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Effect of Thyroid Dysfunction on Hematological Parameters: A Comparative Study Conducted on Male and Female Patients At Psh (Parul Sevashram Hospital, Vadodara)

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ABSTRACT
Since thyroid hormone is essential for the production of blood, thyroid dysfunction should be examined to see if the blood chemistry parameters have changed. The thyroid gland is especially important for body metabolism and hematopoiesis. They control the bone marrow's sanguification. They focus on the development of hemoglobin in fetuses as well as its production in adults. They promote the growth of erythroid progenitor cells, which boosts erythropoiesis. By controlling the expression of the erythropoietin gene and renal synthesis of erythropoietin, they boost the production of erythropoietin (EPO). This study aimed to examine how thyroid dysfunction affects hematological markers in male and female patients. This study assessed and compared parameters like HB, RBC, WBC, Platelet, HCT, MCV, MCH, and RDW between the male and female groups. The results showed that female patients had significantly lower HB, RBC, WBC, HCT, MCV, MCH, and RDW levels. It was seen that compared to male patients, these effects were more prevalent in female patients. This study suggests that thyroid dysfunction can affect most of the parameters and that one should conduct a follow-up CBC investigation to determine the etiology of diseases like anemia, thrombocytopenia, and leukopenia, among others, that are brought on by variations in blood parameters.
Keywords: *Hypothyroid; Hematological parameters; Thyroid dysfunction; Erythrocytes.*

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INTRODUCTION

Thyroxine (T-4) and triiodothyronine (T-3), the thyroid gland's main hormones, are produced by the thyroid gland. The thyroid gland is especially important for body metabolism and hematopoiesis. Because thyroid hormones are essential for the formation of red blood cells, patients with thyroid illnesses frequently experience blood problems. This study aims to compare hematological parameters in the thyroid dysfunction group of hypothyroidism in male and female patients. Thyroid hormones frequently affect all blood parameters by increasing the production of erythropoietin and erythrocyte precursors (1). The prevalence of hypothyroidism in India is around 11% (2). The thyroid hormone controls the bone marrow's sanguification. They focus on the development of hemoglobin in fetuses as well as its production in adults. They promote the growth of erythroid progenitor cells, which boosts erythropoiesis (3). Hypothyroidism is one of the most frequently diagnosed thyroid disorders, especially in women prevalence of anemia in subclinical and overt hypothyroid patients is 26.6 % and 73.2 %, respectively. Thus, hematological abnormalities are frequent in hypothyroid patients but rarely investigated(4).

MATERIALS AND METHOD

This study was conducted at Parul Sevasharam Hospital, Vadodara. Male and female hypothyroid patients aged between 15 to 55 years were included in this study. Patients with comorbid diseases like T.B., HIV, Anaemia, Heart disease, and chronic diseases were excluded from this study. Patients taking any hormonal medications that affect complete blood counts (CBC), such as non-steroidal anti-inflammatory drugs, penicillin and its derivatives, phenazopyridine, and quinidine, were excluded from this study. This cross-sectional prospective study included 100 participants, including 32 men and 68 women. Three milliliters of whole blood and two milliliters of EDTA-anticoagulated blood were taken for the thyroid function test and complete blood count (CBC). EDTA specimens were placed in a mixer and whisked for a short period and performed using the BC-6000 Mindray Auto Haematology Analyzer. A thyroid function test was

performed using Maglumi 800. The parameters that were investigated involved TSH, T3, T4, white blood cells (WBC), red blood cells (RBC), hematocrit (HCT), hemoglobin (HB), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin volume (MCHC), red cell distribution width (RDW), and platelet counts.

ETHICAL CONSIDERATIONS

Approval for conducting this study was given by The Parul University – Institutional Ethics Committee on Human Research (PU-IECHR). Approval number: PUIECHR/PIMSR/00/081734/5304.

STATISTICAL ANALYSIS

Utilizing SPSS software version 26, statistical analysis was carried out. Results for quantitative variables were presented as Mean Standard Deviation. A statistically Independent T-test was utilized to determine the significance of differences between the male and female groups. A significant change was defined as a P value of less than 0.05. Using Microsoft Excel 2019, a Z test was performed to see the significant difference between a sample and the population mean.

