

Assessment of the Relationship Between Thyroid Hormones and Body Mass Index in Underweight and Obese Individual in Baghdad City

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Abstract

This study was conducted in Baghdad, Iraq, over a period of time extending from the 1 / November /2024 to 25 /February /2025 among individuals within the community in Baghdad, Iraq. This study takes Ninety blood sample were collected and divided into three groups (30 sample from the control group, 30 sample from the skinny group and 30 sample from the obesity group) from the community with attached personal information. All laboratory tests were analyzed in the laboratories of the College of Medical Technology/ Al-Farahidi University/Baghdad. The thyroid hormone analyses were performed using Fine-care technique. The results appear a significant increase in BMI ($P < 0.05$) and Thyroid-stimulating hormone ($P < 0.05$), while there were no significant differences with triiodothyronine (T3) hormone ($P > 0.05$) between the study groups. Age showed a significant increase with (BMI) with ($P < 0.05$) and TSH hormone ($P < 0.05$), while age hasn't statistically significant with T3 hormone ($P > 0.05$).

Introduction:

The thyroid gland is an active organ that appears a butterfly-like design, it is located in front of the trachea within the second and third rings. The scientist Thomas Wharton named it in 1656 due to its external resemblance to the cartilage near the larynx in humans; The thyroid It is one of the endocrine glands that works to store and produce its hormones related to metabolic function, which are the inactive amino acid thyroxine and the active thyroglobulin. [1]. Both genomic and non-genomic mechanisms are essential for the function of this gland to activate both the adaptive and innate immune systems. [2]. The main function of the hormone is to control and regulate the human metabolism to convert it into a source of energy by secreting both hormones together. [3]. The gland is shaped like multiple spherical structures called follicles and is made up of connective tissues interspersed with blood

capillaries [4]; Each follicle is made up of simple cuboidal epithelial cells and its cavity is surrounded by other epithelial cells with the presence of single or clustered cells in the basal region of the follicles. Each follicular lumen surrounded by the follicular epithelium is a completely enclosed area, storing colloid materials (thyroglobulin) secreted by the epithelial cells. The secretory process of T3 and T4, consists of several complicated steps [5]. Thyroid hormone increases the basal metabolic rate. It increases the gene expression of Na⁺/K⁺ ATPase in different tissues leading to increased oxygen consumption and temperature depend on the metabolic state and may stimulate fat synthesis or breakdown, carbohydrate metabolism and protein synthesis or catabolism in large quantities. These hormones play a role in glucose reabsorption, oxidation and glycogen formation but they do not directly manipulate blood glucose levels. [6]. It contains four iodine atoms, while it contains three iodine atoms, so today it is the most important element in the function of the gland which is transported through the plasma membrane into the thyroid cells with the presence of Na⁺ [7]. One of the thyroid disorders is Hypothyroidism which is define as a lack of thyroid hormones which affects frequently females and the ageing. Symptoms of hypothyroidism are nonspecific when thyroid gland produces too much of thyroid hormones. This consequence in high levels of the 2 main T3 and T4 hormones in human body [8] then Hyperthyroidism is 2% in females and 0.2% in males, associated with increased levels of free thyroid hormones. Symptoms: mass loss, tachycardia and tiredness. Also caused: increased tremor, nervousness, heat intolerance and sweating [9]. Hypothyroidism is usually diagnosed by blood tests, and if there is suspicion of hypothyroidism, the thyroid hormone is tested [10]. Body Mass Index BMI it is an equation for measuring the ideal weight and knowing the gain by linking the weight with the height of the human body. one hypothesis that The risk of thyroid cancer was observed to increase with increasing this indicator [11]. This study aimed to assessment the relationship of thyroid hormones to body mass.

Materials and method

Study Design and Physiological tests: The researchers divided the study groups into three groups: (obesity group, skinny group and a control group) and taking age information into account; It was divided into the three previous groups to demonstrate the relationship of thyroid hormones to body mass due to their direct relationship to metabolic processes in the body. All laboratory tests analyzed in the laboratories of the College of Medical Technology/Al-Farahidi University/Baghdad. Samples were collected by drawing blood through needles and then separating the serum by centrifugation. The concentration for thyroid hormone (TSH and T3) in the serum was measured by Finecare technique (Wondfo China manufacturer) with its procedure choose a device that is finecare and press on (Quick test), select the serum or plasma than select standard. Make a mix by add 75 ul from sample to buffer solution than take 75 ul from mix and add to Cassette than Incubate the Cassette for 10 minutes at 37C than read the value. The body mass index (determine using mass and height by BMI equation (Mass divided by height in meters squared (kg/m²)).

Statistical analysis:

Data were examined by Minitab database system Ver.17 and ANOVA examination were applied. The means compared by Duncan's Multiple Variety at a meaningfully level of 0.05.

Results and Discussion

In table 1. Means \pm standard deviations of BMI of different groups: An elevated was observed among the study groups within the normal clinical limits (18-24 kg/m²), as it was highest in the obesity group (27.78 \pm 2.85) kg/m², while in the skinny group reduction (17.91 \pm 0.44) kg/m² compare to the control group (20.98 \pm 1.50) kg/m² with high increased significantly (P < 0.05).

