Nutritional Status and Other Associated Factors of Patients with Tuberculosis in Selected Urban Areas of Bangladesh

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Abstract

To maintain good health and ensure that all bodily systems are working as they should, appropriate nutrition is essential. Cellular immunity is significantly impacted by malnutrition. Malnutrition increases the likelihood of tuberculosis (TB) because it compromises the host's primary defense mechanism, cell-mediated immunity (CMI). This study set out to determine how common undernutrition is among adult tuberculosis patients in various metropolitan locations of Bangladesh and what variables contribute to it. In a cross-sectional study that lasted from January to June 2023, 314 adult tuberculosis (TB) patients from 12 separate sites in Dhaka, Gazipur, and Narayanganj City Corporation in Bangladesh were evaluated. A semi-structured questionnaire was used to gather data from in-person interviews, while anthropometric measurements (such as height and weight) were taken using a bathroom scale and measuring tape. Three groups were used to classify the nutritional status: underweight (BMI <18.5 kg/m2), normal weight (BMI 18.5-24.9 kg/m2), and overweight (BMI>24.9 kg/m2). We used multiple logistic regression analyses and chi-square tests to find out what factors were associated with nutritional status. Out of 314 tuberculosis patients, 33.4% were underweight, while 45.5% were overweight or obese and 21.0% were clinically over weight. With 51.3% being male, the average age of the participants was 35.18±14.97 years. The percentage of those getting anti-TB treatment for fewer than six months was 91.4%, and 55.1% of those people had extrapulmonary tuberculosis. There is a strong association between the nutritional state of tuberculosis patients and the presence of diabetes mellitus, which affected around 10.8% of the patients (p<0.05). The odds ratio of underweight was shown to be raised with both the duration of tuberculosis therapy (OR = 3.639, 95% CI: 1.193-11.085, p = 0.023) and the age group (OR = 2.94, 95% CI: 0.994-6.253, p = 0.051). This study adds to the growing body of evidence that nutritional status should be a component of adult tuberculosis treatment plans, since over one-third of TB patients in metropolitan areas of Bangladesh are underweight.
Keyword: Associated factors, Bangladesh, Nutritional status, Tuberculosis, Urban areas

Background

A major public health concern once again is tuberculosis (TB). Its death toll in the past five years exceeds that of AIDS and other tropical diseases put together. Poor countries account for a disproportionate 95% of these cases [1-4]. This disease is responsible for around 25% of

avoidable deaths in adults. Consequently, tuberculosis was declared a global emergency in 1993 by the World Health Organization (WHO), which predicts that 35 million people will die from the disease between 2000 and 2025 if current trends persist [2].

To maintain good health and ensure the functioning of all bodily systems, proper nutrition is essential [5]. There is a strong correlation between malnutrition and impaired cellular immune activity. Since cell-mediated immunity (CMI) is the principal host defense against tuberculosis (TB), malnutrition is a significant risk factor for TB as well. Active illness from a primary or dormant infection is more common in malnourished individuals [1]. Communities with high rates of latent tuberculosis infection may have malnutrition as a major contributor to tuberculosis incidence. People with tuberculosis (TB) often suffer from malnutrition, and this problem affects both wealthy and developing nations. Malnutrition and TB are major problems in public health worldwide, and Bangladesh is no different. About 186 people die from tuberculosis every day in Bangladesh, and over 68,000 people die from the disease every year [6]. For TB patients, the World Health Organization suggests the five-part direct observed treatment short course (DOTS) strategy: (a) rapid diagnosis of cases through microscopy and a multi-tiered system of sputum smear quality assurance and cross-checking; (b) a consistent and reliable supply of medications; (c) healthcare providers or community volunteers closely observing patients during chemotherapy; (d) thorough assessment and monitoring; and (e) the determination of policymakers.

In recent years, Bangladesh has achieved remarkable strides in tuberculosis control [6]. The Bangladeshi government and various non-governmental organizations, notably BRAC, have been working together since 1993 to implement a community-based National Tuberculosis Control Program (NTP) that is based on the DOTS technique. A person's nutritional health is a major factor in determining how well it works. Among the most prevalent signs of tuberculosis is weight loss, or wasting. This is due to a combination of factors, including a decrease in appetite, which leads to a low daily food intake, and changes in metabolism brought on by the immune and inflammatory response [7]. There is a correlation between wasting and impaired physical function and increased mortality in tuberculosis patients. Weight gain is common during treatment for tuberculosis, but the healing process is slow, and the patient may experience wasting for months when treatment begins. A protein consumption of about 1.2-1.5 g/kg body weight is crucial, as are sufficient multivitamins and mineral supplements, due to the fact that energy demands are increased (35-40 kcal/kg body weight) due to this condition [8]. The usefulness of dietary supplements is universally acknowledged.

