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**Original Research Article**

# Effect of thyroid dysfunction on hematological parameters-retrospective study

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## ABSTRACT

**Background:** Thyroid gland is an important endocrine gland in the human body. Thyroid hormones are required for the appropriate development, metabolic balance, differentiation and physiological function of almost all tissues. The thyroid gland produces hormones such as triiodothyronine (T3) and tetraiodothyronine or thyroxine (T4). Under physiological settings, thyroid hormone influences hematological parameters. This study was done to evaluate the effect of various types of thyroid function abnormalities on different haematological parameters.
**Methods:** This was a retrospective study which included 323 subjects who were grouped as hypothyroidism, hyperthyroidism, subclinical hypothyroidism and euthyroid groups. Two blood samples were collected from patients in EDTA tubes and plain tubes for estimation of hematological parameters and thyroid hormonal assay respectively. The results were analysed using SPSS software.
**Results:** The mean age of patients is 34.50 years with females comprising about 89.16% of cases and males comprising 10.84% of cases. Analysis of data obtained showed that there was a significant statistical difference in TLC, MCHC, RDW, TSH, FT4 and euthyroid, hypothyroid, hyperthyroid and subclinical hypothyroid (p value <0.05) respectively. However, there was no significant correlation in Hb, PLT, RBC, PCV, MCV, MCH (p value >0.05) thyroid groups.
**Conclusions:** The study found that thyroid diseases impacted female more frequently than males. Thyroid diseases were more common in age group of 18-28 years. Study also revealed a strong link between haematological parameters and thyroid dysfunction in patients.

**Keywords:** Blood count, Euthyroidism, Hemoglobin, Hyperthyroidism, Hypothyroidism, Red cell indices, Subclinical hypothyroidism

## INTRODUCTION

Thyroid gland is an important endocrine gland in the human body.[1] It is situated on the anterior aspect of the neck. It consists of thyroid follicles bordered by cuboidal epithelium and has two lobes joined by an isthmus. Thyroid hormones in the form of thyroglobulin are stored in these thyroid follicles.[2] Thyroid hormones are required for the appropriate development, metabolic balance, differentiation, and physiological function of almost all tissues. The thyroid gland produces hormones such as triiodothyronine ($T_3$) and tetraiodothyronine or thyroxine ($T_4$) and plays an important role in the development, differentiation, physiological functions and metabolic balance of tissues in the human body.[2,3]

Anemia is defined as a decrease in number of red blood cells or hemoglobin (Hb),which results in the reduction in the ability of the oxygen carrying capacity of blood to various body tissues.[4] It can have several reasons, such as abnormality of the formation and reduction in the half life time of the red cells.[5] Thyroid function abnormalities have a wide range of clinical manifestations and are common clinical concern.[1] The two major disorders of

the thyroid gland are hypothyroidism (serum TSH value >5.5 µIU/ml)and hyperthyroidism (serum TSH value <0.3 µIU/ml). These dysfunctions modify the thyroid hormone receptor (TR) gene expression on hematopoietic progenitor cells (HPC'S). Hypothyroidism can cause various forms of anemia such as normochromic normocytic, macrocytic hypochromic-microcytic, mainly due to decrease in erythropoietin levels in plasma and hypoplasia of all myeloid cell lineages.[2] Changes in hematological variables such as hemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW) have also been associated with thyroid gland disorders.[3] Neutropenia, thrombocytopenia and increased levels, normal or slight decrease in total white blood cell count, are all symptoms of hyperthyroidism.[1]

Thyroid hormones play an important function in bone marrow hematopoiesis. Thyroid hormones are involved in the generation of hemoglobin in adults as well as the maturation of hemoglobin in the fetus.[3] Thyroid hormone affects blood parameters directly by boosting erythrocyte precursors and indirectly by increasing erythropoietin production. Patients with thyroid abnormalities may have low iron levels and reduced levels of folate and vitamin $B_{12}$ which eventually impact Hb levels and RBCs.[5] Thyroid dysfunction induced hematological changes is common health problem, so early detection and treatment of thyroid disorders is necessary for reversal of changes in thyroid dysfunction.[2]

The aim of the study to evaluate the thyroid dysfunction on hematological parameters.

