Effect of thyroid dysfunction on hematological profiles at Menelik II Referral Hospital, Addis Ababa, Ethiopia

Haymanot Tewabe (haymanottewabe@gmail.com)
Debre Markos University

Assaye Mitiku
Dilla University

Abtie Abebaw
Debre Markos University

Research Article

Keywords: Hematological profile, Hypothyroidism, Hyperthyroidism

Posted Date: December 29th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-1193193/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License
Abstract

Background

Thyroid hormones have a crucial role in the metabolism, production, and proliferation of blood cells. So the current study aimed to assess the hematological profile of patients with thyroid dysfunction.

Methods

A comparative prospective study was conducted from June to September 2021; on a total of 360 participants (120 health groups and 240 patients with thyroid dysfunction. 10 ml of venous blood samples were collected and separated into two test tubes (in the SST tube used for measurement of TSH, T3, and T4, and sample in the EDTA tubes was used for CBC analysis). The analysis was done by using SPPS software. Finally, the result was interpreted by using chi-square, Pearson's correlation, and multivariate logistic regression. The level of statistical significance was set at a 95% confidence and P-value is less than 0.05 was considered clinically significant.

Results

Out of 360 study participants (120 (33.33%) hypothyroidism, 120 (33.33%) hyperthyroidism, and 120 (33.33%) healthy controls); 195 (54.2%) were female, 150 (41.7%) were in the age range of 25-44 years. The finding indicated a statistically significant decrease in RBC, Hgb, HCT, MCV, PLT, MCH, MCHC, MPV, and a significantly increased valve in RDW, WBC, and NEU% in both types of thyroid dysfunction compared to control groups (p-value <0.05). Finding of MON%, EOS% and BAS% did not show significant differences between the groups (p-value >0.05).

Conclusion

The finding showed that thyroid dysfunction has a significant effect on RBCs, Hgb, HCT, MCV MCHC, MCH, WBC, neutrophils, PLT count, and MPV findings (p<0.05). But no show significant effect on monocyte, eosinophil and basophils (p-value > 0.05).

Introduction

Background

The thyroid gland is a small organ that's located in the front of the neck, wrapped around the windpipe (trachea). The thyroid gland is a vital hormone gland: It plays a major role in the metabolism, growth, and development of the human body. It helps to regulate many body functions by constantly releasing a steady amount of thyroid hormones into the bloodstream (1, 2). The thyroid gland releases the two basic
triiodothyronine (T3) and thyroxine (T4) which play an important role in the regulation of your weight, energy levels, internal temperature, skin, hair, nail growth, and more. Hormonal output from the thyroid is controlled by thyroid-stimulating hormone (TSH) or thyrotropin secreted by the anterior pituitary which is mediated by thyrotropin-releasing hormone (TRH), secreted by the hypothalamus (3, 4). Thyroid hormones have a crucial role in the metabolism and proliferation of blood cells. Thyroid dysfunction induces different effects on blood cells such as anemia, erythrocytosis, leukopenia, thrombocytopenia, and in rare cases causes' pancytopenia. It also alters RBC indices include MCV, MCH, MCHC, and RDW (5, 6).

Thyroid dysfunction happens when the thyroid gland makes either too much or too little of these important hormones and this condition is also known as thyroid disease. The cause of this problem can be primary or secondary and the types of thyroid disease can be hyperthyroidism, hypothyroidism, thyroiditis, and Hashimoto's thyroiditis (7, 8). Hypothyroidism (underactive thyroid) is a condition in which your thyroid gland doesn't produce enough of certain crucial hormones. Primary hypothyroidism is defined by elevated TSH levels and reduced thyroid hormones (T3 and T4) and secondary hypothyroidism is defined by reduced levels of TSH, T3, and T4 (9, 10). Causes of primary hypothyroidism could be functional problems within the thyroid gland, infiltrate disease of the thyroid, and secondary hypothyroidism caused due to anterior pituitary gland failures (9-11). Hyperthyroidism (overactive thyroid) occurs when the thyroid gland produces too much of the hormone thyroxine and this problem can accelerate our body's metabolism, causing unintentional weight loss and a rapid or irregular heartbeat. The cause of hyperthyroidism can also be primary, secondary, or tertiary with the most known cause of autoimmune (12-14).

