ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

Original research article:

To evaluate thyroid dysfunction and platelet Indices: understanding the connection

Dr. Madhumati Varma
MD, Ph.D Medicine in Diabetology, MMsc Diabetology, FRCP London
Associate professor in medicine
JNU Medical College and Hospital Jaipur, Rajasthan, India

Corresponding Author:
Dr. Madhumati Varma

Abstract

Background: Hypothyroidism, a common endocrine disorder characterized by insufficient thyroid hormone production, has been linked to various haematological alterations, including changes in platelet indices. This article provides evidence regarding the impact of hypothyroidism on platelet count, mean platelet distribution width (PDW), and plateletcrit. This study is aimed at evaluating the influence of hypothyroidism on platelet indices, including platelet count, MPV, PDW, and plateletcrit.

Methods: A prospective cross-sectional study was conducted for a period of 8 months with 109 hypothyroid subjects. Demographic details were compared between the groups. A fasting blood sample was collected to determine thyroid profile and complete blood count (CBC), including platelet indices.

Results: On correlation between TSH and platelet distribution width, TSH value shows a statistically significant increase in (P = 0.00034) values. Pearson correlation = -0.0071; correlation between mean platelet volume and thyroid-stimulating hormone mildly increased, found P = 0.75; Pearson correlation = -0.06, mildly statistically significant; and correlation between FreeT4 increase with decrease in plateletcrit (PCT), P = 0.00013; Pearson correlation = 0.198, found statistically significant.

Conclusion: Our results suggest that TSH with PDW, TSH with MPV, free T4, and platelets are the reliable markers among the platelet parameters in hypothyroid patients.

Keywords: Platelet parameters, hypothyroidism, mean platelet volume, platelet count, platelet distribution width, plateletcrit.

Introduction:

Hypothyroidism affects approximately 5-10% of the adult population and is predominantly caused by autoimmune diseases such as Hashimoto's thyroiditis. The thyroid gland plays a pivotal role in numerous metabolic processes, and thyroid hormones are involved in the regulation of the haematological system. Recent studies have highlighted significant changes in platelet indices in patients with hypothyroidism,

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

potentially indicating an underlying pathophysiological mechanism. Thyroid dysfunction refers to abnormal functioning of the thyroid gland, which can lead to disorders such as hypothyroidism (underactive thyroid) or hyperthyroidism (overactive thyroid). The thyroid gland, located in the neck, produces hormones that regulate metabolism, growth, and development. When these hormones are imbalanced, it affects various bodily systems, blood cells, and platelets. Platelets are small blood cells that play a crucial role in clot formation and wound healing. The health and function of platelets are often assessed through various platelet indices, including platelet count, mean platelet volume (MPV), and platelet distribution width (PDW). These indices can provide insights into the body's clotting ability and inflammatory status, and they may change in response to thyroid dysfunction.

Effects of Hypothyroidism on Platelet Count

1. Thrombocytosis and Thrombocytopenia.

Some studies have reported an increase in platelet count (thrombocytosis) in hypothyroid patients. For example, a study by Zhan et al. (2017) found that hypothyroid patients had significantly higher platelet counts compared to euthyroid controls. This increase could be attributed to elevated inflammatory cytokines and changes in hemostatic balance secondary to reduced metabolic activity. Conversely, other studies suggest that severe or prolonged hypothyroidism can lead to thrombocytopenia (lower platelet count). A study by Cakir et al. (2013) noted that some hypothyroid patients exhibited reduced platelet counts, potentially due to marrow suppression.

Mean Platelet Volume (MPV) in Hypothyroidism

MPV is an indicator of platelet production and activation. In hypothyroidism, findings on MPV levels are inconsistent.

Increased MPV: Several studies, such as that by Artunc et al. (2014), report that MPV levels are elevated in hypothyroid patients, suggesting increased platelet activation and production as a compensatory mechanism. Higher MPV is often associated with cardiovascular risks, indicating that hypothyroid patients may have an increased risk of thrombotic events.

Decreased MPV: In contrast, some analyses indicate that MPV can be low in cases of severe hypothyroidism, reflecting inadequate platelet production. The discrepancies in findings may arise from variations in patient demographics, severity of disease, and concurrent medications.

Platelet Distribution Width (PDW) and Hypothyroidism PDW, a measure of platelet size variation, may reflect platelet activation levels. Studies show that PDW can be increased in hypothyroidism. A study by Yilmaz et al. (2016) observed significant elevations in PDW among hypothyroid patients, suggesting that these patients experience heightened platelet activation and changes in platelet morphology.