Nearly half of all tuberculosis cases occur in five Southeast Asian countries: India, Indonesia, Bangladesh, Thailand, and Myanmar [9]. Of these 22 nations, the majority have a high burden of tuberculosis. Among the top 30 nations having a high TB burden, Bangladesh is home to 3.6% of the global population. The estimated tuberculosis incidence rate in Bangladesh is 221 cases per 100,000 people, with a predicted mortality rate of 24 per 100,000 people [10]. Of all

the tuberculosis cases in Bangladesh, pulmonary TB accounts for more than 80% [11]. The capital of Bangladesh, Dhaka, has one of the highest population growth rates among megacities globally. Urban tuberculosis (TB) outbreaks are more difficult to contain than rural ones for a variety of reasons, including poor sanitation, poverty, and overcrowding [12].

Findings from this study provide credence to the idea that public health campaigns are required to improve treatment quality and fund food programs for adults with tuberculosis. Some examples include including food assistance in the TB National Program Strategic Plan, advocating on behalf of partners and the Ministry of Health to raise funds for food assistance, raising awareness of the effects of undernutrition on tuberculosis patients and their families through health education, and developing nutritional care guidelines and providing support to improve the quality of nutritional care [13]. Adult tuberculosis patients in Bangladesh can benefit from nutritional intervention programs, and this study has the potential to raise awareness and change people's understanding of the disease.

Materials and Methods

Adult tuberculosis (TB) patients in certain metropolitan regions of Bangladesh were the subjects of a descriptive cross-sectional study that aimed to determine their nutritional condition and other relevant parameters. Twelve separate DOTS centers in the Dhaka, Gazipur, and Narayanganj City Corporations provided the data. Three DOTS centers in Narayanganj and two in Gazipur City Corporation were selected for data collection, in addition to six in Dhaka City Corporation. January 2023–June 2023 was the duration of the study. Participants were adults (18+) with a confirmed diagnosis of active tuberculosis (TB) using sputum microscopy or gene expert tests. They were enrolled in a directly observed treatment short course (DOTS) that provided anti-TB medication in three chosen city corporations in Bangladesh.

Six data enumerators who had received training interviewed 314 tuberculosis patients in person. All of the participants had their height, weight, and body mass index measured using anthropometric instruments. In order to achieve the study's objective, the questionnaire was built using prior research [13]. Bengali, the official language of Bangladesh, was used to translate the first questionnaire from English. The questionnaire was fine-tuned after pre-testing at Shaheed Suhrawardy Medical College Hospital, which used 10% of the estimated sample size. Part I of the questionnaire addressed the patients' sociodemographic characteristics; Part II dealt with their lifestyle choices; Part III with their health status; Part IV with their dietary habits; and Part V with their nutritional status as adults were the five sections that made up the questionnaire. Respondents' age, sex, level of education, occupation, housing, income, family size, and tobacco use were among the sociodemographic variables examined. Tuberculosis patients' daily routines included access to clean water, the use of designated restrooms, smoking, the use of smokeless tobacco, iodized salt, fortified oil, regular exercise,

and a healthy diet. Type of tuberculosis, length of tuberculosis therapy, functional status, problems following anti-TB treatment, and co-morbidities (diabetes, hypertension) were all factors in determining a patient's health status. A balanced diet, meal frequency, daily protein intake, appetite, changes in appetite following anti-TB medication, and dietary counseling were all part of the TB patients' eating patterns. A bathroom scale was used to measure the weight in kilograms, while a measuring tape was used to measure the height in centimeters. We used kilograms per square meter as the unit of measurement for body mass index. Three groups were used to classify the nutritional status: underweight (BMI <18.5 kg/m2), normal weight (BMI 18.5-24.9 kg/m2), and overweight (BMI>24.9 kg/m2).

On the day of data collection, we addressed patients who were eligible and asked whether they would want to take part in the study. The study only included respondents who were both present and willing to participate on the day of data collection. Researchers at Dhaka, Bangladesh's Institute of Public Health Nutrition (IPHN) sought and received approval from an institutional review board (IRB) to conduct this study.

