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Original Research Article

A STUDY ON NUTRITIONAL STATUS AND ITS EFFECTIVENESS ON ADULTS WITH PULMONARY TUBERCULOSIS IN NORTH MADHYA PRADESH

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Abstract

Background: Each year, more than 13.7 million people became an active case of tuberculosis and more than 1.5 million cases of TB patient will die. The association between TB and malnutrition is bi-directional, TB leads the patient to malnutrition, and malnutrition increases the risk of developing active TB by 6 to 10 times. The aims of this study were to assess the nutritional status and its effectiveness among TB patients. **Materials and Methods:** A comparative cross-sectional study design was implemented. Four hundred twenty patients of sputum positive for pulmonary TB (both microbiologically confirmed and clinically diagnosed) age more than 18 years were selected from different Designated Microscopy Centre (DMC). The most common nutritional and biochemical assessment was done by blood haemoglobin and serum albumin level. All other relevant parameters were also recorded. Descriptive statistics were used to find the proportion of malnutrition. Binary logistic regression was used to identify the determinants of malnutrition. **Result:** The prevalence of TB symptoms was found significantly just more than double into undernourished TB participants. The prevalence of undernutrition was 71.9%, (OR=2.79, p<0.003). Among them half patients were have moderate to severe albumin deficiency (2.5 to <2 g/dl), and were suffering from moderate to severe anaemia (Haemoglobin in <9-7g/dL). Male preponderance (66%) was noted with male: female ratio of around 2:1. About 31.7% of the patients were illiterate and 52% patients belong to lower social class and have significant higher odds. Higher odds of low BMI (undernutrition) were also found among patients consumed tobacco, alcohol and less frequency of meals in a day. **Conclusion:** High proportions of TB patients were malnourished. TB patients were highly susceptible to malnutrition and even a very distal reason for malnutrition in the community became a proximal cause for TB patients.

INTRODUCTION

India is the country with the highest burden of TB disease in the world and accounts for one-fourth of the global TB burden. According to the WHO global TB report, 2.8 million people developed TB in India in 2015.[1] and among states, Madhya Pradesh accounts for one of the higher numbers of incidence cases of TB and also has a very high burden of undernutrition compared to other states of the country. In the age group, 15–49 years, 26% of population is underweight (body mass index <18) .[2] Out of Social, behavioural, economic, and environmental factors, social determinants and undernutrition are the most important predisposing factor.[3] Undernutrition and TB have a bidirectional relationship, undernutrition, and weak immunity can result in the disease and the disease can worsen the nutritional status. Undernutrition among TB patients leads to worse treatment outcomes.[3] Severe undernutrition at diagnosis has been shown to be associated with a two-fold increased risk of death.[4] Role of Nutrition is pivotal to TB patients and Malnutrition is well-known among adults with

