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The relationship between thyroid stimulating hormone, thyroid hormones and lipid profile in patient sample of thyroid disorders

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Abstract

The thyroid hormones regulate synthesis, mobilization, and breakdown of lipids. Lipid profiles are often negatively altered by thyroid dysfunction, which is becoming increasingly prevalent. **Objectives:** The current study aimed to evaluate the association between serum levels of thyroid-stimulating hormone and thyroid hormones and the lipid profile in patients with thyroid disorders. **Materials and Methods:** The study included 100 participants, aged between 18 and 65 years. Participants were recruited from endocrinology clinics at hospitals in Al-zawia, Surman, Sabratha, and the neighboring regions. Participants were divided into two groups: Group (1): 50 healthy individuals as control. Group (2): 50 patients with thyroid dysfunction. A 5 ml blood sample was collected from each participant after 12 hours of fasting. TSH, T4 & T3 hormones, total cholesterol, triglycerides, HDL, LDL, and VLDL were measured. The associations between TSH levels and thyroid hormone and lipid profile levels were assessed using the Chi-square test, t-test, and Spearman correlation using SPSS version 26. **Results:** The distribution of thyroid disorder patients according

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gender were 86% females and 14% males, according age groups were 04%, 10%, 36%, and 50% in age groups ≤30, 31-40, 41-50, and >50 years, respectively, according body weight groups were 06%, 56%, and 38% in body weight groups ≤60, 61-90, and >90 kg, respectively. 46% of the thyroid disorder patients had chronic diseases, including 22% hypertension, 20% diabetes mellitus, 6% heart diseases, 6% hemodialysis, and 4% cancer. The mean of TSH levels was significantly ($P<0.05$) increased in patients compared with the control group, was significantly ($P<0.01$) increased in the hypothyroidism group compared with the euthyroid group in thyroid disorder patients, but significantly ($P<0.01$) decreased in females compared with male thyroid disorder patients. The mean of T3 levels was significantly ($P<0.01$) decreased in patients compared with the control group. The mean of T4 levels was significantly ($P<0.01$) decreased in the hypothyroidism group compared with the euthyroid group. The levels of lipid profiles were showed variations and correlations with TSH, T3, T4. **Conclusion:** It can be concluded that the thyroid dysfunction patients were 86% female, 50% in the age group >50 years, 56% and 38% in body weight groups 61-90 and >90 kg, 62% had secondary education. The mean duration of thyroid disorder and medication was 5.8 ± 1.2 and 5.0 ± 1.1 years. The levels of thyroid hormones and lipid profiles were showed variations and correlations with each other.

Keywords: Thyroid disorders, TSH, T3, T4, Lipid Profile, Correlation, Surman region, Western Libya

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تقييم العلاقة بين مستوى هرمون تحفيز الغدة الدرقية وهرمونات الغدة الدرقية ومستوى الدهون في عينة من مرضى اضطرابات الغدة الدرقية

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الملخص

تنظم هرمونات الغدة الدرقية تخليق الدهون وتعبئتها وتكسيرها. غالبًا ما تتغير ملامح الدهون سلبًا بسبب خلل الغدة الدرقية، والذي أصبح منتشرًا بشكل متزايد. الأهداف: هدفت الدراسة الحالية إلى تقييم العلاقة بين مستويات هرمون تحفيز الغدة الدرقية في المصل وهرمونات الغدة الدرقية وملف الدهون لدى المرضى الذين يعانون من اضطرابات الغدة الدرقية. المواد والطرق: شملت الدراسة 100 مشارك تتراوح أعمارهم بين 18 و65 عامًا. تم تجنيد المشاركين من عيادات الغدد الصماء في مستشفيات الزاوية وصرمان وصبراتة والمناطق المجاورة. تم تقسيم المشاركين إلى مجموعتين: المجموعة (1): 50 فردًا سليمًا كمجموعة ضابطة. المجموعة (2): 50 مريضًا يعانون من خلل في الغدة الدرقية. تم جمع عينة دم 5 مل من كل مشارك بعد 12 ساعة من الصيام. تم قياس هرمونات TSH وT4 وT3 والكوليسترول الكلي والدهون الثلاثية وHDL وLDL وVLDL. تم تقييم الارتباطات بين مستويات TSH وهرمون الغدة الدرقية ومستويات الدهون باستخدام اختبار مربع كاي واختبار t وارتباط سبيرمان باستخدام برنامج SPSS الإصدار 26. النتائج: كان توزيع مرضى اضطراب الغدة الدرقية حسب الجنس 86٪ إناث و14٪ ذكور، وفقًا للفئات العمرية كانت 04٪ و10٪ و36٪ و50٪ في الفئات العمرية ≥30 و31-40 و41-50 و> 50 عامًا على التوالي، وفقًا لمجموعات وزن الجسم كانت 06٪ و56٪ و38٪ في مجموعات وزن الجسم ≥60 و61-90 و> 90 كجم على التوالي. كان لدى 46٪ من مرضى اضطراب الغدة الدرقية أمراض مزمنة، بما في ذلك 22٪ ارتفاع ضغط الدم و20٪ داء السكري و6٪ أمراض القلب و6٪ غسيل الكلى و4٪ السرطان. كان متوسط مستويات TSH أعلى بشكل ملحوظ (P <0.05) في المرضى مقارنة بالمجموعة

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الضابطة، وأعلى بشكل ملحوظ (P <0.01) في مجموعة قصور الغدة الدرقية مقارنة بالمجموعة السليمة في مرضى اضطراب الغدة الدرقية، ولكنه انخفض بشكل ملحوظ (P <0.01) في الإناث مقارنة بمرضى اضطراب الغدة الدرقية من الذكور. انخفض متوسط مستويات T3 بشكل ملحوظ (P <0.01) في المرضى مقارنة بالمجموعة الضابطة. انخفض متوسط مستويات T4 بشكل ملحوظ (P <0.01) في مجموعة قصور الغدة الدرقية مقارنة بالمجموعة السليمة. أظهرت مستويات الملامح الدهنية اختلافات وارتباطات مع TSH وT3 وT4. الاستنتاج: يمكن الاستنتاج أن مرضى خلل وظائف الغدة الدرقية كانوا 86٪ من الإناث، و50٪ في الفئة العمرية> 50 عامًا، و56٪ و38٪ في مجموعات وزن الجسم 61–90 و> 90 كجم، وكان 62٪ حاصلين على تعليم ثانوي. كان متوسط مدة اضطراب الغدة الدرقية والعلاج ٥,٨ ± ١,٢ و٥,٠ ± ١,١ سنة. وأظهرت اختلافات وارتباطات بين مستويات هرمونات الغدة الدرقية ومستويات الدهون.

