e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2023; 15(9); 1310-1331

Original Research Article

Assessment of Nutritional Status, Initial Haematological Parameters and Sociodemographic Factors in New Sputum Positive Pulmonary Tuberculosis Patients and Their Correlation with Treatment Outcome

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Received: 25-06-2023 / Revised: 28-07-2023 / Accepted: 30-08-2023

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Conflict of interest: Nil

Abstract:

Purpose: The purpose of the study was to find out the correlation between the initial nutritional status, initial haematological parameters, and sociodemographic factors and the treatment outcome at the end of 6 months of anti-tubercular therapy of the patients enrolled in the study.

Materials & Methods: 100 new sputum positive Pulmonary TB patients were enrolled and the initial nutritional status of the patients was assessed with height, weight and BMI. Other anthropometric indices such as Waist Hip ratio, Mid Upper Arm Circumference, Waist Height ratio were also noted down to find out the nutritional status of the patients. The baseline haematological parameters such as Serum Haemoglobin, Total Leukocyte count, Platelet count, Total Serum Protein, Total Serum Bilirubin, ALT, AST, Blood Urea, Serum Creatinine, Random Blood Sugar were also determined.

All the patients who were enrolled in the study were provided with Anti Tubercular Therapy for Drug Sensitive TB for a period of 6 months, as per the guidelines for Drug Sensitive TB under RNTCP. At the end of 6 months of treatment, the treatment outcome of the patients was found out. The patients who were cured were grouped into positive treatment outcome group. The patients who failed the regimen, who were lost to follow up and died during the course of treatment, were grouped into negative treatment outcome group. A few patients who got diagnosed with drug resistant TB during the study were grouped into treatment regimen changed group. None of the patients enrolled in the study developed any serious adverse effects during the study that required them to modify their ATT regimen.

Result: In this study, out of 100 new sputum positive pulmonary TB patients, 60% patients were male with a mean age of 42.92± 3.46 years. Out of the total number of patients, 49% patients had a positive treatment outcome (cured), 5% patients succumbed to the infection, 9% patients were lost to follow up, 17% patients failed the treatment and 20% patients had to change their treatment regimen during the course of the therapy. Age and gender of the patients were found to have no significant association with the treatment outcome. 73.5% patients with their body weight above 60 kg had a positive treatment outcome. This corroborates the fact that by improving the nutritional status of the patient, the treatment outcome can improve. The mean BMI of the patients was 20.2±3.7 and 31% patients were underweight. Among the patients who were underweight, 64.5% patients had a negative treatment outcome. This substantiates the fact that underweight TB patients are more prone to have a negative treatment outcome than patients who have a normal BMI. 74.2% of the patients who had a low waist hip ratio ended up having a negative treatment outcome. This further confirms that nutritional status is a determining factor in the treatment outcome of Pulmonary TB patients. The MUAC of the patients were measured and 74.2% patients who were malnourished had a negative treatment outcome. Also, 49 patients who had a normal MUAC ended up having a positive treatment outcome. This establishes that improving the nutritional status of the patients can improve the treatment outcome. The waist height ratio of the patients was also measured and 74.2% of the patients who were underweight, ended up having a negative treatment outcome. Also, 55.1% of the patients who had a healthy weight had a positive treatment outcome. This also favours the fact that proper nutrition can improve the treatment outcome of the patients. 77.4% of the patients who belonged to the lower socioeconomic class, as determined by the modified Kuppuswamy scale had a negative treatment outcome. Also, 55% of the patients who had their treatment regimen changed also belonged to lower socioeconomic class. These points out that backwardness in social and economic conditions of the patients can result in negative treatment outcome. 87.1% of the patients who were anaemic had a negative treatment outcome. This suggests the strong correlation between anaemia and poor treatment outcomes in pulmonary TB

patients. Correction of anaemia has to be a priority in pulmonary TB patients undergoing treatment. 87% of the patients with low protein levels had a negative treatment outcome. This points out the fact that hypoproteinemia has to be addressed alongside ATT for improving the treatment outcome in Pulmonary TB patients.

Conclusion: Pulmonary TB is associated with significant nutritional abnormalities. The findings of the study point to the fact that apart from BMI as the sole parameter for assessing the nutritional status in TB patients, there is a need to consider other anthropometric indices such as waist hip ratio, mid upper arm circumference, waist height ratio that can significantly correlate with the treatment outcome.

Keywords: Pulmonary TB, anti-tubercular therapy, Sputum Positive Pulmonary Tuberculosis Patients, Nutritional Status, Initial Haematological Parameters, Sociodemographic Factors.

Introduction

Tuberculosis (TB) is an infectious disease caused by Mycobacterium tuberculosis. Even after rapid advances in medical science & technology, TB continues to remain an important public health problem with significant morbidity & mortality. According to the Global Tuberculosis report published by World Health Organization (WHO) in 2018, the best global estimate is that 10.0 million people developed TB disease in 2017, 5.8 million being men, 3.2 million being women and 1.0 million being children. Overall 90% were adults (aged ≥ 15 years), 9% were people living with HIV (72% in Africa) and two thirds were in eight countries: India (27%), China (9%), Indonesia (8%), the Philippines (6%), Pakistan (5%), Nigeria (4%), Bangladesh (4%) and South Africa (3%). These and 22 other countries in WHO's list of 30 high TB burden countries accounted for 87% of the world's cases. [1]

India has the highest TB burden in the world. In India, there were 2.5 million prevalent TB cases with 2.2 lakh deaths [2]. The maximum number of TB related deaths occurs in men, but the burden of TB is high among women as well.

The TB problem in Inia was 1st recognised through a resolution passed in the All-India Sanitary Conference, held at Madras in 1912. The anti-TB movement in the country gained momentum with the TB association of India was established in developed1939. WHO and UNICEF took keen interest in providing assistance for introducing mass BCG vaccination with low cost in 1951.

National Tuberculosis Programme (NTP) was formulated in 1962, which was implemented in phased manner. The deficiency in NTP was identified in 1963 and RNTCP was developed [5].

In 1993, the Revised National Tuberculosis Control Programme was piloted in a population of 2.4 million populations in the states of Delhi, Gujarat, Kerala, Maharashtra and West Bengal. This was later expanded to cover 13 million by 1995 and 20 million by 1996. The programme was based on DOTS [5,6].

In 1997 India started implementing the Directly Observed Treatment Short-course (DOTS) strategy under the Revised National TB Control Programme (RNTCP) and covered the entire country by 2006. Despite this scale-up of DOTS, TB incidence continues to remain high, indicating that there could be substantial on-going transmission.

The treatment outcome of Tuberculosis patients under DOTS is determined by a number of factors. These include many factors including the nutritional status of the patient at the onset of the treatment, their basic lab parameters and their socio demographic profile

Under-nutrition is a known risk factor for TB with the relation being bidirectional and can adversely affect treatment outcomes. [3,4]. Tuberculosis can lead to or worsen pre-existing under-nutrition, by decreasing appetite, and by increased catabolism [5,6] and being underweight is considered a risk factor for developing TB. However, data from India are sparse, despite the high burden of TB as well as malnutrition in India.

Various inter-related social factors such as poverty, illiteracy, ignorance, poor standard of living; overcrowding etc. contributes to the increased prevalence of TB. [7,8] In addition, there are several studies to indicate a higher TB occurrence in patients with smoking, alcoholism, HIV/AIDS, malnutrition and Diabetes Mellitus (DM). [9,10,11] Due to the same reasons, the aforesaid socio-economic characteristics are likely to have a crucial role in the treatment success of TB patients under DOTS. Hence, the role of these parameters in the treatment outcome needs to be further studied. [12]

Monitoring the outcome of treatment is essential in order to evaluate the effectiveness of the DOTS program. Furthermore, understanding the specific reasons for unsuccessful outcomes is important for the improvement of treatment systems. [13] These factors are absolutely critical to cure the patients, prevent further transmission, and stop the emergence of resistance cases

The aim of this study is to determine these factors at the initiation of Anti Tubercular therapy in new sputum positive Pulmonary Tuberculosis patients and correlate them with the treatment outcome in new sputum positive Pulmonary Tuberculosis patients under DOTS regimen at the end of six months of treatment.

