Original article

A culture-specific nutrient intake assessment instrument in patients with pulmonary tuberculosis

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A R T I C L E   I N F O

S U M M A R Y

Background & aim: To develop and evaluate a culture-specific nutrient intake assessment tool for use in adults with pulmonary tuberculosis (TB) in Tbilisi, Georgia.
Methods: We developed an instrument to measure food intake over 3 consecutive days using a questionnaire format. The tool was then compared to 24 h food recalls. Food intake data from 31 subjects with TB were analyzed using the Nutrient Database System for Research (NDS-R) dietary analysis program. Paired t-tests, Pearson correlations and intraclass correlation coefficients (ICC) were used to assess the agreement between the two methods of dietary intake for calculated nutrient intakes.
Results: The Pearson correlation coefficient for mean daily caloric intake between the 2 methods was 0.37 ($P = 0.04$) with a mean difference of 171 kcals/day ($p = 0.34$). The ICC was 0.38 (95% CI: 0.03–0.64) suggesting the within-patient variability may be larger than between-patient variability. Results for mean daily intake of total fat, total carbohydrate, total protein, retinol, vitamins D and E, thiamine, calcium, sodium, iron, selenium, copper, and zinc between the two assessment methods were also similar.
Conclusions: This novel nutrient intake assessment tool provided quantitative nutrient intake data from TB patients. These pilot data can inform larger studies in similar populations.

1. Introduction

Tuberculosis (TB) is an enormous global health problem. In 2011, the World Health Organization (WHO) estimated that there were 8.7 million new cases of TB and 1.4 million deaths attributable to TB disease, with the overwhelming majority of cases occurring in low- and middle-income countries.[1] The country of Georgia, a former Soviet republic, has been designated by the WHO as a one of 27 high-burden countries for multidrug-resistant (MDR)-TB. The annual incidence rate of TB in Georgia exceeds 100 cases per 100,000.[2]

Malnutrition is a risk factor for the development of TB disease. The link between nutritional status and TB has long been appreciated, but remains an emerging area of study that has focused on

investigations of related biomarkers and nutrient supplementation trials. A recent Cochrane review on the quality of evidence of trials on nutrient supplementation in TB concluded there is insufficient evidence to determine whether an increase in energy intake improves patient outcomes; further, rigorous research on the clinical impact of various strategies for micronutrient supplementation in patients with TB was found to be limited.[3] Surprisingly little data are available in the literature on habitual macronutrient and micronutrient intake in patients with TB. One study from Singapore focused on energy intake in TB patients using the 24-hr recall method.[4] In a pilot study in patients with pulmonary TB in Tbilisi, Georgia (using the nutrient intake assessment tool described in detail in this report), we estimated that vitamin D intake from diet was markedly lower than the Recommended Dietary Allowance (RDA) for this micronutrient, concomitant with a high prevalence of vitamin D insufficiency (low plasma 25 hydroxyvitamin D concentrations) in this patient population.[5]

Accurate dietary intake data is historically difficult to obtain and continues to be particularly problematic in subjects studied in the developing world due to lack of training and resources, logistical issues and lack of validated nutrient content of certain food items. Several studies have been conducted involving the validity of self-administered food frequency questionnaires (FFQ) in various populations of patients without TB, but involve the validation of only a few macro- or micronutrients.[6–14] These studies used a variety of validating instruments, including nutrition-related biomarkers,[7] three day food records,[8] serial 24-h recalls,[10] and use of food journal data in comparison to specific FFQs.[11–14] The study of Schroder et al., in a Spanish population, was the only investigation that validated both a FFQ and a structured 72-h recall using three day food records.[9]

The purpose of this study focused on the development of a novel instrument to serially estimate micronutrient and macronutrient intake data from a generally low income, non-English speaking, Georgian population via a structured interview process administered by trained personnel. We also sought to assess the validity of this structured 72-h recall tool in a specific population—namely patients with pulmonary TB in Tbilisi, Georgia. The tool was developed as a component of a current double-blind, randomized, controlled study assessing the efficacy of high-dose vitamin D treatment to enhance Mycobacterium tuberculosis clearance in patients with pulmonary TB in Tbilisi, Georgia (Clinicaltrials.gov identifier NCT00918086).[5]