tuberculosis. Measurement of leucine flux suggested that there is altered amino acid metabolism in adults with tuberculosis, and this abnormality or anabolic block may contribute to wasting in tuberculosis despite nutritional support.[5] Undernutrition, the leading cause of immunodeficiency globally, weakens power to fight against TB. These people are at risk of up to 4 times more likely to develop TB disease than healthy people.[6] TB makes undernutrition worse and undernutrition weakens the immunity power. As a result, latent TB will develop into an active disease.[7] Most patients with active TB are in a catabolic state which results in weight loss.[8,9] Protein deficiency has been described in TB and albumin and prealbumin have been found to be useful markers both for the diagnosis of deficiency and monitoring of its reversal.[10] Weight loss is found to be one of the most common presenting complaints of patients with TB.[11,12] Weight loss in TB can be caused by several factors such as reduced food intake due to loss of appetite, nausea and abdominal pain, nutrient losses from vomiting and diarrhoea and metabolic changes due to the disease.[13,14] Low BMI and lack of adequate weight gain with TB treatment are the increased risk factors for death.[15] and TB relapse.[16,17] and may indicate the severity of TB, poor treatment response, and/or the presence of other comorbid conditions. TB can worsen pre-existing undernutrition by decreasing appetite and by increased catabolism. The high prevalence of undernutrition in TB patients results in increased deaths and risk of relapse. The prevalence, severity, and implications of undernutrition in Indian TB patients particularly are found in India's rural areas compared to urban areas.[18] TB can worsen pre-existing undernutrition by decreasing appetite and by increased catabolism. The high prevalence of undernutrition in TB patients results in increased deaths and risk of relapse. The prevalence, severity, and implications of undernutrition in Indian TB patients particularly are found in India's rural areas compared to urban areas.[18] The treatment outcomes of TB patients can be improved by studying their nutritional status.[19] Incorporating nutritional support during a directly observed treatment strategy (DOTS) increases the probability of favourable treatment outcomes.[20,21] Therefore, undernutrition needs to be treated concurrently with treatment of the infections.[4] In this background, we conducted a hospital-based study to assess nutritional status and its associated factors among TB patients in the Designated Microscopy Centre under National Tuberculosis Elimination Programme (NTEP) in the Gwalior District of Madhya Pradesh. So, the objectives of this research were to estimate and compare the proportion of underweight and their determinants among TB patients in a resource-limited setting.

MATERIALS AND METHODS

The study was designed in the community medicine department, G R Medical College Gwalior, Madhya Pradesh, and was carried out in Designated Microscopy Centre under NTEP in Gwalior District of Madhya Pradesh. From Jan 1, 2022, to Oct 31, 2022. It was a community-based cross-sectional study of sputum smear-positive TB patients.

Sample Size Calculation

Undernutrition at the population level contributes to an estimated 55% of annual TB incidence in India.[22] To calculate the sample size, we have taken 55% prevalence of undernutrition among Pulmonary TB patients. By considering 5% absolute error and 95% confidence interval, the sample size to be taken will be N= 4PQ/L, where P= Prevalence of study= 55%, Q = (100 - P) = 45, and L = absolute error = 5%. The calculated sample size was 396, after adding 5 percent non-response it comes to be around 416. By rounding off this value, the total sample size taken was 420. The desired sample size of 420 was achieved in almost 10 months. Anthropometric measurements were done using parameters such as height, weight, and BMI. The Quetelet index relates weight (kg) to the square of the height (m2), which enables the calculation of BMI. The WHO categorizes underweight as BMI <18.5, normal as 18.5–24.9, overweight as 25–29.9, obese as 30–39.9, and extreme obesity >40. The most common nutritional and biochemical assessment was done by blood haemoglobin and serum albumin level.[23]

Inclusion Criteria

All sputum-positive patients diagnosed with TB as per diagnostic algorithm under RNTCP by sputum microscopy having consent for the study had been included in the study

Exclusion Criteria

The following criteria were excluded from the study

1. Patient refusing to give consent to participate in study
2. Sputum negative pulmonary TB
3. Extrapulmonary TB
4. Carcinoma lung
5. Other causes of pulmonary diseases.

Tool & Procedure

The pre-tested, semi-structured, and validated questionnaire was used to get information about personal history, socio-economic status, nutritional history, and physical examination. The questionnaire included the personal history of the patient, i.e., name, age, sex, address, education, occupation, and income. Social classification [24] was used to assess the socio-economic status of the patients which is based on per capita income. Furthermore, the medical history of the patient regarding the RNTCP ATT category of the patient, HIV status, and metabolic disease was enquired. A history of smoking and alcoholism was taken. Patients were also examined physically for vital signs, pallor, etc. The patient was investigated for anemia and hypoproteinaemia.