Some previous study findings indicated thyroid dysfunction induces different effects on blood cells such as anemia, erythrocytosis, leukopenia, thrombocytopenia, and in rare cases causes' pancytopenia (5). Thyroid hormones involve in involvement in hemoglobin production, enhance erythropoiesis through a hyper proliferation of immature erythroid progenitors, increase secretion of erythropoietin (EPO) by inducing erythropoietin gene expression, motivate the growth of erythroid colonies (BFU-E, CFU-E), intensify erythrocyte 2, 3 DPG compactness, effect on megakaryocytes through modulation of bone marrow matrix proteins, such as fibronectin, increase the expression of fibronectin gene, an alter platelet function and affects hematopoiesis in many ways (15, 16). So the current study aimed to assess the effect of thyroid dysfunction on the hematological profile of patients.

**Materials And Methods**

**Study area**

The study was conducted at Menelik II Referral Hospital which is found in Addis Ababa under Addis Ababa health bureau, Addis Ababa, Ethiopia.
Study design and period:
A hospital-based comparative cross-sectional study was conducted from June to August 2021, at Menelik II Referral Hospital in Addis Ababa, Ethiopia.

Study Population
Patients who have confirmed thyroid dysfunction at Menelik II referral hospital was considered as case group and healthy individuals were randomly selected from Menelik II referral hospital were recruited as control groups.

Inclusion and exclusion criteria:
All age patients with thyroid dysfunction and visiting Menelik II referral hospital during the study period were taken as case groups and also all age group healthy individuals were taken as control groups for this study. On the other hand, patients taking any hormonal drugs which affect complete blood counts (CBC) such as non-steroidal anti-inflammatory drugs, Penicillin and its derivatives, Phenazopyridine, Quinidine, and patients with comorbid disease (such us: TB, HIV, Heart disease, and chronic kidney disease) were excluded from case groups. Also, control groups of individuals with signs of illness and those who are taking medications were excluded.

Sampling method and Data Collection Procedure
The sample was collected by using convenient sampling to enroll patients with thyroid dysfunction and healthy controls in Menelik II referral hospital (MRH). After consent and assent were obtained from each study participant, socio-demographic and clinical information was obtained using a pretested semi-structured questionnaire. Then 10 ml of venous blood sample was aseptically collected from each study participant by an experienced laboratory technologist and transferred into two test tubes (5 ml in each tube). 5 ml blood to EDTA test tube for CBC analysis and 5 ml blood into SST test tube for thyroid function test analysis. Then the blood sample in EDTA test tubes was transported to the hematology department of Menelik II referral hospital and CBC is analyzed by using a fully automated Mindray BS-500 analyzer. The blood specimen in the SST tube was transported to the clinical chemistry department of the MRH laboratory department and centrifuged at 3000 RPM for 5 minutes to separate the serum. Then the thyroid function test was determined from the serum sample by using Mindray CL-960i Chemiluminescence Immunoassay fully automated analyzer.

Laboratory analysis
Thyroid function tests were performed using Mindray CL-960i Chemiluminescence Immunoassay system which is a fully automated, random access, software-controlled system for immunoassay analysis. It works based on the electrochemiluminescence (ECL) assay principle. The competitive immunoassay principle was for the measurement of T3, T4, and the two-site sandwich immunoassay method was used for the measurement of TSH. For hematological profile or complete blood count analysis mindray BS-500
five differential fully automated hematological analyzer with test principle of impedance principle (electric resistance) was used.

**Data Quality Assurance**

To assure the quality of the data, training was given to the data collectors, and the data was collected by using a pretested questionnaire. Standard operating procedures (SOPs) were strictly followed during specimen collection and laboratory procedures. Before sample analysis commercially prepared low, normal, and high-quality control reagents were used to check the reliability (accuracy and precision) of the data generated by the hematology analyzer, and two-level control was used for the hormonal analyzer. The accuracy and completeness of the collected data were checked every day by the principal investigator. Data were cleaned, coded, and entered correctly.

**Data analysis and interpretation**

All the data collected from the laboratory investigation and questionnaire were analyzed using SPSS software (SPSS Inc., Chicago, IL, USA, version 21.0). Descriptive statistics were used to express the socio-demographic and clinical characteristics. Binary and multiple logistic regressions were computed to assess the association between variables. Differences in mean values were determined by an independent t-test for patients with thyroid dysfunction and healthy participants. P-values < 0.05 were taken as statistically significant.