Aim and Objectives

Primary Objective

To study the correlation between initial nutritional statuses, hematological parameters, socio demographic factors and the treatment outcome at the end of six months of 1st line anti tubercular therapy for drug sensitive tb in new sputum positive pulmonary tuberculosis patients registered under RNTCP.

Secondary Objective

To find out the factors contributing to unfavorable treatment outcome in new sputum positive pulmonary tuberculosis patients on 1st line anti tubercular therapy for drug sensitive TB at the end of 6 months.

Material & Methods

It was a Prospective observational hospital-based study conducted from 1st September 2019 to 31st August 2020.

All newly diagnosed sputum positive pulmonary tuberculosis patients reporting to Kingsway Chest Centre Outpatient Department and Inpatient Department of Rajan Babu Institute of Pulmonary Medicine and Tuberculosis (RBIPMT) and registered under RNTCP who met our inclusion and exclusion criteria were taken up as study group. The enrolment was done through Outpatient Department and Inpatient Department.

Sample Size

At Kingsway Chest Centre (KCC), in 2018, 220 new smear positive patients were initiated on 1st line Anti Tubercular Therapy. The sample size was limited to the area covered by Kingsway Chest Clinic (KCC).

In a study (Das et al, 2018), 66% of the study population was having malnutrition (BMI<18.5 kg/mtr^2) the sample size was calculated using the following formula. [58]

$n=4pq/d^2$

Where n is the required sample size, p=Prevalence of cause, q=1-q, d=Precision

Taking 80% power, 5% significance level with 0.10 precision, the calculated sample size is 90.

n=4*0.66*0.34/ (0.10*0.10)= 90

Inclusion Criteria

1. Diagnosed case of New Sputum positive Pulmonary Tuberculosis patients attending Outpatient department of Kingsway Chest Clinic and admitted in the Inpatient department of RBIPMT.
2. All newly diagnosed sputum positive Pulmonary Tuberculosis patients in the age group of 18-75 years who had given informed consent for their inclusion in the study and were willing to undergo diagnostic evaluation.

Exclusion Criteria

1. Patients less than 18 years of age (since they could not give written informed consent)
2. Patients above the age of 75 years (since there were increased chances of associated co morbidities that could interfere with the study results)
3. All patients who were not willing to participate in study
4. Past history of intake of ATT
5. Pulmonary TB retreatment cases
6. Patients with extrapulmonary tuberculosis
7. New sputum negative pulmonary tuberculosis patients
8. Patients with Multi Drug Resistant Tuberculosis
9. Patients with proven HIV
10. Pregnant women
11. Patients with co-morbidities that could alter the nutritional status like heart disease, diabetes, chronic liver disease, chronic kidney disease, any GI disorder or malabsorption syndrome, malignancy
12. Past history of recent major surgery or trauma

Consent and Ethical Consideration

The study was carried out after obtaining approval from the Institutional Human Ethics Committee. An informed, written consent was obtained from all the patients. Patients who gave written consent were enrolled in study. The consent was not obtained by false representation or enticement benefits. All patients had the freedom of opting out of study at any point of time during study.

Sampling Technique:

All consecutive patients who fulfilled the inclusion and exclusion criteria were taken up to complete the sample size in the stipulated time period and registered under RNTCP for DOTS as newly diagnosed sputum positive Pulmonary Tuberculosis patients at RBIPMT.

Data Collection Technique And Tools:

The various parameters assessed were:

A. Nutritional Status Indicators

1. **Height**
2. **Weight**

3. **Body mass index (BMI)** –

Body mass index was calculated by the formula BMI = Weight in kilograms / Height in square meters. BMI ranges for Indian standards, as per the Asia- Pacific perspective for BMI classification by WHO 2000, are as follows

- Mild malnutrition = 17 - 18.49
- Moderate malnutrition = 16 – 16.99
- Severe = <16
- Healthy range = 18.5 to 25
- Overweight = 25 to 30
- Obese = 30-35
- Severely obese = > 35

4. **Waist Hip Ratio –**was calculated using a measuring tape. Waist circumference / hip circumference were taken in centimeter.

The WHO advises that a healthy WHR is: 0.85 or less for women and 0.9 or less for men.

Health Risk	Male	Female
LOW	0.95 or lower	0.80 or lower
MODERATE	0.96 – 1.0	0.81- 0.85
HIGH	More than 1	0.86r higher

5. Mid upper arm circumference – was measured conventionally in the left upper arm, at a point marked mid-way between acromion (shoulder) and olecranon (elbow) with arm

- Males - >/= 23 cm (normal); < 23 cm – malnourished
- Females - >/= 22 cm (normal); < 22 cm – malnourished

6. Waist height ratio- waist to height ratio was calculated by dividing waist size by height

a) Less than 43%: underweight
b) Ratio 43% to 52%: healthy weight
c) Ratio 53% to 62%: overweight
d) Ratio over 63%: obese

B. Socio-Economic Status Indicators

This was assessed based on the Modified Kuppuswamy's Scale 2019 which is the most commonly used scale for determining the SES of an urban family. The parameters included were

1. Education of head of family

Professional degree	7
Graduate or Post Graduate	6
Intermediate or Post High school diploma	5
High school certificate	4
Middle school certificate	3
Primary school certificate	2
Illiterate	1

2. Occupation of head of family

Professional (white collar)	10
Semi – professional	6
Clerical, Shop –owner/ farm	5
Skilled worker	4
Semi-skilled worker	3
Unskilled worker	2
Unemployed	1

3. Monthly income of family

>/= 52734	12
26355 - 52733	10
19759 - 26354	6
13161 – 19758	4
7887 – 13160	3
2641 – 7886	2
</= 2640	1