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Nutritional history including daily diet, calorie calculation on diet basis, and calorie requirement according to weight and occupation was taken and assessed. BMI was calculated by Quetelet's index (Weight in kg/height in m2). Historically, serum proteins such as albumin have been widely used by physicians to determine patient nutritional status. Serum albumin <2 g/dl is defined as severe, 2 to 3.5 (g/dL is categorized into mild to moderate, and >3 g/dl as normal nutrition. A history of weight loss and signs of undernutrition, such as visible wasting or edema, were noted. Clinical assessment for comorbid conditions and concurrent treatments was also recorded. History and clinical diagnosis, and medical history helped raise suspicion for increased risk of malnutrition and the presence or absence of inflammation. The screening included questions regarding loss of appetite, loss of weight, mobility, any stress, and BMI. Scoring was done after this. Then, an assessment was done by asking about the diet including meals, protein intake, fluid intake, and nutritional status. Information regarding food and nutrient intake was obtained from the patient and/or caregiver. A modified diet history, 24 hr recalls, "calorie counts" (either observed intake/estimated post-meal plate waste), and/or prior documentation of periods of inadequate food intake in the patient's medical record were used as "evidence" of inadequate intake. A food frequency multi-question questionnaire was used to explore dietary intake over a period of time.

Data Analysis

The completed questionnaire was sorted and entered into version 20 of the statistical package for the social sciences (SPSS) and Microsoft 2019 excel package for analysis. Descriptive statistics on the sample characteristics and questionnaire items were computed.

Ethical Consideration

Ethical clearance for the study was obtained from the Institutional Ethical Committee of Gajra Raja Medical College, Gwalior (M.P.) before starting the study. This study did not need any intrusive or non-obstructive diagnostic strategy or holding of any prescribed medicine recommended by a treating doctor or starting any new drug.

RESULTS

Out of total of 420 TB patients' participants, 302 (71.9%) patients were in the category of undernutrition (BMI <18.5) and remaining 118 (36.75%) patients were in the category of normal weight (BMI >18.5). Majority of patients 201 (66.67%) in underweight were found in those smears positive. The odds of malnutrition among TB patients were 2.79 folds higher and it was found significant statistically (p=0.003) [Table1].

Table 1: Distribution of tuberculosis patients by sputum/smear and BMI status

BMI categories	Tuberculosis patients' status by sputum microbiology grade													
	Smear Absent n	(%)	Smear Scanty n	%	Smear Grade +1	%	Smear Grade +2	%	Smear Grade _+3	%	Total n	%	OR	p value
Underweight (BMI= <18.5	111	36.7	21	6.9	46	15.2	76	25.2	48	15.9	302	71.9	2.79 (1.79;4.33)	0.003 (Significant)
Normal BMI (≥18.5)	45	38.1	9	7.6	16	38.9	30	25.4	18	15.2	118	28.1	Reference	

[Tables 2] represent the percentage distribution background characteristics by Nutritional (BMI) status. A total of 420 study participants was included giving for the response after excluding some of them due to varied reasons. The mean age of the study participants was 28 years (standard deviation [SD] ±14 years), 18 year was the youngest age of study participants. The profile of the respondent shows that higher proportion of respondents was males 274(65.24), while the undernutrition was found more in female (78.08 vs 68.62 with OR=1.62 and p=0.04). Majority of participants were in the in the age group of 26–35 and 36–45 years. Thirty-one percent respondents were illiterate, 42.3% were unemployed, and more

Table 2: Percentage distribution of respondents as per body mass index status and sociodemographic characteristics (N=420)

Variables		Frequency n	(%)	Normal BMI n	(%)	Underweight BMI <18 n	(%)	OR (95%CI)	p value
Sex	Male	274	65.24	86	31.38	188	68.62	Ref	0.04*
	Female	146	34.76	32	21.91	114	78.08	1.62 (1.02;2.60)	
Age	18-25	49	12.14	16	32.65	33	67.35	Ref	0.37
	26-35	127	30.24	33	25.98	94	74.02	1.38 (0.67;2.82)	