To begin, we made sure all of the data was there and accurate by looking for inconsistencies or missing values. Statistical Package for the Social Sciences (SPSS) version 25 was used for data analysis. Metrics like percentage, standard deviation, and mean were used to examine the descriptive data. The chi-square test and logistic regression analysis were used to examine different correlations among the variables. A two-sided p value < 0.05 was used to establish the statistically significant level.

Results

About 33.4% of tuberculosis patients were underweight, defined as having a body mass index (BMI) below 18.5 kg/m2. The nutritional status of 45.5% of the 314 patients was normal (BMI 18.5-24.9 kg/m2), while 21% were overweight or obese (BMI>24.9 kg/m2) (Figure 1).
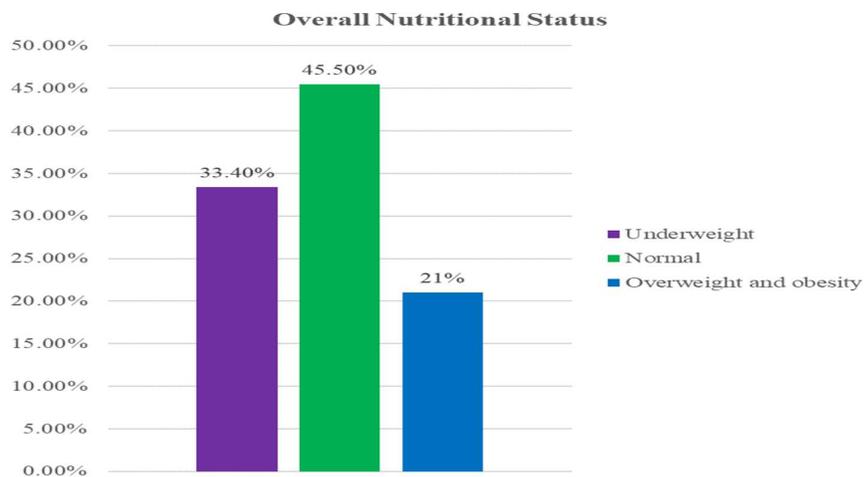

Figure 1: Overall nutritional status of tuberculosis patients

The average age of the participants in the study was 35.18±14.97 years, with a range of 18–80 years, and men made up 51.3% of the sample. A total of 26.8% of the respondents had only completed elementary school, 32.5% were working, and 38.5% were dependant on someone else. Of those who took the survey, 56.4% had two or less children, 52.9% lived in homes with concrete floors, and 54.8% had an annual income of 20,000 taka or less (Table 1).

A large majority of the participants (82.8%) did not report a history of tuberculosis in their family. Of those who participated in the survey, 44.9% were diagnosed with TB in the lungs, 55.1% with TB elsewhere in the body, and 91.4% had been on anti-TB medication for fewer than six months. Among those who took the survey, 85.4% were employed. As seen in Table 1, the majority of participants did not suffer from diabetes (89.2%) or hypertension (82.5%).

A whopping 96.8% of people who took the survey also used a clean restroom, and 95.9% of those people had access to safe drinking water. A total of 94.3% of respondents used iodized salt, 80.9% used fortified oil, 8.6% smoked, and 10.2% chewed smokeless tobacco. Table 2 shows that 68.2% of respondents did not engage in regular physical activity.

Most people (93.6% to be exact) ate three times a day. Among those who took the survey, 87.3% said they included protein in at least one meal per day, and 38.9% said they felt no hunger at all. Table 2 shows that after a tuberculosis diagnosis, 49.7 percent of patients made dietary changes and 65.3 percent got nutritional guidance from their doctors.

There was a significant association ($p<0.05$) between the nutritional status, age group, educational status, employment status, housing condition, type of tuberculosis, duration of tuberculosis therapy, and diabetes status of the tuberculosis patients evaluated (Table 3).

Table 4 shows that there was a significant association between the nutritional status of the tuberculosis patients, the number of meals they ate per day, the amount of protein they ate, the frequency with which they received dietary guidance from facilities, the availability of safe drinking water, and the consumption of enriched oil ($p<0.05$).