Increased PDW could also indicate a response to systemic inflammation commonly seen in patients with hypothyroidism. The relationship between PDW and hypothyroidism remains an area for further exploration, but initial findings indicate it could be an important marker for assessing the hematologic effects of thyroid hormone deficiency.

The Impact of Treatment on Platelet Indices

Treatment of thyroid dysfunction often leads to normalization of thyroid hormone levels, which can reverse many of the changes observed in platelet indices: For hypothyroid

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

patients, thyroid hormone replacement therapy (e.g., levothyroxine) can restore normal platelet counts and decrease MPV to within normal ranges. For hyperthyroid patients, anti-thyroid medications (e.g., methimazole or propylthiouracil) or radioactive iodine therapy can reduce the excess thyroid hormone levels, helping to bring platelet counts back to normal and improving platelet function.

Monitoring platelet indices is important in patients with thyroid dysfunction, as it can provide clues about the risk of bleeding or clotting, which are potential complications of both hypothyroidism and hyperthyroidism.

Link between Thyroid Dysfunction and Platelet Indices

2. Hyperthyroidism and Platelet Indices Hyperthyroidism occurs when the thyroid gland produces excessive thyroid hormones, leading to an increased metabolic rate. This condition can cause:

Elevated Platelet Count: Hyperthyroid patients may experience thrombocytosis (increased platelet count), which can raise the risk of clot formation and thromboembolic events.

Decreased MPV: In hyperthyroidism, the average size of platelets may be smaller, as the condition tends to enhance the production of smaller, less active platelets.

Altered PDW: Similar to hypothyroidism, PDW may also be affected in hyperthyroidism, though the trends vary. Some studies suggest increased variability in platelet size, reflecting an imbalance in platelet production.
Previous research has shown that thyroid disorders can significantly impact platelet indices, with hypothyroidism and hyperthyroidism exerting different effects: Previous research has shown that thyroid disorders can significantly impact platelet indices, with hypothyroidism and hyperthyroidism exerting different effects:

3. Hypothyroidism and Platelet Indices
In hypothyroidism, the thyroid gland does not produce enough thyroid hormones, leading to a slowed metabolism. This condition can cause:

Reduced Platelet Count: Patients with hypothyroidism often exhibit mild thrombocytopenia, a condition characterized by a low platelet count. This may increase the risk of bleeding.

Increased MPV: Mean platelet volume, which measures the size of platelets, tends to be higher in people with hypothyroidism. Larger platelets are generally younger and more active, and their presence may signal the body's attempt to compensate for platelet loss.

Altered PDW: Platelet distribution width, a measure of platelet size variability, may increase in hypothyroidism due to the production of more variable-sized platelets as the bone marrow tries to maintain an adequate platelet supply.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

Materials and Methods

A prospective cross-sectional study was conducted at JNU Hospital/Medical College, Jaipur, Rajasthan, India. JNU Medical College Scientific and Ethical Committee permission and approval were obtained. Written informed consent of patient obtained. The study was done about 12 months apart between hypothyroid subjects, 110. All patients with thyroid dysfunction were included in the study, and then patients with local or systemic diseases that could affect platelet indices and also with inadequate samples/samples with clots were excluded from the study.

Enzyme-Linked Immunosorbent Assay (ELISA) Triiodothyronine hormone (T3), thyroxine hormone (T4), and thyroid-stimulating hormone (TSH) levels in subjects' serum/plasma were done for patients. A venous blood sample was collected from all test and control subjects in an ethylene diamine tetra acetate (EDTA)-coated vacutainer and analyzed using an automated seven-part cell analyzer, Sysmex, to measure complete blood count (CBC) and platelet indices such as platelet count (PLT), plateletcrit (PCT), MPV, and PDW. Statistical analysis in Excel was done by applying nonparametric tests such as the paired "t'' test. Results were The P value of 0.05 or less has been considered significant.

Inclusive Criteria:

Patient hypothyroidism and seen in OPD of JNU hospital.

Patient willing to participate in study.

Exclusive Criteria:

Patient not willing to participate in study.

The patient had other diseases that can affect platelet indices: examples include Cushing syndrome, dengue with hypothyroidism, ITP, and others.

