Journal of Cardiovascular Disease Research
ISSN: 0975-3583, 0976-2833 VOL 16, ISSUE 01, 2025

Original Article

Association of Thyroid Profile with Serum Magnesium in Hypothyroid Disorders

Pooja[1]; Dr. Gulab Kanwar[2]; Dr. Remesh Kunjunni[3]; Dr. Mukesh Gehlot[4]

[1] Ph.D. Scholar, Department of Biochemistry, Government Medical College, Kota, Rajasthan.
[2] Senior Professor & Head, Department of Biochemistry, Government Medical College, Kota, Rajasthan.
[3] Assistant Professor, Department of Biochemistry, Government Medical College, Kota, Rajasthan.
[4] Junior Specialist, Department of General Medicine, Sawai Man Singh Medical College, Jaipur, Rajasthan.

Corresponding author: Dr. Mukesh Gehlot*

ABSTRACT

Background: Hypothyroidism is an insufficiency of thyroid hormone secretion & action. Both sexes are influenced more commonly by enhancing age & more women are suffering from hypothyroidism than men. Hypothyroidism is measured as a big health problem in India and globally.
Objectives: This study was designed to assessserum T3, serum T4, serum TSH, and serum magnesiumin hypothyroid patients and control subjects & its correlation with serum Magnesium in hypothyroid patients.
Materials and Methods: After ethical committee approval, a case-control study was conducted in the Department of Biochemistry in Govt. Medical College and associated group of Hospital, Kota, Rajasthan. A total of 144 subjects included in this study were divided into two groups – control and hypothyroid.
Result: The significant ($p< 0.001$) decreased mean value of serum Magnesium in hypothyroid patients when compared with control subjects. A significant positive correlation of serum T3 and serum T4 with serum Magnesium& also we found a significant negative correlation of serum TSH with serum Magnesium in hypothyroid patients.
Conclusion: In our study, we found that serum magnesium concentrations declined in subjects having hypothyroid disorder because of impaired magnesium absorption or via enhanced renal blood flow causing high clearance of magnesium from the renal. Among hypothyroid subjects, serum magnesium levels must be tested on a routine basis, as timely recognition and improvement may stop further problems from mineral metabolism dysfunction.

Keywords: Hypothyroidism, Magnesium, T4, TSH

INTRODUCTION

Hypothyroidism is a disease of the thyroid gland that is characterized bya low level of thyroid hormone (T3 and T4) in addition to a high level of thyroid-stimulating hormone (TSH). Hypothyroidism is popular among women as ten times in men and its prevalence increases with age. The occurrence of thyroid dysfunction, by definition, is testing patients in different geographical areas, primary care clinics, and in populations that have not been screened previously it can be severe with obvious, moderate to mild or sub-clinical hypothyroidism. Insufficiency of thyroid hormones distresses the whole metabolism of the body[1, 2].

The mean annual incidence rate of hypothyroidism is up to 4 per 1000 women, 1 per 1000 men, and 1 in 4000 inborns. The prevalence of overt hypothyroidism increases with age[3].As of 2013, the estimated worldwide prevalence of hypothyroidism as per the NHANES III study, stood at 4.6%, and a good deal higher in India; at 10%. Furthermore, higher rates were observed in inland than in coastal regions, and among all urban centers studied, the highest prevalence was noted in Kolkata at 21.67%[4].

Magnesium has a role in influencing membrane permeability thereby secretion of thyroid hormones. Thyroid hormones also in turn affect its metabolism and clearance. Serum levels of calcium and magnesium are altered in thyroid disorders and this alteration may be vital for the patients in the long run[5].Furthermore, hypothyroidism is often accompanied by hypomagnesemia, which leads to increased fractional excretion of magnesium through urine[6]. Low levels of magnesium can alter the function of Complex V of oxidative phosphorylation, the element being the key player in ATP synthesis through the F1F0-ATPase[7].

Hence, the present study was undertaken to evaluate the alteration in Magnesium levels in patients diagnosed with hypothyroidism and its correlation with thyroid profile T3, T4, and thyroid-stimulating hormone (TSH) levels in these patients and to observe the importance of checking the levels of Magnesium in hypothyroid disorders.

