# PULMONARY TUBERCULOSIS AND IRON DEFICIENCY ANEMIA, IN A TERTIARY CARE HOSPITAL, ODISHA: A CROSS-SECTIONAL STUDY.

Debaranjan Das[1], Srinibas Sahoo[2*], Yera Dhanurdhar [2], Sarat ku. Behera[3], Surjya Shankar Meher [4]
[1]PGT, Dept. of Respiratory Medicine, Hi-tech Medical College & Hospital.
[2]M.D., Assistant Professor, Dept. of Respiratory Medicine, Hi-tech Medical College & Hospital.
[3]M.D., Professor & HOD, Dept. of Respiratory Medicine, Hi-tech Medical College & Hospital.
[4]PGT, Dept. of Respiratory Medicine, Hi-tech Medical College & Hospital.

## ABSTRACT.

### Background:
Tuberculosis is a pulmonary infection that is a global health concern it affects a wide range of people worldwide. This infectious disease is contagious and spreads through droplets in the air.

### Methods:
52 patients participated in this study 19 among them female and 33 were males. The study was conducted O.P.D. and I.P.D. in the P.G. department of Pulmonary, Hitech Medical College and Hospital, Bhubaneswar. In the period of 7 months from January 2023 to July 2023. This was a cross-sectional study in a hospital setting. The participants were analyzed for tuberculosis and hematological parameters. The data obtained was statistically analyzed and the correlation was determined.

### Results:
Female patients' ages ranged from 21 to 64, averaging 31 years, while males were 28 to 85 years old, averaging 52. Approximately 45% had +1 sputum microscopy results. Significant associations with tuberculosis diagnosis were found in hemoglobin levels, leukocyte count, serum ferritin, iron levels, CRP, and total iron-binding capacity (p < 0.01). Neutrophil and lymphocyte counts peaked at 70 and 28, respectively. The study showed increased ferritin and CRP levels, indicating inflammation and infection, and a notable anemia prevalence, underscoring the need for an integrated treatment approach.

### Conclusion:
The study reveals elevated ferritin and CRP levels, alongside a significant prevalence of anemia in tuberculosis patients, highlighting the disease's systemic impact. These findings advocate for incorporating hematological parameters in tuberculosis diagnostics, underlining the need for integrated treatment approaches to enhance patient care and outcomes.

### Recommendation:
Anaemia is often associated with pulmonary tuberculosis. Iron supplementation can help in the management of tuberculosis with anemia.

**Corresponding author:** *Dr Srinibas Sahoo*[*]
**Email:** Srisahoo89@gmail.com
*MD Pulmonary Medicine, Assistant Professor, PG Department of Respiratory Medicine Hi-tech Medical College & Hospital Pandara, Bhubaneswar, Odisha- 751025.*

## INTRODUCTION.

Tuberculosis is a pulmonary infection that is a global health concern it affects a wide range of people worldwide. This infectious disease is contagious and spreads through droplets in the air. World Health Organization states tuberculosis spreads systemically and affects the peripheral organs. There are various comorbidities associated with tuberculosis anaemia is common among them. Tuberculosis is characterized by cough, fever congestion in the chest, and pain. According to data, in 2021 1.6 million individuals died because of tuberculosis. Among infectious diseases tuberculosis is the second largest cause of death, the first is COVID-19. The ranks even above fatal diseases like AIDS. Although

tuberculosis can be prevented it has been spread over all age groups. According to 2021 statistics, 3.4 million, 6 million, and 1.2 million of the female, male, and children were infected with tuberculosis. Subsequently, it has affected 10.2 million people around the globe. One of the sustainable developmental goals of the United Nations is to eradicate tuberculosis by 2030[1]

Geographically there is more prevalence of tuberculosis in the South Asian and African populations. There is a marked decrease in tuberculosis among the European population [2] before COVID-19 in 2019 tuberculosis was the leading cause of death and around 10.1 million people globally were infected with tuberculosis [3]. Tuberculosis is recognized by prolonged sputum production, loss of weight and appetite, hemoptysis, and fever [4].
Samples collected from the patient for diagnosis of tuberculosis include sputum and lavage of the bronchoalveolar region. Tests done for diagnosis of the disease include PCR and CBNAT. X-ray scan and computed tomography scan of the lungs is done to confirm the diagnosis of tuberculosis. The DOTS treatment for tuberculosis is recommended by WHO which includes 2 months of treatment with ethambutol, pyrazinamide, rifampicin, and isoniazid. Followed by four months of isoniazid, rifampicin, and ethambutol [5].

