Journal of Clinical Pediatrics Research

ISSN-2583-4525
Kalra RK, et al., 2024-J Clin Ped Res
**Research Article**

# Effect of Intensive Phase Anti-tubercular Treatment on Hematological Parameters in Pulmonary Tuberculosis in Children

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Received Date: 12-25-2023

Accepted Date: 01-12-2024

Published Date: 01-26-2024



## Abstract

**Aim and objectives:** To study the effect of intensive phase ATI on various hematological parameters in pulmonary TB in children.

**Material and methods:** Study design: Prospective observational study. Children were chosen at random from children who were identified and diagnosed at the Dr. Ram Manohar Lohia Hospital in New Delhi's Atal Bihari Vajpayee Institute of Medical Sciences using a straightforward sampling technique. Every patient is diagnosed with pulmonary tuberculosis based on RNTCP standards. The research was conducted from November 2019 to March 2021 (one year four months).

**Results:** Hemoglobin count (t-value -2.914), Red Blood Cells (t-value -4.338), Platelet Count (t-value -4.762), Lymphocytes (t-value -4.472), Monocyte (t-value 5.991),ESR count (t-value 5.118), Packed Cell Volume (t-value -4.228), Mean Corpuscular Volume (t-value -3.418), Platelet Large Cell Ratio (t-value -4.254), C-reactive count (t-value 3.131), Ferritin (t-value 4.747), X-ray (t-value 5.213) significant at <0.05 level respectively.

**Conclusion:** The various parameters used in the study as the inflammatory process have an extremely important part in the TB pathogenesis. These parameters can be used as markers can be used for prognosis, response to treatment, and follow-up purposes. It can increase the predicting accuracy of treatment outcomes as ones can monitor the TB cases objectively in addition to subjective parameters (improvement in clinical symptoms and examination findings, weight gain, Increase in appetite). Anti-tuberculosis Drug Treatment


**Citation**: Kalra RK, Chandra S, Sandhir S. Effect of Intensive Phase Anti-tubercular Treatment on Hematological Parameters in Pulmonary Tuberculosis in Children. J Clin Ped Res. 2024;3(1):36-49.
**DOI:** https://doi.org/10.37191/Mapsci-2583-4525-3(1)-016

(ATT) is highly successful in enhancing hematological parameters, which suggests that responders' immune responses have improved in an indirect manner.

**Keywords:** Pediatrics age group; Tuberculosis; Diagnostics; Anti-tuberculosis drug treatment (ATT).

## Introduction

Tuberculosis (TB) caused by mycobacterium tuberculosis is one of the most common causes of death in the world. It is the leading cause of death from a single infectious agent (ranking above HIV/AIDS). As per the Global TB report, 2020 [1] reports it is estimated that about 10.0 million (range, 8.9-1 1.0 million) people fell sick with TB in 2019 worldwide. TB is a rare but contagious disease caused by a bacterium called Mycobacterium tuberculosis. It primarily affects the lungs but can also target parts of the body. A more thorough knowledge of the prevalence of tuberculosis in children would make it possible to identify the young patients, enabling programs to focus interventions on those who are most needed and aid in the sensible allocation of resources. Finding differences between the number of treated cases and the predicted instances would enable health services to be held accountable for failing to detect, diagnose, treat, or report the right number of child cases.

Although there is less of a chance of contracting the disease than there formerly was, certain groups of kids and teenagers are more vulnerable than others. Parents should be aware of the following. Out of all the people who developed TB in 2019, 56% were males (age 15 years), 32% were females 12% were children (age <15 years). Among the affected people, 8.2% were people living with HIV. In the same year, there were 1.4 million deaths across the world, including 2,08,000 among HIV-positive people. The WHO regions of South-east Asia (44%), Africa (25%), and the Western Pacific (18%) had the most people with TB. Two-thirds of the global total was accounted for by these eight countries: India (26%), Indonesia (8.5%), China (8.4%), the Philippines (6.0%), Pakistan (5.7%), Nigeria (4.4%), Bangladesh (3.6%) and South Africa (3.6%) [1].

A new challenge is emerging in the treatment of TB, i.e., drug-resistant TB, which continues to be a threat to public health. In 2019 worldwide, approximately half a million people developed rifampicin-resistant TB (RR-TB), out of which 78% had multidrug-resistant TB (MOR-TB). Since childhood TB disease is less contagious than adult TB disease, children are less likely than adults to infect others with TB bacterium. Because children typically have an unproductive cough and have very few bacteria in the mucus productions, kids under the age of ten are less contagious. Children who are immunocompromised (have a damaged immune system) or infants and young children are especially vulnerable to developing severe types of tuberculosis (TB), such as disseminated TB illness or TB meningitis.

In India, the incidence of TB in 2019 was 193 per lac population (26.9 lack cases) and MDRIRR-TB is 9.1 per lac population [1]. Of all the notified TB cases, 82% were pulmonary, 57% were bacteriologically confirmed, 6% comprised of pediatric population (0-14


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years) and 60% were men. Of the bacteriologically confirmed cases, 46% of the new cases and 91% of the previously treated cases tested positive for rifampicin resistance. Approximately 26% of children aged <5 years who are household contacts of microbiologically proven TB cases were on preventive treatment. Children of age <14 years contribute about 35% of the Indian population and about 10% of the caseload.

