

# The Case Control Study of Serum Magnesium level In Pulmonary Tuberculosis and Its Correlation with the Stage of Pulmonary Tuberculosis

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## Abstract

**Background:** In 2016, 6.3 million cases of PTB were reported by WHO. Magnesium is extremely essential for life and is present as intracellular ion in all living cells and tissues<sup>1</sup>. Some workers have found serum Magnesium level to decrease in cases of PTB, which rises towards normal with specific treatment.

**Objectives:** 1. To estimate and compare serum Magnesium levels in cases and controls  
2. To measure correlation between Magnesium levels and severity of PTB

**Materials and Methods:** This was a prospective case control study, conducted on 30 PTB patients and 30 controls who met the inclusion and exclusion criteria of the study. This study was done in S.Nijalingappa Medical College, Bagalkot, Karnataka during the period September 2021 to January 2022. All patients were clinically evaluated and underwent relevant investigations.

**Results:** There was significant decrease in Serum Magnesium in cases and more decreased in moderately advanced and far advanced disease.

**Conclusion:** The study concludes that there is significant reduction in Serum Magnesium in PTB and it further decreases as the severity of PTB increases, hence necessitating early treatment of PTB and need for Magnesium supplementation in PTB patients.

**Key words:** Pulmonary Tuberculosis, Serum Magnesium, Severity of PTB

## Introduction

Magnesium is one of the important minerals present in the human body as its role in enzymatic reactions and as a co-factor. Magnesium is the fourth most abundant cation present in the body<sup>[1]</sup>.

In some studies (Jain et al., Narang et al.)<sup>[2,3]</sup> it has been found that the serum magnesium level is decreased in cases of pulmonary tuberculosis, which rises towards normal with treatment. The purpose of the present study was to correlate severity of pulmonary tuberculosis with serum magnesium.

Normal Serum Magnesium is 1.9-2.9 mg/dL

Many of the essential trace elements like copper, zinc, magnesium influence the function of the immune system<sup>[4]</sup>. The pathophysiology of tuberculosis is linked to delay in immune response of the host and alterations in T-lymphocyte and macrophage

functions contributing to the natural course of the disease<sup>[5]</sup>. Previous reports have studied the levels of these elements in serum in patients of pulmonary tuberculosis<sup>[3]</sup>.

Patients with hypomagnesaemia usually presents with personality changes, gastrointestinal disturbances, tremors, hyporeflexia and convulsions. Hence, detection of hypomagnesemia is necessary in PTB cases.

## Objectives:

1. To estimate and compare serum Magnesium levels in cases and controls
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## Materials and Methods:

Ethical committee clearance was obtained on 31<sup>st</sup>

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August,2021

Source of data is inpatients/outpatients in the Department of General Medicine at HSK Hospital, Bagalkot. Study design being Case Control study

Inclusion criteria for cases being age >15 years and history of cough for more than 2 weeks, fever, weight loss, night sweats (Eligibility criteria); Sputum positive for AFB and chest xray with features of PTB (Diagnostic criteria)

Inclusion criteria for controls being no history of fever, cough, weight loss, night sweats; sputum negative for AFB, chest xray normal and subjects not on Magnesium supplementation

Exclusion criteria for both cases and controls being age <15 years, diarrhea and those on Magnesium supplementation

**Sample size estimation:**

Samples size estimation was done using OpenEpi Software Version 2.3.1.

At 95% confidence level, and 80% power of the study  $\alpha$  (two-tailed) = 0.050 and at 95% confidence level.

$\beta$  = 0.200 and 80% of power of the study

Where  $Z_{\alpha}$  = standard table value for 95% CI = 1.96

$Z_{1-\beta}$  = Standard table value for 80% Power = 0.84

Based on previous study, Irfan et al [9]

Mean Mg level in Cases Group:  $2.03 \pm 0.07$

Mean Mg level in cases Group =  $1.85 \pm 2.12$

Sample size is calculated using the formula,

$$n = 2(Z_{\alpha} + Z_{1-\beta})^2 \sigma^2 / d^2$$

Sample size estimated is 28 which is rounded off to 30

30 cases and 30 controls.