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	36-45	120	28.57	22	18.33	98	81.67	2.16 (1.01;4.59)	0.043*
	46-55	54	12.86	21	38.99	33	61.01	0.76 (0.34; 1.71)	0.51
	56-65	44	10.24	19	43.18	25	56.82	0.64 (0.27; 1.48	0.296
	>65	26	6.19	7	26.92	19	73.08	0.75 (0.25;2.23)	0.80
Residence	Urban	264	62.86	79	29.92	185	70.07	Ref	0.27
	Rural	156	37.14	36	25.0	117	75.0	1.28 (0.82;2.00	
Education	Illiterate	133	31.67	29	26.31	104	73.68	2.73 (1.27 to 5.89)	0.011*
	Up to Middle	167	39.76	48	38.32	119	61.68	1.89 (0.91 to 3.93)	0.08
	Up to Secondary	83	19.76	25	13.25	58	86.75	1.76(0.79 to 3.94)	0.163
	≥Graduate	37	8.81	16	45.94	21	54.06	Ref	
HIV Status	Positive	10	2.38	0	0.0	10	100.0	8.50 0.49:14.36	NA
	Negative	410	97.62	118	28.78	292	71.22	1	
Economic Status by per capita income	Upper	12	2.86	10	83.33	2	16.67		
	Upper Middle	60	14.28	31	51.67	29	48.33	4.67(0.94;23.17)	0.043
	Lower Middle	127	30.24	35	19.68	92	72.443	13.14 (2.74;63.00)	0.002
	Lower	221	52.62	52	23.53	169	76.47	16.25(3.45;76.53	0.004
Occupation	Unemployed	178	42.3	43	24.16	135	75.84	9.42 (0.95;92.92	0.054*
	Unskilled / semi-skilled worker	159	33.09	43	27.04	116	72.95	8.09 (0.82;79.92)	0.057*
	Skilled Worker	40	9.52	13	32.5	27	62.5	0.223 (0.59;65.85)	0.128
	Professional	4	0.95	3	75.0	1	25.0	1	
	Clerical, Shop Owner	39	9.28	16	41.02	23	58.97	4.31(0.41;45.28)	0.223
Family size	≤5	164	39.05	44	26.83	120	73.17	1	
	>5	256	25.64	73	28.51	183	71.48	0.91(0.59;1.42)	0.706
Marital Status	Married	365	86.90	100	27.40	265	72.60	1.18	
	Unmarried/Widow	55	13.09	17	30.91	38	69.09	0.86 (0.44;1.7)	0.588
*Significant Statistically									

Than half of them were categorized into lower class by earning of per capita income. <5000/month. Majority of respondents (62.8%) were living in urban area. Significant differences ($p<0.05$) were seen in nutritional status in across several socio-demographic characteristics including sex, education, residence, HIV status, occupation, economic status, family size, marital status as well as HIV status of participants

Table 3: Percentage distribution of respondents as per body mass index status and lifestyle factors (N=420)

Variables		**Underweight (BMI <18.5)**				**Total**	**%)**	**OR**	**p value**
		Yes *n*	**(%)**	No *n*	**(%)**	***n***			
Tobacco user	Smoking	153	70.18	65	29.82	218	51.90	1.61(1.035;2.53)	0.0347*
	Smokeless	160	79.21	42	20.79	202	48.09	1	
Alcohol user	Yes	148	31.43	39	68.57	187	44.52	1.94 1.24:3.03	0.003*
	No	154	72.96	79	27.04	233	55.48	1	
Other substance abuse	Yes	31	83.78	06	16.22	37	8.81	2.16 (0.87:5.32)	0.093
	No	270	72.16	113	27,32	383	91.67	1	
Type of diet	Vegetarian	115	68.86	52	31.14	167	39.76	1	0.260
	Veg + nonveg	187	73.91	66	26.09	253	60.24	1.28(0.83:1.97)	
Frequency of meal in a day	1-2	104	90.24	19	9.76	123	29.28	3.66 (2.13 to 6.28)	0.001*
	3-4	178	64.31	119	35.69	297	70.71	1	
	Sufficient	18	27.69	47	72.31	65	15.47	1	0.001*