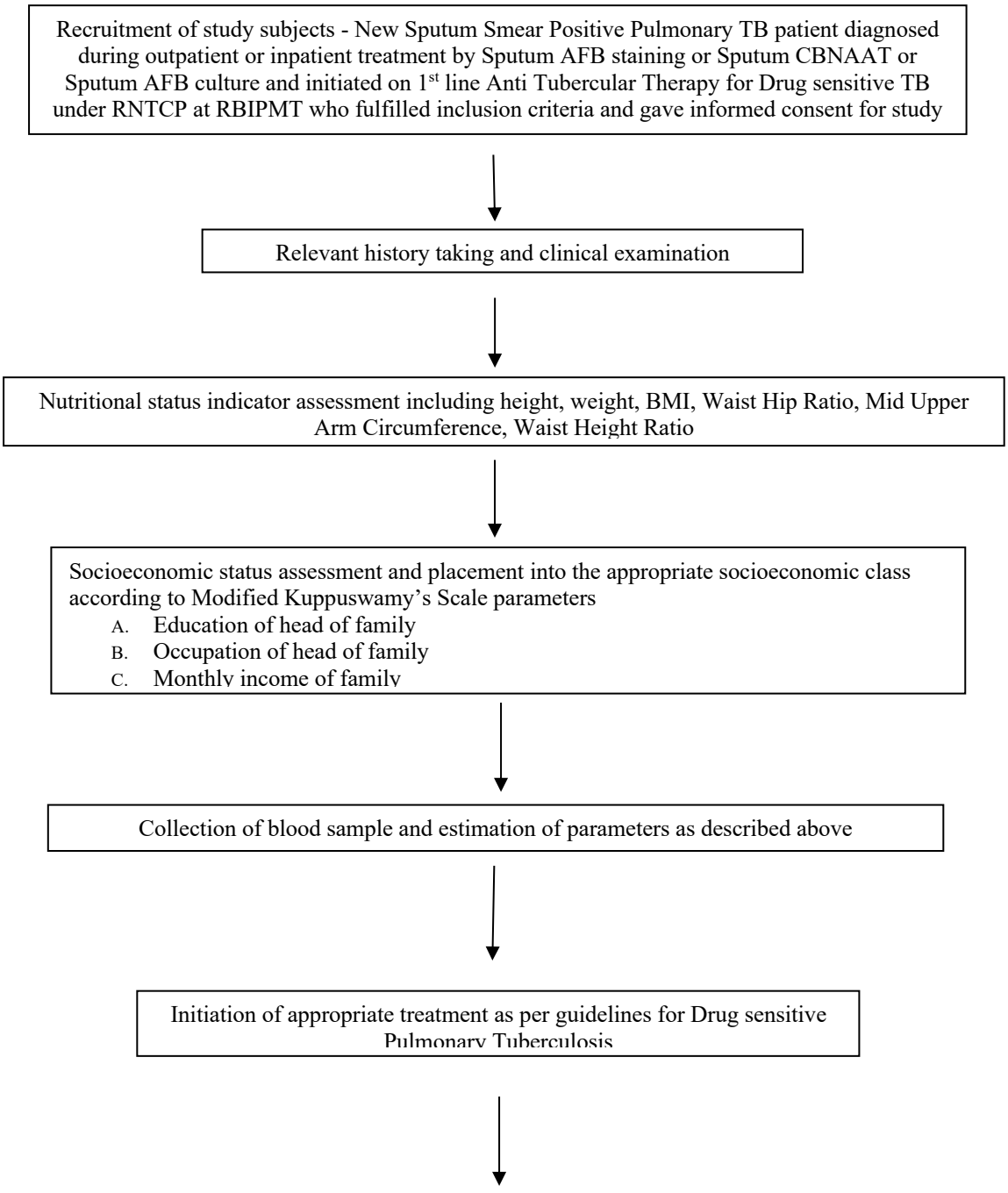
The total score was calculated by adding up all the three scores, namely, education, occupation, and total family income. According to the total score thus calculated, the family was placed in the appropriate socioeconomic class as explained below

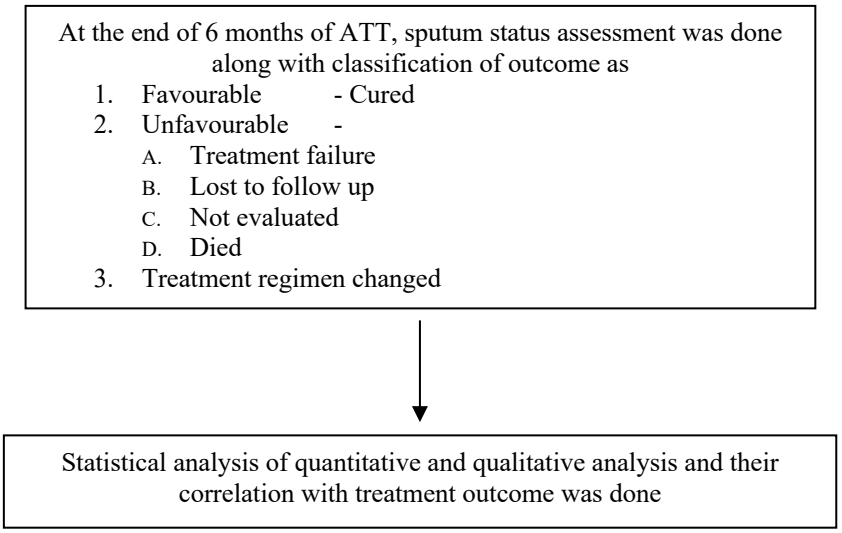
Socioeconomic class

I	Upper	26 – 29
II	Upper Middle	16 – 25
III	Lower Middle	11 – 15
IV	Upper Lower	5 – 10
V	Lower	1 – 4

Haemotological Parameters: The hematological parameters assessed were Hemoglobin, Total Leukocyte count, Differential Leukocyte count, Platelet count, Total Serum Protein, Blood Urea, Serum Creatinine, Total Bilirubin, AST, ALT and Random Blood Sugar.

Methodology





At the end of 6 months of 1st line ATT for Drug sensitive Pulmonary TB, the sputum smear status of the patient was noted, along with classification of the outcome as

A. Favorable (Positive Treatment Outcome), which included:

- Cured - Microbiologically confirmed TB patients at the beginning of treatment who were smear or culture negative at the end of the complete treatment
- Treatment Completed –A TB patient who completed treatment without evidence of failure or clinical deterioration BUT with no record to show that the smear or culture result in the last month of treatment was negative, either because the test was not done or because the result is unavailable

B. Unfavorable (Negative Treatment Outcome)

- Treatment Failure – A TB patient whose biological specimen was positive by smear or culture at the end of treatment
- Lost To Follow Up – A TB patient whose treatment was interrupted for 1 consecutive month or more
- Not Evaluated – A TB patient for whom no treatment outcome was assigned
- Died - A patient who had died during the course of anti TB treatment

C. Treatment Regimen Changed – A TB patient who was on first line regimen and had been diagnosed as having DR TB and switched to drug resistant TB regimen prior to being declared as failed. This consisted of patients who were started on ATT for drug sensitive Pulmonary TB and had to change their regimen during the course of 6 months of this study.

Results

Statistical Analysis:

For statistical analysis data were entered into a Microsoft excel spread sheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and Graph Pad Prism version 5. Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Two-sample t-tests for a difference in mean involved independent samples or unpaired samples. Paired t-tests were a form of blocking and had greater power than unpaired tests. One-way analysis of variance (one-way ANOVA) was a technique used to compare means of three or more samples for numerical data (using the F distribution). A chi-squared test ($\chi 2$ test) was any statistical hypothesis test wherein the sampling distribution of the test statistic is a chi-squared distribution when the null hypothesis is true. Without other qualification, 'chi-squared test' often is used as short for Pearson's chi-squared test. Unpaired proportions were compared by Chi-square test or Fischer's exact test, as appropriate. P-value ≤ 0.05 was considered for statistically significant.

Table 1: Distribution of Age

Age	Frequency	Percent
18 – 33 years	25	25.0%
34 – 48 years	46	46.0%
49 – 63 years	19	19.0%
64 – 75 years	10	10.0%
Total	100	100.0%

As shown in the table above, 25 (25.0%) patients were in the age group of18 - 33 years, 46 (46.0%) patients were in the age group of 34 -48 years, 19(19.0%) patients were in the age group of 49 - 63years, and 10 (10.0%) patients were in the age group of 64 -75 years.

Table 2: Distribution of Gender

Gender	Frequency	Percent
Female	40	40.0%
Male	60	60.0%
Total	100	100.0%

As shown in the table above, 40 (40.0%) patients were Female and 60 (60.0%) patients were Male.

Table 3: Distribution of Height (in meter)

Height	Frequency	Percent
1.41 – 1.55	30	30.0%
1.56 – 1.65	37	37.0%
1.66 – 1.75	27	27.0%
1.76 – 1.85	6	6.0%
Total	100	100.0%

As shown in the table above, 30 (30.0%) patients had their height in the range of1.41m - 1.55m, 37 (37.0%) patients had their height between 1.56m &1.65m, 27(27.0%) patients had their height between 1.66m &1.75m and 6 (6.0%) patients had their height in the range of 1.76m - 1.85m.