A TB test ought to be given to kids who could get the disease. There is a considerable risk of infection for children who are exposed to adults who have smear-positive pulmonary tuberculosis, and this risk rises with the intensity of contact [2,3]. Children who come into touch with people who have tuberculosis (TB) run a 30% to 50% chance of contracting the disease, which is far higher than the rates reported by industrialized nations [4,5].

There are two TB tests for TB infection: a skin test or a blood test. During a tuberculin skin test, a small needle is used to place tuberculin (testing material) under the skin on the forearm. The patient sees the doctor again in two to three days, at which point the doctor will assess how the test went. The patient's skin at the injection site will expand and turn red if there has been an infection [6-8]. A TB blood test gauges an individual's immune system response to the TB-causing bacterium [7]. To test for TB disease, other tests such as a chest X-ray [9] and a sample of sputum (mucus that is coughed up from the lower airways) may be needed. Diagnosis of tuberculosis in children is difficult because children are less likely to have symptoms of tuberculosis. Also, sputum samples are difficult to collect from children [10].

## Aim and objectives

### Aim

To study the effect of intensive phase ATI on various hematological parameters in pulmonary TB in children.

### Primary objective

To assess the changes in Hematological parameters (CBC, ESR, POW, MPV, Plateletcrit, P-LCR) after two months of intensive phase of treatment, and the Correlation of CRP, Ferritin, Procalcitonin, along with the association of skiagram chest with these parameters.

### Outcome measures

Clinically there will be the resolution of fever, weight gain, increase in appetite, improvement in breathlessness, and cough. Lab parameters will show changes in a complete hemogram (improvement in hemoglobin, RBC count, platelet indices, leucocyte count), fall in ESR, serum ferritin, CRP, Procalcitonin. Skiagram chest* will be compared pre and post-treatment to look for cavitation, pulmonary infiltrates, collapsed lung, consolidation, and military mottling (*it is a subjective parameter, and is operator dependent).

## Material and methods

### Study design

Prospective observational study. Who were selected randomly via a simple sampling procedure from children who were identified and diagnosed in Atal Bihari Vajpayee Institute of Medical Sciences, Dr. Ram


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Manohar Lohia Hospital, New Delhi. All patients with pulmonary TB as per diagnosis from RNTCP guidelines. The research was conducted from November 2019 to March 2021 (one year four months). Inclusion Criteria: Children of paediatric age group (<18 years) presenting to paediatric outpatient department, paediatric wards, emergency with a diagnosis of pulmonary TB (new case) will be enrolled for the study. Pulmonary TB will be diagnosed as per RNTCP guidelines. Exclusion Criteria: Relapse case, previously treated case, drop out cases, defaulters, extrapulmonary TB, comorbidity with HIV, Severe anemia, patient on iron therapy, receiving a blood transfusion, patients having secondary infection, rheumatological disease, and malignancies.

**Methodology**

Symptoms like persistent fever, cough >2 week, weight loss, fatigue, malaise, hemoptysis, and history of contact with TB patient. Investigations for diagnosis- Sputum/GA for AFB and gen expert, skiagram chest, montoux test was done. Enrolled after confirmation. Extrapulmonary TB cases were excluded either by clinical evaluations or by USG/CT abdomen, FNAC, L.P.

- Pulmonary TB cases in the pediatric age group were enrolled.
- Blood samples and skiagram chest were taken for the study before starting the treatment.
- ATI was started.
- Patients were reviewed after two months of the intensive phase of treatment.
- After the intensive period of treatment for two months, blood samples and a skiagram chest were obtained for the study.
- Values were recorded and compared.

**Declaration of ethics**

An ethical review board of the Dr. Ram Manohar Lohia Hospital in New Delhi's Atal Bihari Vajpayee Institute of Medical Sciences granted ethical clearance. Information from the case file was recognized and coded during data collection.

**Statistical techniques used**

Using descriptive statistics (average, percentile, mean, standard deviation, and paired t-test) to assess the significance of mean differences across variables, the collected data will be statistically analyzed. The author will enter all of the data, and IBM's SPSS-25 program will be used to help with additional statistical analysis.

**Results**

In this study, 76.36% of patients belonged to the age group 10-17 years. The age group was <10 years only 13 out of 55 patients (23.63%). The mean value of age (was 12.05 years ± SD 2.520). 54.54% of patients were females and 45.45% of patients were males.

As shown in Table 1, a significant difference was seen in Hemoglobin, Leucocyte Count, Red Blood Cells, Platelet, and Lymphocyte. As shown in Table 1, a significant difference was seen between pre-and post-treatment (p-value <0.05).