الكلمات المفتاحية: اضطرابات الغدة الدرقية، TSH، T3، T4، مستوى الدهون، الارتباط، منطقة صرمان، غرب ليبيا

1. Introduction

The thyroid gland, situated in the front of the neck, produces the chemicals known as thyroid hormones. It converts iodine into the hormones thyroxine and triiodothyronine (Duntas, 2002, Al-Odat *et al.*, 2024). The anterior pituitary gland produces thyroid-stimulating hormone, which is in turn controlled by thyrotropin-releasing hormone that is generated in the hypothalamus (Shahid *et al.*, 2018, Al-Odat *et al.*, 2024).

Thyroid hormones are essential for controlling cell metabolism because they preserve the amounts of phospholipids in cell membranes and the fatty acid makeup of lipids. All facets of metabolism, particularly lipid metabolism, including synthesis, mobilization, and breakdown, are known to be impacted by thyroid hormones (Pucci *et al.*, 2000, Peppa *et al.*, 2011, Jawzal *et al.*, 2022). Thyroid dysfunction is becoming more common and frequently results in negative changes to lipid profiles. Dyslipidemia is a risk factor for cardiovascular disease (Al-Odat *et al.*, 2024). Patients with subclinical hypothyroidism have changes in both LDL-c and HDL-c (Jawzal *et al.*, 2022). Thyroid disease may lead to lipid abnormalities that are associated with endothelium dysfunction, diastolic hypertension, and cardiovascular disease (Duntas, 2002).

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Numerous variables, including iodine consumption and ethnic, age, and regional characteristics, may contribute to the prevalence of thyroid dysfunction in the general population. Four to ten percent of persons have subclinical hypothyroidism, and one to two percent have hyperthyroidism (Taylor *et al.*,2018, Jawzal *et al.*, 2022).
Thyroid disorders cause significant disruptions in the transit and composition of lipoproteins. Hypercholesterolemia and a significant rise in low-density lipoproteins (LDL) and apolipoprotein B (apo A) are hallmarks of overt hypothyroidism. This is due to a lower fractional clearance of LDL via fewer LDL receptors in the liver. Because thyroid hormones regulate the activity of the enzymes cholesteryl-ester transfer protein and hepatic lipase, high-density lipoprotein (HDL) levels are normal or even higher in severe hypothyroidism (Duntas, 2002). 3-hydroxy-3-methyl-glutaryl coenzyme A reductase in the liver catalyzes the creation of cholesterol, which is stimulated by thyroid hormones. According to Loh *et al.* (2019) and Jawzal *et al.* (2022), thyroid hormones influence the activity of lipoprotein lipase, which promotes the hydrolysis of triglycerides in chylomicrons, breaking them down into their constituent fatty acids and glycerol. Alteration in lipid profile is a common observation in patients with thyroid dysfunction (Chin *et al.*, 2014). Patients with thyroid dysfunctions have a definite correlation between thyroid hormones and lipid metabolism. Triglyceride and cholesterol values are higher in overt hypothyroid individuals and lower in overt hyperthyroid patients. These findings have been demonstrated to extend beyond the subclinical hypo/hyperthyroid range, indicating that thyroid-stimulating hormone influences lipid metabolism independently of thyroid hormones (Peppa *et al.*, 2011).
Thyroid hormones are chemical substances produced by the thyroid gland, which is located in the front of the neck and uses iodine to make thyroxine and triiodothyronine hormones (Duntas, 2002, Al-Odat *et al.*, 2024). The thyroid gland is regulated by thyroid-stimulating hormone, produced by the anterior pituitary gland, which is in turn regulated by thyrotropin-releasing hormone synthesized in the hypothalamus (Shahid *et al.*, 2018, Al-Odat *et al.*, 2024).

2. Objectives

The current study was aimed to investigate the distribution of thyroid dysfunction according to gender, age and body weight

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groups, determine the levels of thyroid hormones and lipid profiles, and assessment of the correlation between serum levels of thyroid stimulating hormone with thyroid hormones and lipid profile in patients with thyroid disorders.

3. Materials and Methods

3.1. Study Population

This study included 100 participants, aged between 18 and 65 years. Participants were divided into two groups: Group (1): 50 healthy individuals as control. Group (2): 50 patients with thyroid dysfunction. Participants were recruited from endocrinology clinics at hospitals in Alzawia, Surman , Sabratha, and surrounding areas.

3.2. Blood collection

A 5 ml blood sample was collected from each participant after 12 hours of fasting. Lipid profiles including total cholesterol (TC), and triglycerides (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL) were analyzed using enzymatic colorimetric methods. The blood was analyzed for thyroid hormones: T3, T4, and TSH levels to assess thyroid function. TSH ,T4, T3 hormones were measured using electrochemiluminescence with the COBAS e 411 machine (Roche, Germany). Lipid Profile Tests: The levels of total cholesterol, triglycerides, LDL, and HDL were measured using Evolution 3000.

