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# Relationship between Serum Ferritin and Thyroid Hormones: A Hospital Based Cross Sectional Study

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## ABSTRACT

### Background

Thyroid gland is one of the major endocrine gland, which plays a key role in growth, differentiation, development, and maintenance of body homeostasis. These hormones are synthesized from thyroglobulin, a large iodinated glycoprotein which is iodinated on tyrosine residues after secretion into the thyroid follicle. The prevalence of this study was done to determine the correlation between thyroid hormones and serum ferritin.

### Methods

A descriptive cross-sectional study was carried out in the department of Biochemistry of College of Medical Sciences in Bharatpur, Chitwan, Nepal, from 1st June, 2023 to 1st December 2023. Ethical approval was taken from institutional review committee of College of Medical Sciences, Bharatpur, Chitwan. The patient visiting to medicine OPD were included and patients with confirmed case of thyroid disorder and iron deficiency anemia were excluded from the study. Data was analyzed by using SPSS version16. Data was analyzed by using descriptive statistical tolls.

### Results

Among the total 199 study subject's majority (54.8%) of them were in the age group 20-40 years. The Mean±SD of age was found to be 41.45+14.75 years. The prevalence of iron deficiency anemia was found to be 57.8% (with 95% Confidence Interval as 51.11% to 67.16%). The result showed that there was statistically significant positive correlation between fT3 and fT4 while statistically negative correlation between fT3, fT4 and TSH. The prevalence of thyroid disorders was high in anemic patients and showed statistically significant relationship between iron deficiency anemia and hypothyroidism.

### Conclusions

This study concluded that more than half of the study subjects had thyroid disorders and hypothyroidism is most common. Serum ferritin level is decreased in hypothyroid patients and it further aggravates hypothyroidism, so ferritin level should be assessed in hypothyroid subjects.

**Keywords:** hypothyroidism, iron deficiency anemia; serum ferritin; thyroid hormones; biochemistry.

## INTRODUCTION

Thyroid gland is one of the major endocrine gland, which plays a key role in growth, differentiation, development, and maintenance of body homeostasis. Thyroid gland produces hormones: Triiodothyronine (T3) and thyroxine (T4). These hormones are synthesized from thyroglobulin, a large iodinated glycoprotein which is iodinated on tyrosine residues after secretion into the thyroid follicle. Reuptake of thyroglobulin into the thyroid follicular cell can allow proteolysis and subsequent release of newly synthesized T4 and T3. Trace elements like iron, selenium, iodine and zinc are needed for the normal functioning of the thyroid gland. So, deficiencies

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of these elements can impair thyroid functions.[1] Iron is one of the essential elements for the thyroid gland to function properly and it is stored in the form of ferritin.[2] First two initial steps of thyroid hormone biosynthesis require an iron containing enzyme known as thyroperoxidase (TPO), which is a membrane bound glycosylated protein. If there is deficiency of iron, tissue iron start to diminish at an early-stage lead to alteration in the activity of heme dependent enzyme TPO and impaired synthesis of thyroid hormones. So, serum ferritin level is altered in thyroid diseases. Low iron, or more specifically, low ferritin, is one of the causes of low thyroid function.[3] Ferritin is an intracellular iron storage protein. All cells in the body contain ferritin in a stored form that act as a reserve of iron and small amount secreted in serum for the formation of hemoglobin and other heme proteins.[4-7] So the present study was done to determine the correlation between thyroid hormones and serum ferritin.

## METHODS

A descriptive cross-sectional study was carried out in the department of Biochemistry of College of Medical Sciences in Bharatpur, Chitwan, Nepal, from 1st June, 2023 to 1st December 2023. The patient visiting to medicine OPD were included and patients with confirmed case of thyroid disorder and iron deficiency anemia were excluded from the study. Ethical approval was taken from institutional review committee of College of Medical Sciences, Bharatpur, Chitwan (Ref No. COMSTH-IRC/2023-58). Study conducted by Anshumali Joshu and Priyadarshini Yonzon on "Community based study of thyroid disorder prevalence in Nepal"[8] showed the prevalence of hypothyroidism as 4.32%. By taking this as prevalence, with 95% CI and 3% margin of error sample size was calculated by using following formula,

$n = Z^2PQ/ d^2$,

where, Z=1.96, P=Prevalence (4.32%), Q=100-P, d=precision (3%)

=1.96*1.96*0.0432*0.9568/(0.03*0.03) =177

By adding 10% non-response rate. The optimal sample size will be 195. However, the research was conducted among 199 cases. Sociodemographic variables were collected by using pre define questionnaire. 5 ml of venous blood samples were collected in gel tube. It was then allow to clot and centrifuge at 4000 rpm for 10 minutes to collect serum for the estimation of thyroid hormones and ferritin. The serum level of thyroid hormone and ferritin were estimated in Maglumi 2000 immuno assay analyzer at central laboratory of COMS-TH. Data was analyzed by using SPSS version16. Data was analyzed by using descriptive statistical tolls. In the descriptive statistics for categorical variable frequency and percentage were calculated while for continuous variable mean and standard deviation were calculated.