| Paired Samples Test) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | Std. deviation | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | | | | Mean | Std. deviation | Std. Error Mean | 95% confidence interval of the difference | | | | |
| | | | | | | | | Lower | Upper | | | |
| **Pair 1** | **Hemoglobin** | **Pre** | 61.76 | 7.918 | 9.164 | 23.319 | 3.144 | 2.86 | 15.468 | 2.914 | 54 | 0.005 |
| | | **Post** | 52.6 | 21.204 | | | | | | | | |
| **Pair 2** | **Leucocyte count** | **Pre** | 53.69 | 14.145 | 1.727 | 15.642 | 2.109 | -2.501 | 5.956 | 0.819 | 54 | 0.416 |
| | | **Post** | 51.96 | 14.293 | | | | | | | | |
| **Pair 3** | **Red blood cell** | **Pre** | 58.8 | 10.906 | -12.018 | 20.546 | 2.77 | -17.572 | -6.464 | -4.338 | 54 | 0 |
| | | **Post** | 70.82 | 16.047 | | | | | | | | |
| **Pair 4** | **Platelet count** | **Pre** | 45.38 | 19.602 | -14.182 | 22.087 | 2.978 | -20.153 | -8.211 | -4.762 | 54 | 0 |
| | | **Post** | 59.56 | 19.516 | | | | | | | | |
| **Pair 5** | **Neutrophil** | **Pre** | 57.67 | 11.029 | -0.2 | 15.794 | 2.13 | -4.47 | 4.07 | -0.094 | 54 | 0.926 |
| | | **Post** | 57.87 | 12.642 | | | | | | | | |
| **Pair 6** | **Lymphocyte** | **Pre** | 50.05 | 17.944 | -14.2 | 23.551 | 3.176 | -20.567 | -7.833 | -4.472 | 54 | 0 |
| | | **Post** | 64.25 | 12.464 | | | | | | | | |
| **Pair 7** | **Monocyte** | **Pre** | 61.8 | 8.491 | 16.455 | 20.37 | 2.747 | 10.948 | 21.961 | 5.991 | 54 | 0 |
| | | **Post** | 45.35 | 20.9 | | | | | | | | |
| **Pair 8** | **Eosinophil** | **Pre** | 55 | 15.722 | 1.127 | 18.279 | 2.465 | -3.814 | 6.069 | 0.457 | 54 | 0.649 |
| | | **Post** | 53.87 | 14.102 | | | | | | | | |

**Table 1:** Comparison of complete blood count, differential leucocyte counts between pre and post treatment.

Chandra S | Volume 3; Issue 1 (2024) | Mapsci-JCPR-3(1)-016 | Research Article
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Mean ± SD of Hemoglobin count in post-treatment was 61.76 ± 7.918, respectively which was significantly higher as compared to pre-treatment ( 52.60 ± 21.204), (t-value -2.914) significant at <0.05 level respectively. Red Blood Cells in post-treatment were 70.82 ± 16.047 respectively which was significantly higher as compared to pre-treatment 58.80 ± 10.906, (t-value -4.338) significant at <0.05 level respectively. Platelet Count in post-treatment was 59.56 ± 19.516 respectively which was significantly higher as compared to pre-treatment 45.38 ± 19.602, (t-value -4.762) significant at <0.05 level respectively. Lymphocytes in post-treatment were 64.25 ± 12.464 respectively which was significantly higher as compared to pre-treatment 50.05 ± 17.944, (t-value -4.472) significant at <0.05 level respectively. Monocyte in post-treatment was 45.35 ± 20.900 respectively which was significantly lower as compared to pre-treatment 61.80 ± 8.491, (t-value 5.991) significant at <0.05 level respectively.

| Paired Samples Test | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Mean | Std. Deviation | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | | | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | | | | Lower | Upper | | | |
| **Pair 1** | **ESR** | **Pre** | 61.76 | 7.918 | 18.582 | 26.925 | 3.631 | 11.303 | 25.861 | 5.118 | 54 | 0 |
| | | **Post** | 43.18 | 23.907 | | | | | | | | |
| **Pair 2** | **Packed cell volume** | **Pre** | 41.75 | 17.34 | -13.964 | 24.49 | 3.302 | -20.584 | -7.343 | -4.228 | 54 | 0 |
| | | **Post** | 55.71 | 12.052 | | | | | | | | |
| **Pair 3** | **Mean corpuscular volume** | **Pre** | 52.93 | 15.974 | -9.018 | 19.565 | 2.638 | -14.307 | -3.729 | -3.418 | 54 | 0.001 |
| | | **Post** | 61.95 | 8.646 | | | | | | | | |
| **Pair 4** | **Mean corpuscular hemoglobin** | **Pre** | 58.8 | 10.117 | 0.618 | 10.666 | 1.438 | -2.265 | 3.502 | 0.43 | 54 | 0.669 |
| | | **Post** | 58.18 | 12.106 | | | | | | | | |
| **Pair 5** | **Mean platelet** | **Pre** | 55.73 | 13.663 | -0.527 | 21.099 | 2.845 | -6.231 | 5.177 | -0.185 | 54 | 0.854 |
| | | **Post** | 56.25 | 15.164 | | | | | | | | |
| **Pair 6** | **Platelet distribution** | **Pre** | 58.04 | 15.716 | 2.291 | 21.133 | 2.85 | -3.422 | 8.004 | 0.804 | 54 | 0.425 |
| | | **Post** | 55.75 | 17.811 | | | | | | | | |
| **Pair 7** | **Platelet crit** | Pre | 48.71 | 23.116 | -5.364 | 27.546 | 3.714 | -12.81 | 2.083 | -1.444 | 54 | 0.155 |
| | | Post | 54.07 | 18.028 | | | | | | | | |


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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pair 8** | **Platelet large cell ratio** | Pre | 52.51 | 17.713 | -8.8 | 16.814 | 2.267 | -13.346 | -4.254 | -3.881 | 54 | 0 |
| | | Post | 61.31 | 9.916 | | | | | | | | |

**Table 2:** Comparison of other hematological parameters between pre and post treatment.

As shown in Table 2, a significant difference was seen between pre and post-treatment (p-value <0.05). Mean ± SD of ESR count in post-treatment was 43.18 ± 23.907 respectively which was significantly lower as compared to pre-treatment 61.76 ± 7.918, (t-value 5.118) significant at <0.05 level respectively.

