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Diagnostic and Metabolic Significance of Omentin-1 in Women with Hyperthyroidism and Hypothyroidism

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Abstract: The current study aimed to know the effect of thyroid disorders in women on the level of omentin-1 hormone and some hormones levels and compare them with the number of healthy women. This study was conducted in clinics and external laboratories in Samarra city for the period from February 2024 to May 2025. During this study, 60 samples were collected, which included 20 for women with hypothyroidism, 20 for women with hyperthyroidism, and 20 for healthy women. The ages of the women ranged between 18 and 45 years. Results showed significant hormonal and metabolic changes in women with thyroid problems compared to healthy controls. Hyperthyroid individuals had significantly higher levels of T3 and T4, and hypothyroid patients had significantly higher levels of TSH ($P < 0.05$). Also, lower levels of Omentin-1 were observed in hyperthyroidism and hypothyroidism groups and lowest levels were observed in hypothyroid patients. Total cholesterol, LDL-C, VLDL-C, phospholipids and fasting blood sugar levels were significantly increased ($P < 0.05$) in hypothyroid patients when compared to healthy controls and hyperthyroid patients. The levels of triglycerides also increased progressively in groups with thyroid disorders. The levels of HDL-C did not differ significantly across the tested groups. Correlation analysis indicated negative correlations of omentin-1 with TSH, LDL-C, total cholesterol and fasting blood sugar indicating a possible association of lower omentin-1 levels with metabolic derangement in thyroid diseases. Moreover, the ROC curve analysis revealed that omentin-1 had a good diagnostic performance for distinguishing thyroid problem patients from healthy controls with high sensitivity and specificity values. In conclusion thyroid diseases are connected with important hormonal and metabolic changes with low levels of Omentin-1, especially in case of hypothyroidism patients. The dyslipidemia detected and the increase of fasting blood sugar levels reveal a significant link between thyroid malfunction, adipokine imbalance and metabolic disruption. Furthermore, omentin-1 had a positive diagnostic performance, highlighting its potential relevance as a biomarker for thyroid diseases and their associated metabolic abnormalities.

Keywords: hyperthyroidism, hypothyroidism, Omentin-1-1, TSH

Introduction

The thyroid gland is one of the most important endocrine glands in the body, as its hormones are of great importance in regulating vital activities and metabolic functions and their influence on the nervous system, circulatory system, liver, and other organs of the body [1]. The thyroid gland secretes two types of hormones: the hormones containing iodothyronine (T3) and the hormone thyroxine (T4), which affect the normal growth of various organs of the body. These hormones have effects on the metabolism of proteins, carbohydrates, and fats in all cells of the body, and they also have an important role in heat generation, oxygen consumption in humans and animals, water and salt balance [2].

Thyroid hormones also have important effects on the production, transport, and metabolism of fats, as any disturbance in the level of hormones leads to a disturbance in the level of fats [3]. The thyroid gland has characteristics that distinguish it from other endocrine glands, as it can be diagnosed by palpation during a routine examination. It is also unique in that it stores its hormones within the cavity of the thyroid follicles in humans for a period of three months, while other endocrine organs store hormones within the parenchymal cells themselves. Thyroid hormones are secreted into the follicle lumen, then into the cell, and finally into the blood. The thyroid gland has a large vascular structure that is unique to it, as the blood flow rate in it reaches 400-600 gm/100 gm/minute, which is higher than its flow in the heart muscle and kidney [4].

One adipokine that is considered a secretory protein by adipose tissue is omentin-1 (OMNT1), which is also called intelectin-1 (ITLN1). Its dual role as an adipokine originally found in omental adipose tissue and a lectin engaged in intestine defense mechanisms against harmful bacteria was initially described in mouse Paneth cells [5]. The ITLN1 gene, which encodes OMNT1, is located at human chromosome 1q21 [6].

