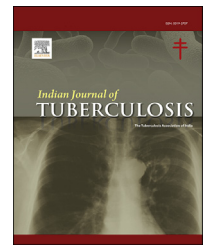


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Original article

N-TB: A mobile-based application to simplify nutritional assessment, counseling and care of patients with tuberculosis in India

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ABSTRACT

Undernutrition is the most prevalent comorbidity in patients with tuberculosis (TB) in India. Undernutrition is often severe and results in higher risk of death, drug toxicity during treatment, poor functional status at end of treatment and a higher risk of relapse after successful treatment. A World Health Organization guideline has recommended nutritional assessment, counseling, and care as integral parts of TB care. The Revised National Tuberculosis Control Programme has recognized undernutrition as a significant comorbidity, released a guidance document for improving nutritional care and support, and launched a scheme for direct bank transfer of monthly cash benefit to TB patients. However, there are gaps at the provider level on nutritional assessment, due to challenges in calculation and interpretation of body mass index (BMI). A mobile based application has been developed for use in the programme, which makes estimation of BMI possible, classifies the severity of undernutrition, suggests triage and clinical actions based on the BMI, indicates desirable body weight corresponding to a BMI of 21 kg/m², and the daily caloric and protein intake for underweight patients with active TB. The app also provides tips for dietary counseling for TB patients, information on the major food groups, emphasizes an adequate and balanced diet from locally available foods for nutritional recovery of TB patients.

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In the pre-chemotherapy era, a nutritious high protein diet was an essential component in the sanatorium-based management of tuberculosis (TB). However, the success of home-based chemotherapy and the closure of sanatoria led to

nutrition falling off the radar of TB programmes. In many high-TB burden countries like India, “consumption” is still an apt descriptor for TB which literally means ‘wasting away’. In a cohort of patients with pulmonary TB (PTB) in central India,

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undernutrition was nearly universal.¹ Adult men and women had median body mass indices (BMIs) of 16 kg/m² and 15 kg/m², and a BMI as low as 10 kg/m² was also documented.¹ Data on weights of adult patients from India's Revised National Tuberculosis Control Programme (RNTCP) also revealed severe undernutrition with median weights of 42 kg and 38 kg in men and women respectively.² In the absence of nutritional support, undernutrition persists even at the end of therapy.^{1,3}

Undernutrition in patients with TB has numerous implications such as increasing the risk mortality by 2–4-fold.^{1,4} Low BMI is a risk factor for drug-induced hepatotoxicity and drug malabsorption.^{5,6} Low baseline weight and inadequate weight gain during treatment are risk factors for relapse.⁷ Poor nutritional recovery affects the performance status and return to active life following cure.

The high prevalence and serious implications of undernutrition in patients with TB, led the World Health Organization (WHO) to frame a guideline for nutritional care and support of TB patients.⁸ It emphasized the need for nutritional screening, assessment and management as key components to the TB care cascade. Further, it also alluded to an adequate diet being essential for proper health for all, including TB patients.⁸

India, the country with the largest global burden of TB, where undernutrition is a co-epidemic, has seen recent policy initiatives in addressing the TB-undernutrition link. A guidance document, which is a context-specific adaptation of the WHO guideline, has been formulated.⁹ Undernutrition has now been regarded as co-morbidity and a key driver of the TB epidemic by the programme, in addition to HIV and diabetes.¹⁰ The Government of India has also announced a direct benefit transfer (DBT) scheme of 500 Indian rupees per month for TB patients to ensure access to a nutritious diet under the *Nikshay Poshan Yojana*.¹¹ These initiatives in India are aligned with the priorities of patient-centered care and management of co-morbidities of the END TB strategy.

Nutritional assessment, counseling and care in patients with TB are all linked activities. Nutritional assessment requires measurement of height, weight, calculation of BMI and classification of nutritional status based on BMI. This should be followed by nutritional counseling emphasizing an adequate and balanced diet with focus on locally available foods and patient preferences. Provision of food/supplements occurs in many programmes, and their choice is guided by scientific rationale, cultural acceptability, operational feasibility and cost considerations.

Implementing of nutritional assessment and support in programmatic setting for frontline care providers has numerous challenges. For example, in India, heights were not included in routine patient data till the recent past. Currently heights are being measured as per the new TB card but are not being translated into BMI values and/or categories. In an ongoing operational research study we found that primary care providers were unfamiliar with calculation of BMI and BMI-based nutritional classification of nutritional status.¹² As a result, they assessed nutritional status by variable and arbitrary weight-based cutoffs for underweight patients (35 kg or 40 kg). Ideally, nutritional assessment should lead to

clinical decisions relevant to patients and care providers. The recognition of high risk patients with severe undernutrition and their management is one such clinical action. Counseling on adequate intake of calories and proteins assumes knowledge of calorie and protein requirement for patients based on their nutritional status, which may be challenging for care providers.

1. N-TB app: an enabler for nutritional assessment, monitoring and counseling for frontline care providers of patients with tuberculosis

An android and iOS based application called N-TB has been developed to address some of these challenges in the domain of nutritional care of TB patients. It has been endorsed by the RNTCP and WHO (India).¹³ The only input values required are height in cm and weight in kg of adult TB patients. Based on these input values it provides the following information (Fig. 1):

1.1. Nutritional assessment at diagnosis and follow up

It calculates the BMI and categorizes the patient into different color coded nutritional categories using WHO recommended cut-offs. It also mentions an extremely underweight category for those at or below a BMI of 14 kg/m², which are at extremely high risk of adverse outcomes, including death.