Packed Cell Volume in post-treatment was 55.71 ± 12.052 respectively which was significantly higher as compared to pre-treatment 41.75 ± 17.340, (t-value -4.228) significant at <0.05 level respectively. Mean Corpuscular Volume in post-treatment was 61.95 ± 8.646 respectively which was significantly higher as compared to pre-treatment 52.93 ± 15.974, (t-value -3.418) significant at <0.05 level respectively. Platelet Large Cell Ratio in post-treatment was 61.31 ± 9.916 respectively which was significantly higher as compared to pre-treatment 52.51 ± 17.713, (t-value -4.254) significant at <0.05 level respectively.

| **Paired Samples Test** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Mean** | **Std. Deviation** | **Paired Differences** | | | | | **t** | **df** | **Sig. (2-tailed)** |
| | | | | | **Mean** | **Std. Deviation** | **Std. Error Mean** | **95% Confidence Interval of the Difference** | | | | |
| | | | | | | | | **Lower** | **Upper** | | | |
| **Pair 1** | **C-reactive** | **Pre** | 58.22 | 14.913 | 11.545 | 27.345 | 3.687 | 4.153 | 18.938 | 3.131 | 54 | 0.003 |
| | | **Post** | 46.67 | 25.531 | | | | | | | | |
| **Pair 2** | **Procalcitonin** | **Pre** | 49.33 | 17.728 | -2.782 | 22.315 | 3.009 | -8.814 | 3.251 | -0.925 | 54 | 0.359 |
| | | **Post** | 52.11 | 17.328 | | | | | | | | |
| **Pair 3** | **Ferritin** | **Pre** | 55.73 | 15.552 | 19.691 | 30.765 | 4.148 | 11.374 | 28.008 | 4.747 | 54 | 0 |
| | | **Post** | 36.04 | 24.341 | | | | | | | | |
| **Pair 4** | **X-ray** | **Pre** | 53.4 | 17.933 | 16.673 | 23.718 | 3.198 | 10.261 | 23.084 | 5.213 | 54 | 0 |
| | | **Post** | 36.73 | 20.057 | | | | | | | | |

**Table 3:** Comparison of C-reactive protein (mg/dL), procalcitonin (ng/mL), ferritin (ng/mL), chest X-ray between pre and post treatment.


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As shown in Table 3, a significant difference was seen between pre-and post-treatment (p-value <0.05).

Mean ± SD of C-reactive count in post-treatment was 46.67 ± 25.531 respectively which was significantly lower as compared to pre-treatment 58.22 ± 14.913, (t-value 3.131) significant at <0.05 level respectively. Ferritin in post-treatment was 36.04 ± 24.341 respectively which was significantly lower as compared to pre-treatment 55.73 ± 15.552, (t-value 4.747) significant at <0.05 level respectively. X-ray in post-treatment was 36.73 ± 20.052 respectively which was significantly lower as compared to pre-treatment 53.40 ± 17.933, (t-value 5.213) significant at <0.05 level respectively.

| | | | |
|---|---|---|---|
| **X-ray** | Improve | 48 | 87.27% |
| | No changes | 7 | 12.72% |