Pulmonary tuberculosis patients have low hemoglobin levels. According to a study, more than 50% of the patients infected with tuberculosis tend to have anemia [6]. The presence of mild anemia is found in 35% of the cases, moderate anemia is reported in 31 % of the cases and 11% of the cases of tuberculosis had mild anemia. Abnormally elevated levels of ferritin, C-reactive protein, and erythrocyte sedimentation rate have been reported in most of the cases of tuberculosis. However, it reverses within 60 days of treatment. This suggests that chronic inflammation is responsible for the anemia.
Anemia as a chronic disease is prevalent in 50% of the patients and iron deficiency anemia in 20% of the patients. Anemia in patients with tuberculosis has severe effects on the outcome of the treatment. Patients with anemia have fair chances of recurrence after the treatment it also dictates the prognosis of tuberculosis. Thus, the treatment of anemia along with tuberculosis leads to better management of the disease [7].
In response to the infection chronic inflammation caused by tuberculosis leads to the release of acute phase reactants and plasma proteins from the liver. The ferritin and C-reactive protein are released by the liver in tuberculosis which indicates the prognosis of the disease. Elevated levels of ferritin do not necessarily indicate anemia it can be released by the liver in response to inflammation [8]. The study aims to determine the levels of ferritin and CRP levels in tuberculosis and determine the prevalence of anemia in tuberculosis patients by examining the hematological parameters

## MATERIAL AND METHODOLOGY.
### Study design.

This was a cross-sectional study done in a hospital setting prospectively.

### Study setting.

The study was conducted O.P.D. and I.P.D. in the P.G. Department of Pulmonary, Hitech Medical College and Hospital, Bhubaneswar, India, which served as the site of this study in the period of 7 months from January 2023 to July 2023.

### Study Population.

The patients with symptoms of tuberculosis, positive acid-fast bacilli in sputum, and biochemical examination were taken for the study. Patients below 18 years of age, extra-pulmonary tuberculosis patients, and associated other clinical diseases such as carcinoma, chronic kidney disease, diabetes mellitus, and heart and liver disease not included in the study

### Sample Size.

52 patients participated in the study after meeting the selection criteria. 33 among them were males and 19 were female.

### Inclusion Criteria.

- Patients exhibiting symptoms of tuberculosis.
- Patients who tested positive for acid-fast bacilli in sputum samples.
- Patients who underwent biochemical examination.

### Exclusion Criteria.

Patients below 18 years of age.
Patients diagnosed with extra-pulmonary tuberculosis.
Patients suffering from other clinical diseases such as carcinoma, chronic kidney disease, diabetes mellitus, heart, and liver disease.

### Procedure.

Sputum microscopy was performed on the sputum samples of the patients. Other hematological parameters such as total leucocyte count, hemoglobin level, neutrophil count, transferrin saturation, total iron binding capacity, serum ferritin level, serum iron level, and levels of C-reactive protein were determined for each patient.

## Bias.

There was a chance that bias would arise when the study first started, but it was avoided by giving all participants identical information and hiding the group allocation from the nurses who collected the data.

## Statistical Analysis.

A statistical package for social science was used to analyze the data statistically. Averages of each parameter were determined and then it was correlated with the diagnosis of tuberculosis using a student-t-test.

## Ethical consideration.

The ethical committee approved this study. Written informed consent was received from the participants before the study.

## RESULTS.

Table 1 illustrates the number of cases considered for the study from those who were admitted to the pulmonary department, Hitech Medical College, Bhubaneswar from Jan 2023 and July 2023. It shows the variation in the age of participants. The majority of the participants were of 20-30 years of age females 10(52.63%) and 50-60 years in the case of males 14 (42.42%) out of the 52 study participants.