Results

Results were organized in tables and graphs. Various variables were cross-correlated, and t-tests were performed, and graphs also showed correlation between two variables as followed:

Table 1: t-Test: Paired Two Sample for Means between TSH and PDW. When TSH increased, then PDW decreased, showing a strong negative significant correlation.

	TSH	**PDW**
Mean	11.50769	20.09676
Variance	609.8846	38.97656
Pearson Correlation	-0.00718	
Hypothesized Mean Difference	0	
P(T<=t) two-tail	0.000684	
t Critical two-tail	1.982383	

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

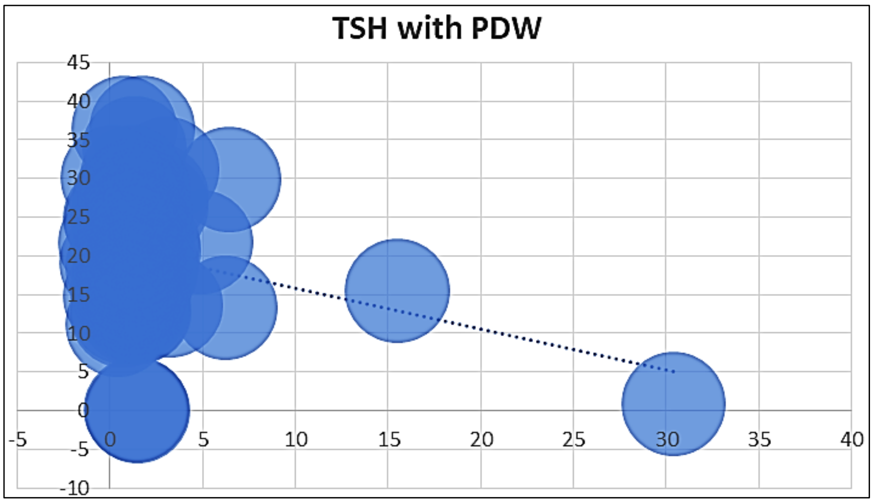

Fig 1: Correlation between thyroid-stimulating hormone and platelet distribution width decreases in P = 0.00034. Pearson Correlation = -0.0071

When TSH increased then MPV is decreases, showed negative significant correlation. Pearson correlation strongly negative and P is significant statically.

When TSH increased, then MPV decreased, showing a negative significant correlation. Pearson correlation is strongly negative, and P is not statistically significant.

Table 2: t-Test: Paired Two Sample for Means between TSH and MPV

T

MPV	TSH	MPV
Mean	11.48083333	10.71611111
Variance	610.2442042	3.234119315
Pearson Correlation	-0.068368518	
t Critical one-tail	1.659219312	
P(T<=t) two-tail	0.750134091	
t Critical two-tail	1.98238337	

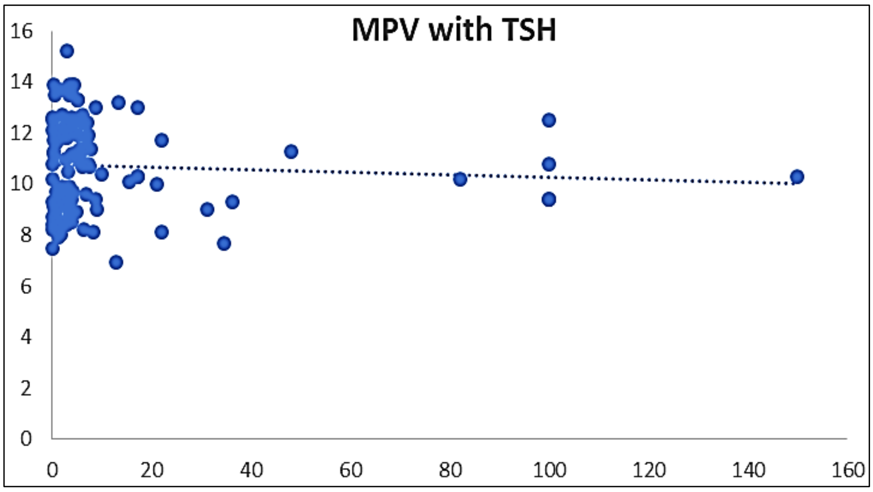

Fig 2: Correlation between mean platelet volume and thyroid-stimulating hormone. P=0.75, Pearson Correlation = -0.06

When free T3 increased, then MPV increased, showing a weakly positive significant Pearson correlation, and P is not statistically significant.