**Ethical considerations**

The study was conducted after ethical approval is obtained from the Research and Ethics Institutional Review Board. An official permission letter was submitted to the Addis Ababa Health Bureau and Menelik II referral hospital. Informed written consent and assent were also obtained from each participant in Menelik II referral hospital before the actual data collection.

**Result**

A total of 360 participants of the 240 (110 males, 130 females) patients with thyroid dysfunction and the rest 120 (55 males, 65 females) healthy controls were recruited for this study. Out of 240 patients with thyroid dysfunction, 120 (50%) were with hypothyroidism and the rest 120 (50%) were with hyperthyroidism. Most of the study participants who participated in the current study were in the age range of 25-44 years (41.7) with an average age of 28.7 years (a minimum of 1 year and a maximum of 82 years). The majority of study participants in the current study were females 195 (54.2%). The age of the case group and the control group in the current study was relatively matched (Table 1).
Table 1
Socio-demographic finding of the participants who participated in the current study at MSH, Addis Ababa, Ethiopia from June to August 2021.

| Variable               | Category       | Thyroid functional status |
|------------------------|----------------|---------------------------|
|                        |                | Normal   | Hypothyroidism | Hyperthyroidism |
|                        |                | 120 (33.3%) | 120 (33.3%) | 120 (33.3%) |
| Sex                    | Male           | 54 (45%)   | 56 (46.7%) | 55 (45.8%) |
|                        | Female         | 66 (55%)   | 64 (53.3%) | 65 (54.2%) |
| Age/years              | ≤14            | 7 (5.8%)   | 5 (4.2%)   | 6 (15) |
|                        | 15-24          | 15 (12.5%) | 15 (12.5%) | 10 (8.3%) |
|                        | 25-44          | 45 (37.5%) | 50 (41.7%) | 55 (45.8%) |
|                        | 45-64          | 34 (28.3%) | 25 (20.8%) | 23 (19.2%) |
|                        | ≥65            | 19 (15.8%) | 25 (20.8%) | 26 (21.7%) |
| Educational status     | Illiterate     | 3 (2.5%)   | 4 (3.4%)   | 5 (4.2%) |
|                        | Primary school | 5 (4.2%)   | 6 (5%)     | 20 (16.7%) |
|                        | Certificate and diploma | 18 (15%) | 23 (19.2%) | 20 (16.7%) |
|                        | First degree and above | 97 (80.8%) | 90 (75%) | 75 (62.5%) |
| Residence              | Rural          | 2 (1.7%)   | 2 (1.7%)   | 12 (10%) |
|                        | Urban          | 118 (98.3%) | 118 (98.3%) | 108 (90%) |

From a total of 360 study participants, almost all of the respondents 118 (98.33%) healthy controls and 226 (94.2%) patients were from urban residents. The educational status finding also indicated that the majority of study participants 115(95.83%) normal controls and 190(79.2%) participants with thyroid dysfunction were had primary and above education level and was significantly associated with hematological findings (p=0.004) (Table 1 and Table 2).
Table 2
Hematological profile findings of the participants who participated in the current study at MSH, Addis Ababa, Ethiopia from June to August 2021.