**Table 1: Age and sex-wise distribution of study participants.**

| Age group | Female | Male |
|-----------|--------|------|
| 20-30 | 10 | 1 |
| 30-40 | 4 | 5 |
| 40-50 | 3 | 7 |
| 50-60 | 1 | 14 |
| above 61 | 1 | 6 |
| Total | 19 | 33 |

**Table 2: Descriptive statistics.**

| Sex | | Min | Max | Mean ± SD |
|-----|-----|-----|-----|-----------|
| Female | Age | 21 | 64 | 31.68±12.57 |
| Male | Age | 28 | 85 | 52.51±14.90 |

The descriptive statistics in Table 2 give a total of 52 study participants, the average age group (was 31.68 ± 12.57), with a range of 21-64 for females, and (52.51 ± 14.90), with a range of 28-85 for males

**Table 3: Distribution of Sputum Microscopy.**

| Sputum microscopy | Frequency | Percent |
|-------------------|-----------|---------|
| 1+ | 23 | 44.2 |
| 2+ | 14 | 26.9 |
| 3+ | 15 | 28.8 |
| Total | 52 | 100.0 |

Table 3 gives a total of 52 study participants out of which the maximum number of cases from 1+,23(44.2%), followed by 3+,15(28.8%), and the minimum no of cases was from 2+,14(26.9%).

**Table 4: Sputum microscopy of Different parameters.**

| Sputum microscopy | F STATISTICS | P VALUE |
|---|---|---|
| Hb (g/dl) | 10.654 | 0.001 |
| TLC ( | 10.417 | 0.001 |
| CRP (mg/L) | 18.758 | 0.001 |
| Sr Iron (ug/dl) | 10.949 | 0.001 |
| Sr FERRITIN (ng/ml) | 6.023 | 0.005 |
| Transferrin Saturation (%) | 0.601 | 0.552 |
| Sr TIBC (ug/dl) | 8.943 | 0.001 |

Table 4 shows that ANOVA analysis of different parameters significant differences between our group average. There is a statistically significant difference in the mean as per the p-value. Except for the parameter Transferrin saturation p value 0.552, there is no statistically significant difference in the mean.

**Table 5: Descriptive Statistics of Different Parameters**

| Descriptive Statistics | | | | | |
|---|---|---|---|---|---|
| | N | Minimum | Maximum | Mean | Std. Deviation |
| Hb (g/dl) | 52 | 6.50 | 12.40 | 9.23 | 1.89 |
| TLC(/ul) | 52 | 3340.00 | 13780.00 | 7984.23 | 2811.86 |
| CRP (mg/L) | 52 | 18.00 | 153.90 | 75.58 | 49.03 |
| Sr Iron (ug/dl) | 52 | 11.80 | 70.00 | 37.25 | 19.40 |
| Sr FERRITIN (ng/ml) | 52 | 18.70 | 3638.00 | 504.43 | 747.96 |
| Transferrin Saturation (%) | 52 | 3.57 | 58.36 | 20.09 | 11.04 |
| Sr TIBC (ug/dl) | 52 | 79.40 | 380.00 | 208.88 | 88.34 |

The descriptive statistics in Table 5 give a total of 52 study participants, The average of Hb (g/dl) (9.23 ± 1.89), with a range of 6.50-12.40. The average of TLC (7984.23 ± 2811.86), with a range of 3340-13780. The average CRP (mg/L) (75.58 ± 49.03), with a range of 18 -153.90. The average Sr Iron (ug/dl) (37.25 ± 19.40), with a range of 11.80-70.00.

The average of Sr Ferritin (ng/ml) (504.43 ± 747.96), with a range of 18.70 -3638.00. The average of Transferrin Saturation (%) (20.09 ± 11.04), with a range of 3.57-58.36. The average of Sr TIBC (ug/dl), (208.88 ± 88.34), with a range of 79.40-380.00.