**Table 4:** Distribution of chest X-ray improvement of study subjects.

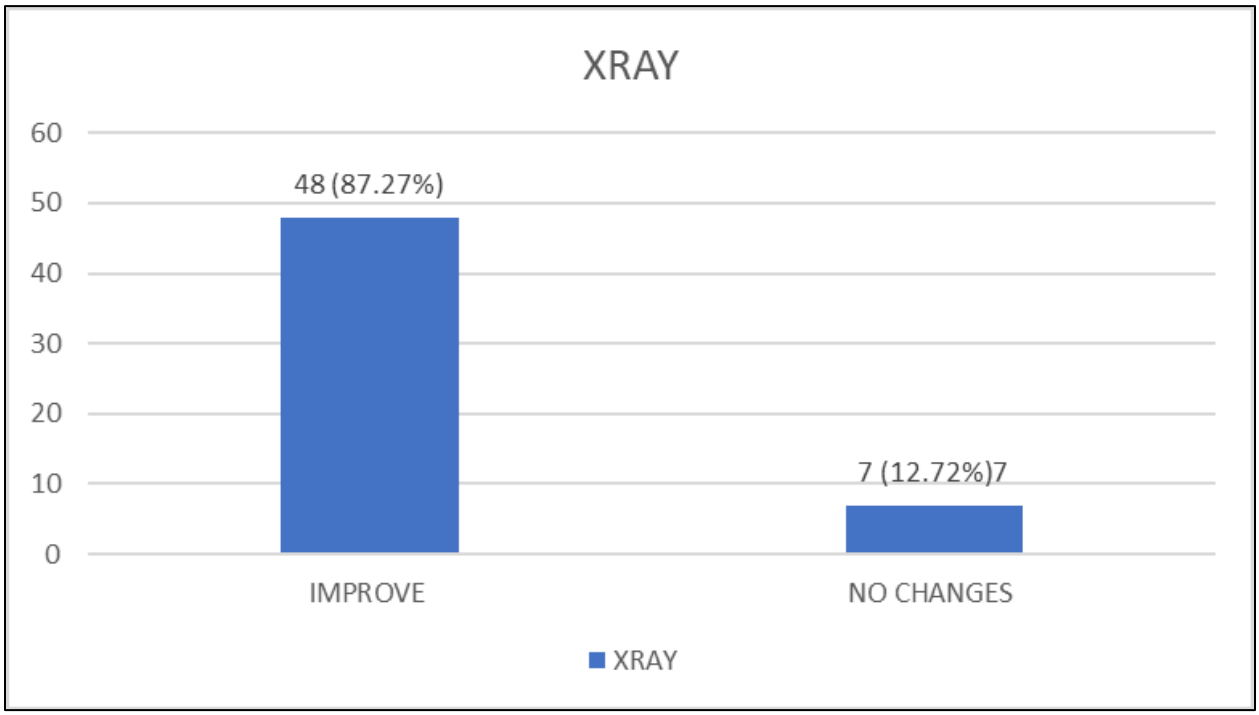


**Figure 1:** Distribution of chest X-ray improvement of study subjects.

In this study, shown in Table 4 and Figure 1; in the majority 48 (87.27%) of patients, chest X-rays showed improvement. No changes in X-rays were seen in only 7 out of 55 patients (12.72).


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| Variables | C-reactive protein (mg/dL) | Procalcitonin (ng/mL) | Ferritin (ng/mL) |
|---|---|---|---|
| | Correlation coefficient | Correlation coefficient | Correlation coefficient |
| **ESR (mm/hr)** | 0.037 | 0.082 | 0.294 |
| **Hemoglobin (gm/dL)** | -0.181 | -0.093 | -0.028 |
| **Total leucocyte count (/mm$^3$)** | 0.089 | 0.044 | -0.048 |
| **Neutrophil (%)** | 0.038 | -0.072 | 0.141 |
| **Lymphocyte (%)** | -0.101 | -0.034 | -0.216 |
| **Monocyte (%)** | 0.076 | 0.361 | 0.102 |
| **Eosinophil (%)** | 0.137 | 0.118 | 0.245 |
| **Red blood cells (millions/mm$^3$)** | -0.112 | -0.16 | -0.151 |
| **Packed cell volume (%)** | -0.164 | -0.129 | -0.1 |
| **Mean corpuscular volume (fL)** | 0.018 | 0.108 | 0.154 |
| **Mean corpuscular hemoglobin (pg)** | -0.035 | 0.123 | 0.153 |
| **Mean corpuscular hemoglobin concentration (gm/dL)** | -0.18 | 0.007 | 0.125 |
| **Platelet count (lacs/mm$^3$)** | -0.15 | -0.18 | -0.213 |
| **Mean platelet volume (fL)** | 0.227 | 0.15 | 0.26 |
| **Platelet distribution width (fL)** | 0.092 | -0.017 | -0.179 |
| **Platelet crit (%)** | -0.118 | -0.154 | -0.133 |
| **Platelet large cell ratio** | 0.133 | 0.151 | -0.044 |

**Table 5:** Correlation of pre-treatment C-reactive protein (mg/dL), ferritin (ng/mL) and procalcitonin (ng/mL), with other parameters.

As shown in table 5, no correlation was seen between C-reactive protein (mg/dL) with ESR (mm/hr), neutrophil (%), monocyte (%), mean corpuscular volume (fL), mean corpuscular hemoglobin (pg) with correlation coefficient of 0.037, 0.038, 0.076, 0.018, -0.035 respectively.

Non-significant mild positive correlation was seen between C-reactive protein (mg/dL) with total leucocyte count (/mm$^3$), eosinophil (%), platelet distribution width (fL), platelet large cell ratio with correlation coefficient of 0.089, 0.137, 0.092, 0.133 respectively. Non-significant moderate positive correlation was seen between C-reactive protein (mg/dL) with mean platelet volume (fL) with correlation coefficient of 0.227. Non-significant mild negative correlation was seen between C-reactive protein (mg/dL) with Hemoglobin (gm/dL), lymphocyte (%), red blood cells (millions/mm$^3$), Packed cell volume (%), Mean corpuscular hemoglobin concentration (gm/dL), platelet count (lacs/mm$^3$), platelet crit (%) with correlation coefficient of -0.181, -0.101, -0.112, -0.164, -0.18,


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-0.15, -0.118 respectively. Significant positive correlation was seen between procalcitonin (ng/mL), with monocyte (%) with correlation coefficient of 0.361 as shown. No correlation was seen between procalcitonin (ng/mL) with total leucocyte count (/mm$^3$), neutrophil (%), lymphocyte (%), mean corpuscular hemoglobin concentration (gm/dL), platelet distribution width (fL) with correlation coefficient of 0.044, -0.072, -0.034, 0.007, -0.017 respectively.