### *Objectives*

To study the changes in hematological parameters such as hemoglobin (Hb), packed cell volume (PCV), RBC count, red cell distribution width (RDW), MCV, MCH, MCHC, WBC count and platelet count in hypothyroidism, hyperthyroidism, subclinical hypothyroidism and euthyroid cases. To study the sociodemographic profile in different thyroid dysfunctions.

## METHODS

A retrospective study was conducted on 323 subjects who were grouped as hypothyroidism, hyperthyroidism, subclinical hypothyroidism and euthyroid groups.

All these patients were divided into 4 groups based on the serum TSH and free $T_4$: group 1- hyperthyroid cases (TSH<0.3 µIU/ml, $FT_4$>1.8 ng/dl), group 2- hypothyroid cases (TSH>5.5 µIU/ml, $FT_4$<0.7 ng/dl), group 3- subclinical hypothyroid cases (TSH =4.6-10 µIU/ml, $FT_4$ 0.7-1.8 ng/dl), group 4- euthyroid cases (TSH 0.3-5.5 µIU/ml, $FT_4$ 0.7-1.8 ng/dl).

The study was conducted on 81 cases of hyperthyroid, 81cases of hypothyroid, 81 cases of subclinical hypothyroid and 80 cases of euthyroid cases in a Medical College Hospital Laboratory for a period of two years from November 2020 to November 2022.

Venous blood was aseptically collected using plain and EDTA vacutainer tubes for thyroid function tests and CBC measurement. Two blood samples were collected from patients. 3 ml of venous blood on EDTA tubes for hematological parameters 6 part, fully automated SYSMEX XN-1000 i.e. Hb, PCV%, RBC count, RDW, MCV value, MCH value, MCHC value, WBC count, platelet count and 4 ml venous blood was collected in a plain tube for thyroid assay and centrifuged 3000 rpm for 10 minutes to separate the serum samples and used for determination of thyroid function within one hour. Thyroid function was assessed by determining $FT_4$ and TSH levels in patient serum by VITROS-5600 which was totally automated.

### *Inclusion criteria*

All the patients above 18 years who underwent thyroid function test and complete blood cell count were included in the study.

### *Exclusion criteria:*

Pediatric patients were not included in the study.

### *Statistical analysis*

Data was entered into Microsoft excel data sheet and data was analysed using SPSS software sampling technique Simple random sampling. continuous data was represented as mean and standard deviation. Categorical data was represented form of frequency and percentage. One-way ANOVA was used to compare the hematological parameters in hyperthyroidism, hypothyroidism and subclinical hypothyroidism and normal individuals. The p value <0.05 was considered as statistically significant.

## RESULTS

A total of 323 cases were included in the study, which were divided into four groups 81 cases of hyperthyroid, 81 hypothyroid cases, 81 subclinical hypothyroid and 80 euthyroid cases respectively.

The age distribution was assessed and the youngest patient in this study was 18 years and oldest patient was 79 years with mean age of 34.50. In our study out of 323 patients, 132 (40.8%) patients were in the age group of 18-28 years and 102 patients (31.7%) were between the ages of 29 and 38, 31 cases (9.7%) were between the ages of 39 and 48, 36 cases (11.1%) were within the ranges of 49-58, 13 cases (4.0%) were between the ages of 59-68, whereas 9 patients (2.7%) were less than 68 years

respectively. The most commonly affected age group was 18-28 years (Table 1).