RESULTS

32 male patients and 68 female patients with hypothyroidism. The mean age of the females and males are 44.93 and 35.57 respectively. The prevalence of hypothyroidism in India is around 11% (2). The percentage of male and female participants is 32% and 68% respectively, as shown in Fig.1. The overall characteristics of the research participants, as shown in Table 1 are HB (64% low), RBC (51% low), platelet (89% normal), MCV (56% low), MCH (56% low), MCHC (73%normal), RDW (75% high), TSH (60% high), T3 (78% normal), and T4 (72%normal). Descriptive statistics show the mean and standard deviation of the study population as shown in Table 2. Patients with hypothyroidism's overall characteristics and laboratory results have been separated by gender and there are significantly lower levels of HB, RBC, MCV, and MCH in females because the mean value of these parameters are low compared to males and the mean value of RDW value is higher in females compared to males as shown in Table 3. In a test of normality, there is a significant difference between HB, HCT, MCV, and MCH in the studied population as shown in Table 4. According to the result obtained from the test of normality, z-test was conducted to determine if there is a significant difference between the males and females groups. The null hypothesis assumes that there is no variation in the mean population between the two groups and the alternative hypothesis is that there is a difference between both groups. Using a significant level of $\alpha = 0.05$, the z calculated value p-values) of HB, MCV, MCH, and HCT are 0.35, 0.12, 0.13, and 0.47 respectively with a corresponding z-critical value of 1.64, which is the same for all parameters. Based on this result, here we are not able to reject the null hypothesis. As shown in Table 5, there is no discernible difference between HB, MCV, MCH, and HCT. Fig. 2 represents the average value in significant parameters of the study population.

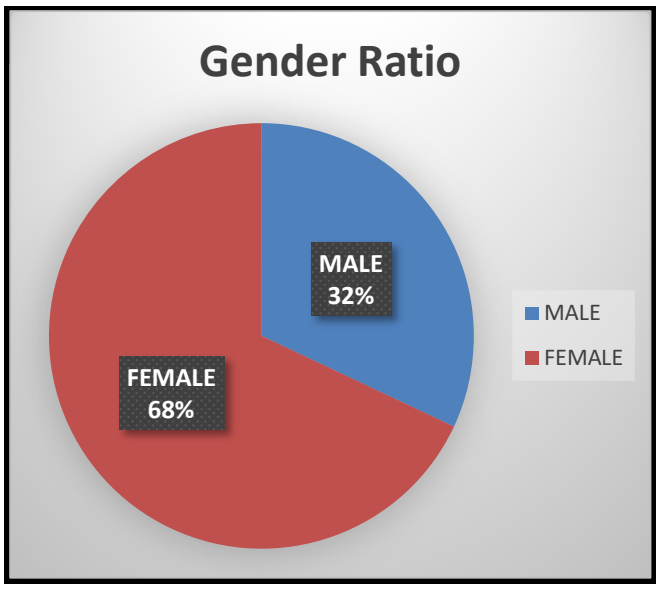

Fig .1 Pie chart showing the gender ratio

Table 1. The overall characteristics of the patients enrolled in this study.

Main category(n=100)	Subcategories	Frequency	Percentage
Gender	F	68	68.0
	M	32	32.0
HB	Low	64	64.0
	Normal	36	36.0
RBC	High	9	9.0
	Low	51	51.0
	Normal	40	40.0
Platelet	High	4	4.0
	Low	7	7.0
	Normal	89	89.0
HCT	Low	81	81.0
	Normal	19	19.0
MCV	High	1	1.0
	Low	61	61.0
	Normal	38	38.0
MCH	High	1	1.0
	Low	56	56.0
	Normal	43	43.0
MCHC	High	2	2.0
	Low	25	25.0
	Normal	73	73.0
RDW	High	75	75.0
	Low	1	1.0
	Normal	24	24.0
TSH	High	60	60.0
	Normal	40	40.0
T3	High	1	1.0
	Low	21	21.0
	Normal	78	78.0
T4	High	6	6.0
	Low	22	22.0
	Normal	72	72.0

Table 2. Descriptive analysis of a patient with hypothyroidism

Parameters	N (subject)	Mean	Standard deviation
RBC	100	4.46	0.79
WBC	100	10640.63	11877.67
HB	100	11.27	2.02
HCT	100	35.22	5.88
PLT	100	322600.00	384636.25
MCV	100	79.27	9.74
MCHC	100	31.96	1.40
MCH	100	25.42	3.86
TSH	100	18.91	42.66
RDW	100	16.06	3.85
T4	100	7.88	2.78
T3	100	1.25	0.80

Table 3. General characteristics and parameters differentiated by gender.