## RESULTS

Among respondent majority (54.8%) of them were in the age group 20-40 years. The Mean±SD of age was found to be 41.45+14.75 years. The minimum age was 20 years where as maximum age was 80 years. The majority of subjects were female (88.4%) and 11.6% were male (Table 1).

**Table 1. Sociodemographic information of respondents.(n=199)**

| Sociodemographic information | Frequency (%) |
|---|---|
| **Age** | |
| 20-40 | 109 (54.8) |
| 40-60 | 63 (31.7) |
| 60-80 | 27 (13.6) |
| Mean±SD | 41.45+14.75 |
| Minimum (Maximum) | 20 (80) |
| **Gender** | |
| Male | 23 (11.6) |
| Female | 176 (88.4) |

The prevalence of hypothyroidism was found to be 49.8%, (with 95% Confidence interval as 54.67 % to 68.59%), followed by 32.7% subclinical hypothyroidism and 17.1 % primary hypothyroidism. While the prevalence of hyperthyroidism was found to be 2% (with 95% Confidence Interval as 26.20% to 39.65%) (Figure 1).

The prevalence of iron deficiency anemia was found to be 57.8% (with 95% Confidence Interval as 51.11% to 67.16%) (Figure 2).

The correlation matrix between thyroid hormone (fT3,

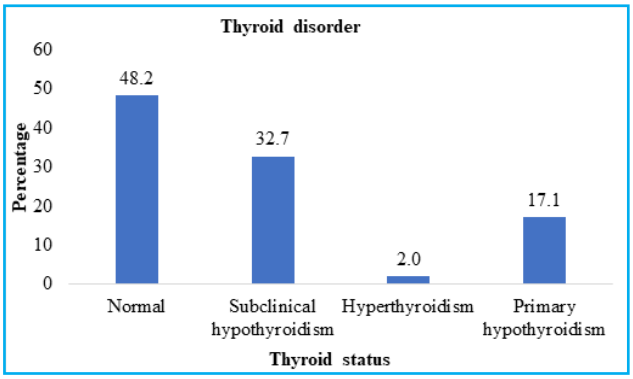


**Figure 1. Prevalence of thyroid dysfunction. (n=199)**

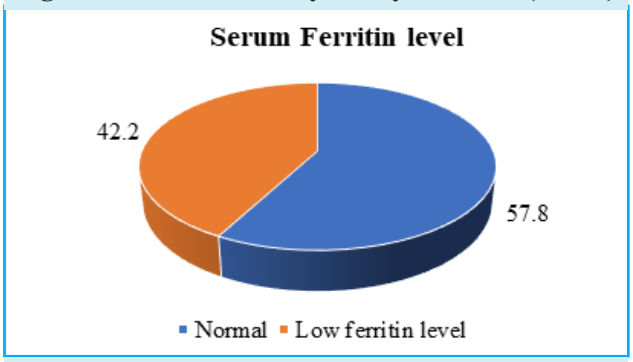


**Figure 2. Prevalence of iron deficiency anemia. (n=199)**

fT4, TSH) and serum ferritin shows the statically significant positive correlation between fT3 and fT4 while statistically negative correlation between fT3, fT4 and TSH (Table 3).

**Table 3. Correlation matrix between thyroid hormone (fT3, fT4, TSH) and serum ferritin. (n=199)**

| Correlation matrix | fT4 | TSH | S. ferritin |
|---|---|---|---|
| fT3 | 0.645 (p-value <0.001) | -0.361 (p-value <0.001) | 0.023 (p-value=0.374) |
| fT4 | | -0.410 (p-value <0.001) | 0.137 (p-value=0.033) |
| TSH | | | -0.023 (p-value=0.065) |

Following table shows the association between thyroid status and sociodemographic information. The result revealed that prevalence of thyroid dysfunction was highest in 20-40 years of age group. The prevalence of hypothyroidism was high among female subjects. There was no statistically significant relationship between thyroid status with age and gender (Table 4).