**Table 1: Age distribution of the study population.**

| Age (years) | Frequency | % |
|---|---|---|
| **18-28** | 132 | 40.8 |
| **29-38** | 102 | 31.7 |
| **39-48** | 31 | 9.7 |
| **49-58** | 36 | 11.1 |
| **59-68** | 13 | 4.0 |
| **>68** | 9 | 2.7 |

**Table 2: Gender distribution of euthyroid, hypothyroid, hyperthyroid, subclinical hypothyroid.**

| | | Frequency | % |
|---|---|---|---|
| **Euthyroid** | F | 79 | 98.8 |
| | M | 1 | 1.2 |
| **Hypothyroid** | F | 63 | 77.8 |
| | M | 18 | 22.2 |
| **Hyperthyroid** | F | 76 | 93.8 |
| | M | 5 | 6.2 |
| **SC hypothyroid** | F | 70 | 86.4 |
| | M | 11 | 13.6 |

Table 2 shows the gender distribution of all four groups. In our study, out of 323 cases majority of them were females 288 (89.16%) than males 35 (10.84%). Out of 80 euthyroid cases, 79 (98.8%) were females and one male (1.2%). In 81 hypothyroid cases, females were 63 (77.8%) and males were 18 (22.2%).

Among the 81 hyperthyroid cases, females were 76 (93.8%) and were more commonly affected than males 5 (6.2%). In subclinical hypothyroid females were 70 (86.4%) and 11 (13.6%) were males.

**Table 3: Descriptive analysis of hematological parameters and serum TSH and $FT^4$.**

| | Mean | Standard deviation |
|---|---|---|
| **Hb** | 11.70 | 1.71 |
| **TLC** | 9.60 | 3.44 |
| **PLT** | 270.34 | 77.5 |
| **RBC** | 6.17 | 19.8 |
| **PCV** | 36.14 | 4.6 |
| **MCV** | 87.98 | 48.2 |
| **MCH** | 28.55 | 14.14 |
| **MCHC** | 32.49 | 1.46 |
| **RDW** | 13.94 | 2.0 |
| **TSH** | 23.27 | 77.06 |
| **$FT_4$** | 1.23 | 1.18 |

Table 3 shows the mean and standard deviation value of hematological parameters like hemoglobin, TLC, PLT, RBC count, PCV (%), MCV, MCH, MCHC, RDW (%) and serum TSH and $FT_4$ were calculated.

In this study there was significant difference in mean TLC, MCHC, RDW, TSH, $FT_4$ with respect to their thyroid function status (p value <0.05). However, there was no statistically significant difference in Hb, PLT, RBC, PCV, MCV, MCH and euthyroid, hypothyroid, hyperthyroid and subclinical hypothyroid cases (p>0.05) (Table 4).

**Table 4: Comparison of haematological parameters between hypothyroid, hyperthyroid, subclinical hypothyroid and euthyroid cases.**

| | | Mean | SD | Frequency | P value |
|---|---|---|---|---|---|
| **Hb** | Euthyroid | 11.65 | 1.20 | 0.68 | 0.563 |
| | Hypothyroid | 11.53 | 2.12 | | |
| | Hyperthyroid | 11.69 | 1.79 | | |
| | SC hypothyroid | 11.91 | 1.60 | | |
| **TLC** | Euthyroid | 10.13 | 3.09 | 5.73 | 0.001 |
| | Hypothyroid | 8.59 | 2.68 | | |
| | Hyperthyroid | 10.55 | 4.40 | | |
| | SC hypothyroid | 9.12 | 3.05 | | |
| **PLT** | Euthyroid | 262.30 | 58.13 | 1.35 | 0.256 |
| | Hypothyroid | 261.02 | 77.74 | | |
| | Hyperthyroid | 279.86 | 86.610 | | |
| | SC hypothyroid | 278.07 | 83.64 | | |
| **RBC** | Euthyroid | 5.95 | 7.95 | 1.12 | 0.338 |
| | Hypothyroid | 9.54 | 38.67 | | |
| | Hyperthyroid | 4.36 | 0.52 | | |
| | SC hypothyroid | 4.81 | 4.10 | | |
| **PCV** | Euthyroid | 35.69 | 3.40 | 1.22 | 0.301 |
| | Hypothyroid | 35.88 | 5.98 | | |

Continued.