Table 3: t-Test: Paired Two Sample for Means between Free T3 and MPV

	Free T3	MPV
Mean	3.856481481	10.72537037

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

Variance	7.701365074	3.229993319
Pearson Correlation	0.023530583	
P(T<=t) two-tail	3.33541E-41	
t Critical two-tail	1.98238337	

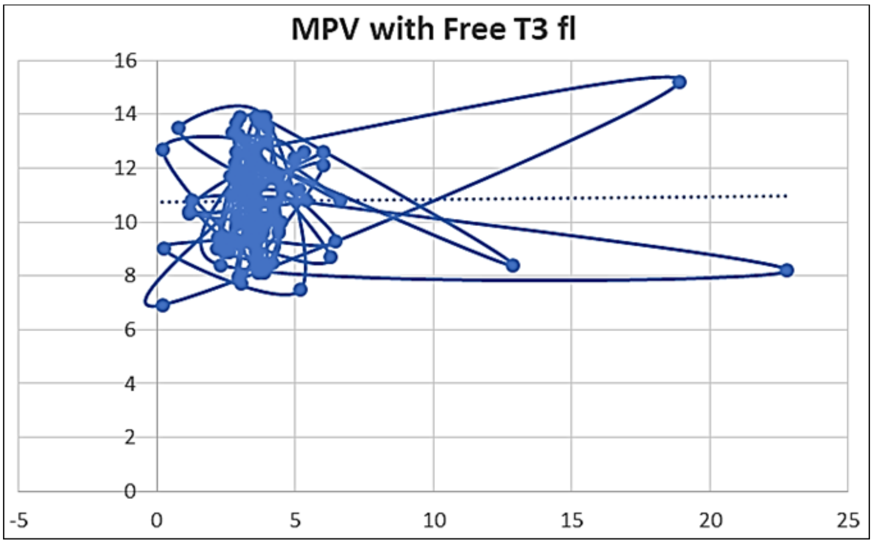

Fig 3: Correlation between mean platelet volume and free T3. P=3.33, Pearson Correlation=0.02

When Free T3 increased, then PCT decreased, showing a strongly negative significant Pearson correlation, and P is not statistically significant.

Table 4: t-Test: Paired Two Sample for Means between Free T3 and PCT

	Free T3	**PCT**
Mean	3.850462963	0.500407407
Variance	7.702972681	2.312825197
P(T<=t) two-tail	4.75677E-19	
t Critical two-tail	1.98238337	
Pearson Correlation	-0.022850105	

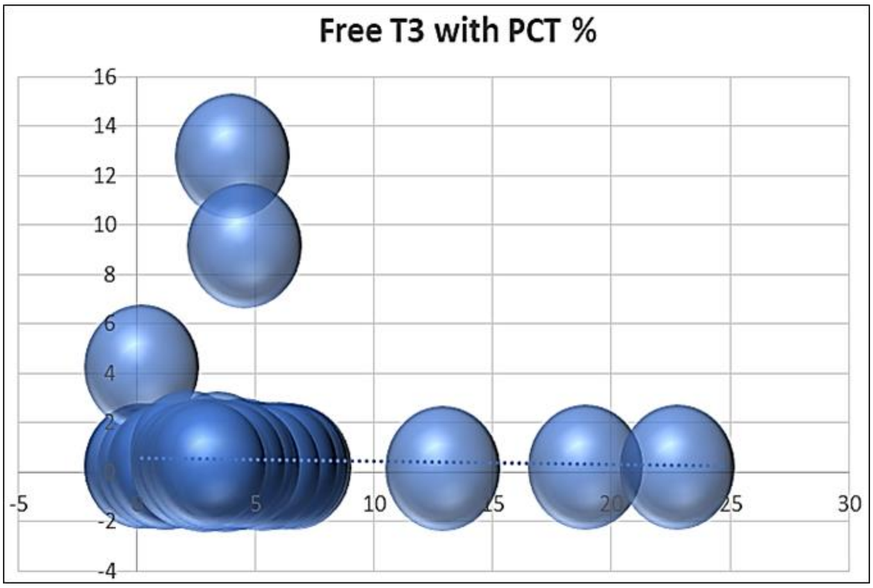

Fig 4: Correlation between free T3 and plateletcrit. P=4.75, Pearson Correlation=-0.02.