2. Methods

2.1. Study subjects

Subjects were recruited from the Georgian National Center for Tuberculosis and Lung Diseases (NCTBLD) and the Tbilisi Ftizio-Pulmonologic Center (an outpatient TB clinic) in Tbilisi, Georgia. The inclusion criteria included age ≥18 years, documented new case of smear-positive pulmonary TB, ≤1 week of anti-TB therapy, agreement to receive anti-TB therapy in Tbilisi, completion of the 72-h recall instrument at baseline (week 1) and the serial 24-hr recalls during week 2, and a signed informed consent. Exclusion criteria included > 30 days of TB therapy, current pregnancy or lactation status, history of organ transplant, cancer during the previous 5 years, seizure disorder, cirrhosis, hypercalcemia, hyperparathyroidism, sarcoidosis, or nephrolithiasis, use of oral corticosteroids during the past 30 days, current use of cytotoxic or immunosuppressive drugs, current significant renal dysfunction (serum creatinine concentration >250 mmol/L), requirement for dialysis therapy, current incarceration, markedly elevated week 1 mean daily caloric intake (defined *prehoc* as mean daily caloric

intake of >6000 kcal/day) and inability to complete all study visits in Tbilisi. The Institutional Review Boards from Emory University in Atlanta, USA and the NCTBLD Ethics Committee in Tbilisi approved the study protocol. All subjects provided written informed consent in their native language for participation in the study.

2.2. Nutritional assessment

The nutrition assessment instrument was developed to capture the mean daily micronutrient and macronutrient intake over the previous three day period via face-to-face interviews by trained investigators (ES and MK; please see below). The dietary intake interviews were performed at baseline and again at the eight and sixteen-week time points, respectively, of the randomized clinical trial (RCT). The instrument was designed prior to initiation of the RCT to assess nutrient intake in a low socioeconomic status, non-English speaking adult population. During the instrument developmental phase, we initially explored typical foods and meal patterns of adult Georgians by face-to-face and email discussions between the Georgian- and United States (U.S.)-based investigators involved in the RCT. The instrument was designed to follow principles routinely utilized by nutritionists and dietitians in standardized food record intake forms. In addition, food items (including beverages and snacks) consumed commonly in Georgian culture and typical recipes for these were included in the questionnaire as prompts. For example, Table 1 outlines details of the questions for typically consumed tea and soup, respectively. A free text comment section at the end of the questionnaire as added to allow for additional details regarding recipes.

The Georgian-based physician investigators (ES, MK) were extensively trained prior to the initiation of the RCT by the registered dietitian investigator (JKF) on the interview process via video training uploads (YouTube), demonstrations with mock face-to-face interviews, a comprehensive training DVD, and regular live training sessions via Skype. TRZ also conducted face-to-face training sessions with the Georgian investigators on the specific methodologies at the NCTBLD in Tbilisi during a study initiation visit prior to beginning the RCT. Standardized food models and common household measurement instruments were provided to the investigators in Tbilisi and used in the patient interviews to help to determine accurate serving sizes.

Table 1
Example questions in Georgian food intake instrument.

Q2. How many glasses of tea did you have? __ __ __ __number of glasses __ __ __ __ ml volume of each glass
If 0 glasses, skip to Question 3
Below are questions about what you added to the tea. Each question should be the amount added per glass (one glass)
Did you add sugar? Yes No
If yes, how much?
If the sample spoon is 15 ml, how many spoonfuls did you have? __ __number of spoonfuls __converted to ml
Did you add fruit syrup? Yes No
If yes, how much? If the sample spoonfull is 15 ml, how many spoonfulls did you have? __ __number of spoonfulls __converted to ml
Q12. Soup " Borshi "
Did you have this in the last three days? Yes No **If no, Skip to the next dish**
How much did you have at one time ? __ __ __ __ __ __ ml
How many times have you had this recipe for dinner in the last three days? __ __ times
Below are typical ingredients in borshi. Please comment if there are any major differences in ingredients from what you eat. Yes No
1 kg Beef, 1 kg cabbage, 100 g carrots, 200 g red beetroot, 1 kg potatoes, 0.5 kg tomatoes, 300 g onion, 30 g garlic, 100 g of greens, sour cream 50–100 mg per serving black pepper, salt to taste