| | | Mean | SD | Frequency | P value |
|---|---|---|---|---|---|
| | Hyperthyroid | 36.02 | 3.90 | | |
| | SC hypothyroid | 36.983 | 4.89 | | |
| **MCV** | Euthyroid | 90.60 | 35.05 | 1.00 | 0.392 |
| | Hypothyroid | 85.23 | 11.12 | | |
| | Hyperthyroid | 82.07 | 10.71 | | |
| | SC hypothyroid | 94.06 | 88.44 | | |
| **MCH** | Euthyroid | 28.37 | 2.30 | 0.94 | 0.417 |
| | Hypothyroid | 27.88 | 3.20 | | |
| | Hyperthyroid | 27.22 | 2.83 | | |
| | SC hypothyroid | 30.75 | 27.93 | | |
| **MCHC** | Euthyroid | 32.63 | 1.15 | 2.96 | 0.032 |
| | Hypothyroid | 32.17 | 1.72 | | |
| | Hyperthyroid | 32.80 | 1.48 | | |
| | SC hypothyroid | 32.36 | 1.38 | | |
| **RDW** | Euthyroid | 13.51 | 1.43 | 3.05 | 0.029 |
| | Hypothyroid | 14.36 | 2.47 | | |
| | Hyperthyroid | 13.73 | 1.86 | | |
| | SC hypothyroid | 14.15 | 2.02 | | |
| **TSH** | Euthyroid | 1.50 | 0.85 | 28.68 | 0.000 |
| | Hypothyroid | 84.43 | 137.20 | | |
| | Hyperthyroid | 0.13 | 0.10 | | |
| | SC hypothyroid | 6.76 | 1.20 | | |
| **FT4** | Euthyroid | 1.11 | 0.36 | 6.66 | 0.000 |
| | Hypothyroid | 0.87 | 0.93 | | |
| | Hyperthyroid | 1.65 | 1.17 | | |
| | SC hypothyroid | 1.30 | 1.71 | | |

## DISCUSSION

Thyroid gland is a largest and an important endocrine gland which is required for normal growth and secretes $T_3$ and $T_4$ hormones which play a major role in metabolism of cells and organs.[2] Thyroid hormones stimulate the precursors of erythrocytes thereby having a direct effect on hematological parameters and are also necessary for appropriate tissue growth, differentiation, metabolic balance, and physiological function.[2] The present retrospective study was conducted to categorize the patients into euthyroid, hypothyroid, hyperthyroid ,subclinical hypothyroid and also compare hematological parameters with thyroid dysfunction.

In our study total of 323 patients were included and based on TSH and FT4 results patients were further classified into 80 euthyroid (24.76%) 81 hyperthyroid (25.07%) 81 hypothyroid (25.07%) 81 subclinical hypothyroid (25.07%).

In our study, females (77.8%) had a higher incidence of hypothyroidism than males (22.2%) and also showed hypothyroidism was more prevalent than hyperthyroidism. These findings were similar to the studies done by Dorgalaleh et al and Bashir et al.[1,4]

According to the results obtained from our study, there was a statistically significant difference in TLC, MCHC, RDW, TSH, $FT_4$ and euthyroid, hypothyroid, hyperthyroid and subclinical Hypothyroid. However, there was no statistically significant difference in Hb, PLT, RBC, PCV, MCV, MCH. In the study done by Maheshwari et al In terms of Hb, PCV, and RDW, there was a statistically significant difference between hypothyroid patients and controls (p=0.05) and there was no statistically significant difference in MCHC and MCV.[3] In the study done by Dorgalaleh et al, there was a statistically significant difference between hypothyroid and hyperthyroid cases in hemoglobin, PCV, MCV, and MCHC, but not in RDW.[1] Geetha et al found RDW and MCV showed statistically significant differences, but not other hematological variables. However, in our study Hb, PCV and RBC were increased in cases of hyperthyroidism hypothyroid, subclinical hypothyroid and euthyroid cases (p>0.05) respectively.[7]