**Data collection:**

Informed consent was taken for participation in the study and a questionnaire was used to collect history of fever, night sweats, weight loss, cough

**Investigations:**

1. Sputum for AFB
2. Chest Xray
3. Serum Magnesium

**Chest Xray:**

All cases included in the study were classified as minimal, moderately advanced and far advanced disease according to the classification by National Tuberculosis and Respiratory Disease Association, America, after Postero-Anterior view Chest xray [7].

1. Minimal Disease: Lesions that are of slight to moderate density but do not contain demonstrable cavitation. They may involve a small part of one or both lungs, but the total extent, regardless of distribution, should not exceed the volume of lung on one side that occupies the space above the second chondrosternal junction and the spine of the fourth or the body of the fifth thoracic vertebra.
2. Moderately Advanced Disease: Lesion may be present in one or both lungs, but the total extent should not exceed the following limits: disseminated lesions of slight to moderate density that may extend throughout the total volume of one lung or the equivalent in both lungs; dense and confluent lesions limited in extent to one-third the volume of one lung; total diameter of cavitation, if present, must be less than 4cm.
3. Far Advanced Disease: Lesions more extensive than moderately advanced.

**Statistical analysis:**

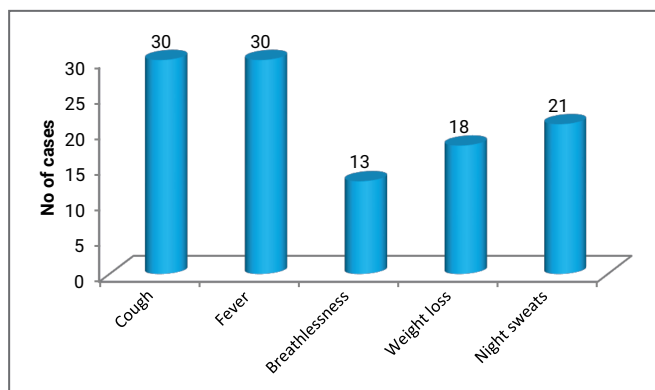
Qualitative data represented in the form of frequency and percentage. Association between variables was assessed with Chi Square test.

Qualitative variables were represented as mean & Sd. Unpaired t test was used to compare the groups. ANOVA was used to come more than two variables. A P value of <0.05 was considered statistically significant.

IBM SPSS Version 28 for windows was used to do statistical analysis.

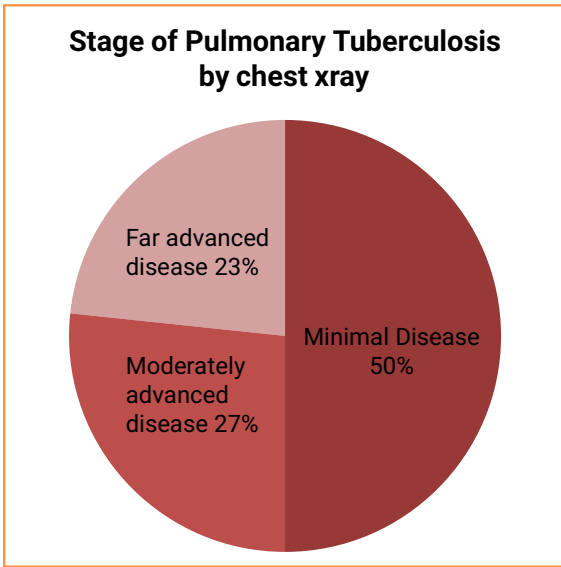
**Results:**

The most common symptoms among cases are fever and cough, found in all cases. (Figure 1)