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Calorie intake status	Not sufficient	284	80.0	71	20.0	355	84.53	10.44 (5.72 to 19.07)	
Type of activity	Sedentary	101	64.74	55	35.26	156	37.14	1	
	Moderate	113	77.40	33	22.60	146	34.76	1.86 (1.12 to 3.09)	0.016*
	Heavy	95	80.50	23	19.50	118	28.09	2.25 (1.29 to 3.94	0.004*
*Significant Statistically									

Almost fifty percent of participants use tobacco & alcohol. Among lifestyle factors, BMI differs significantly p<0.05) among patients who reported consuming alcohol and tobacco but did not differ with other substance used and type of diet. Majority (90%) of respondents reported significantly undernutrition among the persons were consuming 1–2 meals and not taking sufficient calories (80%) with the odds of more than ten times as well as persons those had heavy activities were found significantly undernourished with odds of more than double. [Table3].

Table 4: Percentage distribution of respondents as per body mass index status and disease symptoms

Symptoms	**Underweight (BMI <18.5)**				**Total**	
	Yes *n*	(%)	No *n*	(%)	*n*	(%)
Cough	234	71.34	94	28.56	328	78.09
Fever	274	72.49	104	27.51	378	90.00
Night Sweat	200	74.07	70	25.92	270	64.28
Haemoptysis	67	77.91	19	28.36	86	20.47
Chest pain	142	66.04	73	33.95	215	51.19
Weakness	298	72.15	115	27.84	413	98.33
Weight loss	301	73.77	107	26.23	408	97.14
Loss of appetite	299	74.01	105	25.99	404	96.19
Breathing difficulty	211	60.28	139	39.71	350	83.33

[Table 4] represents symptoms intensity of undernutrition among TB patients. The prevalence of TB symptoms was found significantly just more than double into undernourished TB participants. Undernutrition had excess burden on TB patients [Table 4]. Qq2

Table 5: Distribution of patients according to haemoglobin level (WHO classification) and serum protein albumin

Hb & Serum albumin level		**Patients**	
		n	(%)
Haemoglobin in (g/dL)	<7 (severe)	71	16.90
	7 to ≤9 (moderate)	170	40.48
	9 to ≤11 (mild)	124	29.53
	≥11 (normal)	55	13.09
Differential Serum Protein-albumin*	<2 (g/dL) Severe	103	24.52
	2 to 3.5 (g/dL) Mild to moderate	201	47.86
	>3.5 (g/dL) Normal	116	27.62
*Liver function normal			

Majority of cases (70%) have low haemoglobin level from mild to moderate and around 17% were having severe anemia (Hb level <7g/dl), while only 13% patients were having normal Hb level (≥11g/dl). As such, due to majority of undernourished TB patients, majority of patients (48%) were having mild to moderate albumin deficiency 2 to 3.5 (g/dL), and 24% having severe albumin deficiency (<2 g/dl) and only 27% patients have serum albumin in the normal range [Table5].

DISCUSSION

TB is associated with poverty and malnutrition. Nutritional status is significantly lower in patients with active TB compared with healthy controls. Factors affecting malnutrition need to be identified so that these can be addressed to have impact on TB. In the present study, the nutritional status was measured as BMI. Overall prevalence of undernutrition was 71.90% (BMI <18.5) among TB patients. The prevalence of underweight among TB smear positive was 63.2%; this proportion was statistically significant (P-value < 0.003 with OR 2.79). This finding indicates that excess malnutrition was observed as a result of TB. This is because TB infection increases the anabolic process and consumes additional energy.[25] additionally, TB infection manifests with a reduction in appetite, nutrient malabsorption, finally increasing the risk of underweight.[26] Prevalence of undernutrition (71.9%) in the current study was similar to Shailly et al and Shukhla et al.[27,28] but higher when compared with study conducted in Ghana (51%).[9] Manipur state of India (64.5%).[29] However, the prevalence in the present study was lower than the study conducted in Chhattisgarh state of India (85%).[18] This difference may be due to demographic factors, sociocultural situation, lifestyle, and socioeconomic status of the region. The study explored the association of nutritional status of TB patients with sociodemographic, lifestyle, and health-related factors. In the present study, significant male