Fig 1 gives the distribution of neutrophils. The maximum number of Neutrophil 70, 18(34.6%) and all others are N60,6(11.5%), N76, N84, N90 (9.6%), Minimum no of cases from N82, N80, N68 (5.8%).
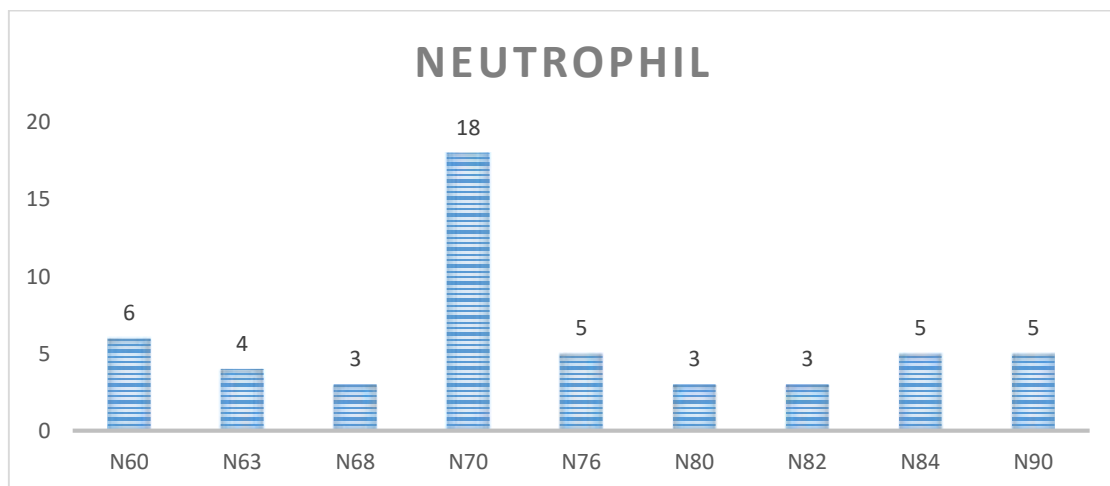
**Fig.1: Distribution of Neutrophil**.

**Table 6: Distribution of Lymphocyte.**

| Lymphocyte | Frequency | Percent |
|---|---|---|
|  |  |  |
| L12 | 5 | 9.6 |
| L13 | 3 | 5.8 |
| L16 | 5 | 9.6 |
| L21 | 5 | 9.6 |
| L24 | 3 | 5.8 |
| L28 | 13 | 25.0 |
| L29 | 4 | 7.7 |
| L30 | 6 | 11.5 |
| L7 | 5 | 9.6 |
| L8 | 3 | 5.8 |
| Total | 52 | 100.0 |

Table 6 gives the maximum number of Lymphocyte 28, 13(25.0%) and all others are L12, L16, L21, L7, (9.6%), Minimum no of cases from L8, L13, L24 (5.8%). The above table 7.0 gives the maximum number of Lymphocyte 28, 13(25.0%) and all others are L12, L16, L21, and L7, (9.6%), Minimum no of cases from L8, L13, and L24 (5.8%).

| Table 7: Correlations | | Hb | Sr Iron | Transferrin Saturation |
|---|---|---|---|---|
| Hb | Pearson Correlation | 1 | .643 | .257 |
|  | Sig. (2-tailed) |  | .001 | .066 |
|  | N | 52 | 52 | 52 |
| Sr Iron | Pearson Correlation | .643 | 1 | .610 |
|  | Sig. (2-tailed) | .001 |  | .001 |
|  | N | 52 | 52 | 52 |
| Transferrin Saturation | Pearson Correlation | .257 | .610** | 1 |
|  | Sig. (2-tailed) | .066 | .001 |  |
|  | N | 52 | 52 | 52 |

| Table 8: Correlations | | CRP | Sputum microscopy |
|---|---|---|---|
| CRP | Pearson Correlation | 1 | .567 |
|  | Sig. (2-tailed) |  | .001 |
|  | N | 52 | 52 |
| Sputum microscopy | Pearson Correlation | .567** | 1 |
|  | Sig. (2-tailed) | .001 |  |
|  | N | 52 | 52 |

The Pearson Correlation gives the correlation coefficient between Hb and Sr. Iron r = 64.3%, p-value is 0.001, Sr_Iron and Transferrin Saturation r=61%, p-value is 0.001, The Pearson Correlation gives the correlation coefficient between Hb and Sr. Iron r = 64.3%, p-value is 0.001, Sr_Iron and Transferrin Saturation r=61%, the p-value is 0.001. Given in Tables 7 and 8.