Parameters	Gender	N	Mean	Std.Deviation	P value
HB	female	68	11.20	1.77	0.012
	male	32	11.40	2.49	
RBC	female	68	4.45	0.69	0.091
	male	32	4.47	1.00	
WBC	female	68	10461.22	13284.95	0.946
	male	32	11021.88	8299.20	
PLT	female	68	349264.7	459854.6	0.464
	male	32	265937.5	102742.1	
HCT	female	68	35.18	5.14	0.28
	male	32	35.29	7.30	
MCV	female	68	78.58	9.37	0.384
	male	32	80.72	10.47	
MCHC	female	68	31.81	1.34	0.847
	male	32	32.28	1.50	
MCH	female	68	25.08	3.64	0.389
	male	32	26.16	4.25	
RDW	female	68	16.16	4.35	0.382
	male	32	15.85	2.53	
TSH	female	68	14.67	20.02	0.003
	male	32	27.92	69.45	
T3	female	68	1.37	0.927	0.112
	male	32	0.98	0.35	
T4	male	68	8.16	2.93	0.343
	female	32	7.28	2.36	

Table 4. Showing the normality test between all parameters.

Parameters	Statistic	Significant
HB	0.63	0.200
RBC	0.92	0.037
WBC	0.307	.000
PLT	0.330	.000
HCT	0.071	0.200
MCV	0.075	0.179
MCH	0.078	0.141
MCHC	0.079	0.123
RDW	0.195	0.000
TSH	0.352	0.000
T3	0.158	0.000
T4	0.116	0.002

Table 5. Showing z-test for significant parameters HB, MCV, MCH and HCT

PARAMETER	GENDER	Mean	Known Variance	Observations	P(Z<=z) one-tail	z Critical one-tail	P(Z<=z) two-tail	z Critical two-tail
HB	Male	11.40	6.24	32	0.35	1.64	0.71	1.95
	Female	11.22	3.18	68				
HCT	Male	35.29	53.29	32	0.47	1.64	0.94	1.95
	Female	35.18	26.52	68				
MCV	Male	80.72	76	32	0.12	1.64	0.25	1.95
	Female	78.58	83.4	68				
MCH	Male	26.16	25.1	32	0.13	1.64	0.27	1.95
	Female	25.08	13.3	68				

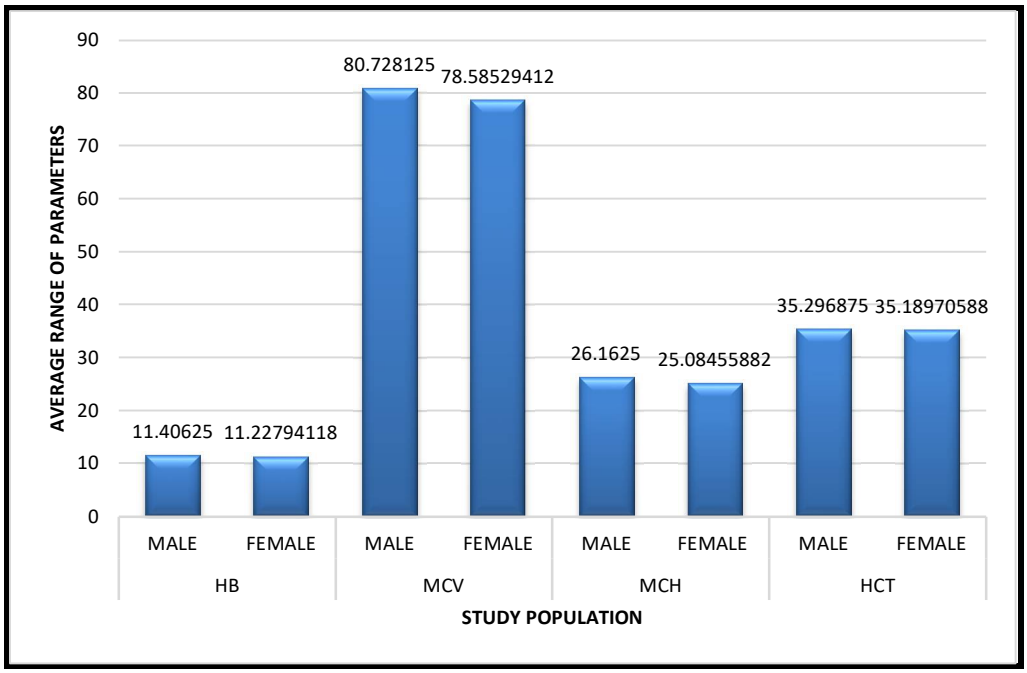

Fig .2 Graph representing average value in significant parameters of the study population.