| Variable          | Category | Thyroid functional status |
|-------------------|----------|----------------------------|
|                   |          | Normal (120 (33.3%)) | Hypothyroidism (120 (33.3%)) | Hyperthyroidism (120 (33.3%)) |
| Hgb (g/dl)        |          |                           |                              |                              |
| <12               | 21 (17.5%) | 69 (57.5%) | 64 (53.3%)                  |
| 12.1-17.2         | 86 (71.7%) | 36 (30.0%) | 26 (21.7%)                  |
| >17.2             | 13 (10.8%) | 15 (12.5%) | 30 (25.0%)                  |
| RBC (×10¹²/L)     |          |                           |                              |                              |
| <4                | 21 (17.5%) | 69 (57.5%) | 64 (53.3%)                  |
| 4-6               | 85 (70.8%) | 41 (34.2%) | 30 (25.0%)                  |
| >6                | 14 (11.7%) | 10 (8.3%) | 26 (21.7%)                  |
| MCHC (g/dl)       |          |                           |                              |                              |
| <32               | 22 (18.3%) | 70 (58.3%) | 64 (53.3%)                  |
| 32-36             | 86 (71.7%) | 40 (33.3%) | 30 (25.0%)                  |
| >36               | 12 (10.0%) | 10 (8.3%) | 26 (21.7%)                  |
| MCH (pg/cell)     |          |                           |                              |                              |
| >27               | 21 (17.5%) | 69 (57.5%) | 64 (53.3%)                  |
| 27-32             | 86 (71.7%) | 36 (30.0%) | 26 (21.7%)                  |
| >32               | 13 (10.8%) | 15 (12.5%) | 30 (25.0%)                  |
| MCV (fl)          |          |                           |                              |                              |
| <70 fl            | 21 (17.5%) | 69 (57.5%) | 64 (53.3%)                  |
| 70-100 fl         | 86 (71.7%) | 36 (30.0%) | 26 (21.7%)                  |
| >100 fl           | 13 (10.8%) | 15 (12.5%) | 30 (25.0%)                  |
| WBCs count((×10⁹/L) |          |                           |                              |                              |
| <4                | 12 (10.0%) | 5 (4.2%) | 4 (3.3%)                    |
| 4-10              | 101 (84.2%) | 30 (25.0%) | 31 (25.8%)                  |
| ≥10.1             | 7 (5.8%) | 85 (70.8%) | 85 (70.8%)                  |
| Neutrophil (%)    |          |                           |                              |                              |
| <40%              | 10 (8.3%) | 5 (4.2%) | 5 (4.2%)                    |
| 40-60%            | 105 (87.5%) | 25 (20.8%) | 25 (20.8%)                  |
| >60%              | 5 (4.2%) | 90 (75.0%) | 90 (75.0%)                  |
| Monocyte (%)      |          |                           |                              |                              |
| <2%               | 12 (10.0%) | 12 (10.0%) | 20 (16.7%)                  |
| 2-8%              | 88 (73.3%) | 86 (71.7%) | 70 (58.3%)                  |
| >8%               | 20 (16.7%) | 22 (18.3%) | 30 (25.0%)                  |
As indicated in Table 2 hematological profile findings indicated that the majority of the healthy study participants were had normal value of hemoglobin (71.7%), WBC (84.2%), RBC (70.8%), MCV (71.7%), Neutrophil (87.5%) and PLT (91.7%). On the other hand, most of the study participants who have thyroid problems both hypothyroidism and hyperthyroidism were had relatively low levels of hemoglobin (57.5% and 53.3%), WBC (70.8% and 70.8%), RBC (57.5% and 53.3%), MCV (57.5% and 53.3%), Neutrophil (75.0% and 75.0%) and PLT (50.0% and 50.0%) respectively (Table 1).

Our multivariate logistic regression analysis indicated that study participants with the educational level of the first degree and above had 2.8 more chances to develop thyroid dysfunction when compared with study participants with the educational level of below degree level (AOR 2.8, 95% CI: 1.23, 6.69, p value=0.001) and those whose age is greater than 65 years were have 5.2 times more chance to develop any types of thyroid dysfunction relative with healthy individuals AOR 5.2,95% CI: 1.34-7.90, p value=0.003) (Table 3).

This study finding also indicated that study participants with Hb value of less than 12 g/dl were more likely to be affected by thyroid dysfunction (AOR 2.3, 95% CI (1.03-6.52)), p value=0.001), MCV value less than 70 fl were 3.13 times more likely to develop thyroid dysfunction (AOR 3.13, 95% CI:1.21- 9.46, p value=0.003), RBC value less than 4X10^{12} cells /L were 3.4 times more likely to develop thyroid dysfunction (AOR 3.4, 95% CI:1.51-3.69, p value=0.002), WBC value greater than 10X10^{9} cells /L were have 5.6 times more chance to develop thyroid dysfunction (AOR 5.6, 95% CI:1.09-10.82, p value=0.001), and those whose PLT value less than 150x10^{9} cells /L were 2.7 times more likely to develop thyroid dysfunction (AOR 2.7, 95% CI:1.26-11.36, p value=0.004) compared with control groups (Table 3).