Table 4: Distribution of Weight (in kilogram)

Weight	Frequency	Percent
20 – 40	15	15.0%
41 – 60	49	49.0%
61 – 80	36	36.0%
Total	100	100.0%

As shown in the table above, 15 (15.0%) patients had their weight between 20 kg & 40 kg, 49 (49.0%) patients had their weight between 41 kg & 60kg, and 36 (36.0%) patients had their weight in the range of 61 kg – 80 kg.

Table 5: Distribution of Body Mass Index (in kg/m^2)

BMI	Frequency	Percent
< 18.5	31	31.0%
18.5 – 22.9	43	43.0%
23 – 24.9	7	7.0%
25 – 29.9	19	19.0%
Total	100	100.0%

As shown in the table above, 31 (31.0%) patients were in the < 18.5 BMI group(underweight), 43 (43.0%) patients were in18.5 – 22.9 BMI group(normal), 7 (7.0%) patients were in23 – 24.9 BMI group(overweight) and 19 (19.0%) patients were in 25 – 29.9 BMI group(obese).

Table 6: Distribution of Waist Hip Ratio

Waist Hip Ratio	Frequency	Percent
Low	42	42.0%
Moderate	42	42.0%
High	16	16.0%
Total	100	100.0%

A s shown in the table above, 42 (42.0%) patients had a Low waist-hip ratio, 42 (42.0%) patients had a Moderate waist-hip ratio and 16 (16.0%) patients had a high waist-hip ratio.

Table 7: Distribution of Mid Upper Arm Circumference

Mid Upper Arm Circumference	Frequency	Percent
Normal	70	70.0%

Malnourished	30	30.0%
Total	100	100.0%

As shown in the table above, 70 (70.0%) patients had Normal mid-upper arm circumference and 30 (30.0%) patients had low mid-upper arm circumference (malnourished)

Table 8: Distribution of Waist/height ratio

waist/height ratio	Frequency	Percent
Underweight	30	30.0%
Healthy weight	48	48.0%
Overweight	13	13.0%
Obese	9	9.0%
Total	100	100.0%

As shown in the table above, 30 (30.0%) patients were Underweight, 48 (48.0%) patients were of Healthy weight, 13 (13.0%) patients were Overweight and 9 (9.0%) patients were Obese, as suggested by their waist/height ratio.

Table 9: Distribution of Socioeconomic status (Modified Kuppuswamy Scale)

Socioeconomic Status Scale	Frequency	Percent
Upper (26 – 29)	10	10.0%
Upper Middle (16 -25)	29	29.0%
Lower Middle (11 – 15)	25	25.0%
Upper Lower (5 – 10) and Lower (< 5)	36	36.0%
Total	100	100.0%

As shown in the table above, 10 (10.0%) patients were in the Upper (26 – 29) class, 29 (29.0%) patients were in the Upper Middle (16 -25) class, 25 (25.0%) patients were in the Lower Middle (11–15) class, and 36 (36.0%) patients were in the Lower (< 5 – 10) class, as calculated by Modified Kuppuswamy Scale.

Table 10: Distribution of Haemoglobin (in grams/decilitre)

Haemoglobin	Frequency	Percent
Normal	46	46.0%
Anaemic	54	54.0%
Total	100	100.0%

As shown in the table above, 46 (46.0%) patients had Normal Hemoglobin and 54 (54.0%) patients were Anaemic. Patients who had their Hb level equal to or above 12 g/dL were considered to be normal (for males) and those who had Hb < 12 g/dL were considered to be anaemic. For female patients, those who had Hb equal to > 11 g/dL were considered to be normal and those who had Hb< 11 g/dL were considered to be anaemic.

Table 11: Distribution of Total Leukocyte count (in cells/millimetre^3)

Total Leukocyte Count	Frequency	Percent
Abnormal	47	47.0%
Normal	53	53.0%
Total	100	100.0%

In our study, 47 (47.0%) patients had leucocytosis and 53 (53.0%) patients had Normal Total leukocyte count. Patients who had leukocyte count between 4000 – 11000 cells/mm^3 were considered to have a normal TLC and those who had leukocyte count above 11000 cells/mm^3 were considered to be abnormal (having leukocytosis)

Table 12: Distribution of Platelet count (in lakhs/mm^3)

Platelet count	Frequency	Percent
< 1.5	27	27.0%
1.5 – 4.5	73	73.0%
Total	100	100.0%

As shown in the table, 27 (27.0%) patients had thrombocytopenia and 73 (73.0%) patients had normal platelet count. Patients who had their platelet count between 1.5 – 4.5 lakhs/mm^3, were considered to have normal

platelet count and those who had platelet count less than < 1.5 lakhs/mm^3 were considered to be abnormal (having

Table 13: Distribution of Serum Protein (in grams/decilitre)

Serum Protein	Frequency	Percent
Hypoproteinemia	43	43.0%
Normal	57	57.0%
Total	100	100.0%

As shown in the table above, 43 (43.0%) patients had Hypoproteinemia and 57 (57.0%) patients had Normal serum protein levels.

Patients who had serum protein < 6 g/dL were considered to be abnormal (having hypoproteinemia) and those who had protein levels > or equal to 6 g/dL were considered to be normal.

The haematological parameters like AST, ALT, Total Serum Bilirubin, Blood Urea, Serum Creatinine, Random Blood Sugar were also measured. Since the patients with abnormal liver function tests, kidney function tests and abnormal blood sugar levels were in the exclusion criteria, only the patients with normal AST, ALT, Total Serum Bilirubin, Blood Urea, Serum creatinine and Random Blood Sugar were included in the study. Hence the relevance of these parameters was insignificant to the study and not included in the data analysis.

Table 14: Distribution of Treatment Outcome

Treatment Outcome	Frequency	Percent
Cured	49	49.0%
Died	5	5.0%
Lost to follow up	9	9.0%
Treatment failure	17	17.0%
Treatment regimen changed	20	20.0%
Total	100	100.0%

As shown in the table above, 49 (49.0%) patients were cured, 5 (5.0%) patients died during course of treatment, 9 (9.0%) patients were lost to follow up, 17 (17.0%) patients failed the treatment and 20 (20.0%) patients had to change their treatment regimen during the course of therapy.

Table 15: Distribution of Outcome

Outcome	Frequency	Percent
Negative outcome	31	31.0%
Positive outcome	49	49.0%
Treatment regimen changed	20	20.0%
Total	100	100.0%

In our study, the patients who were cured at the end of 6 months of Anti tubercular therapy were considered to have a positive outcome; the patients who died during their course of treatment, who were lost to follow up during their treatment and those who failed the therapy at the end of 6 months of ATT were considered to have a negative outcome. 31 (31.0%) patients had a Negative outcome, 49 (49.0%) patients had a Positive outcome and 20 (20.0%) patients had their treatment regimen changed during the course of treatment.

Table 16: Association between Age and Treatment Outcome

Outcome				
Age	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
18 – 33	6	18	1	25
Row %	24.0	72.0	4.0	100.0
Col %	19.4	36.7	5.0	25.0
34 – 48	15	19	12	46
Row %	32.6	41.3	26.1	100.0
Col %	48.4	38.8	60.0	46.0
49 – 63	6	9	4	19
Row %	31.6	47.4	21.1	100.0
Col %	19.4	18.4	20.0	19.0
64 – 75	4	3	3	10

Row %	40.0	30.0	30.0	100.0
Col %	12.9	6.1	15.0	10.0
Total	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 9.2616; **p-value:** 0.1594.

As shown in the table, 6 (19.4%) patients in the age group of18 – 33years, 15(48.4%) patients in the age group of 34 – 48 years, 6 (19.4%) patients in the age group of49 – 63 years and 4 (12.9%) patients in the age group of 64 – 75 years had a negative outcome.