**Table 4. Association between thyroid status and sociodemographic information. (n=199)**

| Demographic variables | Thyroid status | | Chi-square | p-value |
|---|---|---|---|---|
| | Frequency (%) | Thyroid dysfunction (%) | | |
| **Age (years)** | | | | |
| 20-40 | 55 (52.9) | 49 (47.1) | 2.626 | 0.296 |
| 40-60 | 27 (40.3) | 40 (38.8) | | |
| 60-80 | 14 (50.0) | 14 (50.0) | | |
| **Gender** | | | | |
| Male | 13 (56.5) | 10 (43.5) | 0.714 | 0.398 |
| Female | 83 (47.2) | 93 (52.8) | | |

Following table shows the association between iron deficiency anemia and thyroid dysfunction. The prevalence of thyroid disorders was high in anemic patients and showed statistically significant relationship between iron deficiency anemia and hypothyroidism (Table 5).

Table 6 shows the association between iron deficiency anemia and sociodemographic information. This shows that prevalence of iron deficiency anemia was high in 20-40 years of age group. The prevalence of iron deficiency anemia was high among female. There was no statistically significant relationship between iron deficiency anemia with age and gender (Table 6).

**Table 5. Association between thyroid status and serum ferritin level. (n=199)**

| Serum Ferritin level | Thyroid status | | | | Chi-square | p-value |
|---|---|---|---|---|---|---|
| | Normal | Subclinical hypothyroidism | Hyperthyroidism | Primary hypothyroidism | | |
| Normal | 69(60.0) | 33(28.7) | | 13(11.3) | 19.92 | <0.001 |
| Anemia | 27(32.1) | 32(38.1) | 4(4.8) | 21(25.0) | | |

| Table 6. Association between serum ferritin level and sociodemographic information. (n=199) | | | | |
|---|---|---|---|---|
| Demographic variables | Serum Ferritin | | Chi-square | p-value |
| | Normal (%) | Anemia (%) | | |
| **Age (years)** | | | | |
| 20-40 | 54 (51.9) | 50 (48.1) | 3.86 | 0.143 |
| 40-60 | 45 (67.2) | 22 (32.8) | | |
| 60-80 | 16 (57.1) | 12 (42.9) | | |
| **Gender** | | | | |
| Male | 15 (65.2) | 8 (34.8) | 0.588 | 0.443 |
| Female | 100 (56.8) | 76 (43.2) | | |

## DISCUSSION

In our study, the prevalence of thyroid dysfunction was found to be 51.8%, in which hypothyroidism was found to be 49.8% followed by 32.7% subclinical hypothyroidism and 2% hyperthyroidism. Similar finding was observed in western region of Nepal, the prevalence of thyroid dysfunction was 17.42%. Among them 2.26% had hypothyroidism, 10.5% had subclinical hypothyroidism and 1.5% had hyperthyroidism.[9] We observed thyroid dysfunction was more common in female participants in our study. However, study done by Baral et al[10] mentioned the equal distribution among male and female participants. In our study, the female age groups between 20-40 years of age were more likely to have thyroid disorders. The study done by Abdo ES et al[11] mentioned women between 26-35 years of age were more likely to have thyroid disorders. In our study we observed prevalence of iron deficiency anemia was 57.8% among total participants, and 43.84% of thyroid dysfunction had iron deficiency anemia and majority was female population. Several factors like access to micronutrient and nutrition rich diet, physiological conditions like menstrual blood loss might be the causes of higher prevalence in female. Subclinical hypothyroidism may cause iron malabsorption or a decrease in iron incorporation and as a result an increase in iron loss.[12] In our study, there was statistically significant positive correlation between fT3 and fT4 while statistically negative correlation between fT3, fT4, and TSH. Similar result was observed in the study done by Krishnamurty HK et al.[13]Low level of serum ferritin were positively correlated with circulating level of fT3, and also found to be negatively correlated with serum level of fT4; however, there was no significant correlation between TSH and serum ferritin. In this study, we found that there was statistically significant relationship between iron deficiency anemia and hypothyroidism. The findings of our study were similar to that of study conducted by Chatterjee et al.[1] Similarly, in a randomized double blind controlled study done by Ravanbod M et al[12] demonstrated that treatment of patients with subclinical hypothyroidism and iron-deficiency anemia with a combination of iron levothyroxine resulted in a favorable outcome compared with treatment of patients with monotherapy of iron or levothyroxine alone. The study conducted by Binita et al showed, there was no statistically significant relations of thyroid dysfunction in patient with IDA in Lalitpur Nepal.[14]

## CONCLUSIONS

This study concluded that more than half of the study subjects had thyroid disorders and hypothyroidism is most common. Serum ferritin level is decreased in hypothyroid patients and it further aggravates hypothyroidism, so ferritin level should be assessed in hypothyroid subjects.

**Conflict of interest:** None

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