MATERIAL & METHODS

The present case-control study was conducted in the Department of Biochemistry in Govt. Medical College and associated group of Hospital, Kota (Raj.). A total of 144 subjects recruited from department of medicine with formal approval from the concerned department and the institution Ethics Committee.

Inclusion Criteria

1. A total of 144 subjects included in this study were divided into two groups – control and hypothyroid.

a) Group I: 72 healthy individuals were included as the control group.

b) Group II: 72 hypothyroid patients were diagnosed with increased levels of TSH (> 10 μIU/ml) and decreased serum T3 and serum T4.

2. The subjects aged 25-55 years were included in this study.
3. The subjects who were willing to give written consent for the project.

Exclusion Criteria

1. Hemolyzed samples were excluded.
2. Patients suffering from hepatic disease, renal disease, bone disease, pituitary adenomas, and diabetes mellitus.
3. Patients on mineral supplementation or any drugs that affect mineral metabolism.

Collection and Analysis of Blood Sample

A 5ml venous blood sample was drawn from the anticubital vein of each subject by using standard aseptic techniques. Blood samples were collected in plain vials: Plain vial: In this vial, collected blood was allowed to clot. The serum was separated from the clotted specimen by centrifugation at 3000 rpm for 10 minutes and serum was used for the estimation of serum T3, serum T4, serum TSH, and serum Magnesium.

Biochemical Investigations

Serum T_3, serum T_4, and serum TSH were estimated by the Chemiluminescence Immunoassay method on Backman Coulter "Access-2".Serum Magnesium was assessedby the Xylidyl Blue method on ERBA EM-360 (Transasia Bio-Medicals Ltd., Mumbai, India).

Statistical Analysis

We conducted the data analysis using the statistical package for the social sciences (SPSS) Version 20.0 (IBM, New York, USA). Results were expressed as Mean ± SD. The statistical significance was calculated by using the student's *t*-test; $p<0.05$ is considered significant and $p<0.001$ is considered highly significant. The coefficient of correlation (r) was determined between various parameters to find out the correlation.

RESULTS

The significant ($p< 0.001$) increased mean value of TSH and significant ($p< 0.001$) decreased mean value of T3 and T4 in hypothyroid patients when compared with control subjects.

Table 1: Comparison of serum magnesium status.

	Control	**Hypothyroid**
Serum Magnesium (mg/dL)	2.20 ± 0.23	1.83 ± 0.27
Statistical significance	$p< 0.001$	

There was a significant reduction in serum magnesium in hypothyroid patients when compared to the control subjects.

Table 2: Correlation between serum magnesium and thyroid hormones of hypothyroid patients.

R-Value	0.539	0.591	-0.603
***p*-value**	< 0.001	< 0.001	< 0.001

Serum magnesium showed a significant positive correlation with serum T3 and serum T4 levels. However, there was a significant negative correlation between serum magnesium andserum TSH levels.