| Lymphocyte | <20% | 4 (3.3%) | 8 (6.7%) | 8 (6.7%) |
|------------|------|----------|----------|----------|
|            | 20-40% | 110 (91.7%) | 90 (75.0%) | 100 (91.7%) |
|            | > 40% | 6 (5.0%) | 22 (18.3%) | 12 (10.0%) |
| Basophiles | < 0.5% | 2 (1.7%) | 3 (2.5%) | 15 (12.5%) |
|            | 0.5 -1% | 112 (93.3%) | 112 (93.3%) | 85 (70.8%) |
|            | > 1% | 6 (5.0%) | 5 (4.2%) | 20 (16.7%) |
| PLT count (K/mm3) | <150 | 10 (8.3%) | 60 (50.0%) | 45 (37.5%) |
|            | 150-450 | 110 (91.7%) | 58 (48.3%) | 45(37.5%) |
|            | >450 | 0 | 2 (1.7%) | 30 (25.0%) |
| MPV (femtoliter) | < 7 | 5 (4.2%) | 60 (50.0%) | 50 (41.7%) |
|            | 7-12 | 105 (87.5%) | 54 (45.0) | 40 (33.3%) |
|            | >12 | 10 (8.3%) | 6 (5.0%) | 30 (25.0%) |
Table 3
Multivariate analysis outcome of thyroid dysfunction and independent variables for study participants who participated in the current study at MSH, Addis Ababa, Ethiopia from June to August 2021.

| Variables            | Thyroid dysfunction |
|----------------------|---------------------|
|                      | AOR: 95%, CI        | p-value |
| Age /year ≤14        | 1.13: 0.20-2.45     | 0.09    |
| 15-24                | 1: 1.0-12.2         | 0.07    |
| 25-44                | 0.9: 1.20-4.5       | 0.07    |
| 45-64                | 1: 0.12-3.34        | 0.06    |
| ≥65                  | 5.2: 1.34-7.90      | 0.003   |
| Educational level    | Illiterate 1        |         |
| Primary school       | 1                   |         |
| Certificate and diploma | 1.2: 1.99-14.65 | 0.06    |
| First degree and above | 2.8: 1.23-6.69 | 0.001   |
| Hb g/dl <12          | 2.3: 1.03-6.52      | 0.001   |
| 12.1-17.2            | 1                   |         |
| >17.2                | 1                   |         |
| RBC ×1012/ L <4      | 4.4: 1.51-3.69      | 0.002   |
| 4-6                  | 1                   |         |
| >6                   | 1.09: 2.1-22.23     | 1.2     |
| MCV (fl) <70         | 3.13: 1.21-9.46     | 0.003   |
| 70-100               | 2.1: 0.98-18.71     | 1.0     |
| >100                 | 1                   |         |
| WBC (x10^9 cells/L) <4 | 1                   |         |
| 4-10                 | 5.6: 1.09-10.82     | 0.001   |
| ≥10.1                | 1                   |         |
| Neutrophil (%) <40   | 1                   |         |
| 41-60                | 1.8: 1.11-13.36     | 0.005   |
| >60                  | 3.7: 1.67-11.23     | 0.003   |
| PLT (x10^9 cells/L) <150 | 2.7: 1.26-11.36 | 0.004   |
Comparison of hematological parameters between control and participants with thyroid dysfunction

The result of this study showed that there was a statistically significant decrease in RBC count, Hgb, HCT, MCV, MCH, MCHC, MPV, and PLT counts in thyroid dysfunction patients when compared with apparently healthy controls (p-value <0.05). WBC, RDW, and Neutrophils were statistically significantly higher in thyroid dysfunction patients when compared with apparently healthy controls (p-value <0.05). The valve of monocyte, basophils, and eosinophils were not shown a significant difference between the groups (p-value >0.05) (Table 2, and 4).
Table 4
Comparison of RBCs count and RBC indices between patients with hypothyroidism, hyperthyroidism, and healthy controls participated in the current study at MSH, Addis Ababa, Ethiopia from June to August 2021.