3.3. Statistical analysis

SPSS version 26 was used to analyze the data. Throughout, the Chi-square test, t-test, and Spearman correlation were used to evaluate the relationships between TSH levels with thyroid hormone and lipid profile levels. Data were expressed as mean ± SE. All statistical tests were considered significant if the P-value was less than 0.05.

4. Results

4.1. Distribution of thyroid disorder patients and controls according to gender

Data in figure (1) show the distribution of thyroid disorder patients and controls according to gender. The females were 38 subjects (76%) in control group and 43 subjects (86%) in thyroid disorder patients but, the males were 12 subjects (24%) in control group and 07 subjects (14%) in thyroid disorder patients.

4.2. Distribution of thyroid disorder patients and controls according to age groups

Data illustrated in figure (2) show the distribution of thyroid disorder patients and controls according to age groups. The

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distribution of thyroid disorder patients and controls according to age groups were 16%, 10%, 28%, and 46% in the control group, and 04%, 10%, 36%, and 50% in the thyroid disorder patients in age groups ≤30, 31-40, 41-50, and >50 years, respectively.

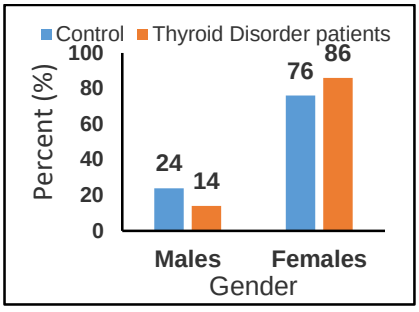

Figure.1: Distribution of thyroid disorder patients and controls according to gender

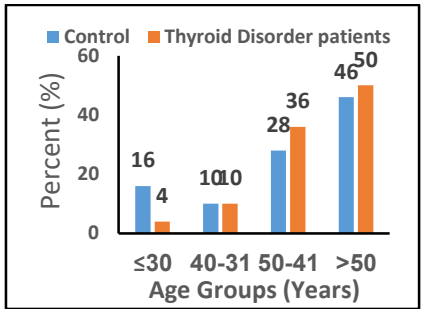

Figure.2: Distribution of thyroid disorder patients and controls according to age groups

4.3. Distribution of thyroid disorder patients and controls according to body weight groups

The distribution of thyroid disorder patients and controls according to body weight groups were 06%, 64%, and 36% in the control group, and 06%, 56%, and 38% in the thyroid disorder patients in body weight groups ≤60, 61-90, and >90 Kg., respectively (Figure. 3).

4.4. Distribution of thyroid disorder patients and controls according to the level of education

Figure (4) revealed that the distribution of thyroid disorder patients according to the level of education was 19 subjects (38%) primary education and 31 subjects (62%) secondary education.

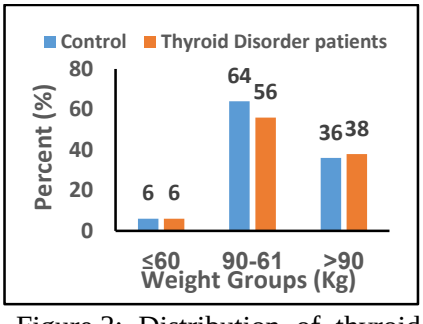

Figure.3: Distribution of thyroid disorder patients and controls according to body weight groups

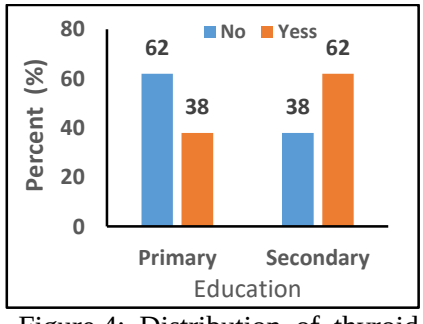

Figure.4: Distribution of thyroid disorder patients according to education

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4.5. Distribution of thyroid disorder patients according to chronic diseases

Data in the figure (5) show the distribution of thyroid disorder patients according to chronic diseases. The results indicated that 23 of the thyroid patients (46%) had chronic diseases, including 22% hypertension, 20% diabetes mellitus, 06% heart diseases, 06% hemodialysis, and 04% cancer.

4.6. Duration of Thyroid Disorder and Medication

The mean and standard error of duration of thyroid disorder and medication were 5.8 ± 1.2 and 5.0 ± 1.1 years, respectively as shown in the figure (6). The mean of duration of thyroid disorder and medication in both gender showed a none significant differences between males [(2.3 ± 0.5) & (2.2 ± 0.4) years] and females [(6.41± 1.3), (5.4 ± 1.2) years] patients, respectively (Figure.7). In addition, the mean of duration of thyroid disorder and medication showed none significant differences between patients with euthyroids, subclinical hypothyroidism, and hypothyroidism patients, 6.3 ± 1.5, 7.2 ± 3.6, 2.6 ± 0.6, 5.2 ± 1.4, 6.4 ± 3.5, 2.6 ± 0.6 years, respectively (Figure. 8).

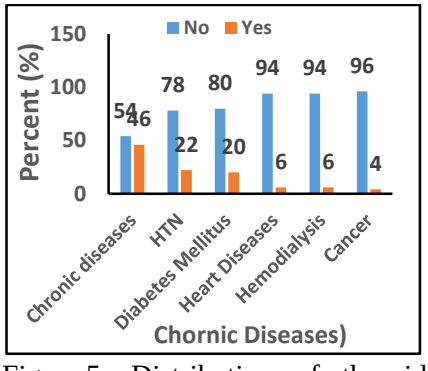

Figure.5: Distribution of thyroid disorder patients and controls according to chronic diseases