Patients under the age of 20 had a much higher risk of underweight compared to those 50 and older, as shown by the multivariate logistic regression model (OR = 2.94, 95% CI: 0.994-6.253; p = 0.051). Table 5 shows that the risks of underweight were substantially higher for tuberculosis (TB) treatment durations of less than 6 months compared to those of 6 months or more (OR = 3.639, 95% CI: 1.193-11.085, p = 0.023).

Discussion

While 45.5% of tuberculosis (TB) patients in various metropolitan locations of Bangladesh were of normal body mass index (BMI), 33.4% were underweight, and 21% were overweight or obese. In this study, we found that the nutritional status of adults with tuberculosis was independently correlated with age, education level, employment status, family size, access to safe drinking water, consumption of fortified oil, diabetes type, daily protein consumption, and dietary counseling.

According to a study conducted in Bangladesh, patients from different socioeconomic backgrounds saw improvements in their body mass index (BMI) at different stages throughout treatment. However, by the end of the treatment, the majority of patients still had a malnourished state (BMI < 18.5 kg/m2) [5]. Additionally, according to another study, 87.8% of the participants had a body mass index (BMI) greater than 17, while the remaining participants had a BMI below 17 [14]. Another study in Ghana found that 51% of the participants were malnourished when they enrolled; of them, 24% had mild malnutrition, 12% moderate, and 15% severe [15].

However, due to variations in research methods and subject inclusion criteria, it may not be suitable to directly compare the prevalence of malnutrition among studies. Possible explanations for the discrepancy in prevalence rates found in different studies include differences in lifestyle, degree of illness, socioeconomic status, demographics, and time period of the research. In spite of these differences, undernutrition was found to be quite common among TB patients across all trials. Malnutrition is a major problem in countries where tuberculosis is common, according to these results.

While most adult tuberculosis patients ate three square meals each day, just over a third of those patients got their recommended daily allowance of protein, according to this study. A third or more of the patients reported feeling hungry. This finding is consistent with previous research showing that adults with tuberculosis (TB) lose their appetite and do not eat enough, which has been reported in Kenya [16], Nepal [17], Uganda [17], and Kenya [17]. Most tuberculosis patients regularly ate protein-rich diets, according to another study [20]. One of the reasons people do not eat enough throughout the day is because their sickness leads them to lose appetite, which in turn causes them to lose weight. Multiple studies conducted in India [19], Gondar (Ethiopia) [20], and Kenya [16] found that malnourished tuberculosis patients had a much lower and more noticeable micronutrient status than healthy patients. This status included low concentrations of hemoglobin, serum albumin, serum retinol, and serum zinc. We need to provide more nutritional support for TB patients than for non-TB patients since this study suggests that undernutrition in TB patients is linked to food intake and nutrient absorption, both of which have harmful effects on nutritional status.

This study found that among adults with tuberculosis, diabetes and nutritional status were independently correlated. Several studies have shown that tuberculosis (TB) can change metabolism, cause muscles to atrophy, and make it harder for the body to tolerate glucose [21-24, 23-25]. Diabetes also increases the number of first symptoms, especially weight loss, and worsens the clinical presentation of tuberculosis (TB) in patients [22, 25]. In low- and middle-income nations, there is a correlation between undernourishment in tuberculosis patients and an increase in diabetic complications and deaths. An Indian study found that among active tuberculosis patients across all body mass index (BMI) categories, a considerable proportion (55% to be exact) were ignorant that they had diabetes when diagnosed with tuberculosis

[26,27]. These results, together with our own observations, highlight the importance of routine bidirectional screening for the detection of prediabetes and the assessment of TB patients' nutritional status. There is some evidence that reducing the impact of tuberculosis and improving nutritional care can be achieved through early detection of comorbid medical illnesses [27,28].

There was a statistically significant relationship between the nutritional status of adults with tuberculosis (TB), age, education level, occupation, and family size in this study. Among those who participated, over 50% were between the ages of 21 and 50, and over 50% had completed both elementary and secondary school. Fifty-6.4 percent of tuberculosis patients in this study had no more than four relatives. The participants' ages ranged from twenty-five to sixty-five in a related study conducted in Bangladesh, with a mean age of thirty-three. Of the respondents under the age of 35, 68.2% were under the age of 35, and 31.8% were above the age of 35 [12]. Among those in a different research, almost 50% were between the ages of 15 and 29 [29]. Among those who participated in a different survey, 69.6% had some kind of formal education [29]. Among those who took part in another survey, 63.9% had completed some kind of formal education whereas 36.1% had none at all [5]. A comparable study conducted in Africa found that 56.3% of patients belonged to families with 5-8 members, while 40.4% belonged to families with 1-4 members [13].