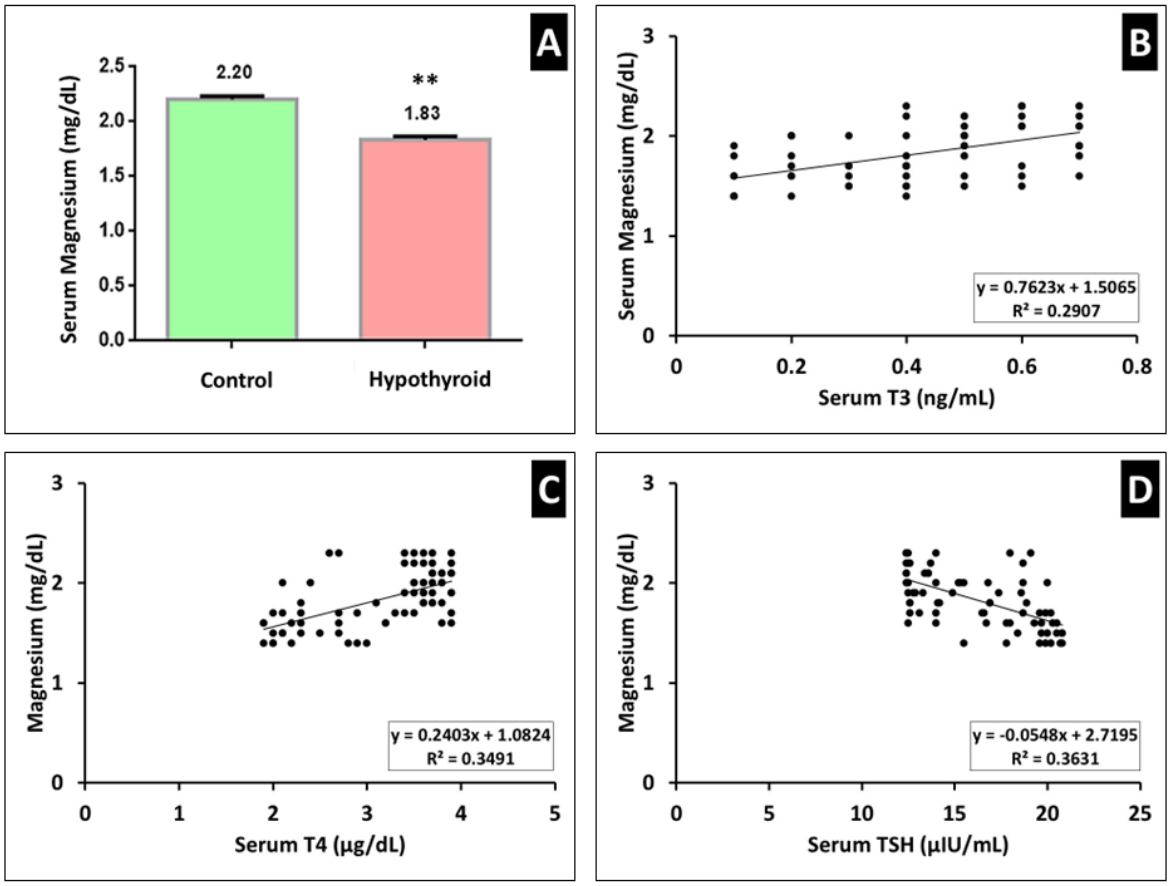

Figure 1: (A) Comparison of serum magnesium among the control and hypothyroid groups. (B) Correlation between serum magnesium and serum T3 levels. (C) Correlation between serum magnesium and serum T4 levels. (D) Correlation between serum magnesium and serum TSH levels. ** *p*-value (<0.01).

DISCUSSION

Thyroid hormones, which are secreted by the thyroid gland, have an impact on practically all metabolisms, including glucose, lipid, and protein metabolism also maintain fluids and electrolytes balance. Thyroid hormones have recently received more interest due to their effects on mineral metabolism[8].

As the most common endocrine disease, hypothyroidism can cause a variety of clinical problems such as electrolyte and mineral imbalances, congestive heart failure, and coma. Thyroid dysfunctions frequently disrupt calcium, magnesium, and phosphorous homeostasis, and have a direct effect on calcium and magnesium resorption by influencing glomerular filtration rate and blood flow[9].

In our study, we observed that the mean value of serum Magnesium was 2.20±0.23 mg/dl and 1.83±0.27 mg/dl in the healthy control subjects and hypothyroid cases. Serum Magnesium was significantly (<0.001) decreased in hypothyroid cases as compared with control subjects.As per our study, we observed a significant positive correlation of serum T4 and serum T3 with serum Magnesium in hypothyroid patients & also found a significant negative correlation of serum TSH with serum Magnesium in hypothyroid patients.