Also, 18 (36.7%) patients in the age group of18 – 33years, 19 (38.8%) patients in the age group of 34 – 48 years, 9 (18.4%) patients in the age group of 49 – 63 years, and 3 (6.1%) patients in the age group of 64 – 75 years had a positive outcome.

The Treatment regimen had to be changed for 1 (5.0%) patient in the age group of 18 – 33years, 12(60.0%) patients in the age group of 34 – 48 years, 4 (20.0%) patients in the age group of 49 – 63 years, and 3 (15.0%) patients in the age group of 64 – 75 years.

Association between Age and Treatment Outcome was not statistically significant (p=0.1594).

Table 17: Association between Gender and Treatment Outcome

Outcome				
Gender	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
Female	11	21	8	40
Row %	27.5	52.5	20.0	100.0
Col %	35.5	42.9	40.0	40.0
Male	20	28	12	60
Row %	33.3	46.7	20.0	100.0
Col %	64.5	57.1	60.0	60.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: .4301; **p-value:** 0.8065. As shown in the table above, among patients with Negative outcome, 11 (35.5%) were Female and 20 (64.5%) were Male. Among patients with Positive outcome, 21 (42.9%) were Female and 28 (57.1%) were Male. Also, in patients who had their Treatment regimen changed, 8 (42.9%) were Female and 12 (60.0%) were Male. Association between Gender and Treatment Outcome was not statistically significant (p=0.8065).

Table 18: Association between Height and Treatment Outcome

Outcome				
Height	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
1.41 – 1.55	14	11	5	30
Row %	46.7	36.7	16.7	100.0
Col %	45.2	22.4	25.0	30.0
1.56 – 1.65	14	16	7	37
Row %	37.8	43.2	18.9	100.0
Col %	45.2	32.7	35.0	37.0
1.66 – 1.75	3	16	8	27
Row %	11.1	59.3	29.6	100.0
Col %	9.7	32.7	40.0	27.0
1.76 – 1.85	0	6	0	6
Row %	0.0	100.0	0.0	100.0
Col %	0.0	12.2	0.0	6.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 15.8251; **p-value:** 0.0147. In Negative outcome, 14 (45.2%) patients height was 1.41 – 1.55, 14(45.2%) patients height was 1.56 – 1.65 and 3 (9.7%) patients height were 1.66 – 1.75. In Positive outcome, 11 (22.4%) patients height was 1.41 – 1.55, 16 (32.7%) patients height was

1.56 – 1.65, 16 (32.7%) patients height was 1.66 – 1.75 and 6 (12.2%) patients height were 1.76 – 1.85. In Treatment regimen changed, 5 (25.0%) patients height was 1.41 – 1.55, 7(35.0%) patients height was 1.56 – 1.65 and 8 (40.0%) patients height was 1.66 – 1.75. Association of Height and Treatment Outcome was not statistically significant (p=0.0147).

Table 19: Association between Weight and Treatment Outcome

Outcome				
Weight	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
20 – 40	11	0	4	15
Row %	73.3	0.0	26.7	100.0
Col %	35.5	0.0	20.0	15.0
41 – 60	20	13	16	49
Row %	40.8	26.5	32.7	100.0
Col %	64.5	26.5	80.0	49.0
61 – 80	0	36	0	36
Row %	0.0	100.0	0.0	100.0
Col %	0.0	73.5	0.0	36.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 64.3185; **p-value :**< 0.0001. As shown in the table above, 11 (35.5%) patients who had their weight between 20kg &40 kg and 20(64.5%) patients who had their weight between 41kg & 60kg had a negative outcome. Also, 13 (26.5%) patients who had their weight between 41kg &60kg, and 36 (73.5%) patients whose weight was in the range of61kg – 80kg had a positive outcome. Among the patients who had their treatment regimen changed, 4 (20.0%) patients had their weight between 20kg &40kg, and 16(80.0%) patients had their weight between 41kg &60kg.Association between Weight and Treatment Outcome was statistically significant (p<0.0001).

Table 20: Association between Body Mass Index and Treatment Outcome

Outcome				
BMI	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
< 18.5	20	0	11	31
Row %	64.5	0.0	35.5	100.0
Col %	64.5	0.0	55.0	31.0
18.5 – 22.9	11	23	9	43
Row %	25.6	53.5	20.9	100.0
Col %	35.5	46.9	45.0	43.0
23 – 24.9	0	7	0	7
Row %	0.0	100.0	0.0	100.0
Col %	0.0	14.3	0.0	7.0
25 – 29.9	0	19	0	19
Row %	0.0	100.0	0.0	100.0
Col %	0.0	38.8	0.0	19.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 57.8033; **p-value :**< 0.0001. As shown in the above table, 20 (64.5%) patients in the < 18.5 BMI group (underweight) and 11 (35.5%) patients in the 18.5 – 22.9 BMI group (normal BMI) had a negative outcome.

Also, 23 (46.9%) patients in the 18.5 – 22.9 BMI group, 7 (14.3%) patients in the 23 – 24.9 BMI group(overweight) and 19 (38.8%) patients in the 25 – 29.9 BMI group(obese) had a positive outcome.

Among patients who had their treatment regimen changed, 11 (55.0%) patients were in< 18.5 BMI group and 9 (45.0%) patients were in 18.5 – 22.9 BMI group. Association between BMI and Treatment Outcome was statistically significant (p<0.0001).

Table 21: Association between Waist Hip Ratio and Treatment Outcome

Outcome				
Waist Hip Ratio	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
Low	23	7	12	42
Row %	54.8	16.7	28.6	100.0
Col %	74.2	14.3	60.0	42.0
Moderate	8	26	8	42
Row %	19.0	61.9	19.0	100.0
Col %	25.8	53.1	40.0	42.0
High	0	16	0	16
Row %	0.0	100.0	0.0	100.0
Col %	0.0	32.7	0.0	16.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 38.1887; **p-value :**< 0.0001

As shown in the table above, 23 (74.2%) patients who had Low waist-hip ratio and 8 (25.8%) patients who had a Moderate waist-hip ratio ended up having a negative outcome.

Also, 7 (14.3%) patients who had a Low waist-hip ratio, 26 (53.1%) patients who had a Moderate waist-hip ratio and 16 (32.7%) patients who had a High waist-hip ratio were found to have a positive treatment outcome.

In patients who had their treatment regimen changed, 12 (60.0%) had a Low waist-hip ratio and 8 (40.0%) had a Moderate waist-hip ratio.

Association between Waist Hip Ratio and Treatment Outcome was statistically significant (p<0.0001).

Table 22: Association between Mid Upper Arm Circumference and Treatment Outcome

Outcome				
Mid Upper Arm Circumference	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
Normal	8	49	13	70
Row %	11.4	70.0	18.6	100.0
Col %	25.8	100.0	65.0	70.0
Malnourished	23	0	7	30
Row %	76.7	0.0	23.3	100.0
Col %	74.2	0.0	35.0	30.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 50.0691; **p-value :**< 0.0001. As shown in the table above, 8 (25.8%) patients with a Normal MUAC and 23 (74.2%) patients who were malnourished as per their MUAC had a negative outcome. Also, 49 (100.0%) of all patients who had Normal MUAC, ended up having a positive treatment outcome. Among the patients who had their treatment regimen changed, 13 (65.0%) patients had a Normal MUAC and 7 (35.0%) patients were malnourished. Association between Mid Upper Arm Circumference and Treatment Outcome was statistically significant (p<0.0001).