When Free T3 increased, then PDW increased, showing a weakly positive significant Pearson correlation, and P is not statistically significant.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

Table 5: t-Test: Paired Two Sample for Means between Free T3 and PDW

	Free T3	PDW
Mean	**3.865740741**	**20.26805556**
Variance	7.689942437	39.73825319
Observations	108	108
Pearson Correlation	0.052461809	
P(T<=t) two-tail	7.13839E-47	
t Critical two-tail	1.98238337	

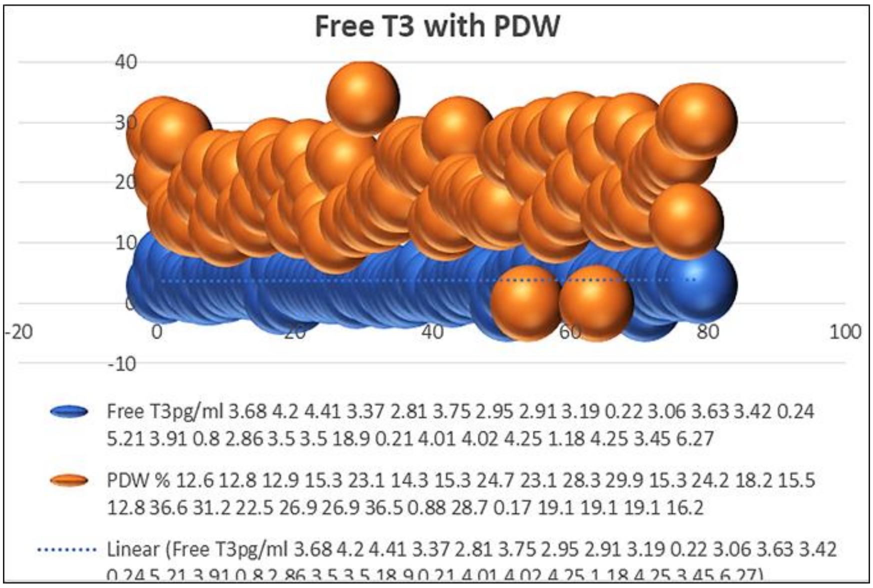

Fig 5: Correlation between free T3 and platelet distribution width P=7.13, Pearson correlation=0.052. MPV increased, then PCT increased, showing a strongly positive significant Pearson correlation, and P is not statistically significant.

Table 6: t-Test: Paired Two Sample for Means between MPV and PCT

	MPV	PCT
Mean	10.72537037	20.27731481
Variance	3.229993319	39.83596001
Pearson Correlation	0.801668763	
t Critical one-tail	1.659219312	
P(T<=t) two-tail	9.37114E-38	

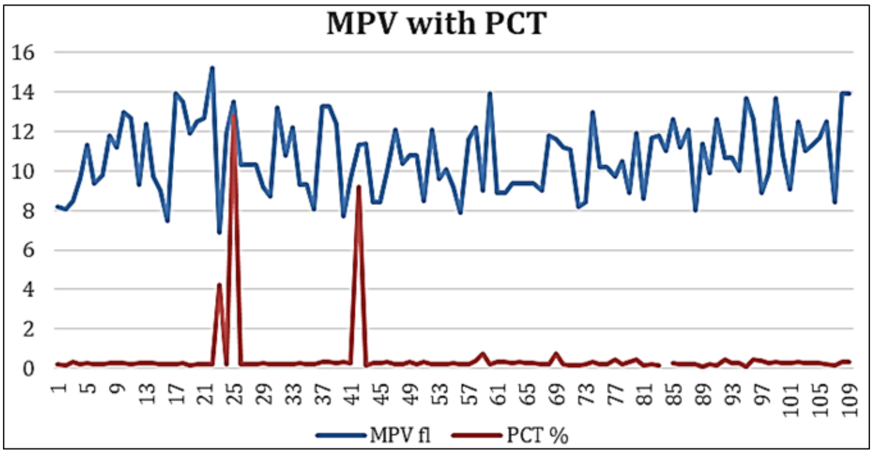

Fig 6: Correlation between MPV and PCT. P=9.3, Pearson Correlation=0.8 When MPV increased, then PCT is at the same level, showing weakly positive Pearson correlation, and P is not statistically significant.

