

## STUDY OF BONE MINERAL METABOLISM IN THYROID DYSFUNCTION

Anand A V<sup>1</sup>, Divya Chandra<sup>2</sup>, Kevin<sup>3</sup>, Sandhya R<sup>4</sup>, Ramya M R<sup>5</sup>

<sup>1</sup>Senior Resident, Department of Medicine, Mysore Medical College and Research Institute, Mysuru, India

<sup>2</sup>Senior Resident, Department of Medicine, Chikkaballapur Institute of Medical Sciences, Chikkaballapur, India

<sup>3</sup>Senior Resident, Department of Medicine, Karwar Institute of Medical Sciences, Karwar, India

<sup>4</sup>Senior Resident, Department of Medicine, Bangalore Medical College and Research Institute, Bangalore, India

<sup>5</sup>Senior Resident, Department of Medicine, Mysore Medical College and Research Institute, Mysuru, India.

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Corresponding Author:

**Dr. Sandhya R,**

Email: rsandhya2608@gmail.com

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### Abstract

**Background:** Disorders of thyroid glands are one of the most common endocrine disorders in India. Thyroid hormones have widespread systemic actions including their effect on bone and mineral metabolism. The changes in mineral metabolism can lead to various complications like osteopenia, secondary osteoporosis and osteoporotic fractures. Hence, I have undertaken this study to assess the changes in mineral metabolism in thyroid dysfunction. The objective is to study the levels of serum calcium and serum phosphate in thyroid dysfunction. **Materials and Methods:** A cross sectional study was conducted on patients attending medicine department in K R Hospital, Mysuru over a period of one and half year from Jan 2020 to July 2021. 96 patients with thyroid dysfunction were included. Serum Calcium and Phosphate levels were measured and the data obtained was analyzed using SPSS software version 22.0 and will be presented as descriptive statistics. **Result:** There is significant increase (p value of <0.005) in mean value of serum calcium and phosphate levels in hyperthyroidism. Hypercalcemia was seen in 27.8% and Hyperphosphatemia in 19.4% of patients with hyperthyroidism. Low serum calcium (8%) and Low serum phosphate (3.3%) levels were seen among hypothyroidism patients. However, there is no significant decrease in mean value of Serum calcium and phosphate levels in Hypothyroidism. **Conclusion:** The present study concludes that serum calcium and phosphate levels are significantly increased in hyperthyroid patients. The changes in mineral metabolism can lead to various complications like osteopenia, secondary osteoporosis and osteoporotic fractures. Hence, monitoring of serum calcium and phosphate levels in thyroid dysfunction and treatment of primary cause and mineral supplementation are advised in order to prevent further bone complications.

## INTRODUCTION

Disorders of thyroid glands are one of the most common endocrine disorders in India. The prevalence of Hypothyroidism and Hyperthyroidism in India is 3.9% and 1.3 % respectively.<sup>[1]</sup> Thyroid hormones have widespread systemic actions involving all organ systems such as CNS, Cardiovascular, Respiratory, Reproductive, Gastrointestinal, including their effect on bone and mineral metabolism.<sup>[2]</sup> It plays an important role in homeostasis of calcium and phosphorous levels by both direct and indirect action on bone remodelling. Mineral metabolism is frequently disturbed in Hyperthyroidism,<sup>[2]</sup> as excess thyroid hormones acts

on osteoblasts via nuclear receptors to stimulate osteoclastic bone resorption and also affects the production of Calcitonin which favors tubular excretion of Phosphate and tubular absorption of Calcium. The opposite effects are seen in Hypothyroidism.<sup>[3-5]</sup>

The changes in mineral metabolism can lead to various complications like secondary osteoporosis and osteoporotic fractures. Regular monitoring of serum calcium and phosphate levels and therapeutic interventions when needed helps in minimizing or delaying the development of complication as they can be fairly used as an index of bone resorption.

Preventive measures like supplementation of minerals or hormone replacement therapy can be

initiated early in those who show rapid bone loss and prevent osteoporotic fractures. Hence, I have undertaken this study to study the changes in mineral metabolism in thyroid dysfunction.

## MATERIALS AND METHODS

This hospital based cross sectional observational study was conducted among inpatients and outpatients attending Department of General Medicine, K R Hospital, Mysuru during the period of January 2020 to July 2021.

Secondary sources of information include published Articles, Journals and Textbooks.

### Method of Collection of Data

Sample Size: 96

In the present study, the sample size was calculated using the formula  $n = z^2pq/d^2$  for the level of confidence of 95% where

$z =$  Desired Confidence Level = 1.96

$p =$  Estimated proportion of an attribute in the population = 1.6% [1]

$q = (100-p) = 98.4\%$

$d =$  Desired level of Precision 2.5%.