Our results were similar to the study done by **Athokpham et al., 2020**[10] who reported serum magnesium level is reduced due to effect on PTH and calcitonin by influencing GFR which leads to increase in clearance. There is an increased renal blood flow leading to high clearance of magnesium from kidneys, so ultimately low level of serum magnesium will cause hypomagnesemia. A significant positive correlation of serum Mg with serum T3 & serum T4 and serum magnesium had a significant negative correlation with serum TSH in hypothyroid patients.Our results were similar to the study done by **Suneel *et al.*, 2011**[6] magnesium levels is decreased due to influence on GFR and decreased clearance. In hypothyroidism, the renal blood flow is increased leading to high clearance of magnesium from kidneys. So it will be causing hypomagnesemia which is matching our study findings of decreased magnesium in hypothyroid patients.Our results were similar to the study done **Gohel *et al.*, 2014**[11] by total magnesium levels in serum were found to be significantly lowered in hypothyroid patients when compared to controls and there was a significant negative correlation between TSH and magnesium level. **Al-Hakeim *et al.*, 2009**[12] had shown reduced total and ionized magnesium in patient with hypothyroidism along with study of lipid profile. Thyroid hormone affects the glomerular filtration rate, blood flow and

tubular sodium transport and has a direct effect on tubular Mg resorption. **Jones *et al.*, 1989**[13]had shown a significant decrease of serum magnesium in hypothyroid patients was observed which is in congruence with the results reported in humans. **Ty et al., 2016**[8] showed decrease in serum magnesium in hypothyroid patients with negative correlation with TSH which is correlating to our study findings. **Khan *et al.*, 2021**[14] had shown a significantly decrease serum Magnesium & a significant negative correlation was observed between serum TSH with total magnesium. **Srinivas *et al.*, 2021**[15] had shown total magnesium levels in serum were found to be significantly lowered in hypothyroid patients when compared to controls and there was a significant negative correlation between TSH and magnesium level. According to **Ganiger*et al.*, 2019**[16]the magnesium levels in hypothyroid patients were significantly decreased with positive correlation with T3 and T4 and negatively correlated with TSH. According to **Kaur*et al.*, 2024**[17]the mean ± SD of serum magnesium levels was 1.40 ± 2.09 mg% in the hypothyroid patients and 3.68 ± 0.88 mg% in the control group. Their study reveals that the hypothyroid patients had significantly lower magnesium levels than the control group (p value <0.001). A highly significant negative correlation was found between Serum Magnesium and TSH (r= -0.454 and p value<0.001).

According to **Nisa *et al.*, 2013**[18] the decreased magnesium levels will be influencing the action of thyrotrophic hormone on the thyroid gland through the formation of cyclic amp involved in the activation of adenylyl cyclases and stimulates cyclic 3, 5 nucleotide phosphodiesterase disturbing various metabolism in the body that has been shown in the in vitro studies.

Our findings were in contrast to **Shivakumar *et al.*, 2020**[19]who reported increase serum levels of Magnesium in hypothyroid patients in comparison with control subjects. **Sridevi *et al.*, 2020**[20] who reported a statistically significant increase in serum Magnesium was observed in cases compared to controls in our study. Insignificant correlation between TSH and serum Magnesium level among cases was observed. According to **McCaffrey *et al.*, 1984**[9] plasma magnesium tends to be elevated in hypothyroid rats presumably as a result of renal retention which has been thought to be the result of hypofiltration.

CONCLUSION

In our study, we found that serum magnesium concentrations declined in subjects having hypothyroid disorder because of impaired magnesium absorption or via enhanced renal blood flow causing high clearance of magnesium from the renal. Therefore, reduced levels of magnesium will produce hypomagnesemia. The present study concluded that impaired metabolism of magnesium can lead to various metabolic disorders. Among hypothyroid subjects, serum magnesium levels must be tested on a routine basis, as timely recognition and improvement may stop further problems from mineral metabolism dysfunction.

ACKNOWLEDGEMENT

My sincere thanks to my Research Supervisor & Head of Department. I would like to thank the entire staff of the Medicine Department and technicians of the Department of Biochemistry, GMC, Kota for their constant support & help. Special thanks to all the sample donors for their valuable contribution to this study.