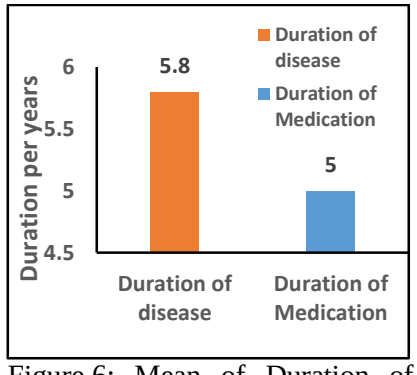

Figure.6: Mean of Duration of thyroid Disorder and Medication

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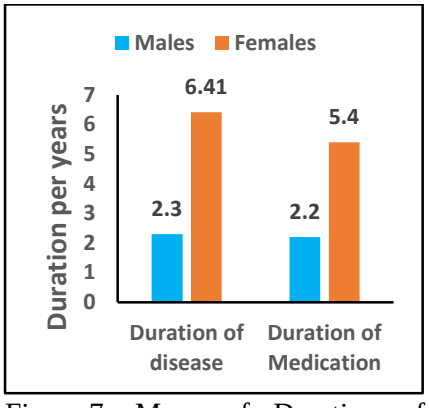

Figure.7: Mean of Duration of thyroid Disorder and Medication in both gender

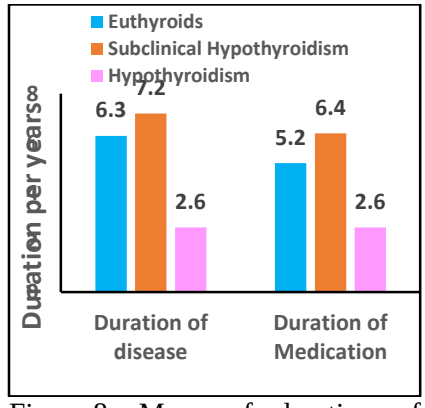

Figure.8: Mean of duration of thyroid disorder and medication in patients with euthyroids, sub-clinical hypothyroidism and hypo-thyroidism patients

4.7.1. Thyroid hormones levels in thyroid disorder patients and controls

Data analysis in figures (9 & 10) show the levels of thyroid hormones in thyroid disorder patients and controls. The mean of TSH levels were significantly ($P<0.05$) increased (4.54 ± 1.16) in thyroid disorder patients compared with the control group (2.11 ± 0.18). While, the mean of T_3 levels were significantly ($P<0.01$) decreased (1.96 ± 0.14) in thyroid disorder patients compared with the control group (7.56 ± 3.97). The mean of T_4 levels were none significantly ($P>0.05$) changed (109.07 ± 6.52) in thyroid disorder patients compared with the control group (108.20 ± 5.95).

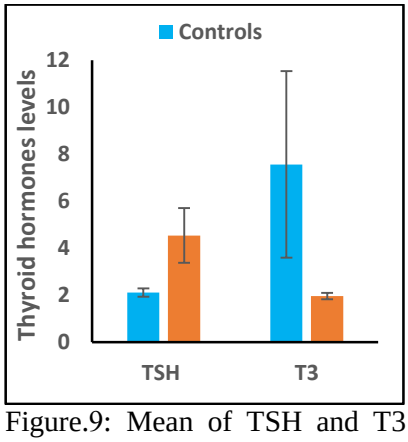

Figure.9: Mean of TSH and T3 levels in thyroid disorder patients and controls

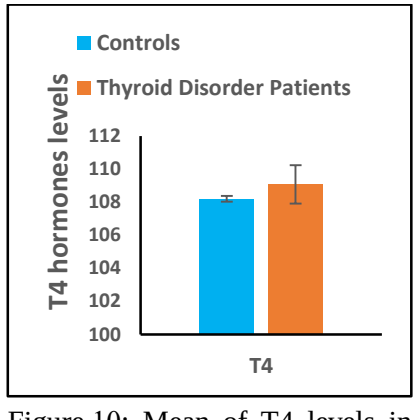

Figure.10: Mean of T4 levels in thyroid disorder patients and controls

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4.7. 2. Thyroid hormones levels in both gender of thyroid disorder patients

The mean of TSH levels were significantly (*P<0.01*) decreased (3.63 ± 0.520) in females compared with males thyroid disorder patients (12.404± 10.54). But, the mean of T_3 and T_4 levels were none significantly (*P>0.05*) changed (109.07 ± 6.52), (1.96 ± 0.264) in females compared with males thyroid disorder patients (113.8 ± 20.76), (1.95 ± 0.264), respectively (Figures 11 & 12).

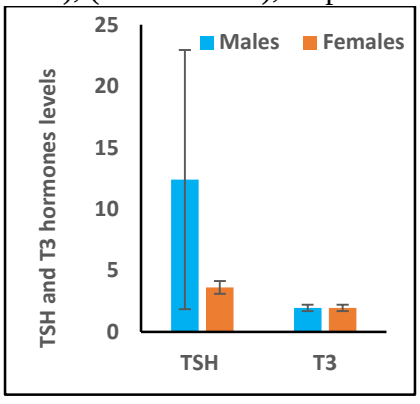

Table.11: Mean of TSH and T3 hormones levels in both gender

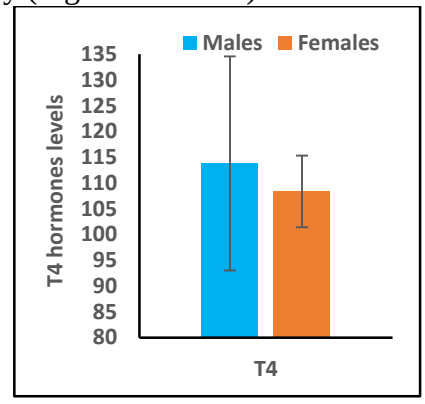

Figure.12: Mean of T4 hormones levels in both gender

4.7. 3. Thyroid hormones levels in thyroid disorder patients according to TSH levels

The mean of TSH levels were significantly (*P<0.01*) increased (32.4 ± 9.1) in hypothyroidism group compared with euthyroids group (2.3 ± 0.2) in thyroid disorder patients. The mean of T_4 levels were significantly (*P<0.01*) decreased (74.8±2.0) in hypo-thyroidism group compared with euthyroids group (110.9 ± 6.2) in thyroid disorder patients. (Figures 13 & 14). But, the mean of T_3 levels were none significantly (*P>0.05*) changed (1.5 ± 0.09) in hypothyroidism group compared with euthyroids group (2.1 ± 0.1) in thyroid disorder patients.