## DISCUSSION.

The present study showed out of 52 study participants Majority of the participants were of 20-30 years of age from Female 10(52.63%) and 50-60 years in the case of

male 14 (42.42%) out of the 52 study participants. Tuberculosis is a public health threat and major death suffering, in developing countries. Pulmonary tuberculosis was found to be more common in young adults, and males. [9].

Haemoglobin, iron, and ferritin levels decreased in the tuberculosis patients and total iron binding capacity, and ferritin C-reactive protein levels increased significantly from theta of the normal in tuberculosis patients [10,11]. Out of 52 study participants, the average of Hb (g/dl) (9.23 ± 1.89), with a range of 6.50-12.40. The average of TLC (7984.23 ± 2811.86), with a range of 3340-13780.

The average CRP (mg/L) (75.58 ± 49.03), with a range of 18-153.90. The average of Sr Iron (ug/dl) (37.25 ± 19.40), with a range of 11.80-70.00.

The average of Sr Ferritin (ng/ml) (504.43 ± 747.96), with a range of 18.70 -3638.00. The average of Transferrin Saturation (%) (20.09 ± 11.04), with a range of 3.57-58.36. The average of Sr TIBC (ug/dl), (208.88 ± 88.34), with a range of 79.40-380.00.

In a study highest number of Sputum microscopy was found to be sputum microscopy 3+. [12]. First, sputum samples were all samples were processed using standard procedures. The smears were then graded as negative if no pathogen was detected, scanty if some were there 1+, 2+, and 3+ as per WHO recommendation.[13]

In this study the maximum number of cases from 1+, 23(44.2%) , followed by 3+,15(28.8%) and minimum no of cases were from 2+,14(26.9%). Except for the parameter Transferrin saturation p value 0.552, there is no statistically significant difference in the mean. C-reactive protein and ferritin demonstrate the degree of chronic inflammation in patients which indicates the prognosis of the disease and the risk of mortality of the disease [14] From the above tables 6.0 and 7.0 gives the maximum number of Neutrophil 70, 18(34.6%) and the maximum number of Lymphocyte 28, 13(25.0%).

From this study it can be stated that sputum microscopy has a significant relation with C-reactive protein (r=0.57, p = 0.001) increase in the CRP indicates the prognosis of the disease. This also shows that the clinical outcomes might vary if these plasma proteins are higher than normal. Anemia can result in poor outcomes of the treatment.

## GENERALIZABILITY.

The study's findings of elevated ferritin, CRP levels, and widespread anemia among tuberculosis patients point to widespread inflammatory responses and hematological effects, suggesting these markers could be vital for diagnosis and treatment in the broader tuberculosis population. Though based on a small sample, this research hints at the need for comprehensive care that addresses both tuberculosis and its systemic impacts, paving the way for future studies to expand on these findings and their relevance to larger populations.

## CONCLUSION.

From this study, it was found that apart from sputum microscopy, C-reactive protein, transferrin saturation, and serum iron levels are necessary for the diagnosis of pulmonary tuberculosis. Determining the hematological parameters can aid in understanding the prognosis and treatment of the diseases.

## LIMITATION.

The sample size of the population is small in the present study. Such studies are required on large populations to statistically confirm the findings

## RECOMMENDATION.

Anaemia is often associated with pulmonary tuberculosis. Iron supplementation can help in the management of tuberculosis with anemia.

## ACKNOWLEDGMENT.

## ABBREVIATIONS.

**CRP:** C-reactive protein
**WHO:** World Health Organization
**AIDS:** Acquired immunodeficiency syndrome

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## DECLARATION OF COMPETING INTEREST.

The authors declare that there is no conflict of interest regarding the publication of this paper.

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