Non-significant mild positive correlation was seen between procalcitonin (ng/mL) with ESR (mm/hr), eosinophil (%), mean corpuscular volume (fL), mean corpuscular hemoglobin (pg), mean platelet volume (fL), platelet large cell ratio with correlation coefficient of 0.082, 0.118, 0.108, 0.123, 0.15, and 0.151 respectively.

Non-significant mild negative correlation was seen between Procalcitonin (ng/mL) with Hemoglobin (gm/dL), red blood cells (millions/mm$^3$), packed cell volume (%), platelet count (lacs/mm$^3$), platelet crit (%) with correlation coefficient of -0.093, -0.16, -0.129, -0.18, -0.154 respectively. No correlation was seen between ferritin (ng/mL) with Hemoglobin (gm/dL), total leucocyte count (/mm$^3$), platelet large cell ratio with correlation coefficient of -0.028, -0.048, -0.044 respectively.

Non-significant mild positive correlation was seen between ferritin (ng/mL) with neutrophil (%), monocyte (%), mean corpuscular volume (f), mean corpuscular, hemoglobin (pg), mean corpuscular hemoglobin concentration (gm/dL) with correlation coefficient of 0.141, 0.102, 0.154, 0.153, 0.125 respectively.

Non-significant moderate positive correlation was seen between ferritin (ng/mL) with ESR (mm/hr), eosinophil (%), mean platelet volume (fL) with correlation coefficient of 0.294, 0.245, 0.26 respectively. Non-significant mild negative correlation was seen between ferritin (ng/mL) with red blood cells (millions/mm$^3$), packed cell volume (%), platelet distribution width (fL), platelet crit (%) with correlation coefficient of -0.151, -0.1, -0.179, -0.133 respectively.

Non-significant moderate negative correlation was seen between ferritin (ng/mL) with lymphocyte (%), platelet count (lacs/mm$^3$) with correlation coefficient of -0.216, -0.213 respectively.

| **Variables** | C-reactive **Protein (mg/dL)** | **Procalcitonin (ng/mL)** | **Ferritin (ng/mL)** |
|---|---|---|---|
| | **Correlation coefficient** | **Correlation coefficient** | **Correlation coefficient** |
| **ESR (mm/hr)** | 0.293 | 0.361 | 0.504 |
| **Hemoglobin (gm/dL)** | -0.098 | -0.142 | 0.048 |
| **Total leucocyte count (/mm$^3$)** | 0.176 | 0.084 | 0.031 |
| **Neutrophil (%)** | -0.125 | 0 | -0.025 |
| **Lymphocyte (%)** | 0.092 | -0.017 | -0.038 |
| **Monocyte (%)** | 0.09 | 0.134 | 0.187 |
| **Eosinophil (%)** | -0.206 | -0.08 | -0.223 |


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**DOI:** https://doi.org/10.37191/Mapsci-2583-4525-3(1)-016

| | | | |
|---|---|---|---|
| **Red blood cells (millions/mm³)** | 0 | -0.155 | -0.016 |
| **Packed cell volume (%)** | -0.061 | -0.108 | 0.024 |
| **Mean corpuscular volume (fL)** | 0.034 | 0.057 | 0.116 |
| **Mean corpuscular hemoglobin (pg)** | -0.027 | -0.044 | 0.155 |
| **Mean corpuscular Hemoglobin concentration (gm/dL)** | 0.067 | -0.172 | 0.122 |
| **Platelet count (lacs/mm³)** | -0.074 | -0.024 | 0.22 |
| **Mean platelet volume (fL)** | 0.201 | 0.131 | -0.015 |
| **Platelet Distribution width (fL)** | 0.146 | 0.155 | -0.249 |
| **Platelet crit (%)** | 0.049 | 0.068 | 0.277 |
| **Platelet large cell ratio** | 0.159 | 0.148 | -0.014 |

**Table 6:** Correlation of post-treatment C-reactive protein (mg/dL), ferritin (ng/mL) and procalcitonin (ng/mL), with other parameters.

No correlation was seen between C-reactive protein (mg/dL) with packed cell volume (%), mean corpuscular volume (fL), mean corpuscular hemoglobin (pg), Mean corpuscular hemoglobin concentration (gm/dL), platelet count (lacs/mm³), platelet crit (%) with correlation coefficient of -0.061, 0.034, -0.027, 0.067, -0.049 respectively.

**Non-significant mild**

Positive correlation was seen between C-reactive protein (mg/dL) with total leucocyte count (/mm) lymphocyte (%), monocyte (%), platelet distribution width (fL), platelet large cell ratio with correlation coefficient of 0.176, 0.092, 0.09, 0.146, and 0.159 respectively.

Non-significant moderate positive correlation was seen between C-reactive protein (mg/dL) with ESR (mm/hr), mean platelet volume (fL) with correlation coefficient of 0.293, 0.201 respectively. Non-significant mild negative correlation was seen between C-reactive protein (mg/dL) with hemoglobin (gm/dL), neutrophil (%) with correlation coefficient of -0.098, -0.125 respectively. Non-significant moderate negative correlation was seen between C-reactive protein (mg/dL) with eosinophil (%) with correlation coefficient of -0.206.