In our study we found that there was no statistically significant difference in mean value of MCV (p=0.392) in all four thyroid function groups which was similar to the findings seen in study done by Kawa et al.[6] However in the study done by Siddegowda et al, Maheshwari et al, Dorgalaleh et al and Ahmed et al found the mean MCV was higher in hypothyroid individuals than in hyperthyroid cases, and that this difference was statistically significant (p value 0.001).[1-3,5]

In our study, mean Hb was low in hypothyroid patients and slightly increased in hyperthyroid patients, but mean Hb was lower in both hyperthyroid and hypothyroid patients as compared to subclinical hypothyroid patients. There was no statistically significance in Hb and thyroid groups (p=0.563), but in the previous study Siddegowda et al, Dorgalaleh et al and Maheshwari et al found that there was a statistically significance.[1-3]

In the present study the mean RBC count was lower in hyperthyroid and higher in hypothyroid cases, but there was no statistical significance in RBC count and thyroid groups (p=0.338). Similar observation was also seen in study done by Geetha J et al. Whereas studies done by Maheshwari et al, Dorgalaleh et al and Siddegowda et al found significant difference between hypothyroid cases and controls.[1-3,7]

In our study, the mean value of MCH was higher in hypothyroid than compared to hyperthyroid cases, however there was no statistical significance (p=0.417) between the thyroid groups. In the study done by Dorgalaleh et al and Siddegowda et al showed there was statistically significance between euthyroid, hyperthyroid, hypothyroid and subclinical hypothyroid cases.[1,2]

In our study, MCHC mean value was statistically significant (p=0.032), similar findings were also observed in studies done by Ahmed et al, Dorgalaleh et al, and Kawa et al.[1,5,6] Whereas in the study done by Maheshwari et al and Siddegowda et al (p=0.647) showed no statistical significance difference between hypothyroid, hyperthyroid, subclinical hypothyroid and euthyroid cases.[2,3]

In our study all the four thyroid groups and mean value of RDW showed statistical significance (p=0.029), Similar observations were also seen in studies done by Ahmed et al and Siddegowda et a l (p<0.001).[2,5] However Yu et al, Dorgalaleh et al and Maheshwari et al in their study showed no statistical significance.[1,3,9]

According to result obtained in our study, there was no statistical significance (p=0.256) between hypothyroid and hyperthyroid patients in terms of platelet count. This finding was also seen in studies done by Kawa et al, Dorgalaleh et al, Ahmed et al who showed high mean platelet count in hypothyroid patients as compared to hyperthyroid and euthyroid cases.[1,5,6] But in study done by Siddegowda et al showed that mean platelet count was lower in hypothyroid and hyperthyroid cases and there was a statistically significant (p=0.049) between four thyroid groups.[2]

The mean value of total leukocyte count of hyperthyroid patients was higher than hypothyroid patients in our study. The mean WBC showed statistically significance (p=0.001) in four thyroid groups, similar observation was seen in studies conducted by Kawa et al, Dorgalaleh et al and Siddegowda et al (p=0.003).[1,2,6] Whereas Bashir et al showed no statistical significance.[4]

## CONCLUSION

The study was conducted to categorize the patients into euthyroid, hypothyroid, hyperthyroid, subclinical hypothyroid and also compare hematological parameters with thyroid dysfunction. It concluded that females were more commonly affected by thyroid disorders than males. Thyroid diseases were more common in age group of 18-28 years. Thyroid hormones have a significant influence on blood cell count and blood cell indices. This study showed that there was statistically significant difference in TLC, MCHC, RDW (p<0.05). It also revealed a strong link between hematological parameters and thyroid dysfunction in patients. Since the thyroid hormones plays an important role in the regulation and production of red blood cells, evaluation of hematological indices in cases of thyroid dysfunction is become mandatory in patients with anemia. Hence more studies with larger sample size in comparison to various thyroid function status need to be conducted.