Table 23: Association between Waist/Height Ratio and Treatment Outcome

Outcome				
Waist/Height ratio	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
Underweight	23	0	7	30
Row %	76.7	0.0	23.3	100.0
Col %	74.2	0.0	35.0	30.0
Healthy weight	8	27	13	48
Row %	16.7	56.3	27.1	100.0
Col %	25.8	55.1	65.0	48.0
Overweight	0	13	0	13
Row %	0.0	100.0	0.0	100.0
Col %	0.0	26.5	0.0	13.0

Obese	0	9	0	9
Row %	0.0	100.0	0.0	100.0
Col %	0.0	18.4	0.0	9.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 62.8465; **p-value :**< 0.0001. As seen in the table above, 23 (74.2%) patients who were Underweight and 8 (25.8%) patients who had a Healthy weight, ended up with a negative outcome.

Also, 27 (55.1%) patients who had a Healthy weight, 13(26.5%) patients who were Overweight and 9 (18.4%) patients who were Obese had a positive outcome. Among patients who had their treatment regimen changed, 7 (35.0%) were Underweight and 13 (65.0%) were of Healthy weight. Association between waist/height ratio and treatment outcome was statistically significant (p<0.0001).

Table 24: Association between Socio economic Status Scale and Treatment Outcome

Outcome				
Socio economic Status Scale	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
Upper (26 – 29)	0	10	0	10
Row %	0.0	100.0	0.0	100.0
Col %	0.0	20.4	0.0	10.0
Upper Middle (16 -25)	0	27	2	29
Row %	0.0	93.1	6.9	100.0
Col %	0.0	55.1	10.0	29.0
Lower Middle (11 – 15)	7	11	7	25
Row %	28.0	44.0	28.0	100.0
Col %	22.6	22.4	35.0	25.0
Upper Lower (5 – 10)	24	1	11	36
Row %	66.7	2.8	30.6	100.0
Col %	77.4	2.0	55.0	36.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 66.8750; **p-value :**< 0.0001

As shown in the table above, 7 (22.6%) patients in the Lower Middle (11 – 15) class of SES and 24 (77.4%) patients in the Upper Lower (5 – 10) class of SES had a negative outcome.

Also, 10 (20.4%) patients in the Upper (26 – 29) class of SES, 27(55.1%) patients in the Upper Middle (16 -25) class, and 11 (22.4%) patients in the Lower Middle (11 – 15) class, and 1 (2.0%) patient in the Upper Lower (5 – 10) class of SES scale had a positive outcome Among those who had their treatment regimen changed, 2 (10.0%) belonged to the Upper Middle (16 -25) class, 7 (35.0%) patients to the Lower Middle (11 – 15) class and 11 (55.0%) patients in the Upper Lower (5 – 10) class of SES scale. Association between Modified Kuppuswamy Socioeconomic Status Scale and Treatment Outcome was statistically significant (p<0.0001).

Table 25: Association between Haemoglobin and Treatment Outcome

Outcome				
Hemoglobin	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
Normal	4	38	4	46
Row %	8.7	82.6	8.7	100.0
Col %	12.9	77.6	20.0	46.0
Anaemia	27	11	16	54
Row %	50.0	20.4	29.6	100.0
Col %	87.1	22.4	80.0	54.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 38.7501; **p-value :**< 0.0001. As shown in the table above, 4 (12.9%) patients who had Normal Hemoglobin and 27 (87.1%) patients who were anaemic had a negative treatment outcome. Also, 38 (77.6%) patients who had a Normal Hemoglobin and 11 (22.4%) patients who were anaemic had a positive outcome.Among those who had their treatment regimen changed, 4 (20.0%) had Normal Hemoglobin and 16 (80.0%) were anaemic.Association between Haemoglobin levels and Treatment Outcome was statistically significant (p<0.0001).

Table 26: Association between Total Leucocyte count and Treatment Outcome

Outcome				
Total Leucocyte count	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
Leucocytosis	15	22	10	47
Row %	31.9	46.8	21.3	100.0
Col %	48.4	44.9	50.0	47.0
Normal	16	27	10	53
Row %	30.2	50.9	18.9	100.0
Col %	51.6	55.1	50.0	53.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: .1831; **p-value:** 0.9125. As shown in the table above, 15 (48.4%) patients who had leucocytosis and 16 (51.6%) patients with a normal TLC ended up with a negative outcome.
Also, 22 (44.9%) patients who had leucocytosis, and 27 (55.1%) patients with a normal TLC, had a positive treatment outcome. Among those who had their treatment regimen changed, 10 (50.0%) patients had Leucocytosis and 10 (50.0%) patients had Normal TLC. Association of between Total Leucocyte count and Treatment outcome was not statistically significant (p=0.9125).

Table 27: Association between Platelet count and Treatment Outcome

Outcome				
Platelet	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
< 1.5 lakh	9	14	4	27
Row %	33.3	51.9	14.8	100.0
Col %	29.0	28.6	20.0	27.0
1.5 lakh – 4.5 lakh	22	35	16	73
Row %	30.1	47.9	21.9	100.0
Col %	71.0	71.4	80.0	73.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: .6236; **p-value:** 0.7321. As shown in the table above, 9 (29.0%) patients whom had thrombocytopenia and 22 (71.0%) patients with a normal platelet count had a negative outcome. Also, 14 (28.6%) patients with thrombocytopenia and 35 (71.4%) patients with a normal platelet count ended up having a positive outcome. Among patients who had their treatment regimen changed, 4 (20.0%) had thrombocytopenia and 16 (80.0%) had a normal platelet count. Association of Platelet count and Outcome was not statistically significant (p=0.7321).

Table 28: Association between Serum Protein and treatment Outcome

Outcome				
Serum Protein	**Negative Outcome**	**Positive Outcome**	**Treatment Regimen Changed**	**Total**
Hypoproteinemia	27	1	15	43
Row %	62.8	2.3	34.9	100.0
Col %	87.1	2.0	75.0	43.0
Normal	4	48	5	57
Row %	7.0	84.2	8.8	100.0
Col %	12.9	98.0	25.0	57.0
TOTAL	31	49	20	100
Row %	31.0	49.0	20.0	100.0
Col %	100.0	100.0	100.0	100.0

Chi-square value: 66.4893; p-value :< 0.0001. As shown in the table above, 27 (87.1%) patients with Hypoproteinemia and 4 (12.9%) patients with Normal Serum Protein levels had a negative outcome. Also, 1 (2.0%) patient with hypoproteinemia and 48 (98.0%) patients with Normal Serum Protein had a positive outcome. Among patients who had their treatment regimen changed, 15 (75.0%) had Hypoproteinemia and 5(25.0%) patients had Normal Serum Protein levels. Association between Serum protein levels and Treatment Outcome was statistically significant (p<0.0001).

Discussion

The importance of nutritional status in TB patients undergoing treatment, improving the living standards of the TB patients to aid a successful treatment outcome, and the baseline haematological parameters and their correlation with outcome was studies done by many authors in the past. But a study that took into account of all these parameters and compared with treatment outcome of TB patients was lacking in literature.

In this study, 46% patients belonged to the age group of 34 – 48 years. The mean age of the patients was 42.92 ± 3.46 years. The correlation between age of the patients and their treatment outcome was not statistically significant in the present study. In a similar study conducted by Bogam RR, Sagare SM et al in 2014 [7], pulmonary TB was most prevalent in the age group of 35 – 54 years with the mean age group of 43 ± 3.96 years. There was no association between age of the patients and their treatment outcome in this study as well.

In a study by Ramya Anantha krishnan et al [55], older TB patients accounted for 14% of all TB patients, of whom 47% were new sputum positive. They had 38% higher risk of unfavourable treatment outcomes as compared to all other TB patients. The risk for unfavourable treatment outcomes was higher for those aged 70 years and more among older TB patients. This study concluded that the TB treatment outcomes were poor in older TB patients, warranting special attention to this group – including routine assessment and recording of co morbidities, a dedicate recording, reporting and monitoring of outcomes for this age group and collaboration with National programme of non-communicable diseases for comprehensive management of co morbidities. This study was in contrast to our study, probably because the older patients taken up in our study did not have any associated comorbidities, since the presence of associated comorbidities contributed to excluding them from our study.