| Index                        | Thyroid status | No | Mean±SD  | AOR, 95%,CI       | P-Value |
|------------------------------|----------------|----|----------|-------------------|---------|
| Hgb valve less than 12(g/dl) | Hypothyroidism | 69 | 13.6 ± 4.7 | 2.4, 1.11-3.56   | <0.001  |
|                              | Control        | 21 | 14.8 ± 2.2 | 1                 |         |
|                              | Hyperthyroidism| 64 | 13.6 ± 4.2 | 2.6, 1.31-6.56   | <0.001  |
| MCV less than 70fl           | Hypothyroidism | 69 | 74.3 ± 10.3 | 3.5, 1.64-6.78   | <0.001  |
|                              | Control        | 21 | 86.4 ± 11.2 | 1                 |         |
|                              | Hyperthyroidism| 64 | 75.2 ± 12.9 | 2.8, 1.82-7.56   | <0.001  |
| RBC less than 4×10^{12}/L    | Hypothyroidism | 69 | 4.3 ± 2.3  | 4.4, 1.67-7.56   | 0.001   |
|                              | Control        | 21 | 4.9 ± 2.5  | 1                 | <0.001  |
|                              | Hyperthyroidism| 64 | 5.0 ± 2.6  | 4.8, 1.67-8.76   | 0.001   |
| MCH less than 27 pg/cell     | Hypothyroidism | 69 | 28 ± 4.8   | 2.2, 1.13-3.56   | <0.001  |
|                              | Control        | 21 | 31.7 ± 3.9 | 1                 |         |
|                              | Hyperthyroidism| 64 | 27.8 ± 3.8 | 2.6, 1.41-9.99   | <0.002  |
| MCHC less than 32 g/dl       | Hypothyroidism | 70 | 32 ± 3.3   | 1.8, 1.11-6.66   | <0.001  |
|                              | Control        | 22 | 35.4 ± 2.8 | 1                 | <0.001  |
|                              | Hyperthyroidism| 64 | 33.3 ± 2.1 | 3.1, 1.51-4.56   |         |
| WBC greater than 4×10^{9}/L  | Hypothyroidism | 85 | 5.3 ± 3.5  | 3.8, 2.11-12.56  | 0.004   |
|                              | Control        | 7  | 7.3 ± 2.9  | 1                 |         |
|                              | Hyperthyroidism| 85 | 5.6 ± 5.0  | 5.6, 1.31-10.56  | 0.009   |
| PLT less than 150×10^9/L     | Hypothyroidism | 60 | 160 ± 46.3 | 2.9, 1.89-7.56   | <0.001  |
|                              | Control        | 10 | 320 ± 32.4 | 1                 | <0.001  |
|                              | Hyperthyroidism| 50 | 165 ± 33.7 | 2.8, 1.33-5.56   | <0.001  |
| Neutrophils greater than 60% | Hypothyroidism | 85 | 74 ± 8     | 5.4, 2.32-8.56   | <0.001  |
|                              | Control        | 7  | 55 ± 6     | 1                 | <0.001  |
|                              | Hyperthyroidism| 85 | 68 ± 9     | 2.6, 1.41-7.56   | <0.001  |

Discussion
The thyroid gland is a small organ that's located in the front of the neck and is vital for the secretion of two hormones (T3 & T4) which plays a major role in the metabolism, growth, and development of the human body. It helps to regulate many body functions by constantly releasing a steady amount of thyroid hormones into the bloodstream (1, 2). The most common thyroid dysfunctions, hypothyroidism, and hyperthyroidism affect blood cells and cause anemia with different ranges of severity [25].

The finding of the current study indicated a statistically significant decrease in RBC, Hgb, HCT, MCV, PLT, MCH, MCHC, and MPV in both thyroid dysfunction patients when compared with apparently healthy controls (p-value <0.05). RDW, WBC, and NEU% were statistically significantly increased (p-value <0.05) in those patients, and the rest MON%, EOS%, and BAS%, did not show significant differences between the groups (p-value >0.05). And also our multivariate logistic regression analysis showed that RBC count, Hgb, MCV, WBC and PLT had significant difference with thyroid dysfunction compared with control groups (AOR; 95%:CI, p-value: 4.4: 1.51-3.69, 0.002, 2.3: 1.03-6.52, 0.001, 3.13: 1.21-9.46, 0.003, 5.6: 1.09-10.82, 0.001 and 3.7: 1.67-11.23, 0.003 respectively) (Table 3). Contemporary other hematological valves had not shown a significant difference (p-value>0.05). Also as our study finding indicated participants with an age of greater than have 5.2 times more chance to develop thyroid dysfunction (5.2: 1.34-7.9, 0.003) and participants who have a degree and above were have 2.8 times more chance to develop thyroid dysfunction (2.8: 1.03-6.52, 0.001) (Table 3).