A significant positive correlation was seen between procalcitonin (ng/mL) with ESR (mm/hr) with a correlation coefficient of 0.361 as shown. No correlation was seen between procalcitonin (ng/mL) with lymphocyte (%), eosinophil (%), mean corpuscular volume (fL), mean corpuscular hemoglobin (pg), platelet count (lacs/mm³), platelet crit (%) with correlation coefficient of -0.017, -0.08, 0.057, -0.044, -0.024, 0.068 respectively.

Non-significant mild positive correlation was seen between procalcitonin (ng/mL) with total leucocyte count (/mm³), monocyte (%), mean platelet volume (fL), platelet distribution width (fL), platelet large cell ratio with correlation coefficient of 0.084, 0.134, 0.131, 0.155, 0.148 respectively.

Non-significant mild negative correlation was seen between procalcitonin (ng/mL) with


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Hemoglobin (gm/dL), red blood cells (millions/mm$^3$), packed cell volume (%), mean corpuscular hemoglobin concentration (gm/dL) with correlation coefficient of -0.142, -0.155, -0.108, -0.172 respectively.

A significant positive correlation was seen between ferritin (ng/mL) with ESR (mm/hr) with correlation coefficient of 0.504 as shown. No correlation was seen between ferritin (ng/mL) with hemoglobin (gm/dL), total leucocyte count (/mm$^3$), neutrophil (%), lymphocyte (%), red blood cells (millions/mm$^3$), packed cell volume (%), mean platelet volume (fL), platelet large cell ratio with correlation coefficient of 0.048, 0.031, -0.025, -0.038, -0.016, 0.024, -0.015, -0.014 respectively. Non-significant mild positive correlation was seen between ferritin (ng/mL) with monocyte (%), mean corpuscular volume (fL), mean corpuscular hemoglobin (pg), mean corpuscular hemoglobin concentration (gm/dL) with correlation coefficient of 0.187, 0.116, 0.155, 0.122 respectively. Non-significant moderate positive correlation was seen between ferritin (ng/mL) with platelet count (lacs/mm$^3$) platelet crit (%) with correlation coefficient of 0.22, 0.277 respectively. Non-significant moderate negative correlation was seen between ferritin (ng/mL) with eosinophil (%), platelet distribution width (fL) with correlation coefficient of -0.223, -0.249 respectively.

## Discussion

This study demonstrates that there are notable variations in Hb%, RBC, PCV, RBC indices (MCV, MCH, MCHC), Total leucocyte count, Differential leucocytes (lymphocytes, monocytes, eosinophils), Platelet counts, Platelet indices (MPV, PDW, Plateletcrit, PLCR). There was Anemia (normocytic normochromic) which improved after treatment. Leucocytes decreased significantly but remained within normal range post ATT along with a decrease in monocyte, and eosinophils but lymphocytes increased (within normal range). The measurement of platelet volume and RBC fluctuation is done using PDW and red cell distribution width. According to reports, the normal reference range of RDW-CV in adult people is 11.5% to 14.5% [11]. In platelet indices, Platelet counts increased after treatment along with other platelet indices like PDW, plateletcrit, and PLCR. Whereas MPV decreased after the treatment significantly [12]. Among inflammatory markers, significant reduction is noted in levels of ESR, CRP [13-15], Ferritin. The Study by Miranda P, et al., ferritin levels were increased in Tb patients starting ATT and decreased during the first two months of treatment [16]. All these findings suggest that Anti-tuberculosis Drug Treatment (ATT) is highly successful in enhancing hematological parameters, which suggests that responder's immune responses have improved in an indirect manner. However, the prognosis strictly depends on the precocity of the administration of the antituberculosis drugs [17]. Also, this study shows that the objective assessment of improvement in a TB patient can be done by analyzing these parameters mentioned above. A positive correlation between Procalcitonin and monocytes in the pre-treatment phase might direct the author towards predicting the severity of infection. After an intensive phase of ATI, a significant positive correlation was seen between


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Procalcitonin and ESR; serum ferritin and ESR indicated that these inflammatory markers decrease in a proportionate manner. Before initiating treatment, a nonsignificant moderate correlation between CRP and MPV; Ferritin with ESR, MPV, Lymphocyte, and platelet counts were seen. Also, after completing two months of ATT, a nonsignificant moderate correlation was seen in CRP with ESR, MPV; ferritin with platelet count, plateletcrit, and PDW; which can be further established in the future by taking a larger study population. There was a significant association of procalcitonin levels with lung cavitation which may indicate that the extent of tissue involvement can be evaluated by inflammatory marker (serum procalcitonin) levels.

## Conclusion

The various parameters used in the study as the inflammatory process have an extremely important part in the TB pathogenesis. These parameters can be used as markers can be used for prognosis, response to treatment, and follow-up purposes. It can increase the predicting accuracy of treatment outcomes as ones can monitor the TB cases objectively in addition to subjective parameters (improvement in clinical symptoms and examination findings, weight gain, Increase in appetite). While the levels of mean platelet volume dramatically decreased after therapy, it is possible to utilize this common inflammatory biomarker to track how well pulmonary tuberculosis patients are responding to treatment. It was also examined in this study. Further, the study shows that a combination of the above parameters is much more useful and significant in contrast to a single marker.