The strength of this study lies in the fact that it covered patients from many DOT facilities in various urban locations of Bangladesh, rather than focusing on just one hospital. Also taken into account were a plethora of aspects related to health, nutrition, lifestyle, and sociodemographics. The study is not without its flaws. To begin, information about health was gathered by self-report questionnaires; however, it is possible that these assessments of diabetes and hypertension were not fully correct. Secondly, it is probable that the results are not reflective of the country as a whole as this study only included participants from urban areas in Bangladesh. Thirdly, people's smoking histories tend to be longer when they are older [30]. Had we known that smoking and alcohol consumption were linked to undernourishment, we may have inquired about their length. Thus, more studies can be undertaken to find out how long people smoke and how their nutritional status affects tuberculosis patients.

Conclusion

A third of tuberculosis patients in Bangladeshi cities are underweight, according to the latest research. Based on these findings, it appears that public health measures are required to enhance nutritional programs for adult tuberculosis patients in urban regions of Bangladesh and to raise the bar for service quality generally. Health education about the effects of undernourishment on tuberculosis patients and their families, the creation of standards for nutritional care and support to raise the bar on nutritional treatment, and the incorporation of food assistance into the tuberculosis national program's strategic plan are all possible steps in

this direction. The nutritional status of tuberculosis patients was also significantly correlated with variables including age, TB type, occupation, family size, availability of safe drinking water, use of enriched oil, diabetes, daily protein consumption, and dietary counseling.

List of abbreviations

TB stands for tuberculosis, and the acronyms DOTS (Directly Observed Treatment Short Course), IRB (Institutional Review Board), NTP (National Tuberculosis Control Program), and BMI (Body Mass Index) provide consistency.

Declarations

Ethics approval and consent to participate

- The research received ethical clearance from the IPHN's Institutional Review Board (IRB).
- Before any data was collected, participants were asked to read and sign an informed consent form.
- During the course of data collection, participants were given the option to discontinue participation in the study.
- Data gathering was preempted by obtaining permission from DOTS center managers.

Consent for publication

- Not applicable

Availability of data and materials

- The datasets used and analyzed during the current study are available from the corresponding author on reasonable request

Competing interests

- The authors declare that they have no competing interests

Authors' contributions

- Prof. Dr. Shah Golam Nabi designed and supervise the research work
- Dr. Md. Rifat Uddin reviewed literatures and analyzed the data
- Dr. Ruhul Amin Tuhin provided management support for the research
- Dr. Rahnuma Raihan Shuchi, Dr. Nadia Nusreen and Dr. Rifat Jahan took parts in report and manuscript writing
- All authors read and approved the final manuscript

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Tables:

Table 1: Distribution of respondents by sociodemographic and TB-related characteristics (n=314)

Sociodemographic variables		TB-related variables and comorbidities	
Variables	**Frequency (%)**	**Variables**	**Frequency (%)**
Age			
Mean age: 35.18±14.97 years (Min. age= 18 years and Max. age= 80 years)		**Family history of TB**	
Less than 20 years	49 (15.6)	Yes	54 (17.2)
21-50 years	207 (65.9)	No	260 (82.8)
51 and above years	58 (18.5))	**Type of TB**	
Sex		Pulmonary	141 (44.9)
Male	161 (51.3)	Extrapulmonary	173 (55.1)
Female	153 (48.7)	**TB treatment duration**	
Educational status		Less than 6 months	287 (91.4)
No schooling	40 (12.7)	6 months and above	27 (8.6)
Primary	84 (26.8)	**Functional status of patients**	

Secondary	83 (26.4)	Actively working	268 (85.4)
Higher secondary and others	107 (34.1)	Bedridden/need assistance	46 (14.6)
Occupational status		**Diabetes**	
In service	102 (32.5)	Yes	34 (10.8)
Dependent	121 (38.5)	No	280 (89.2)
Others	91 (29)	**Hypertension**	
Housing condition		Yes	55 (17.5)
Concrete	172 (54.8)	No	259 (82.5)
Tin shade and others	142 (45.2)		
Monthly family income			
Less than 20000 tk	166 (52.9)		
20000 tk or above	148 (47.1)		
No. of family members			
Four and below	177 (56.4)		
Above four	137 (43.6)		