REFERENCE

1. Krishnaveni DV. Study of variations in serum lipid profile and transaminase levels in overt hypothyroidism. *Int J Pharm Bio Sci*. 2011;2(3):223-30.
2. Friedman MN. Screening for thyroid disease. Ann Med 1999;;130:161-2.
3. Simşek G, Andican G, Karakoç Y, Yiğit G, Hatemi H, Candan G. Calcium, magnesium, and zinc status in experimental hypothyroidism. Biol Trace Elem Res. 1997;60(3):205-13.
4. Taylor PN, Albrecht D, Scholz A, Gutierrez-Buey G, Lazarus JH, Dayan CM, Okosieme OE. Global epidemiology of hyperthyroidism and hypothyroidism. Nat Rev Endocrinol. 2018; 14(5):301-316.
5. Ford HC, Crooke MJ, Murphy CE. Disturbances of calcium and magnesium metabolism occur in most hyperthyroid patients. ClinBiochem. 1989;22(5):373-6.
6. Suneel B, Nagendra DR, Aparna RR, Balakrishna D, Naidu JN. Mineral status in thyroid disorders (Hypo & Hyper). *Int J ApplBiol Pharm Technol*. 2011;2(4):423-429.
7. Moncayo R, Moncayo H. The WOMED model of benign thyroid disease: Acquired magnesium deficiency due to physical and psychological stressors relates to dysfunction of oxidative phosphorylation. BBA Clin 2014;3:44-64.
8. Ty S, Sagayaraj A, Shashidhar KN, Gomathi M, Mahesh V. A correlative study of thyroid profile and mineral status in patients with hypothyroidism: a hospital-based case-control study. Asian J Pharm Clin Res. 2016;9(3):292-294.
9. McCaffrey C, Quamme GA. Effects of thyroid status on renal calcium and magnesium handling. Can J Comp Med. 1984;48(1):51-7.
10. Athokpham D, Mohanty S, Pinnelli VB. Status of serum calcium, phosphorus, magnesium and copper in hypothyroid patients: a case-control study. *J ClinDiagn Res*. 2020;14(10):05-08.
11. Gohel MG, Shah AM. A study of serum calcium, magnesium, and phosphorus in hypothyroidism patients. *Int J Med Health Sci*. 2014;3(4):308–12.
12. Al-Hakeim HK. Serum levels of lipids, calcium and magnesium in women with hypothyroidism and cardiovascular

ISSN: 0975-3583, 0976-2833 VOL 16, ISSUE 01, 2025

diseases. J Lab Physicians. 2009;1(2):49-52.
13. Jones JE, Desper PC, Shane SR, Flink EB. Magnesium metabolism in hyperthyroidism and hypothyroidism. J Clin Invest. 1966 ;45(6):891-900.
14. Khan MR, Prabha AG, Kumar KS. Study of calcium, magnesium and phosphorus levels among hypothyroid patients in Trichy, Tamil Nadu. J Evid Based Med Healthc. 2021;8(30):2797-2803.
15. Srinivas M, Krishna BM, Rao MM. A study of serum calcium, magnesium and phosphorous levels in patients undergoing hypothyroidism. MedPulseInt J Med 2021;19:64-7.
16. Ganiger A, Swamy KM, Maligi AM. Trace elements in hypothyroidism - A case-control study. MedpulseInt J Biochem 2019;11:1-4.
17. Kaur M, Kaur M, Kaur J, Seema, Chopra S, Kaur S. To evaluate the levels of serum calcium, magnesium and phosphorus in hypothyroid patients. Int J Pharm Pharmacol Res 2024;16:53-7.
18. Nisa F, Mumtaz A, Ullah MI, Atif M, Sami W. Determination of serum zinc and magnesium levels in patients with hypothyroidism. Trace Elem Electrolytes 2013;15:1-5.
19. Shivakumar, Bhargavi SK, Naidu MP. Study of serum calcium, magnesium and phosphorous levels in hypothyroidism. *Scholars Int J Biochem*. 2020;3(2):22-26.
20. Sridevi D, Dambal AA, Sidrah, Challa AS, Padaki SK. A study of serum magnesium, calcium and phosphorus in hypothyroidism. Int J ClinBiochem Res. 2016;3(2):236-9.