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## REFERENCES

1. Dorgalaleh A, Mahmoodi M, Varmaghani B, Kia OS, Alizadeh S, Tabibian S, et al. Effect of thyroid dysfunctions on blood cell count and red blood cell indice. Iran J Pediatr Hematol Oncol. 2013;3(2):73.
2. Siddegowda MS, Chaithra R, Shivakumar, Maithri CM. Effects of thyroid function on blood cell counts and red cell indices- a retrospective study at a tertiary care centre in Mandya, Karnataka. J Evid Based Med Healthcare. 2021;8(27):2434-8.
3. Maheshwari KU, Rajagopalan B, Samuel TR. Variations in hematological indices in patients with of thyroid dysfunction. Int J Contemp Med Res. 2020;7(1):A5-7.
4. Bashir H, Bhat MH, Farooq R, Majid S, Shoib S, Hamid R, et al. Comparison of hematological parameters in untreated and treated subclinical hypothyroidism and primary hypothyroidism patients. Med J Islam Repub Iran. 2012;26(4):172.
5. Ahmed SS, Mohammed AA. Effects of thyroid dysfunction on hematological parameters: case controlled study. Ann Med Surg. 2020;57:52-5.
6. Kawa MP, Grymuła K, Paczkowska E, Baśkiewicz-Masiuk M, Dąbkowska E, Koziołek M, et al. Clinical relevance of thyroid dysfunction in human haematopoiesis: biochemical and molecular studies. Eur J Endocrinol. 2010;162(2):295-305.
7. Jp G, Srikrishna R. Role of red blood cell distribution width (RDW) in thyroid dysfunction. Int J Biol Med Res. 2012;3(2):1476-8.

8. Kamdar PK, Mendpara AV. To study hematological abnormalities in patients of thyroid dysfunction. Int J Sci Res. 2020;8:12.
9. Yu HM, Park KS, Lee JM. The value of red blood cell distribution width in subclinical hypothyroidism. Arq Brasil Endocrinol Metab. 2014;58:30-6.
10. Mehmet E, Aybike K, Ganidagli S, Mustafa K. Characteristics of anemia in subclinical and overt hypothyroid patients. Endocr J. 2012;59(3):213-20.
11. Olt S, Selçuk M, Tutak A, Akbaş F, Öznas O. Investigation the effect of hypothyroidism on hematological parameters. Mustafa Kemal Üniv Tıp Dergisi. 2016;7(25):23-7.
12. Yadav RK, Ahmad M, Mathur MK, Dhingra V. Study of prevalence and types of anemia in primary hypothyroidism. Virtual Health Library. 2019.
13. Erikci AA, Karagoz B, Ozturk A, Caglayan S, Ozisik G, Kaygusuz I, et al., The effect of subclinical hypothyroidism on platelet parameters. Hematol. 2009;14(2):115-7.
14. Saba F, Sayyadipoor F. The relationship between severity of hypothyroidism and red blood cells indices. Int J Med Lab. 2019.
15. Suhail N, Alsel BT, Batool S. Prevalence and association of thyroid dysfunction with anemia/body iron status among northern Border Saudi population. Int J Med Res Health Sci. 2020;9(3):1-7.
16. Souheil O, SamehHadj T, Faouzi K, Mohamed Bassem H, Samia K, Neila Ben R, Moncef F, Hedia S, Naziha K. Erythrocyte abnormalities in thyroid dysfunction. Virtual Health Library. 2010.
17. Montagnana M, Lippi G, Targher G, Salvagno GL, Guidi GC. The red blood cell distribution width is associated with serum levels of thyroid stimulating hormone in the general population. Int J Lab Hematol. 2009;31(5):581-2.
18. Iddah MA, Macharia BN, Ng'wena AG, Keter A, Ofulla AV. Thryroid hormones and hematological indices levels in thyroid disorders patients at Moi teaching and referral hospital, Western Kenya. Int Sch Res Notices. 2013;2013.
19. Mishra AK, Anand R, Verma SP, Gupta KK. Study of impact of subclinical hypothyroidism on iron status and hematological profile. Int J Adv Med. 2018;5(2):446-51.

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