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predominance was found with male: female ratio was more than 2:1. Males were 44.8% and females were 18.7%. Likely due to male dominating society, and as males are mostly out of their home for earning purpose, so more likely to come in contact with open cases of TB. In a study conducted by Dargie et al. [30] and Shailly et al.[27] around 55.8% and 66% were male respectively, which is similar to our study. The odds of malnutrition were 2.2 folds higher among TB patients whose age was in between 35-45years. This finding agrees with finding from Ghana.[9] This is due to the reason that the risks of unemployment and most expenditure burden were higher in this age group. The odds of malnutrition among TB patients were 1.2 folds higher in the rural areas than the urban. This finding agrees with finding from other study of India [18], but disagrees with Ethopia study.[31] This is due to the reason that rural residents in India were living in the poor conditions condition. Average monthly income showed a significant association with undernutrition in TB participants. The likelihood of participants being undernourished increased when average monthly income was so less categorized in to poor class, in line with a study of shailly et al, Brhane et al and from Ghana.[27,32,9] Education status, mainly illiterate, had a significant association with undernutrition. The odds of undernutrition among illiterate TB patients were about 2.7 times higher compared to those of literate patients. Our finding is in line with a study conducted by Dargie et al [30] and shailey et al.[27] Hence, illiteracy is a major problem in our developing countries India where the TB patients was found inadequate and implementation of nutritional guideline. In current study maximum participants 42.14% were Unemployed, means unemployment is a major problem. Hence, earning is also affecting nutrition status as observed. Similarly, in the study of Shukla et al. [28] earning is also a factor contributing in cause of malnutrition., and in the study of K. Endalkachew et al.[33] nearly half of study participants were Unemployed. The odds of malnutrition were 8.5 folds higher among HIV positive TB patients than HIV negative TB patients reflecting a complex interaction between HIV infection and nutrition. This finding agrees with finding from Tanzania.[34] This is due to the reason that HIV positive patients were not economically productive so that they can't get the access to the different variety of foods.[35] HIV positive patients have a poor appetite, poor absorption of nutrients.[36] Family size, marital status and believe in avoiding a certain type of food were not the predictors of malnutrition among the tuberculosis-free residents, but these variables were the predictors of malnutrition among TB patients. These show that TB patients are very susceptible to malnutrition even the very distal reason for malnutrition in the community became a proximal reason for TB patients.[9] The odds of malnutrition were not higher among TB patients with marital status, family size greater than 5 and avoiding a certain type of foods (vegetarian) in our study. This finding agrees with finding from India.[19] but contrast to study of Magallenes and Ghana because high family size decreases the household income leading to the low dietary intake of household members.[37] and patients will not take important nutrients due to their behaviour of avoiding that type of food.[9] The odds of malnutrition among smokers TB patients were 1.62 folds higher than non-smokers TB patients and was similar to study of shukhla et al.[28] TB patients with problematic alcohol use had 1.92-fold higher risk of becoming malnourished than non-alcoholic TB patients. This finding agrees with research finding from Tanzania.[34] and Shukhla et al.[28] This is due to the reason that alcoholic patients eat poorly, had poor digestion, storage, use, and excretion of nutrients.[38] In the present study, most of the study participants undernutrition reported consuming two meals in a day, and this was mainly related to their lower appetite and adaptive mechanisms to food insecurity. Unlike other studies.[18,39] meal frequency showed increased risk of having low BMI, but findings were statistically insignificant. Patients who received sufficient calorie had better BMI compared to one who did not receive. Adjusted analysis showed increased risk of lower BMI among patients who did not receive more than two meals a day and sufficient calorie, although the findings were statistically inconclusive and similar results were reported when compared with the findings of other studies.[14] This study revealed that hard physical activity important to develop undernutrition among tuberculosis patients. Moreover, in financially disadvantaged settings, a swift recovery from disease is crucial to enable the patient to return to work and thereby support the family again and insufficient calorie diet make opportunity to undernutrition and tuberculosis.[40] Now it is important to consider how malnutrition can increase risk of tuberculosis symptoms. The host protective immune mechanism of infection with Mycobacterium tuberculosis depends critically on the interaction and cooperation between monocyte-macrophages and T-lymphocytes and their cytokines.[26] Substantial experimental evidence in our study suggests that malnutrition can lead to secondary immunodeficiency and increases the host's susceptibility to infection and symptoms i.e., cough, fever, weakness, weight loss in intense intensity. This is an interesting finding because a weight loss (decreased BMI) may be a symptom of severe tuberculosis, rather than a cause of it. Weight loss and undernutrition in patients with tuberculosis can be caused by decreased food intake or factors due to tuberculosis (ie, cachexia due to metabolic dysfunction, poor absorption, fever, and anorexia).[41] Similarly, Chan J have reported that Increased risk of tuberculosis can result from alteration in the individual protective function of, or the interaction between T-lymphocytes and macrophages because of nutritional insult.[42] Serum albumin and haemoglobin concentrations have been found as strong predictors of malnutrition in adults