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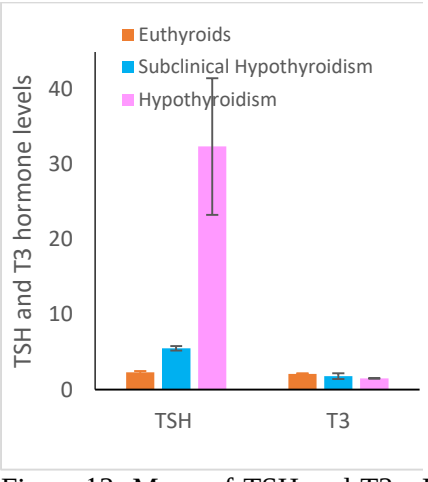

Figure.13: Mean of TSH and T3 hormones levels in thyroid disorder patients according to TSH levels

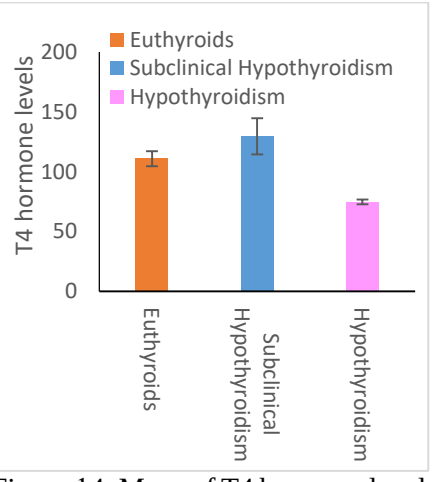

Figure.14: Mean of T4 hormone levels in thyroid disorder patients according to TSH levels

4.8.1. Lipids profile levels in thyroid disorder patients and controls

The levels of serum triglycerides, Cholesterol, and LDL showed none significant alteration in thyroid disorder patients compared to the control group. But, the levels of serum HDL, and VLDL showed a significant alteration in thyroid disorder patients compared to the control group (Figure. 15)

4.8.2. Lipids profile levels in both gender thyroid disorder patients

The levels of serum triglycerides, Cholesterol, HDL, LDL, and VLDL were showed a none significant alteration in females compared to males thyroid disorder patients group (Figure. 16).

4.8.3. Lipids profile levels in thyroid disorder patients according to TSH levels

The mean of serum triglycerides and LDL levels were significantly ($P<0.01$) increased in subclinical hypothyroidism group (164.6 ± 17.3), (125.4 ± 13.8), and hypothyroidism group (186.6 ± 29.6), (137.2 ± 11.0) compared with euthyroids group (113.4 ± 10.1), (112.5 ± 5.8) in thyroid disorder patients, respectively. Also, the mean of serum VLDL levels were significantly ($P<0.01$) increased in subclinical hypothyroidism group (29.1±3.3) compared with euthyroids group (18.9±1.4) in thyroid disorder patients. In addition, the serum cholesterol levels were significantly ($P<0.05$) increased

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in hypothyroidism group (240.6 ± 8.4) compared with euthyroids group (186.9 ± 6.8) in thyroid disorder patients (Figure.17).

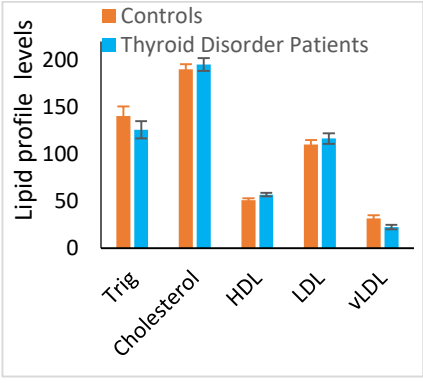

Figure.15: Mean of lipids profile levels in thyroid disorder patients and controls

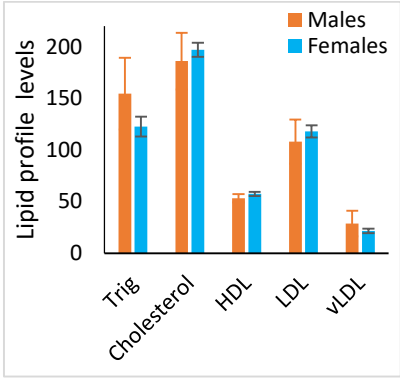

Figure.16: Mean of lipids profile levels in both gender

4.9.1. The distribution of lipids profile levels in thyroid disorder patients

Data in figure (18) illustrate the distribution of lipids profile levels in thyroid disorder patients. The statistical analysis showed that 48%, 34%, 36%, and 6% of thyroid disorder patients has >200 mg/dl of serum cholesterol, >150 mg/dl of serum triglycerides, >130 mg/dl of serum LDL, and >30 mg/dl of serum VLDL levels, respectively and 2% of thyroid disorder patients has serum levels of HDL <30 mg/dl.

