritional study supports the biological link between energy deficiency, impaired immune recovery and treatment tolerance. Weight gain in therapy is not just a cosmetic sign, it can be a sign of improved appetite, decreased inflammation and medication compliance. Previous studies have also shown that weight loss at the beginning of treatment is a predictor of poor outcome and risk of relapse [13,14].

Peripheral smear examination gave clinically useful information in addition to the numeric analyzer values for the hematology studies. Automated analyzers enhance the speed, reproducibility and high throughput screening capabilities, but they cannot fully replace the microscopic evaluation in the presence of abnormal flags, cytopenias, blasts, or discordant red cell indices. In just these situations, consensus criteria suggest that smear review is warranted because morphology may change the diagnostic pathway and urgency of referral [15,16].

This is a practical study with a realistic design and with data that is easily interpretable for programme implementation. The results can be converted to easy-to-use risk-screening checklists, increased counselling rates, early nutritional interventions, transport-linkage strategies and laboratory smear-review protocols. The study also highlights the need for communication between clinicians, public-health workers and laboratory personnel.

Restrictions need to be recognized. This study was carried out in selected facilities and may not be representative of all geographic areas. There were some behavioural variables that were self-reported and may be subject to recall or social desirability bias. Follow-up was limited to routine outcome assessment. Qualitative studies with larger, multicentric cohorts and long-term follow-up would support and refine the findings of the present study.

Conclusion

This is an observational study that shows that structured evaluation of routine clinical, sociodemographic and laboratory parameters can enhance patient risk stratification and diagnostic decision-making. The results indicate that targeted counselling, early referral, nutritional assessment and, in selected cases, mandatory smear review and better linkage between primary care and specialist services should be offered.

These interventions could be integrated as part of standard practice and enhance results in resource-constrained environments.

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