## Limitations of the study

1. This Study involved a smaller sample size. So, a large population is required in the future to establish the nonsignificant results.
2. After a full course of ATT, the researcher was unable to evaluate the significance of these indicators in predicting the treatment outcome (6 months, including both intensive and continuation phases).

## Strength of the study

1. Objective assessment of response to intensive phase (2 months) ATT in children with Pulmonary TB done for the first time.
2. Application of platelet indices as a parameter of ATT response done for the first time.
3. The application of S. Ferritin for the same purpose is also done for the first time in children.
4. A significant positive correlation between Procalcitonin and monocytes in the pre-treatment phase was found, which might give an idea about the severity of infection.
5. A significant positive correlation was seen between Procalcitonin and ESR; serum ferritin and ESR.

The above-mentioned correlations between various parameters done for the first time in the pediatric age groups.


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**Financial support and sponsorship**

The authors have indicated they have no financial relationships relevant to this article to disclose.

**Conflict of interest**

The authors declare that they have no conflict of interest.

## References

1. WHO, Global Tuberculosis Report, 2020.
2. Grzybowski S, Barnett GD, Styblo K. Contacts of Cases of Active Pulmonary Tuberculosis. Bull Int Union Tuberc. 1975;50:90-106. PubMed
3. Loudon RG, Williamson J, Johnson JM. An Analysis of 3,485 Tuberculosis Contacts in the City of Edinburgh During 1954-1955. Am Rev Tuberc. 1958;77:623-43. PubMed | CrossRef
4. Almeida LM, Barbieri MA, Da Paixao AC, Cuevas LE. Use of Purified Protein Derivative to Assess the Risk of Infection in Children in Close Contact with Adults with Tuberculosis in a Population with High Calmette-guerin Bacillus Coverage. Pediatr Infect Dis J. 2001;20:1061-5. PubMed | CrossRef
5. Lienhardt C, Sillah J, Fielding K, Doncor S, Manneh K, Warndorff D, et al. Risk Factors for Tuberculosis Infection in Children in Contact with Infectious Tuberculosis Cases in the Gambia, West Africa. Pediatrics. 2003;111. PubMed | CrossRef
6. Howard TP, Solomon DA. Reading the Tuberculin Skin Test. Who, When, and How? Arch Intern Med. 1988;148:2457-9. PubMed | CrossRef
7. Brock I, Weldingh K, Lillebaek T, Follmann F, Andersen P. Comparison of Tuberculin Skin Test and New Specific Blood Test in Tuberculosis Contacts. Am J Respir Crit Care Med. 2004;170:65-9. PubMed | CrossRef
8. Ewer K, Deeks J, Alvarez L, Bryant G, Waller S, Andersen P, et al. Comparison of T-cell-based Assay with Tuberculin Skin Test for Diagnosis of Mycobacterium Tuberculosis Infection in a School Tuberculosis Outbreak. Lancet. 2003;361:1168-73. PubMed | CrossRef
9. Karakas Z, Agaoglu L, Taravari B, Saribeyoglu E, Somer A, Guler N, et al. Pulmonary Tuberculosis in Children with Hodgkin's Lymphoma. Hematol J. 2003;4(1):78-81. PubMed | CrossRef
10. Nicol MP, Spiers K, Workman L, Isaacs W, Munro J, Black F, et al. Xpert MTB/RIF Testing of Stool Samples for the Diagnosis of Pulmonary Tuberculosis in Children. Clin Infect Dis. 2013;57(3):e18-21. PubMed | CrossRef
11. Vajpayee N, Graham SS, Bem S. Basic Examination of Blood and Bone Marrow. Henry's Clinical Diagnosis and Management by Laboratory Methods. 2011;509-35. CrossRef
12. Bougie DW, Wilker PR, Aster RH. Patients with Quinine-induced Immune Thrombocytopenia have both Drug-dependent and Drug-specific Antibodies. Blood. 2006;108(3):922-7. PubMed | CrossRef
13. Litao MK, Kamat D. Erythrocyte Sedimentation Rate and C-reactive Protein: How Best to Use Them in Clinical Practice. Pediatric Ann. 2014;43(10):417-20. PubMed | CrossRef
14. Lawn SD, Obeng J, Acheampong JW, Griffin GE. Resolution of the Acute Phase Response in West African Patients Receiving Treatment for Pulmonary Tuberculosis. Int J Tuberc Lung Dis. 2000;4(4):340-344. PubMed
15. Wilson D, Badri M, Maartens G. Performance of Serum C-reactive Protein as a Screening Test for Smear Negative Tuberculosis in an Ambulatory High HIV Prevalence Population. PLoS One. 2011;6(1):e15248 PubMed | CrossRef
16. Miranda P, Gil Santana L, Oliveira MG, Mesquite EDD, Silve E, Rauwerdink A, et al. Sustained Elevated Levels of C-reactive Protein and Ferritin in Pulmonary Tuberculosis Patients Remaining Culture Positive upon Treatment Initiation. PLoS One. 2017;12(4):e0175278. PubMed | CrossRef
17. Frieden T. Toman's Tuberculosis: Case Detection, Treatment and Monitoring. Second Edition WHO, Geneva. 2004.