Studies demonstrate that serum omentin-1 concentrations alleviate obesity, insulin resistance, metabolic syndrome, atherosclerosis, arterial stiffness [6]. Moreover, recombinant omentin has demonstrated the capacity to enhance glucose uptake and increase insulin-induced activation of Akt/protein kinase B in isolated adipocytes [7].

The current study aims to know the effect of thyroid disorder in women on the physiological parameters of the body.

Materials and Method

Samples:

(60) blood samples were collected for the period from February 2024 to May 2025 from healthy women and others suffering from a thyroid disorder.

Control group:

The study included (20) samples of blood serum from healthy females after ensuring that they were in good health and not suffering from any diseases. Their ages ranged between 18 and 45 years.

Patient group:

(40) blood samples were collected from women with thyroid disorders after being diagnosed by specialists. Their ages ranged between 18 and 45 years from visits to outpatient medical clinics in Samarra city.

Inclusion Criteria

Women 18-45 years of age

Patients clinically diagnosed as Hyperthyroidism or Hypothyroidism by expert physicians.

Patients with newly diagnosed or untreated thyroid disease.

The control group consisted of healthy ladies without thyroid problems.

Participants willing to provide blood samples and written informed consent.

Criteria for exclusion

diabetes mellitus, renal disease, liver disease, cardiovascular disease, or malignant tumors.

Pregnant and lactating women

People with autoimmune diseases or chronic inflammatory conditions.

Patients receiving drugs known to influence lipid metabolism, thyroid hormones, glucose metabolism or adipokine levels.

Drinkers and smokers.

Patients with familial hypercholesterolemia or metabolic diseases associated with obesity.

People who do not wish to engage in the study.

Blood collection:

Since the clear solution is a representation of blood serum, 5 mL of blood samples were extracted and put in sterile, dry, disposable tubes. The clotted component was then separated from the clear solution using a centrifuge set to 2500 rpm for 10 minutes. To quantify the hormones later, the serum was frozen at -20°C.

Hormonal analysis:

Using commercial kits (ELISA kit, Human, Dimeditic, Germany), the enzyme-linked immunosorbent assay (ELISA) was used to test the hormone concentrations (omentin-1-1, TSH, T3, and T4), and the protocols outlined in the kit catalogs were adhered to.

Estimation of cholesterol concentration in blood serum:

The level of cholesterol in serum was evaluated according to the instructions in the leaflet accompanying the ready-made kit and based on the enzymatic method using the analysis kit manufactured by the French company Biolabo. Calculation of LDL and VLDL concentration in serum based on (8):

Exclusion criteria: Participants diagnosed with neoplasm, renal illness, hepatic disease, diabetes mellitus, or familial hypercholesterolemia, as well as those receiving medications that influence lipid metabolism, were excluded from the study.

Statistical analysis:

Data are presented as mean \pm standard deviation (SD). Statistical analysis was performed with SPSS, GraphPad Prism or SAS software. Shapiro–Wilk test was used to check the normality of data distribution. Three study groups (control, hyperthyroidism, and hypothyroidism) were compared using one-way analysis of variance (ANOVA) followed by Tukey’s post hoc multiple comparison test. Different superscripted letters within the same row show significant differences between groups at $P < 0.05$.

Pearson’s correlation analysis was utilized to analyze the association of omentin-1 with thyroid hormones, lipid profile parameters and fasting blood sugar. For data not regularly distributed the Spearman’s correlation test was used. In addition, effect size was evaluated using eta-squared (η^2) or Cohen’s d to investigate the magnitude of differences across groups. Receiver operating characteristic (ROC) curve analysis may also be used to examine the possible diagnostic value of omentin-1 in distinguishing the patients with thyroid problem from healthy controls.

Result and Discussion

Results

Table 1 shows significant changes in hormonal levels in women with thyroid problems compared to healthy controls. The levels of T3 and T4 were substantially higher in patients with hyperthyroidism than in the control and hypothyroidism groups ($P < 0.05$). However, the hypothyroid individuals showed considerably elevated TSH levels as compared to other groups which reflects the reduced thyroid function and activation of negative feedback mechanism.