DISCUSSION

Thyroid hormone is crucial to produce blood and therefore thyroid dysfunction should be investigated to see if there is a change in the parameters in the blood chemistry. The prevalence of hypothyroidism in India is around 11% (2). The thyroid gland is especially important for body metabolism and haematopoiesis. They control the bone marrow's sanguification. They focus on the development of haemoglobin in foetuses as well as its production in adults. They promote the growth of erythroid progenitor cells, which boosts erythropoiesis. By controlling the expression of the erythropoietin gene and renal synthesis of erythropoietin, they boost the production of erythropoietin (EPO). Because thyroid hormones are essential for the formation of red blood cells, patients with thyroid illnesses frequently experience blood problems. Studying the effect of thyroid dysfunction on haematological parameters is important because it can help us to know the cause of disease that occurs due to variations in blood parameters like anaemia with different severity of thrombocytopenia, and leukopenia. This information can be used to improve the diagnosis and better treatment of this condition. Monitoring haematological indications in thyroid dysfunction patients can aid in determining who is more likely to experience cardiovascular illness, a common outcome of thyroid dysfunction. According to the findings of this study, CBC in hypothyroidism needs to be investigated. Samia Karkoutly *et al* stated that the hypothyroid group had noticeably higher levels of RDW and noticeably lower levels of HB, HCT, MCV, and MCH. Additionally, when they compared male and female patients, they had significantly greater levels of RDW and significantly lower levels of RBC, haemoglobin, haematocrit, MCV, and MCH. TSH and RDW in the hypothyroid group showed a weak but similar relationship. In patients who were female, these effects were more striking (4). According to this study conducted on male and female groups of hypothyroidism, there are significantly lower levels of HB, RBC, WBC, MCV, MCH, and HCT, and greater levels of RDW in the female group compared to males. Most haematology measures are directly affected by hypothyroidism. Female patients were more affected by thyroid dysfunction. Abtie Abebaw, *et al* findings revealed that there was a statistically significant decrease in RBC count, HB, HCT, MCV, MCH, MCHC, MPV, and PLT counts when thyroid dysfunction patients were compared with apparently healthy controls (p-value 0.05). However, there was no discernible impact on monocytes, eosinophils, or basophils (p-value> 0.05) (3). By the result obtained in this study, hypothyroid patients have decreased levels of HB, RBC, PVC, MCV, and MCH and high levels of RDW. As the CBC plays an important role in blood formation and shows variations in blood parameters, it is essential to look into thyroid dysfunction. Geetha JP, *et al* stated in their paper that patients with hypothyroidism have an increased value of RDW and a low value of MCV (7). which has results similar to this study, where RDW is increased and MCV is decreased. RDW value is higher in females compared to males. Mohamed Abd El*, et al* findings suggest that there are no commonalities in WBC count, and differentiation platelet count in hypothyroidism(8). Similarly, in this study platelet and WBC count are normal in hypothyroid patients,

platelet value is higher in female compared to male, and WBC count are low in female compared to male patients. Fakhredin Saba *et al* concluded that thyroid hormones had an impact on the rate of RBC, hemoglobin, and hematocrit formation. However, in hypothyroid groups, they found normal MCV. There might be processes that compensate for normal MCV. However, it is imperative to identify the fundamental reasons for anemia, particularly in cases of severe hypothyroidism. This study shows that a severe fall in thyroid hormone levels can cause a marked decrease in RBC count, hemoglobin, and HCT level (9). According to data obtained in this study, there is decreased value in MCV, HB, RBC count, and HCT. Kawa *et al* reported that though HCT had increased in hypothyroidism, RBC and HB were decreased. They also demonstrated that hypothyroid people had higher MCV and reduced MCH and MCHC(10). Accordingly, in this study also HB, RBC, HCT, MCH, and MCV levels are low. Similar studies need to be conducted with additional parameters and sample sizes.

CONCLUSION

This study concludes that HB, RBC, HCT, MCV, and MCH are the mostly affected blood parameters in hypothyroidism. This study shows that hypothyroid patients tend to have low levels of HB, RBC, HCT, MCH, and MCV and higher levels of RDW. Platelets and RDW are higher in females compared to males. These changes occur due to the effects of thyroid hormone on blood parameters, as it plays an important role in blood formation and the overall metabolism of the body. The mean values of HB, RBC, WBC, HCT, MCV, MCH, and MCHC are lower in female patients compared to males, so we can say that females are more affected than males by thyroid dysfunction. Early investigation of CBC in the thyroid can help us in the diagnosis of diseases like anemia, thrombocytopenia, leukopenia, and erythrocytosis caused due to abnormal blood parameters. Further, this study can be modified by studying more parameters like differential count (eosinophil, monocyte, neutrophils, basophils) and platelets count (mean platelet volume, platelet distribution width) with more sample size to know the exact cause that how thyroid hormone affects the production of blood in our body as it play important role in blood formation. Mostly all studies related to this topic are studied between hypothyroid and hyperthyroid, very few studies are been carried out on male and female patients of hypothyroid dysfunction and very less studies are done on parameters like differential count and platelet count.

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