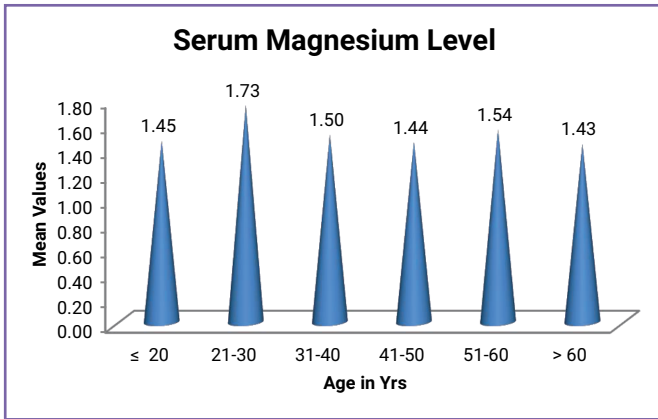
**Figure 1: Distribution of symptoms in PTB cases**

Among 30 PTB cases, 15 are in Minimal disease group (50%), 8 are in moderately advanced group (26%) and 7 are in Far advanced disease group (24%) (Figure 2)



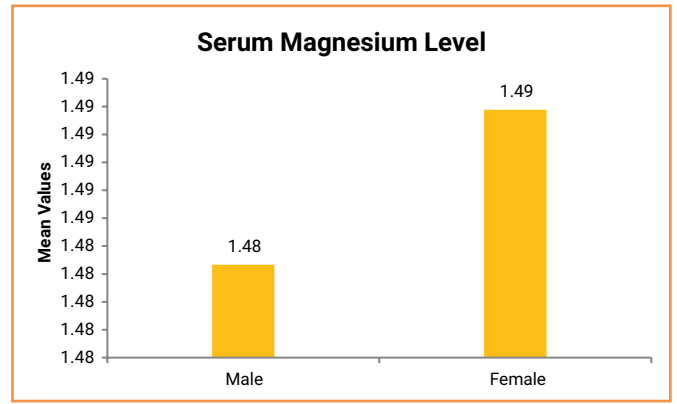
**Figure 2: Severity of disease in PTB cases**

The mean serum Magnesium of cases is  $1.45 \pm 0.07$  in <20 years age group,  $1.73 \pm 0.15$  in 21-30 years age group,  $1.50 \pm 0.14$  in 31-40 years age group,  $1.44 \pm 0.28$  in 41-50 years age group,  $1.54 \pm 0.17$  in 51-60;years age group and  $1.43 \pm 0.27$  in >60 years age group. The variation of serum Magnesium in cases group by age is not statistically significant. ( $P > 0.05$ ) (Figure 3). Serum Magnesium was found to be lowest in >60 years age group and highest in 21-30 years age group



**Figure 3: Agewise distribution of mean Serum magnesium levels in cases**

The mean Serum Magnesium in cases is  $1.48 \pm 0.27$  for males and  $1.49 \pm 0.23$  for females. The variation of Serum Magnesium in cases group by gender is not statistically significant ( $P > 0.05$ ) (Figure 4). The serum magnesium in female cases is almost same as in male cases



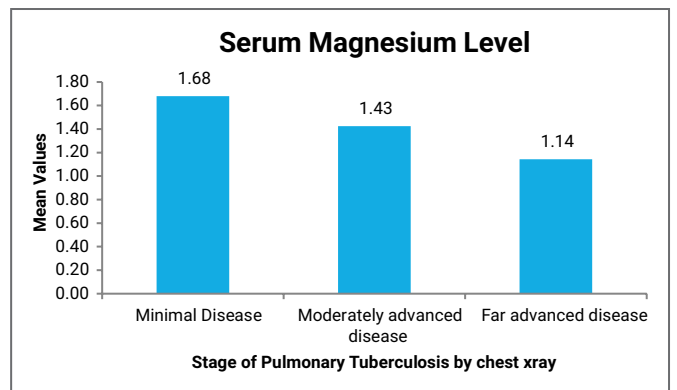
**Figure 4: Gender wise distribution of mean Serum Magnesium in cases**