In this study, 60(60 %) of the patients were male and 40(40%) of the patients were female. There was no significant association between gender and the predilection to have pulmonary TB. In the present study, 21(42.9%) female patients and 28(57.1%) male patients had a positive treatment outcome at the end of 6 months of anti-tubercular therapy. The correlation between gender of the patient and the treatment outcome was not statistically significant. In a similar study by Bogam RR et al [7], majority of the patients were male (74.4%). Majority of the male patients in this study may be explained by the fact that patients could be more concerned towards their health, and approach hospital earlier. There was no significant association between gender and the treatment outcome of patients in this study as well.

In another study by J Y Feng et al [58], it was found that among the TB patients enrolled for the study, the male patients as compared to the female patients were older, more likely to have the habit of smoking, chronic obstructive pulmonary disorder, malignancy and liver cirrhosis, and more likely to present with haemoptysis, body weight loss and pleural effusion. This study also demonstrated significantly higher mortality rates in male TB patients as compared to female TB patients. In our study, the patients with associated co morbidities were excluded at the initial phase itself. This would have led to the finding that there was no significant association between gender and treatment outcome of the patients. In this study, 37(37%) patients had their height in the range of 1.56m – 1.65m. The mean height of the patients was 1.6 ± 0.025m. The height of the patients was not found to have any significant correlation with their treatment outcome at the end of 6 months of ATT. In a similar study by Mary Gracy Tungdim et al [49], the mean height of the patients was found to be 1.63±5.58 m. Also, no significant association was found between height of the patients in the study and their treatment outcome.

In this study, 49% patients belonged to the 41-60 kg group. The mean weight of the patients was 54.6 ± 4.23 kg. In this study, 36 patients (73.5%) who had their weight above 60 kg had a positive treatment outcome. The correlation between weight of the patients and their treatment outcome was statistically significant. This underlines the fact that patients who had access to better nutrition had a positive treatment outcome, compared to those patients who were undernourished. In a similar study by Yenework Sinshaw et al [26], the mean baseline weight at the initiation of tubercular therapy was 43.7 kg. Also, in this study, TB patients who had a mean baseline weight < 43.7 kg at the initiation of TB treatment were having greater chances of treatment failure and anti- TB treatment side effects.

In a study by N B Hoa et al [57], the relationship between changes in body weight and TB treatment

outcomes was assessed. This study concluded that patients failing to gain weight or those who lose weight, during the 1st 2 months of treatment are at an increased risk of unsuccessful treatment outcome. This study focused more on the status of the weight of the patient during the course of ATT, rather than the baseline weight, in contrast to our study. Hence, no significant association was found between the initial weight of the patients and the treatment outcome, in the present study.

In the present study, 31(31%) of the patients were underweight, 43(43%) of the patients had a normal BMI, 7(7%) of the patients were overweight and 19(19%) of the patients were obese. The mean BMI of the patients was 20.2±3.7. In this study, 20 (64.5%) patients who were underweight had a negative treatment outcome. The correlation between BMI at the initiation of treatment and the treatment outcome at the end of treatment was statistically significant. The patients who had a normal BMI were found to have positive treatment outcome as compared to underweight patients. In a similar study by Bhargava M et al [12], 80% of women and 67% of men had moderate to severe under nutrition (BMI < 17 kg/m2). Severe under nutrition was associated with a 2 fold higher risk of death. These findings suggest the need for nutritional support during Pulmonary TB.

In the present study,42 (42%) patients had a low waist hip ratio, 16(16%) patients had a high waist hip ratio and 42(42%) patients had a high waist hip ratio. Also, 7(14.3%) patients who had a low waist hip ratio, 26(53.1%) patients who had a moderate waist hip ratio and 16(32.7%) patients who had a high waist hip ratio were found to have a positive treatment outcome. The relationship between waist hip ratio and treatment outcome was statistically significant. This suggested that patients who had moderate and high waist hip ratios, and thus better anthropometric indices had positive treatment outcomes than those who had low waist hip ratio. In a similar study by Mary Gracy Tungdim et al [49], the values of waist hip ratio measured prior to initiation of ATT in patients with Pulmonary TB were found to be low. In this study, there was clear evidence that TB patients before starting treatment had significantly lower values of anthropometric variables.

In the present study, 70(70%) patients had a normal mid upper arm circumference and 30(30%) patients had a low mid upper arm circumference (malnourished). Also, 8 (25.8%) of the patients with a normal mid upper arm circumference and 23(74.2%) of the patients with a low mid upper arm circumference (malnourished) had a negative treatment outcome. The association between mid-upper arm circumference and treatment outcome was statistically significant. The patients who had a low mid upper arm circumference were malnourished, and had a poorer treatment outcome as compared to the patients who had a normal mid upper arm circumference. This anthropometric index hence signifies the importance of nutrition in the treatment outcome of patients with Pulmonary TB patients.

Poor nutrition increases the susceptibility of TB and other diseases and also weakens the immune system which increases the risk of infections. Infections like TB can reduce appetite, decrease the absorption of nutrients and increase metabolism to repair the immune system. The poor treatment outcome in malnourished TB patients can be explained by this synergistic relationship. In a similar study by Nathaniel Lee et al [50], 46.5% of the TB patients enrolled were found to be malnourished. The in-patient mortality rate from day 3-28 was more in patients who were malnourished. This study supported the use of mid upper arm circumference for triaging acute unwell TB patients and the use of nutrition-based interventions to improve patient outcomes.

In this study, 30(30%) of the patients were underweight, 48(48%) patients were of healthy weight, 13(13%) patients were overweight and 9(9%) patients were obese, as suggested by their waist – height ratio. Also, 23(74.2%) patients who were underweight and 8(25.8%) of the patients with a healthy weight, ended up with a negative treatment outcome. The association between height-weight ratio and the treatment outcome in Pulmonary TB patients was found to be statistically significant. The present study showed that patients who were of healthy weight had positive treatment outcome when compared to patients who were underweight. This also suggests the importance of nutrition in the treatment outcomes of Pulmonary TB patients. In a similar study by Mary Gracy Tungdim et al [49], there was clear evidence that TB patients before starting treatment had significantly lower values of anthropometric indices including Waist height ratio. The study also found that morbidity in TB patients was 3 times greater in underweight patients as compared to overweight patients.

In the present study, 29(29%) patients were in the Upper middle (16-25) class, 25(25%) patients were in the Lower Middle (11-15) class and 36(36%) patients were in the Lower (< 5-10) class, as calculated by Modified Kuppuswamy scale. Also, 7(22.6%) patients in the Lower Middle (11-15) class of SES scale and 24(77.4%) patients in the Lower (< 5-10) class of SES scale had a negative treatment outcome. The association between socioeconomic status of the patient (calculated with Modified Kuppuswamy Status Scale) and the treatment outcome of the patient was statistically significant. The patients, who belonged to Upper socioeconomic class and Middle Socioeconomic

class, had a better treatment outcome. The patients, who belonged to Lower SES class, had more negative treatment outcomes. This underlined the fact that patients who were more educated had positive treatment outcome, compared to patients who were less educated. Also, the patients whose family income was higher had more positive treatment outcomes. The patients who had better family income could afford better nourishment, better education, better employment and better living circumstances. This, in turn would have contributed to the positive treatment outcomes in these patients. This study also found that the patients who were better educated had lower chances of defaulting the regimen and lower chances of developing resistance to the treatment regimen. Thus, in general, improving the Socioeconomic class of the patients by providing them better education, better employment opportunities and better housing facilities can make the patients stick to their treatment regimen and hence contribute to better treatment outcomes.