The app gives an estimate of the desirable weight as a function of the height of the patient, defined as the weight corresponding to a BMI of 21 kg/m², and the minimum acceptable weight corresponding to a BMI of 18.5 kg/m². It also uses these weights to estimate the weight gain required in the patient to reach a desirable or minimum acceptable BMI, which can help assess adequacy of weight gain during follow up.

1.2. Triage for patients with severe acute malnutrition

The app provides a red-flag alert in case the BMI is less than 16 kg/m², and indicates a requirement of hospital admission if there is coexisting poor performance status, pedal edema, and severe anemia. Any patient with a BMI less than 14 kg/m² also mandates admission. The app also provides an overview of the management of severe malnutrition in adults.

1.3. Counseling tips for an adequate and balanced diet

Furthermore, the app provides a recommended daily intake of calories for underweight patients based on the requirements of 40 kcal/kg of desirable body weight. To note here, the daily caloric intake is measured based on a sedentary lifestyle. It also recommends a daily protein intake of 1.2–1.5 g/kg of desirable body weight.⁹ The app has information on major food groups, their caloric and protein values. It provides counseling tips on diet emphasizing locally available foods, clarifying many common misconceptions and myths.

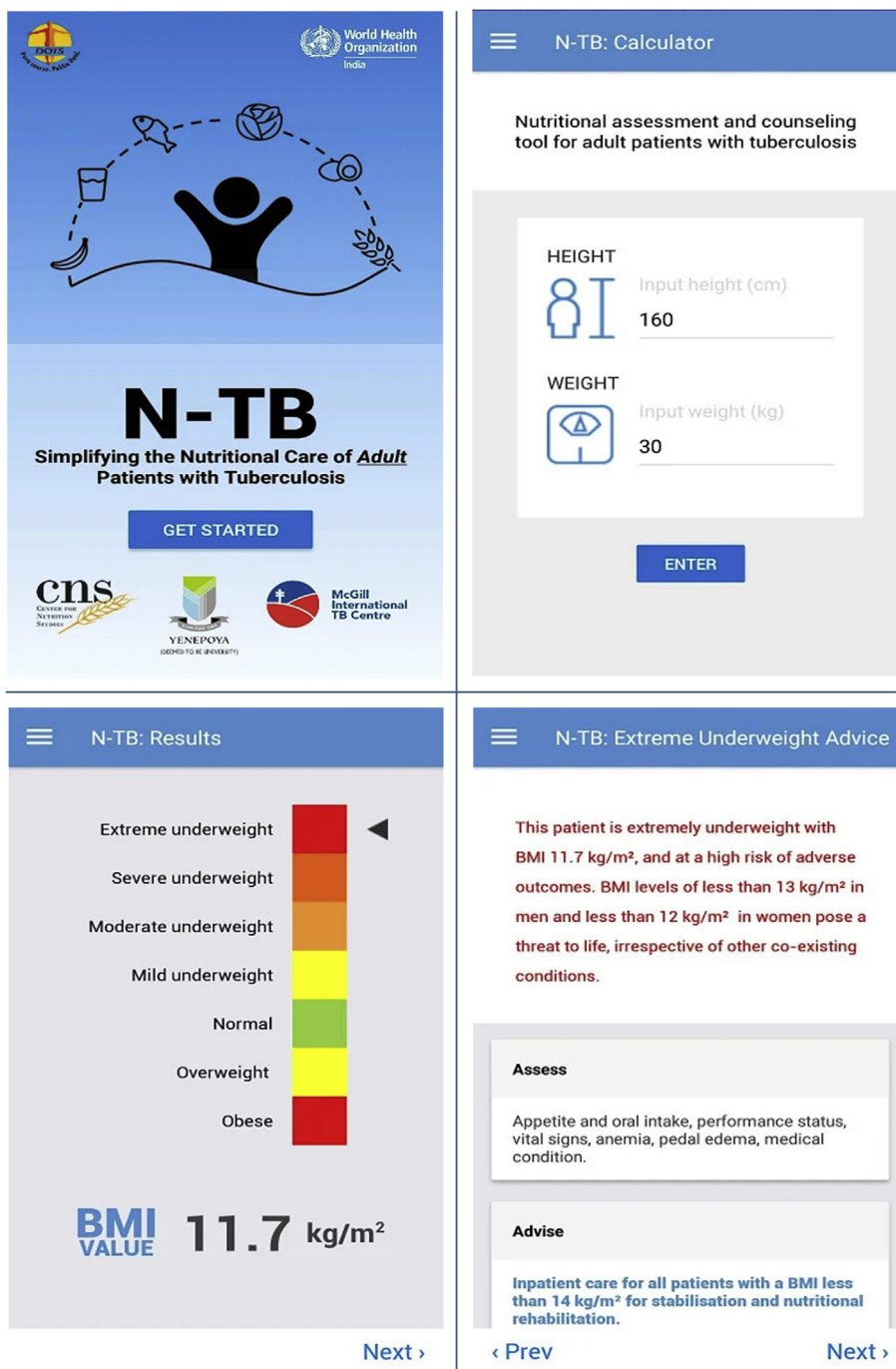


Fig. 1 – Screen shots of N-TB app.

Further development plans for the app include linking the outputs to customized meal plans, availability in other languages and a patient version with more graphic content. Operational research and field validation studies may lead to better understanding of its strengths and limitations as an operational tool at programmatic setting.

Conflicts of interest

The authors have none to declare.

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