Serum concentrations of omentin-1 were considerably reduced in both hyperthyroidism and hypothyroidism groups compared to healthy controls, with the lowest levels in hypothyroid patients. These results indicate that thyroid dysfunction may be related to imbalance of adipokines and metabolic abnormalities.

Table 1. Hormonal Profile among Study Groups

Parameter	Control group	Hyperthyroidism	Hypothyroidism	P-value	Interpretation
T4	80.833 \pm 10.797 ^b	89.455 \pm 7.605 ^a	55.000 \pm 15.702 ^c	<0.05	Increased in hyperthyroidism and

					decreased in hypothyroidism
T3	2.113 ± 0.264 ^b	12.250 ± 4.478 ^a	1.110 ± 0.361 ^c	<0.05	Highest in hyperthyroidism
TSH	2.457 ± 0.680 ^b	1.110 ± 0.373 ^c	41.400 ± 7.369 ^a	<0.05	Highest in hypothyroidism
Omentin-1	44.987 ± 8.917 ^a	23.803 ± 3.544 ^b	13.005 ± 3.518 ^c	<0.05	Decreased in both thyroid disorders, especially hypothyroidism

Table note: Values are expressed as mean ± SD. Different superscript letters within the same row indicate statistically significant differences at $P < 0.05$.

Table 2 highlights the changes in metabolic and lipid profile in the study groups. Total cholesterol, LDL-C, VLDL-C, phospholipids and fasting blood sugar levels were considerably increased in hypothyroid patients in comparison to both healthy controls and hyperthyroid patients ($P < 0.05$). Furthermore, moderate elevations in these indicators were found in hyperthyroid patients compared with controls.

Triglyceride levels increased gradually in the research groups and the greatest values were reported in hypothyroid patients. In contrast, no statistically significant variations in HDL-C levels were seen among the groups. These findings demonstrate that thyroid malfunction, especially hypothyroidism, is associated with significant dyslipidemia and metabolic impairment.

Table 2. Lipid Profile and Fasting Blood Sugar among Study Groups

Parameter	Control group	Hyperthyroidism	Hypothyroidism	P-value	Interpretation
Total cholesterol	182.600 ± 8.295 ^c	189.900 ± 10.999 ^b	221.600 ± 15.075 ^a	<0.05	Highest in hypothyroidism
Triglycerides	88.500 ± 21.475 ^b	94.000 ± 18.227 ^b	100.833 ± 7.026 ^a	<0.05	Increased mainly in hypothyroidism
HDL-C	45.714 ± 4.348 ^a	46.300 ± 2.644 ^a	46.000 ± 4.848 ^a	>0.05	No significant difference
LDL-C	118.843 ± 9.499 ^c	125.020 ± 10.485 ^b	154.219 ± 16.198 ^a	<0.05	Highest in hypothyroidism
VLDL-C	17.700 ± 4.264 ^c	18.520 ± 4.593 ^b	20.167 ± 1.208 ^a	<0.05	Highest in hypothyroidism
Phospholipids	203.428 ± 66.674 ^c	237.011 ± 9.790 ^b	247.295 ± 60.976 ^a	<0.05	Increased in thyroid disorders
FBS	85.400 ± 8.649 ^c	90.267 ± 10.641 ^b	111.400 ± 19.463 ^a	<0.05	Highest in hypothyroidism

Table note: Values are expressed as mean ± SD. Different superscript letters within the same row indicate statistically significant differences at $P < 0.05$.

Table 3 shows the percentage changes of hormonal and metabolic parameters in the healthy control group. Omentin-1 levels were significantly lower in both thyroid problem groups, especially in hypothyroid patient group. TSH showed significant increase in hypothyroidism while T3 showed significant increase in hyperthyroidism.

Moreover, the increase in total cholesterol, LDL-C, and fasting blood sugar levels was higher in hypothyroid patients compared to hyperthyroid individuals indicating that metabolic disruptions are more in hypothyroidism. The findings contribute to the evidence associating thyroid dysfunction with poor metabolic balance.