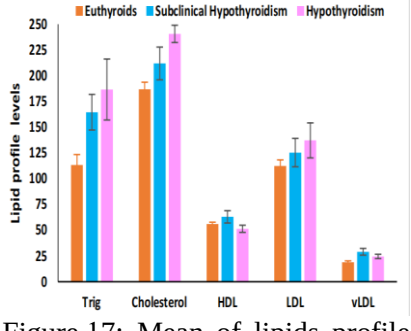

Figure.17: Mean of lipids profile levels in thyroid disorder patients according to TSH levels

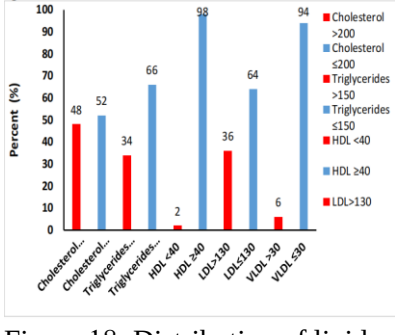

Figure.18: Distribution of lipids profile levels in thyroid disorder patients

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4.9.2. The distribution of lipids profile levels in both gender of thyroid disorder patients

The distribution of lipids profile levels in both gender of thyroid disorder patients are shown in figure (19). There are a significant (*P<0.01*) increase in the percent of females (51.2%) has >200 mg/dl of serum cholesterol compared with males thyroid disorder patients (28.6%). However, there are a significant (*P<0.01*) increase in the percent of males (14.3%) has >30 mg/dl of serum VLDL compared with females thyroid disorder patients (4.7%).

4.9.3. The distribution of lipids profile levels in thyroid disorder patients according to TSH levels

The data shown in figure (20) illustrate the distribution of lipids profile levels in thyroid disorder patients according to TSH levels. The distribution of lipids profile levels in thyroid disorder patients according to TSH levels showed a significant (*P<0.01*) increased in the percent of >200 mg/dl of serum cholesterol, >150 mg/dl of serum triglycerides, >130 mg/dl of serum LDL, and >30 mg/dl of serum VLDL levels, in subclinical hypothyroidism and hypothyroidism groups.

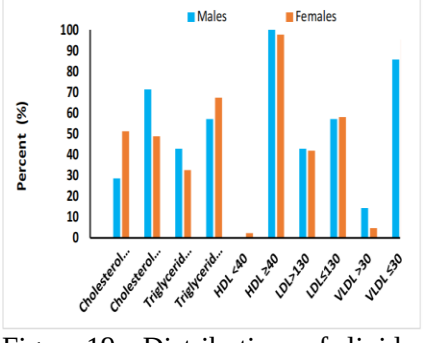

Figure.19: Distribution of lipids profile levels in both gender of thyroid disorder patients.

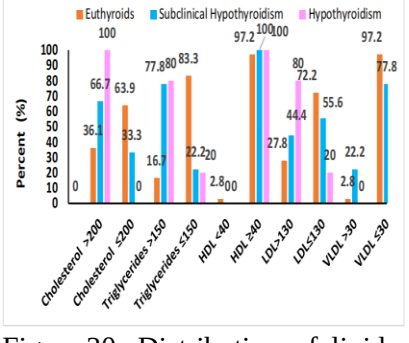

Figure.20: Distribution of lipids profile levels in both gender of thyroid disorder patients according to TSH levels

4.10. Correlation between TSH levels with T4, T3, and lipids profile levels in thyroid disorder patients

The correlation between TSH levels with T4, T3, and lipid profile levels in thyroid disorder patients is shown in figures (21-27). The statistical analysis shows a significant positive correlation between TSH levels and serum triglycerides and VLDL levels and a nonsignificant positive correlation with serum cholesterol and LDL

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levels. On the other hand, there was a non-significant negative correlation between TSH levels and T4, T3, and HDL levels.

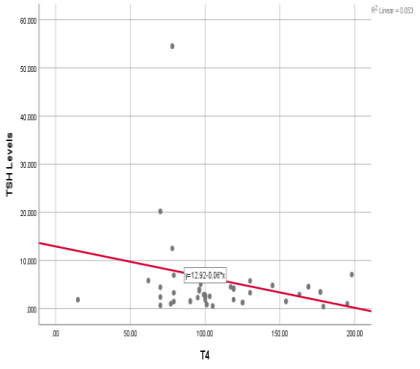

Figure.21: Correlation between TSH levels with T4 levels in thyroid disorder patients

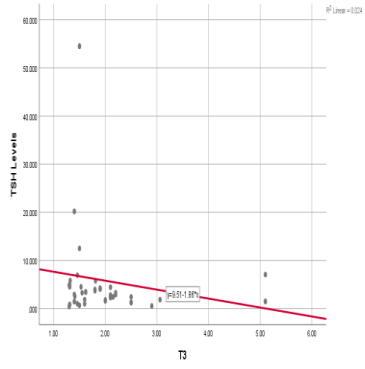

Figure.22: Correlation between TSH levels with T3 levels in thyroid disorder patients

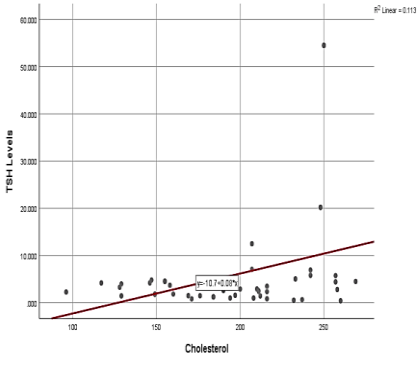

Figure.23: Correlation between TSH levels with cholesterol levels in thyroid disorder patients

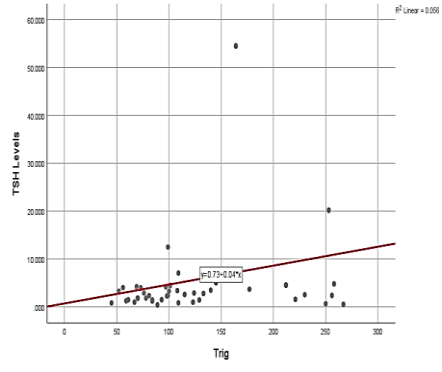

Figure.24: Correlation between TSH levels with triglycerides levels in thyroid disorder patients