### Inclusion Criteria

Patients diagnosed with thyroid dysfunction (Newly diagnosed and those on thyroxine replacement therapy) both males and females with age >18years.

Cut Off<sup>[5]</sup>: TSH- <0.4 or >4.2 micro IU/L

T3 - >190 or < 70 ng/L

T4 - >11 or < 5 mcg/L

### Exclusion Criteria

Chronic Liver disease, Renal Disease

Chronic Alcoholism

Pregnancy

H/O Parathyroid disease

Individuals on Mineral supplements or drugs that affect calcium and phosphorous levels, in the past 3 months.

### Methodology

Institutional Ethical Committee approval has been taken after presenting the study to IEC. As per the inclusion and exclusion criteria, subjects are enrolled in the study. All subjects included in the study have been explained of the procedure and valid informed written consent taken. All subjects included in the study has undergone detailed clinical evaluation and blood sample collected has been sent for analysis of TFT, Serum Calcium, Serum Phosphate, LFT and routine investigations.

### Statistical Analysis

Data obtained from the study is entered in the excel sheets and analyzed using SPSS software version 22.0 and will be presented as descriptive statistics in the form of frequency, tables, figures and graphs. Results will be expressed as Mean  $\pm$  SD. Student T test and Pearson Chi Square test is used to test the significance between the groups. P value of < 0.05 is considered as statistically significant.

## RESULTS

In this study, majority of the cases belong to the age group of 31- 50 years (64.6%), the mean age of the study population is 45.1 and 44.3 years among hyperthyroidism and hypothyroidism respectively. In this study, majority of the subjects were female in both Hyperthyroid (83%) and Hypothyroid (73%) group.

**Table 1: Type Wise Distrubution**

Type	Number (%)
Hyperthyroid	36 (38%)
Hypothyroid	60 (62%)
Total	96 (100%)

**Table 2: Comparison Of Serum Calcium In Hyperthyroid And Hypothyroid**

	Group	Mean	Standard deviation	Min. Value	Max. Value
Serum Calcium	Hyperthyroid	10.13 mg/dl	0.73	8.5 mg/dl	11.9 mg/dl
	Hypothyroid	9.39 mg/dl	0.60	7.7 mg/dl	10.9 mg/dl

P value < 0.005

The mean value of Serum Calcium in Hyperthyroid is  $10.13 \pm 0.73$ , whereas in Hypothyroidism is  $9.39 \pm 0.6$  and the difference is statistically significant with p value of < 0.005 by Independent T test for Mean.

**Table 3: Comparison Of Serum Phosphate In Hyperthyroid And Hypothyroid:**

	Group	Mean	Standard deviation	Minimum	Maximum
Serum phosphate	Hyperthyroid	4.8 mg/dl	0.71	3.2 mg/dl	6.8 mg/dl
	Hypothyroid	4.2 mg/dl	0.60	2.2 mg/dl	5.4 mg/dl

P value < 0.005

The mean value of Serum Phosphate in Hyperthyroidism is  $4.8 \pm 0.71$ , whereas in Hypothyroidism is  $4.2 \pm 0.6$  and the difference is statistically significant with p value of < 0.005 by Independent T test for Mean.

**Table 4: Distribution Of Serum Calcium Among Hyperthyroid And Hypothyroid:**

		Hyperthyroid		Hypothyroid		Total	
Serum calcium	High	Count	10	1	11		
		%	27.8%	1.7%	11.5%		
	Low	Count	0	5	5		

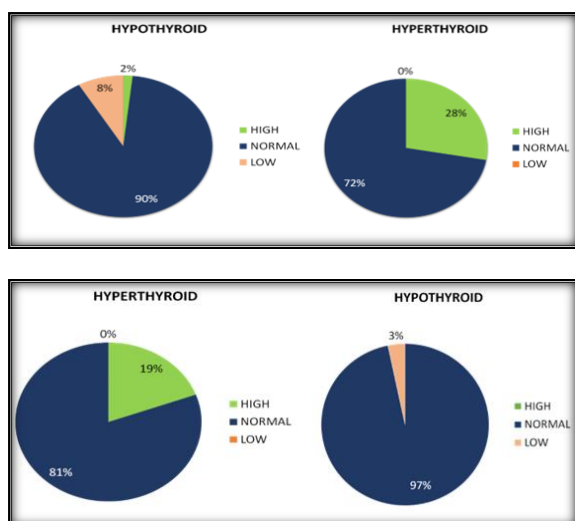
		%	0%	8.3%	5.2%
	Normal	Count	27	54	80
		%	72.2%	90%	83.3%
Total		Count	36	60	96
		%	100%	100%	100%

In this study, 28% of cases showed increased Serum calcium in Hyperthyroid and 8% showed decreased Serum Calcium among Hypothyroid. The Pearson Chi Square showed statistically significant difference with p value of < 0.001.