In a similar study by Fatehpuria et al [44], majority (33.6%) of the patients undergoing treatment for Pulmonary TB belonged to Socioeconomic class V of Modified Kuppuswamy Scale. The incidence of Pulmonary TB was found to be more in patients who belonged to Lower Socioeconomic Status Scale of the Modified Kuppuswamy scale. This study revealed that RNTCP had reached to all Socioeconomic classes of the society, and that improving the Socioeconomic conditions of the patients undergoing treatment for Pulmonary TB can improve the chances of having a better treatment outcome.

In this study, 46(46%) patients had normal levels of Haemoglobin and 54(54%) patients were anaemic. Also, it was found that 4(12.9%) patients who had normal haemoglobin and 27(87.1%) patients who were anaemic at the initiation of Anti tubercular therapy were found to have a negative treatment outcome at the end of 6 months. The association between the levels of Haemoglobin in blood at the initiation of treatment and the treatment outcome at the end of 6 months of ATT was statistically significant. In the present study, it was also found that among the patients who had to change their treatment regimen due to development of drug resistance, 16(80%) were anaemic. Among the 46 patients who had a normal haemoglobin level at the initiation of treatment, 38(77.6%) had a positive treatment outcome. Thus, the presence of anaemia in Pulmonary TB patients at the initiation of treatment was found to be associated with negative treatment outcome at the end of 6 month of ATT. This substantiates the need to address anaemia in Pulmonary TB patients and the need to correct the Haemoglobin levels of the patient along with the Anti-tubercular therapy.

Tuberculosis presents with several types of haematological manifestations. The most common is normocytic normochromic anaemia of chronic disease. Anaemia in tuberculosis is most often due to nutritional deficiency, malabsorption syndromes, failure of iron utilization and bone marrow suppression. TB increases circulating hepcidin and thereby impairs dietary iron absorption and systemic utilization of iron, resulting in iron sequestration and anaemia. The presence of anaemia signifies the systemic inflammation in patients with TB. The patients with significant systemic inflammation were more prone to have poor treatment outcomes. This could explain the poor treatment outcomes in Pulmonary TB patients with baseline anaemia.

In a similar study by Sheila Isanaka et al [35], anaemia was associated with an independent 4 fold increased risk of TB recurrence. Iron deficiency and anaemia were associated with a 2-3 fold independent increase in the risk of death in TB patients. Thus, correction of anaemia in TB patients led to a better treatment outcome, as concluded by this study.

In the present study, 47(47%) of the patients had leukocytosis and 53(53%) patients had a normal leukocyte count. It was found that 22(44.9%) of patients with leukocytosis and 27(55.1%) patients with a normal total leukocyte count had a positive treatment outcome. Among patients who had their treatment regimen changed, 10(50%) patients had leukocytosis and 10(50%) patients had a normal Total leukocyte count. The association between Total leucocyte count and treatment outcome was not statistically significant. This may be due to the fact that patients with leukocytosis were treated with appropriate antibiotics at the baseline, simultaneously with Ani tubercular therapy and this led to the resolution of the accompanying infection.

In a similar study by Carol Chedid et al [39], it was found that High WBC counts and low lymphocyte proportions at baseline are significantly associated with the risk of TB treatment failure. This may be due to the fact that the associated infection that was responsible for the elevated WBC count was not treated simultaneously.

In this study, 27(27%) of the patients had thrombocytopenia and 73(73%) patients had a normal platelet count. Also, 14(28.6%) patients with thrombocytopenia and 35(71.4%) patients with a normal platelet count had a positive treatment outcome. The association between platelet count and treatment outcome was not statistically significant. This may be because the platelet count of the patients would have been influenced by associated viral infections, and elevated total leukocyte count, rather than Pulmonary TB as such.

In a similar study by Donald J Cox et al [51], it was suggested that platelets are causal in TB pathology, and therefore ripe for therapeutic intervention. This was because platelets enhanced monocyte production of IL-1 beta and IL-10 in response to Mycobacterial infection. Hence, this study concluded that elevated platelet count in TB patients was associated with unfavourable treatment outcomes and the role of platelets in TB should be further investigated.

In the present study, 43(43%) of the patients had hypoproteinemia and 57(57%) patients had normal serum protein levels. The mean Total Serum protein levels of the patients were found to be 6.14 ± 0.98 g/dL. In this study, 27(87.1%) patients with Hypoproteinemia and 4(12.9%) patients with normal Serum protein levels had a negative treatment outcome. Also, among the patients who had their treatment regimen changed 15(75%) had hypoproteinemia and 5(25%) patients had normal serum protein levels. The association between Total Serum protein levels and treatment outcome was statistically significant. In this study, low serum protein levels of the patient at the baseline contributed to negative treatment outcome. Also, patients with hypoproteinemia were more prone to develop drug resistance and had their treatment regimen changed. The low serum protein levels in Pulmonary TB patients with negative treatment outcome may be due to inactivity, malnutrition, systemic inflammation, hormonal dysfunction. This signifies the importance of addressing hypoproteinemia in Pulmonary TB patients, in order to improve their treatment outcomes.

In a similar study by Adu Matthew et al [52], the mean total serum protein level of TB patients was 8.2± 1.38 g/dL. The study showed increase in the total serum protein levels in patients with Pulmonary TB in comparison to healthy controls. This may be due to nutritional interventions, targeting the Pulmonary TB patients, thereby increasing their net protein intake during the course of anti-tubercular treatment.

Conclusion

In conclusion, pulmonary TB is associated with significant nutritional abnormalities. The findings of the study point to the fact that apart from BMI as the sole parameter for assessing the nutritional status in TB patients, there is a need to consider other anthropometric indices such as waist hip ratio, mid upper arm circumference, waist height ratio that can significantly correlate with the treatment outcome. Also, the study found out that the socioeconomic class of the patients can also affect the treatment outcome. In addition to this, the levels of haemoglobin and serum protein can also affect treatment outcome. These parameters should also be addressed and due treatment is necessary to improve the treatment outcome.

Limitations

1) The present study is limited by relatively smaller number of patients. For further investigations larger sample size in various populations across the regions would be required.
2) In this study other anthropometric parameters like mid-thigh circumference and triceps skin fold thickness were not used.
3) For nutritional assessment body composition indicators like fat mass, fat free mass and total body water were not taken into consideration for this study.
4) Among the biochemical parameters, nutritional marker cholesterol and serum albumin was not taken.
5) Specific markers of inflammation were not analyzed in the patients, therefore it is hard to say whether bad nutritional status or inflammation has led to lower values of BMI, hemoglobin and protein.
6) It is not clear whether poor lung function is a cause of poor nutritional status or if poor nutritional status precipitates a decline in lung function results.

Recommendation

1) There is no single test to diagnose malnutrition. Body mass index, history taking, the evaluation of the dietary intake, anthropometric measures (waist hip ratio, mid upper arm circumference, waist height ratio, etc) serum protein, hemoglobin, can be used in clinical studies of Pulmonary TB patients, and these factors also play a major role in determining the treatment outcome.
2) Correction of anemia should be an important goal in the management of Pulmonary TB.
3) There is an urgent need for nutrition intervention in Pulmonary TB; policies and guidelines on nutritional support in Pulmonary TB patient needs to be reconsidered.
4) Improving the general living conditions of the patients can also contribute towards a better treatment outcome in patients with Pulmonary TB. Hence the policies designed to provide adequate support to the socially and economically backward classes of patients diagnosed with TB have to be overlooked in order to improve treatment outcome.

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