Table 7: t-Test: Paired Two Sample for Means between Free T4 and PDW

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

	Free T4	PDW
Mean	1.749074074	20.28657407
Variance	10.44898605	39.61573675
Observations	108	108
Pearson Correlation	-0.273278788	
P(T<=t) two-tail	6.82189E-46	
t Critical two-tail	1.98238337	

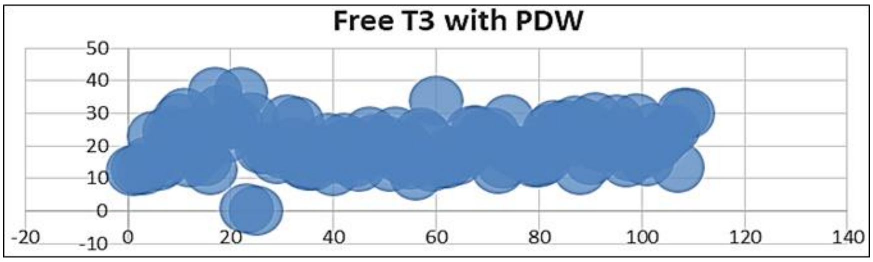

Fig 7: Correlation between free T3 and PDW, P=6.8 is not statistically significant; Pearson correlation is -0.27, weakly negative. When free T4 increased, then PDW decreased. showed weakly negative significant Pearson correlation, and P is not statistically significant.

Table 8: t-Test: Paired Two Sample for Means between Free T4 and PCT

	Free T4	PCT
Mean	1.753796296	0.500407407
Variance	10.44511162	2.312825197
Observations	108	108
Pearson Correlation	0.198131071	
P(T<=t) two-tail	0.00013449	
t Critical two-tail	1.98238337	

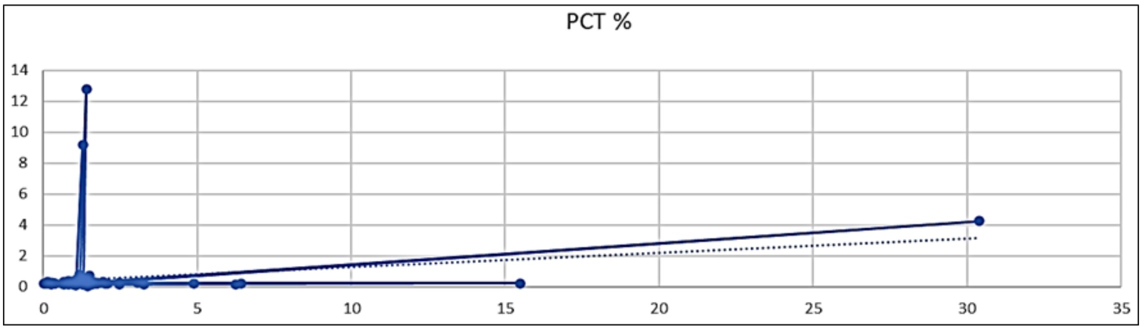

Fig 8: Correlation between Free T4 and Plateletcrit When free T4 increased, then PCT is increased. showed weakly positive significant Pearson correlation, and P is statistically significant.

Table 9 : Shows average HB, TSH, Free T3, T4, Platelet count, MPV, PCT, PDW

	Haemoglobin Gm /dl	TSH uIu/ml	Free T3 pg/ml	Free T4 ng/dl	Platelet count	MPV fl	PCT %	PDW%
Average	12.19	11.43	3.87	1.7	250.32	10.7	0.5	20.19
Count	107	108	105	105	109	107	107	107
Max	16.4	150	22.8	30.4	700	15.2	12.8	36.6
Min	0.16	0.014	0.21	0.02	66	6.92	0.075	0.17

Normal-Platelet count 150-400 per microliter of blood, platelet distribution width 9-17%, normal plateletcrit/PCT 0.22-0.24%, Mean platelets mean volume 7-11.5 Fl, TSH 0.5-5 UIU/l, Free t3 2-7 pmol/l, free t4 0.8-1.9 ng/dl.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