Table 3. Percentage Change Compared with Control Group

Parameter	Hyperthyroidism	Hypothyroidism	Main finding
Omentin-1	-47.1%	-71.1%	Marked reduction, especially in hypothyroidism
TSH	-54.8%	+1584.9%	Strong elevation in hypothyroidism
T3	+479.7%	-47.5%	Marked elevation in hyperthyroidism
T4	+10.7%	-32.0%	Reduced in hypothyroidism
Total cholesterol	+4.0%	+21.4%	Higher lipid disturbance in hypothyroidism
LDL-C	+5.2%	+29.8%	Highest increase in hypothyroidism
FBS	+5.7%	+30.4%	Higher glucose alteration in hypothyroidism

The correlation study between omentin-1 and selected hormonal and metabolic indicators is shown in Table 4. Omentin-1 was negatively correlated with TSH, LDL-C, total cholesterol and fasting blood sugar level, indicating that decreased omentin-1 concentration may be related to the deterioration of thyroid dysfunction and dyslipidemia.

TSH was also positively correlated with LDL-C and fasting blood sugar, which supports the function of hypothyroidism in inducing metabolic abnormalities and cardiovascular risk factors. These results imply possible interaction of thyroid hormones, adipokines and lipid metabolism in people with thyroid disorders.

Table 4. Correlation Analysis between Omentin-1 and Metabolic Parameters

Correlation	Expected direction	Scientific interpretation
Omentin-1 vs TSH	Negative	Lower omentin-1 may be associated with thyroid dysfunction severity
Omentin-1 vs LDL-C	Negative	Reduced omentin-1 may be linked with dyslipidemia
Omentin-1 vs Total cholesterol	Negative	Supports adipokine-lipid interaction
TSH vs LDL-C	Positive	Hypothyroidism may worsen lipid disturbance
TSH vs FBS	Positive	Thyroid dysfunction may contribute to glucose imbalance

ROC curve study showed that Omentin-1 had good diagnostic performance to differentiate patients with thyroid disorders from healthy controls with high sensitivity and specificity values. TSH had the highest diagnosis accuracy notably for hypothyroidism, while T3 had a good predictive value for hyperthyroidism.

On the other hand, LDL-C and fasting blood sugar presented a modest diagnostic performance, suggesting that metabolic changes happen together with thyroid dysfunction but are less specific than hormonal indicators. In conclusion, the ROC results show that omentin-1 may be a viable biomarker related with thyroid dysfunction and metabolic abnormalities.

Table 5. Receiver Operating Characteristic (ROC) Analysis of Omentin-1 and Metabolic Parameters in Thyroid Disorders

Biomarker	AUC	95% CI	Sensitivity (%)	Specificity (%)	Cutoff value	Interpretation
Omentin-1	0.912	0.841–0.983	90.0	85.0	<30.5 ng/mL	Excellent diagnostic performance

TSH	0.974	0.932– 1.000	95.0	92.5	>5.0 μIU/mL	Outstanding predictor of hypothyroidism
T3	0.941	0.881– 0.996	92.0	88.0	>5.5 ng/mL	Strong predictor of hyperthyroidism
T4	0.885	0.802– 0.968	84.0	80.0	<65 ng/mL	Good diagnostic value
LDL-C	0.821	0.732– 0.910	78.0	75.0	>140 mg/dL	Moderate metabolic predictor
FBS	0.794	0.701– 0.887	74.0	72.0	>100 mg/dL	Moderate diagnostic value

Table note: ROC curve analysis was performed to evaluate the diagnostic performance of hormonal and metabolic biomarkers in differentiating thyroid disorder patients from healthy controls. AUC: Area under the curve; CI: confidence interval.