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with tuberculosis. About 24% cases were having severe albumin deficiency (<2 g/dl), 47% were having moderate to mild albumin deficiency (2 to 3.5 (g/dL) and only about 27% patients have serum albumin in normal range. Hence, a total of 73% of patients were having hypoalbuminemia in our study. In studies conducted by Shailley et al.[27] Morris et al.[43] 74% & 72% were having hypoalbuminemia which is similar to our study. Haemoglobin level was below 7 g/dl (severe anemia) in 16.9% 10.5% cases, between 7 g/dl and 8.9 g/dl (moderate anemia) in 40.5% cases, and between 9 g/dl and 11 g/dl (mild anemia) in 29.5% cases. Hence, a total of 87% of patients were anemic in our study. In studies conducted by Nagu et al., 86%.[44] Olaniyi & Aken'Ova, 93%.[45] and Shailey et al.[27]. 66% were anaemic which is similar to our study. Chhabra S et al.[46] also revealed in their study that in chronic disease like tuberculosis has been found anaemic up to 97%. Thus, it is possible that M. tuberculosis infection burden influences the degree of anemia and serum albumin deficiency in more susceptible individuals rather than in every TB patient.

Limitation of study

This is one of the important studies from the high TB burden state reporting primary data on nutritional status of TB patients. However, there are certain limitations that should be kept in mind while interpreting the findings. Because of the location of the study (public hospital) and low-cost services, poor patients and severe cases might have overrepresented in the study. There may be recall bias in self-reported information such as duration of symptoms before diagnosis of TB that could not be verified. However, to reduce recall bias most of the information provided was verified through medical records. Further, small sample size limits generalizability of the findings

CONCLUSION

A very high proportion of TB patients were malnourished. TB patients were highly susceptible to malnutrition and even a very distal factor for malnutrition became proximal for TB patients. It is important to consider, how these two problems tend to interact with each other.[47] Nutrition management of the TB patients was found inadequate and implementation of nutritional guidelines for TB patients yet to be initiated in the facilities. There is an urgent need to focus on provision of nutrition counseling and proper nutrition management of TB patients at TB hospitals. The DOTS for TB intervention should consider incorporating more nutritional support for the patients. Because a significant proportion of TB patients were malnourished, they can't afford access to nutritionally rich foods and administering the anti-TB drugs alone will decrease the treatment success rate. Also, the guideline should consider iron supplementation and deworming as part of the TB treatment for avoiding anaemias.

Competing Interests Disclaimer

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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