Table 2: Distribution of respondents by Lifestyle and dietary habit-related characteristics (n=314)

Lifestyle-related variables		Dietary habit-related variables	
Variables	**Frequency (%)**	**Variables**	**Frequency (%)**
Safe drinking water facility		**Frequency of meal-taking per day**	
Yes	301 (95.9)	3 times a day	294 (93.6)
No	13 (4.1)	Less than and greater than 3 times	20 (6.4)
Type of latrine use		**Daily protein intake**	
Hygienic	304 (96.8)	Yes	274 (87.3)
Unhygienic	10 (3.2)	No	40 (12.7)
Tobacco use		**Appetite to eat**	

Smoking	27 (8.6%)	Yes	192 (61.1)
Smokeless	32 (10.2%)	No	122 (38.9)
Iodized salt taking		**Change in dietary pattern after TB diagnosis**	
Yes	296 (94.3)	Yes	156 (49.7)
No	18 (5.7)	No	158 (50.3)
Fortified oil taking		**Get dietary counseling from the DOT center**	
Yes	254 (80.9)	Yes	205 (65.3)
No	60 (19.1)	No	109 (34.7)
Regular physical exercise			
Yes	100 (31.8)		
No	214 (68.2)		

Table 3: Association between nutritional status and variables related to sociodemographic characteristics and health-related conditions of the respondents (n=314)

Variables	Nutritional status			Total	p value
	Underweight	Normal	Overweight and obesity		
Age group					
Less than 20 years	24 (7.6)	15 (4.8)	10 (3.2)	49 (15.6)	0.001
20-50 years	62 (19.7)	92 (29.3)	53 (16.9)	207 (65.9)	
More than 50 years	19 (6.1)	36 (11.5)	3 (1)	58 (18.5)	
Total	105 (33.5)	143 (45.5)	66 (21)	314 (100)	
Sex					
Male	55 (17.5)	75 (23.9)	31 (9.9)	161 (51.3)	0.734
Female	50 (15.9)	68 (21.7)	35 (11.1)	153 (48.7)	
Educational status					
No schooling	24 (7.6)	13 (4.1)	3 (1)	40 (12.7)	0.000
Primary	34 (10.8)	36 (11.5)	14 (4.5)	84 (26.8)	
Secondary	27 (8.6)	45 (14.3)	11 (3.5)	83 (26.4)	

Higher secondary and others	20 (6.4)	49 (15.6)	38 (12.1)	107 (34.1)	
Occupational Status					
In service	14 (4.5)	55 (17.5)	33 (10.5)	102 (32.5)	
Dependent	48 (15.3)	55 (17.5)	18 (5.7)	121 (38.5)	0.000
Others	43 (13.7)	33 (10.5)	15 (4.8)	91 (29)	
Housing condition					
Concrete	42 (13.4)	85 (27.1)	45 (14.3)	172 (54.8)	
Tin shade and others	63 (20.1)	58 (18.5)	21 (6.7)	142 (45.2)	0.000
Monthly family income					
Less than 20000 tk	61 (19.4)	76 (24.2)	29 (9.2)	166 (52.9)	
20000 tk or above	44 (14)	67 (21.3)	37 (11.8)	148 (47.1)	0.195
No. of family members					
Four and below	55 (17.5)	85 (27.1)	37 (11.8)	177 (56.4)	
Above four	50 (15.9)	58 (18.5)	29 (9.2)	137 (43.6)	0.541
Family history of TB					
Yes	24 (7.6)	21 (6.7)	9 (2.9)	54 (17.2)	
No	81 (25.8)	122 (38.9)	57 (18.2)	260 (82.8)	0.167
Type of TB					
Pulmonary	46 (14.6)	75 (23.9)	20 (6.4)	141 (44.9)	
Extra pulmonary	59 (18.8)	68 (21.7)	46 (14.6)	173 (55.1)	0.011
TB treatment duration					
Less than 6 months	101 (32.2)	125 (39.8)	61 (19.4)	287 (91.4)	
6 months and above	4 (1.3)	18 (5.7)	5 (1.6)	27 (8.6)	0.049
Functional status of patients					
Actively working	87 (27.7)	120 (38.2)	61 (19.4)	268 (85.4)	
Bedridden/need assistance	18 (5.7)	23 (7.3)	5 (1.6)	46 (14.6)	0.18
Diabetes					