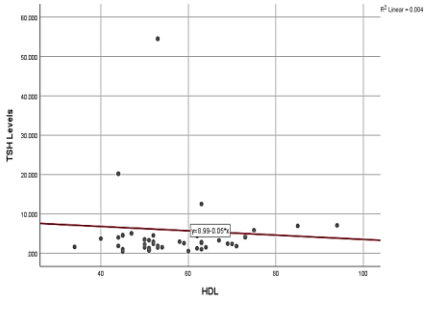

Figure.25: Correlation between TSH levels with HDL levels in thyroid disorder patients

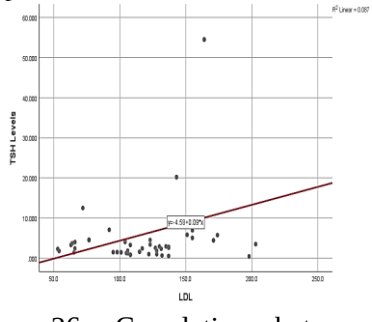

Figure.26: Correlation between TSH levels with LDL levels in thyroid disorder patients

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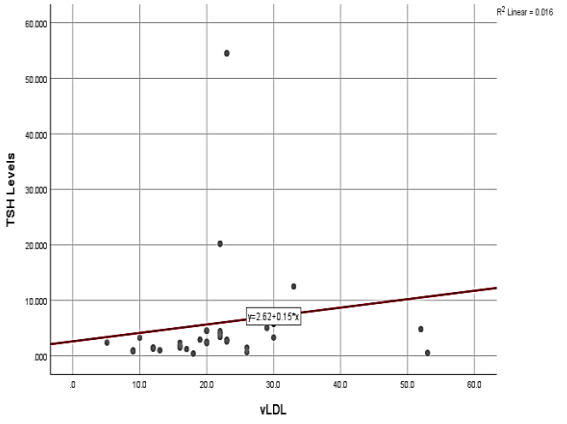

Figure.27: Correlation between TSH levels with VLDL levels in thyroid disorder patients

4.11. Correlation between TSH levels with gender, age, and body weight in thyroid disorder patients

Figure (28) show a significant (*P<0.05*) negative correlation between TSH levels with age (r=-0.295).

4.12. Correlation between TSH levels with education level in thyroid disorder patients

There were a significant (*P<0.01*) positive correlation between TSH levels and education level (Figure. 29).

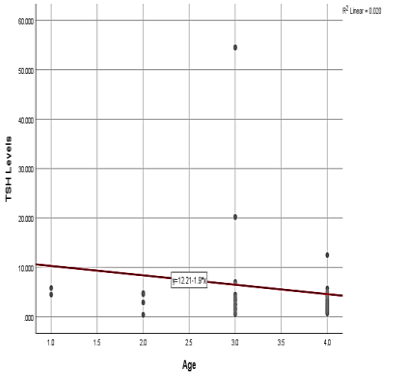

Figure.28: Correlation between TSH levels with gender in thyroid disorder patients

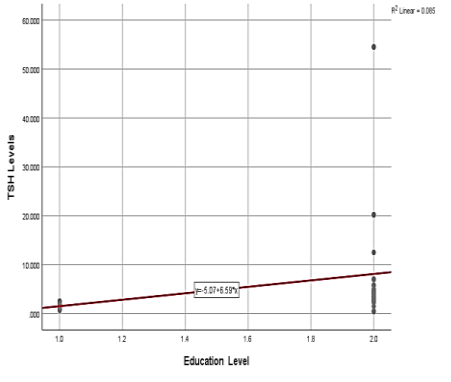

Figure.29: Correlation between TSH levels with primary education level in thyroid disorder patients

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4.13. Correlation between TSH levels with duration of disease and medication, and chronic disease in thyroid disorder patients

The statistical analysis of results showed that there were a positive none significant (*P>0.05*) correlation between TSH levels with chronic diseases and a negative none significant (*P>0.05*) correlation with duration of disease and medication, DM, Heart disease, Hemodialysis, and Cancer (Table. 1).

Table.1: Correlation between TSH levels with duration of disease and medication, and chronic disease in thyroid disorder patients

Parameters	Correlation Coefficient	P-Value
Chronic disease	0.043	0.767
Duration of disease	-0.300	0.101
Duration of Medication	-0.125	0.509
HTN	0.000	1.000
DM	-0.200	0.163
Heart disease	-0.124	0.392
Hemodialysis	-0.015	0.918
Cancer	-0.183	0.203

5. Discussion

This study included 100 participants, aged between 18 and 65 years, 50 healthy individuals as control and 50 patients with thyroid dysfunction. Participants were recruited from endocrinology clinics in hospitals in Alzawia, Surman, Sabratha, and surrounding areas to investigate the distribution of thyroid dysfunction according to gender, age and body weight groups, determine the levels of thyroid hormones, and lipid profiles and assessment of the correlation between serum levels of thyroid stimulating hormone with thyroid hormones and lipid profile in patients with thyroid disorders in the Surman region, western Libya.

Numerous hormonal systems are closely linked to the production, transport, and metabolism of lipid species, with thyroid hormones serving as a key regulator of lipid homeostasis. (Hollenberg & Forrest, 2008, Nicolaou& Toumba, 2024).

The present study showed that the distribution of thyroid disorder patients according to gender were 86% females and 14% males and according age groups were 04%, 10%, 36%, and 50% in age groups ≤30, 31-40, 41-50, and >50 years, respectively. Simillarly, Genez Yeza *et al.* 2021 reported that of the participants, 84% were women, and the median age was 36 (32-43) years for women and 39 (35-47) years for males. Also, the findings of Al-Odat *et al.*, 2024 indicated

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that females are more likely to have a thyroid dysfunction. In addition, Kebamo *et al.,* 2025 mentioned that more than 75% of the participants were female and more than 52.5% of the thyroid dysfunction patients were aged > 40 years. The hypothyroidism patients were 41.7% in age group (20–40) and 50% in age group (41–60). According to Saranya *et al.* (2016), the majority of the patients were female and in the 21–50 age range.