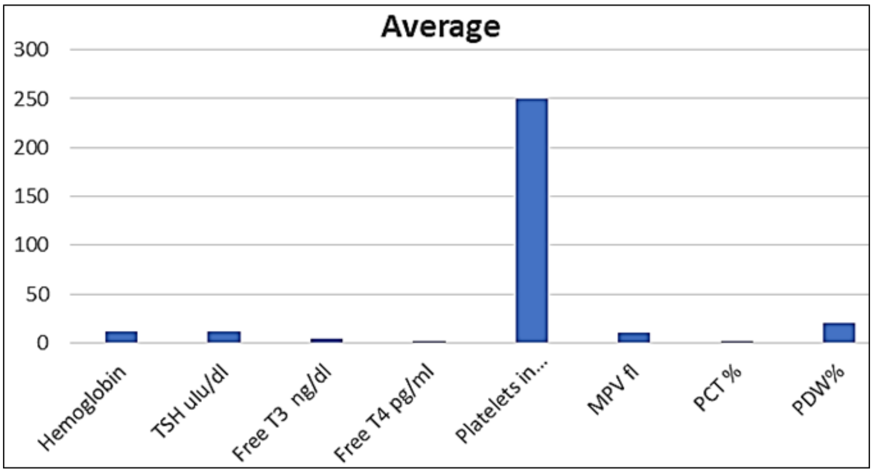

Fig 1: Showing average of all variables

Discussion

The hypothyroidism on platelet parameters may be helpful in understanding the pathogenesis of coagulation abnormalities. Thus, this study has the objective to evaluate platelet indices, including thyroid function—TSH, free T3, free T4, PCT, MPV, and PDW.

On correlation between TSH and platelet distribution width, TSH value shows a statistically significant increase in (P = 0.00034) values. Pearson Correlation = -0.0071, correlation between thyroid-stimulating hormone and mean platelet volume, found P = 0.75, Pearson Correlation = -0.06 mildly statistically significant. The Pearson correlation between FreeT4 increase and decreased plateletcrit (PCT) was 0.19, and P=0.00013 was found statistically significant. Other variables that did not show significant P values were the correlation between free T3 and platelet distribution width, P = 7.13, Pearson correlation = 0.052, and the correlation between free T3 and plateletcrit found P = 4.75, correlation between mean platelet volume and free T3, P = 3.33, Pearson correlation = 0.02. Francesco Scavuzzo et al. studied the evaluation of platelet indicators in individuals affected by subclinical and clinical (overt) hypothyroidism.

The study showed that the PCT remained unaltered in overt hypothyroidism or subclinical hypothyroidism, and MPV and PDW were found to be significantly modified in both groups, thus concluding a hypothetical increase of thromboembolic risk in those patients [5].

Conclusion

Conclusion Thyroid dysfunction can have significant effects on platelet indices, with hypothyroidism and hyperthyroidism causing distinct changes in TSH, platelet count, MPV, and PDW. Free T4 mildly influences PDW. However, there is no significant difference found between the free T3 with PDW, free T3 with plateletcrit, and MPV with free T3. Understanding these relationships helps clinicians assess the risk of thromboembolic or bleeding disorders in thyroid patients and tailor their treatments accordingly. There should be regular monitoring and management of both thyroid levels and platelet indices to improve overall outcomes for those with thyroid dysfunction.

Hypothyroidism has a discernible impact on platelet indices, characterized by potentially elevated platelet counts, altered MPV, and increased PDW. Further research is needed to elucidate these relationships and develop guidelines for the screening and management of haematological alterations in hypothyroid

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE12, 2024

References

1. Artunc U, *et al*. Mean platelet volume: a marker of thyroid hormone status in hypothyroid patients. Endocr J. 2014;61(4):419-24.
2. Cakir M, *et al*. The Changes in Platelet Indices in Patients with Hypothyroidism. Clin Hemorheol Microcirc. 2013;54(1):97-104.
3. Yilmaz R, *et al*. The relationship between hypothyroidism and platelet activation: a comprehensive review. Thyroid Res. 2016;9(1):1-7.
4. Zhang G, *et al*. Thyroid hormones and haematological parameters: a review. Int. J Endocrinol. 2017;2017:1-5.
5. Francesco S, Maria LG, Gianluca N, *et al*. Hypothyroidism and platelet parameters evaluation: a preliminary study. Endocr Abstr. 2015;37:965.
6. Cao YT, Zhang KY, Sun J, Lou Y, Lv TS, Yang X, *et al*. Platelet abnormalities in autoimmune thyroid diseases: A systematic review and meta-analysis. Front Immunol.; 2022.
7. Amitkumar PK, Swaminathan A, Priya GG, Ganapathy S. A comparative analysis of relationship between hypothyroidism and platelet parameters including platelet indices, platelet distribution width, plateletcrit and P-LCR. Ann Pathol Lab Med. 2018;2(12):A996-1001. https://doi.org/10.21276/apalm.2300