**Table 5: Distribution Of Serum Phosphate In Hyperthyroid And Hypothyroid**

Serum phosphate	High	Hyperthyroid		Hypothyroid		Total	
		Count	%	Count	%	Count	%
	High	Count	7	0	7		
		%	19.4%	0%	7.3%		
	Low	Count	0	2	2		
		%	0%	3.3%	2.1%		
	Normal	Count	29	58	87		
		%	80.6%	96.7%	90.6%		
Total		Count	36	60	96		
		%	100%	100%	100%		

In this study, 19.4 % of cases showed increased Serum Phosphate in Hyperthyroid and 3.3% showed decreased Serum Phosphate among Hypothyroid. The Pearson Chi Square showed statistically significant difference with p value of < 0.005.



## DISCUSSION

The present study is intended to assess the levels of serum calcium and serum phosphorous in thyroid dysfunction. In this study, 96 patients were included of which 22(22.9%) were males and 74(77.1%) were females which is comparable to Shivaleela et al.<sup>[6]</sup> Majority of the study population belonged to the age group of 31 to 50 years(64.6%). Mean age among hyperthyroidism being 45.1 years and hypothyroidism being 44.3 years which is comparable to Shivaleela et al.<sup>[6]</sup>

In the present study, the mean value of serum calcium among hyperthyroidism showed significant increase (10.13± 0.73 mg/dL) which is comparable to the study done by Shivaleela et al(10.02±0.8) and Hassan et al(10.00±0.8).<sup>[7]</sup> In this study, Hypercalcemia is present in 27.8% of Hyperthyroidism which is comparable to study Shivaleela et al (23%) and Hassan et al (38%).

Hypercalcemia in Thyrotoxicosis is due to osteoclastic bone resorption activated by excess thyroid hormones along with the loss of balancing effect of TSH on osteoclasts in thyrotoxicosis, accentuating the effects of thyroid hormone. As many as, 20% of hyperthyroid patients have High Normal or Mildly elevated Serum Calcium and Hypercalciuria is even more common. However, as Thyrotoxicosis is treated, bone density may normalize in younger patients but not all (postmenopausal and elderly) and may require prophylaxis with calcium and Vitamin D supplements.

In patients with hypothyroidism, hypocalcemia is present in 8.3%. The mean value of serum calcium among hypothyroidism is 9.39±0.6 mg/dL which is comparable to the study done by Shivaleela et al(9.14±0.51), Abdelmulla et al(8.98±0.83).<sup>[9]</sup>

Hyperphosphatemia is present in 19.4% of Hyperthyroidism which is comparable to study done by Abdel Gayoum et al,<sup>[10]</sup> (24.8%). The mean value of serum phosphate among hyperthyroidism is 4.8± 0.71 mg/dL which is comparable to the study done by Nihad et al(4.6±0.7),<sup>[11]</sup> and Hassan et al(4.3±0.8). Hyperphosphatemia occurs due to enhanced tissue catabolism, increased renal tubular reabsorption of phosphorous both by direct effects of thyroid hormone as well as suppressed PTH levels.

The mean value of serum phosphate among hypothyroidism is 4.2± 0.6 mg/dL which is comparable to the study done by Sridevi et al(4.39±0.38).<sup>[12]</sup> Hypophosphatemia is present in 3.3% of patients in contrast to the findings of Abdel Gayoum et al (20.3%).<sup>[10]</sup>

## CONCLUSION

Disorders of the thyroid gland are one of the most common endocrine disorders in India. Mineral metabolism is frequently disturbed in Thyroid Dysfunction. The present study concludes that serum calcium and phosphate levels are significantly increased in hyperthyroidism patients. Hypercalcemia was seen in 27.8% and Hyperphosphatemia in 19.4% of patients with hyperthyroidism. However, there is no significant decrease in mean value of Serum calcium and phosphate levels in Hypothyroidism.

The changes in mineral metabolism can lead to various complications like osteopenia, secondary osteoporosis and osteoporotic fractures. Hence, monitoring of serum calcium and phosphate levels in thyroid dysfunction and treatment of primary cause is advised in order to prevent further bone complications. Further prospective-follow up study is needed to study the effects of Thyroid replacement or suppression therapy on mineral metabolism.

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