Yes	8 (6.4)	24 (7.6)	2 (0.6)	34 (10.8)	0.005
No	97 (30.9)	119 (37.9)	64 (20.4)	280 (89.2)	
Hypertension					
Yes	20 (6.4)	24 (7.6)	11 (3.5)	55 (17.5)	0.880
No	85 (27.1)	119 (37.9)	55 (17.5)	259 (82.5)	

Table 4: Association between nutritional status and dietary habits and lifestyle-related variables of the respondents (n=314)

Variables	Nutritional status			Total	p value
	Underweight	**Normal**	**Overweight and obesity**		
Frequency of meal-taking per day					
3 times a day	93 (29.6)	137 (43.6)	64 (20.4)	294 (93.6)	0.032
Less than and greater than 3 times	12 (3.8)	6 (1.9)	2 (0.6)	20 (6.4)	
Daily protein intake					
Yes	87 (27.7)	123 (39.2)	64 (20.4)	274 (87.3)	0.022
No	18 (5.7)	20 (6.4)	2 (0.6)	40 (12.7)	
Appetite to eat					
Yes	59 (18.8)	96 (30.6)	37 (11.8)	192 (61.1)	0.132
No	46 (14.6)	47 (15)	29 (9.2)	122 (38.9)	
Change in dietary pattern after TB diagnosis					
Yes	57 (18.2)	73 (23.2)	26 (8.3)	156 (49.7)	0.150
No	48 (15.3)	70 (22.3)	40 (12.7)	158 (50.3)	
Get dietary counseling from the DOT center					
Yes	79 (25.2)	95 (30.3)	31 (9.9)	205 (65.3)	0.001
No	26 (8.3)	48 (15.3)	35 (11.1)	109 (34.7)	
Safe drinking water facility					
Yes	96 (30.6)	141 (44.9)	64 (20.4)	301 (95.9)	0.017
No	9 (2.9)	2 (0.6)	2 (0.6)	13 (4.1)	
Type of latrine use					
Hygienic	100 (31.8)	138 (43.9)	66 (21)	304 (96.8)	0.216
Unhygienic	5 (1.6)	5 (1.6)	0 (0)	10 (3.2)	
Iodized salt taking					
Yes	97 (30.9)	135 (43)	64 (20.4)	296 (94.3)	0.452
No	8 (2.5)	8 (2.5)	2 (0.6)	18 (5.7)	

Fortified oil taking					
Yes	73 (23.2)	127 (40.4)	54 (17.2)	254 (80.9)	0.001
No	32 (10.2)	16 (5.1)	12 (3.8)	60 (19.1)	
Regular physical exercise					
Yes	38 (12.1)	40 (12.7)	22 (7)	100 (31.8)	0.374
No	67 (21.3)	103 (32.8)	44 (14)	214 (68.3)	
Tobacco use					
Smoking	13 (4.1)	10 (3.2)	4 (1.3)	27 (8.6)	0.232
Smokeless	8 (2.5)	12 (3.8)	12 (3.8)	32 (10.2)	0.053

Table 5: Multiple logistic regression analysis for factors associated with underweight status compared with normal nutritional status in adult TB patients receiving anti-TB treatment

Characteristics	Categories	Odds ratio	95% confidence interval	p value
Age group	Less than 20 years vs more than 50 years	2.494	0.994-6.253	0.051
	20-50 years vs more than 50 years	0.977	0.470-1.999	0.933
Educational status	No schooling vs Higher secondary and others	2.708	0.612-11.989	0.189
	Primary vs Higher secondary and others	0.399	0.119-1.337	0.137
	Secondary vs Higher secondary and others	1.158	0.349-3.843	0.811
Safe drinking water facility	Yes vs No	0.151	0.032-0.716	0.017

Daily protein intake	Yes vs No	1.441	0.677-3.068	0.343
Frequency of meal-taking per day	3 times a day vs Less than or greater than 3 times	0.339	0.123-0.936	0.037
Type of TB	Pulmonary vs Extrapulmonary	0.699	0.398-1.226	0.212
TB treatment duration	Less than 6 months vs More than 6 months	3.639	1.193-11.085	0.023
DM	Yes vs No	0.477	0.186-1.223	0.123
Get dietary counseling from the DOT center	Yes vs No	1.530	0.844-2.773	0.162