**Findings of total RBC and RBC Indices between case and control groups**

Thyroid hormones stimulate the proliferation of erythrocyte precursors, directly and indirectly, influencing erythropoietin (EPO) production enhancement. EPO regulates the survival, proliferation, and differentiation of elytroid progenitor cells and the number of red blood cells in the peripheral blood. So the problem in this gland directly or indirectly affects the production of blood cells. In our study, the mean RBC, Hgb, HCT, MCV, MCH, and MCHC valve of participants with thyroid dysfunction were have shown statistically significant decrement and the RDW valve were showed increased valve compared with control groups(p-value <0.001) (Table 2). Our result is in agreement with different study findings conducted in Saudi Arabia (17), Iraq (18), Iran (19), Saudi Arabia (20)and was in opposite with the study finding conducted in Kenya (21). This difference may be due to geographical, physiological, and dietary variations.

On the opposite, the current study finding showed a significant increment in the value of red cell distribution width in participants with thyroid dysfunction compared with the control groups (p-value <0.001) (Table 2). And this finding was supported different previous study findings (22-24).

**Findings of total WBC and WBC differential between case and control groups**
As the multivariate analysis indicated total WBC count and neutrophil percentage were significantly increased in participants with thyroid dysfunction compared with apparently healthy controls (p-value = 0.021) (Table 2). A similar result was also reported by different previous studies (20, 23). On the other hand, the findings of lymphocyte, monocyte, eosinophil, and basophils were not showing a significant difference between the two groups (p-value > 0.05).

**Platelet count finding and thyroid dysfunction**

The current study finding also showed a significantly decreased valve of PLT among individuals with thyroid problems compared with the healthy control groups (p-value = 0.021) (Table 2). This finding was in line with the previous studies conducted in Italy (25), Austria (26), and in opposite with previous studies conducted in Turkey (27).

**Conclusion And Recommendation**

**Conclusion**

Depending on the current study finding thyroid hormones (T3 and T4) have a significant influence on blood cell count and blood cell indices. The current study finding showed that thyroid dysfunction has a significant effect on RBCs, Hgb, HCT, MCV MCHC, MCH, WBC, neutrophils, PLT count, and MPV findings (p<0.05). But no show significant effect on monocyte, eosinophil and basophils (p-value > 0.05).

**Recommendation**

Routine hematological tests particularly RBCs, Hb, RDW, MCHC, PLT, WBCs, and differential count should be done for patients with thyroid dysfunction. So that complications could be detected and managed.