**Table 1: Comparison of Serum Magnesium in cases and controls**

Parameters		Cases	Controls	P Value
Serum Magnesium	Decreased	29 (97)	0	0.001
	Normal	1 (3)	30 (100)	

Serum Magnesium was decreased in 29 cases while in controls it was normal in all controls. The variation being statistically significant ( $P < 0.05$ ) (Table 1). Serum Magnesium was decreased in 97% cases irrespective of the severity of the disease

The mean Serum Magnesium is  $1.68 \pm 0.11$  in Minimal disease,  $1.43 \pm 0.05$  in Moderately advanced disease and  $1.14 \pm 0.10$  in Far advanced disease. The variation of serum Magnesium in different severity of the disease is statistically significant ( $P < 0.05$ ) (Figure 5). The mean serum Magnesium decreases as the severity of disease increases.



**Figure 5: Distribution of Serum Magnesium according to severity of disease**

**Discussion**

Pulmonary tuberculosis is one of the most prevalent infectious diseases among poor communities.

This study was conducted in Department of General Medicine, S. Nijalingappa Medical College, Bagalkot.

Study had 30 cases and 30 controls. The study period was from September 2021 to January 2022.

The cases were diagnosed by Sputum for AFB and Chest xray both of which were positive in all cases.

The severity of PTB was determined by classification by National Tuberculosis and Respiratory Disease Association, America, after Postero-Anterior view Chest xray<sup>[7]</sup>.

This study showed that the mean magnesium levels are lower in the study group than in the control group. The study also showed the mean magnesium of 1.68mg/dL, 1.43mg/dL and 1.14mg/dL

in minimal, moderately advanced and far advanced groups respectively. This finding is consistent with the Narang et al<sup>[3]</sup>, where the study showed similar finding.(Table 2).The lower serum magnesium levels could be explained in relation to tissue destruction in pulmonary tuberculosis, which could be an important factor leading to hypomagnesaemia.

**Table 2: Comparison of Mean Serum Magnesium wity Narang et al study**

Stage of Pulmonary Tuberculosis by chest xray	Serum Magnesium Level (mg/dL)		Serum Magnesium in Narang etal <sup>[3]</sup>	
	Mean	Std. Deviation	Mean	Std. Deviation
Minimal Disease	1.68	0.11	1.90	-
Moderately advanced disease	1.43	0.05	1.78	0.18
Far advanced disease	1.14	0.10	1.61	0.24

Agarwal et al<sup>[8]</sup>, study showed mean serum magnesium levels were significantly lower in test group than the control group.

Our study showed that the mean serum magnesium levels were significantly lower in cavitary type than the non-cavitary type i.e., minimal disease and moderately and far advanced diseases. Our results are consistent with the findings of Jain et al<sup>[9]</sup>, where 40 cases of pulmonary tuberculosis studied and found that cases with cavitary lesions had a lower magnesium level than non-cavitary lesion. This could be explained as the amount of lung destruction increases from no cavity through small cavity to medium or large cavity, the serum magnesium value falls significantly.

Estimation of serum magnesium was thus found to be a reasonable indicator of severity of disease.

**Limitations of the study:**

1. Sample size was small
2. The socioeconomic status of the patients could not be found out to rule out dietary deficiency of magnesium

**Conclusion**

Serum magnesium levels were studied in 30 newly detected cases of pulmonary tuberculosis before treatment with anti-tubercular drugs. The study observed that a significant inverse relationship was observed between the level of serum magnesium with extent of the disease. Thus, serum magnesium was found to, be a reasonable indicator of severity of pulmonary tuberculosis. There is also a need to consider magnesium supplementation in the diet of tuberculosis patients.

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Conflict of interest: Nil  
Source of funding: Nil

Date received: Feb 28, 2022  
Date accepted: Apr 28, 2022