The distribution of thyroid disorder patients according body weight groups were 06%, 56%, and 38% in body weight groups ≤60, 61-90, and >90 kg, respectively. These results are run parallel to Ríos-Prego *et al.,* 2019 who reported that overweight or obesity was observed in 76.5% of hypothyroidpatients, respectively (p=0.23). According to Reihner (2010), little thyroid malfunction may be a contributing reason to notable weight fluctuations, which may be a risk factor for overweight and obesity.

The distribution of thyroid disorder patients according to the level of education was 38% primary education and 62% secondary education. These results are run in accordance with Saranya *et al.* (2016) who mentioned that the majority of the study population (40.8%) had completed high school, 23.1% had completed upper secondary education, 12.9% had a degree or other higher level of education, and 3.3% of the patients were illiterate.

Thyroid follicular cells are then stimulated by TSH to generate T3 or T4 thyroid hormones. The active form of thyroid hormone is called triiodothyronine, or T3. The majority of T3 originates from the peripheral conversion of T4 to T3, while making up just 20% of the released hormone. Over 80% of the hormone released is tetraiodothyronine, commonly referred to as thyroxine or T4. It undergoes de-iodination to create T3 when it is discharged into the bloodstream. The anterior pituitary can then experience negative feedback from T4 and T3, with low levels of T3/T4 boosting TSH release and high levels of T3/T4 lowering TSH secretion (Eghtedari *et al.,* 2023).

The present study showed that the mean of TSH levels was significantly ($P<0.05$) increased in patients compared with the control group. Also, the mean of TSH levels was significantly (P<0.01) increased in the hypothyroidism group compared with the euthyroid group in thyroid disorder patients. But, significantly ($P < 0.01$) decreased in females compared with male thyroid disorder patients. The mean of T3 levels was significantly ($P<0.01$) decreased in patients compared with the control group. The mean of

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T4 levels was significantly (*P<0.01*) decreased in the hypothyroidism group compared with the euthyroid group. According to Berberich's research, a mathematical model of the HPT-loop has been developed to better explain thyroid hormone homeostasis. The real understanding of the thyroid cycle's negative feedback mechanism is shown in our investigation of the deviation of ln(TSH) vs. FT4 trend lines at the set points between euthyroidism and hypo/hyperthyroidism. There are intricate relationships between these variables since T3, T4, and TSH all play interwoven roles in thyroid expressions, metabolic processes, and control (Berberich *et al.,* 2018).

Dyslipidemia has been shown to be a common feature of thyroid dysfunction (Rizos *et al.*, 2011, Chin *et al.*, 2014).

In the current study, the levels of serum HDL and VLDL showed a significant alteration in thyroid disorder patients compared to the control group. The mean of serum triglycerides and LDL levels were significantly (*P<0.01*) increased in the subclinical hypothyroidism group and the hypothyroidism group, and serum VLDL levels in the subclinical hypothyroidism group and serum cholesterol levels were significantly (*P<0.05*) increased in the hypothyroidism group compared with the euthyroid group. The results showed that 48%, 34%, 36%, and 6% of thyroid disorder patients had >200 mg/dl of serum cholesterol, >150 mg/dl of serum triglycerides, >130 mg/dl of serum LDL, and >30 mg/dl of serum VLDL levels, respectively, and 2% of thyroid disorder patients had serum levels of HDL <30 mg/dl. There is a significant (*P<0.01*) increase in the percent of females (51.2%) who have >200 mg/dl of serum cholesterol compared with male thyroid disorder patients (28.6%). However, there is a significant (*P<0.01*) increase in the percent of males (14.3%) who have >30 mg/dl of serum VLDL compared with female patients (4.7%). The results showed a significant (*P<0.01*) increase in the percent of patient with >200 mg/dl of serum cholesterol, >150 mg/dl of serum triglycerides, >130 mg/dl of serum LDL, and >30 mg/dl of serum VLDL levels in subclinical hypothyroidism and hypothyroidism groups. The statistical analysis of results showed that there was a significant positive correlation between TSH levels with serum triglycerides and VLDL levels. On the other hand, there was a significant (*P<0.05*) negative correlation between TSH levels and age and a significant (*P<0.01*) positive correlation with education level. There was a nonsignificant correlation between TSH levels and duration of disease and

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medication, chronic diseases. These results are run parallel to previous studies that reported that patients with overt hypothyroidism exhibit significantly higher TC, LDL-C and TG compared to normal controls (Santi *et al.*, 2010, Shashi & Sharma, 2012, Chin *et al.*, 2014).

This is because there is less activity in LDL receptors, which leads to less degradation of LDL and IDL (Abrams & Grundy, 1981), also thyroid function and lower activity of HMG-CoA reducatase,

people with overt hypothyroidism have higher levels of TC and L DL cholesterol and LDL cholesterol than normal persons (Pearce *et al.*, 2008). Due to a decrease in the clearance of TG-rich lipoproteins, hypothyroid individuals have higher levels of LDL, triglycerides, and VLDL than normal persons. Consequently, individuals with overt hypothyroidism may also exhibit high TG levels linked to elevated VLDL and, on occasion, fasting, Chylomicronemia (Al-Tonsi *et al.*, 2004).

According to Addgepa et al. (1979), hypothyroid individuals had l ower HDL-C levels than people with normal thyroids. This results from enhanced HLmediate degradation of HDL2 and higher CETP-mediated transfer of cholesteryl esters from HDL to VLDL. In 1995, Kung et al. provided support for this.

6. Conclusion

It can be concluded that the thyroid dysfunction patients were 86% female, 50% in the age group >50 years, 56% and 38% in body weight groups 61-90 and >90 kg, 62% had secondary education. The mean duration of thyroid disorder and medication was 5.8 ± 1.2 and 5.0 ± 1.1 years. Thyroid hormones and lipid profiles showed variation and correlation with each other.

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