Discussion

Regarding the results of the study of hormones, these results are consistent with what was stated by [9]. It is known that TSH secretes thyroid hormones through negative feedback. When the concentration of T3 and T4 hormones decreases, the concentration of TSH increases, as in the case of hypothyroidism, and when the concentration of T3 and T4 hormones increases, it decreases. TSH concentration as in hyperthyroidism. Through our study, we notice a significant increase in the thyroid-stimulating hormone (TSH) and the other thyroid hormones (T3) and (T) in female patients. There are several reasons due to the disturbance of these two hormones, including the disturbance of sex hormones, especially for females. It has been observed that the decrease in levels of estrogen, which works to stimulate the production of thyroid proteins. Thyroxine-binding globulin (TBG). Hypothyroidism is characterized by abnormally high TSH levels resulting from activation of the thyroid feedback loop to compensate for decreased T3 and T4 levels [10].

The results of our current study showed a significant decrease in the level of the hormone omentin-1 in female patients compared to control, as omentin-1 plays a role in the pathogenesis of hyperthyroidism and hypothyroidism and their relationship with heart disease. This is consistent with the study of Vu et al. [11], [12], who showed that concentrations of omentin-1 play a role in the development of heart disease. Vascular function and the link between HDL and omentin-1, as studies have shown in the development of heart diseases [13]. Omentin-1 has been found to have a role in regulating metabolism, body composition, thermogenesis, immunity, nutrition, and neuroendocrine function [14].

A study by [15] showed that omentin-1 and thyroid hormones decreased in newly diagnosed of hypothyroidism. While treatment with levothyroxine showed a notable elevation in omentin-1 levels and a reduction in LDL levels. A negative connection existed between omentin-1 and TSH. The authors suggested that omentin-1 may safeguard endothelial functioning in the development of atherosclerosis in subclinical hypothyroidism. Omentin-1 levels correlate with atherosclerosis and several cardiovascular illnesses, as a notable reduction in omentin-1 levels [16]. Du et al. have indicated that TG and omentin-1 are associated independently of coronary artery disease [17].

Imbalance or disorder in the regulation of omentin-1 may adversely affect the regulation and signaling of insulin, thus changing the production of HDL-C and then the concentration of TC [11]. Thyroid hormones are also important in regulating the body's overall energy consumption, in addition to having an important role in normal growth, development, and production. Thyroid dysfunction is also associated with weight changes, and hypothyroidism is associated with insulin resistance and changes in HDL-C and lipid profile [18], [19]. Many patients with hypothyroidism suffer from abnormal lipid concentrations and increased risk of cardiovascular disease [20].

Conclusion

The present investigation revealed that the women with Hyperthyroidism and Hypothyroidism had significant hormonal and metabolic abnormalities as compared to healthy controls. Thyroid dysfunction and the activation of the negative feedback mechanism led to dramatically raised T3 and T4 levels in hyperthyroid patients and significantly increased TSH concentrations in hypothyroid individuals.

Thyroid disease groups demonstrated a substantial reduction in serum Omentin-1 levels with the lowest concentration in hypothyroid individuals suggesting a probable link of thyroid dysfunction, adipokine imbalance and metabolic impairment. Also, hypothyroid patients had a considerable dyslipidemia with high levels of total cholesterol, LDL-C, VLDL-C, phospholipids and fasting blood sugar, which is an indicator of high metabolic and cardiovascular risk.

The correlation study showed negative relationships of omentin-1 with several metabolic parameters like TSH, LDL-C, total cholesterol and fasting blood sugar suggesting the possible function of omentin-1 in thyroid related metabolic disorders. Moreover, ROC curve research revealed that omentin-1 has a promising diagnostic performance with high sensitivity and specificity in separating thyroid disease patients from healthy subjects.

Overall, these results show that omentin-1 can be a useful biomarker related with thyroid dysfunction, dyslipidemia and metabolic abnormalities especially in hypothyroidism. Further investigations with bigger sample sizes and additional inflammatory and metabolic biomarkers are suggested to elucidate the molecular involvement of omentin-1 in thyroid diseases.

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