**References**

1. Ellis HJS. Anatomy of the thyroid and parathyroid glands. 2007;25(11):467–8.
2. Benvena S, Tuccari G, Ieni A, Vita RJ. Endocrinology RC, Metabolism. Thyroid gland: anatomy and physiology. 2018:382–90.
3. Kratzsch J, Pulzer FJB, Endocrinology RC, Metabolism. Thyroid gland development and defects. 2008;22(1):57–75.
4. Mansourian AJ. Metabolic pathways of tetraiodothyronine and triiodothyronine production by thyroid gland: a review of articles. 2011;14(1):1.
5. Davis FB, Cody V, Davis PJ, Borzynski L, Blas SD. Stimulation by thyroid hormone analogues of red blood cell Ca2+-ATPase activity in vitro. Correlations between hormone structure and biological activity in a human cell system. 1983;258(20):12373–7.
6. Davis FB, Kite JR, Davis PJ, Blas SD. Thyroid hormone stimulation in vitro of red blood cell Ca2+-ATPase activity: interspecies variation. 1982;110(1):297–8.
7. Biondi B, Cooper DSJEr. The clinical significance of subclinical thyroid dysfunction. 2008;29(1):76–131.
8. Ladenson PW, Singer PA, Ain KB, Bagchi N, Bigos ST, Levy EG, et al. American Thyroid Association guidelines for detection of thyroid dysfunction. 2000;160(11):1573–5.
9. Cooper DSJNEJoM. Subclinical hypothyroidism. 2001;345(4):260–5.
10. Gaitonde DYJSAFP. Hypothyroidism: an update. 2012;54(5):384–90.
11. Lania A, Persani L, Beck-Peccoz PJ. Central hypothyroidism. 2008;11(2):181–6.
12. Ginsberg J, Lewanczuk R, Honore LJ. Hyperplacentosis: a novel cause of hyperthyroidism. 2001;11(4):393–6.
13. Gittoes N, Franklyn JJD. Hyperthyroidism. Current treatment guidelines. 1998;55(4):543–53.
14. Reid JR, Wheeler SFJ. Hyperthyroidism: diagnosis and treatment. 2005;72(4):623–30.
15. Swaminathan, Chapman, et al. 1976, Dorgalaleh, Mahmoodi, et al. 2013.
16. Jp G, Srikrishna RJIJBMR. Role of red blood cell distribution width (rdw) in thyroid dysfunction. 2012;3(2):1476–8.
17. Alqahtani SAM. Prevalence and Characteristics of Thyroid Abnormalities and Its Association with Anemia in ASIR Region of Saudi Arabia: A Cross-Sectional Study. Clinics and practice. 2021;11(3):494–504.
18. Ahmed SS, Mohammed AA. Effects of thyroid dysfunction on hematological parameters: Case-controlled study. Annals of Medicine and Surgery. 2020;57:52–5.
19. Jafarzadeh A, Poorgholami M, Izadi N, Nemati M, Rezayati M. Immunological and hematological changes in patients with hyperthyroidism or hypothyroidism. Clinical and Investigative Medicine. 2010:E271-E9.
20. Refaat B. Prevalence and characteristics of anemia associated with thyroid disorders in non-pregnant Saudi women during the childbearing age: a cross-sectional study. Biomed J. 2015;38(4):307–16.
21. Iddah M, Macharia B, Ng’wena A, Keter A, Ofulla A. Thyroid hormones and hematological indices levels in thyroid disorders patients at Moi Teaching and Referral hospital, Western Kenya. International Scholarly Research Notices. 2013;2013.
22. Homoncik M, Gessl A, Ferlitsch A, Jilma B, Vierhapper H. Altered platelet plug formation in hyperthyroidism and hypothyroidism. The Journal of Clinical Endocrinology & Metabolism. 2007 Aug 1;92(8):3006-12.
23. Dorgalaleh A, Mahmoodi M, Varmaghani BJ. Al. oncology. Effect of thyroid dysfunctions on blood cell count and red blood cell indice. 2013;3(2):73.
24. Ahmed SS, Mohammed AAJA. Surgery. Effects of thyroid dysfunction on hematological parameters: Case-controlled study. 2020;57:52–5.
25. Franchini M, Montagnana M, Manzato F, Vescovi PP, editors. Thyroid dysfunction and hemostasis: an issue still unresolved. Seminars in thrombosis and hemostasis; 2009: © Thieme Medical
Publishers.

26. Homoncik M, Gessl A, Ferlitsch A, Jilma B, Vierhapper H. Altered platelet plug formation in hyperthyroidism and hypothyroidism. The Journal of Clinical Endocrinology & Metabolism. 2007;92(8):3006–12.

27. Erikci AA, Karagoz B, Ozturk A, Caglayan S, Ozisik G, Kaygusuz I, et al. The effect of subclinical hypothyroidism on platelet parameters. Hematology. 2009;14(2):115–7.

**Declarations**

**Acknowledgment**

We like to say thanks to extend our deepest gratitude and heartfelt thanks go to the Addis Ababa health bureau and management members of Menelik II referral hospital for their permission to do this research. Also, we would like to address our heart full thanks to all participants and health professionals of Menelik II referral hospital.

**Abbreviations**

- **BAS**%- the percentage of basophils
- **CBC**- complete blood count
- **EOS**%- a percentage of eosinophils
- **EPO**-erythropoietin
- **HBV** - Hepatitis B Virus
- **HCV** - Hepatitis C Virus
- **Hgb** - Haemoglobin
- **HIV** - Human Immune Virus
- **MCH**- mean corpuscular hemoglobin
- **MCHC**- mean corpuscular hemoglobin concentration
- **MCV**- mean cell volume
- **MPV**- mean platelet volume
- **MRH** - Menelik II Referral Hospital
- **NEU**% - a percentage of neutrophils
- **PLT**- platelet
- **RBC**- red blood cell
- **RDW**- red cell distribution width
- **T3**- Triiodothyronine
- **T4**- Thyroxine
- **TFT**- thyroid function test
- **TSH**- a thyroid-stimulating hormone
- **WBC**- white blood cell