Table 1. Means \pm standard deviations of BMI of different groups

BMI (kg/m ²)	Groups	Mean \pm S.D	P-Value
	Control	20.98 \pm 1.50	0.00007
	Obesity	27.78 \pm 2.85	
	Skinny	17.91 \pm 0.44	

Where the study agreed with [12] and [13]. Hypothyroidism is associated with low metabolism and low body temperature, along with a relationship with high rates of excess weight, according to the World Health Organization. It is classified as 18.5 – 24.9 a normal level, while more is considered obesity [12]. Hypothyroidism causes mass gain, accompanied by a reduction in thermogenesis and metabolic speed. Furthermore, an inverse relationship has been reported between free (fT₄) standards and BMI, even when fT₄ values remain within the normal range. BMI has been negatively correlated with serum free thyroxine levels [14].

In table 2. Means \pm standard deviations of BMI and age for different groups: The BMI level had high increased significantly (P < 0.05) with age groups. Age group (31-40) were: obesity group (28.18 \pm 3.30) kg/m², while in the skinny group (17.73 \pm 0.42) kg/m², it reached compared to the control group (21.26 \pm 1.54) kg/m² while the other age group (20-30) were: obesity group (26.98 \pm 1.5) kg/m², while in the skinny group (18.03 \pm 0.43) kg/m², it reached compared to the control group (20.81 \pm 1.50) kg/m².

Table 2. Means \pm standard deviations of BMI and age for different groups.

BMI & Age (kg/m ²)	Groups	Mean \pm S.D	P-Value
20-30	Control	20.81 \pm 1.50	0.00002
	Obesity	26.98 \pm 1.5	
	Skinny	18.03 \pm 0.43	
31-40	Control	21.26 \pm 1.54	
	Obesity	28.18 \pm 3.30	
	Skinny	17.73 \pm 0.42	

Where the study agreed with [12] and [13]. Obesity varies by age, sex, race, and ethnicity among the adult population. High body weight is related with liver, cardiovascular disease and diabetes fatty Gene-environment interactions, where individuals are genetically predisposed to an environment that provides palatable, energy-rich foods with limited opportunities for energy loss, increase the prevalence of obesity [14] for example, Asians have a higher body fat percentage than Caucasians for the same BMI [15].

In Table 3. Means \pm standard deviations of TSH of different groups: An elevated was observed among the study groups within the normal clinical limits (0.3-4.2 mIU/L) , as it was

highest in the obesity group (3.278 ± 1.853) mIU/L , while in the skinny group (2.025 ± 1.243) mIU/L it reached compared to the control group (1.642 ± 0.284) mIU/L with increased significantly ($P < 0.05$) .

Table 3. Means \pm standard deviations of TSH hormone of different groups results.

	Groups	Mean \pm S.D	P-Value
TSH (mIU/L)	Control	1.642 ± 0.284	0.015
	Obesity	3.278 ± 1.853	
	Skinny	2.025 ± 1.243	

The results of the study are consistent with both [10] and [16]. Two cross-sectional studies originate an inversely harmful link between TSH and obesity [17] and [18]. The liver acts as a direct controller of metabolism which contributes to hypothyroidism which sources obesity. TSH influences body fat stability which may be linked to obesity. TSH exosomes promote fat loading in adipocytes, suggestively increasing triglyceride content and lipid droplet formation, while reducing lipolysis. These properties depend on the activation of TSH receptors (TSHRs) in vivo, liver cells, TSH stimulate weight advance and adipose tissue evolution in various areas of the body [19]. Based on this evidence, a hypothesis has been formulated that even slightly elevated serum TSH levels within normal ranges, which indicate mild thyroid dysfunction, may performance a role in causing body weight advance as it is associated with an amplified incidence of obesity [20].

In table 4: Means \pm standard deviations of TSH and age of different groups: The TSH hormone level had increased meaningfully ($P < 0.05$) with age groups. Age group (20-30) were: obesity group (3.167 ± 1.77) mIU/L, while in the skinny group (2.171 ± 1.28) mIU/L it reached compared to the control group (1.406 ± 0.94) mIU/L while the other age group (31-40) were: obesity group (3.333 ± 1.30) mIU/L, while in the skinny group (2.050 ± 0.83) mIU/L it reached compared to the control group (1.406 ± 0.94) mIU/L.

Table 4: Means \pm standard deviations of TSH and age of different groups.

TSH & Age (mIU/L)	Groups	Mean \pm S.D	P-Value
20-30	Control	1.406 ± 0.94	0.046
	Obesity	3.167 ± 1.77	
	Skinny	2.171 ± 1.28	
31-40	Control	2.050 ± 0.83	
	Obesity	3.333 ± 1.30	
	Skinny	1.807 ± 0.80	

The results of the study are consistent with [21] while disagreed with [22]. It has been recommended that elevated TSH may reproduce an adaptive reaction of the thyroid axis to increased

energy outflow, which reduces mass gain. The increased degree of these hormone clearance follow-on from increased body size may be because that promotes beginning of the thyroid axis, which aims to maintain serum hormones within the usual variety [23].

In table 5, Means \pm standard deviations of T3 of different groups: An elevated was observed among the study groups with the regular clinical limits (1.23- 3.07) nmol / L, as it was highest in the obesity group (2.609 \pm 0.586) mIU/L, while in the skinny group (2.265 \pm 0.684) nmol/L, it reached compared to the control group (2.648 \pm 0.656) nmol/L with non-significantly (P > 0.05) .

Table 5. Means \pm standard deviations of T3 of different groups.

	Groups	Mean \pm S.D	P-Value
T3 (nmol/L)	Control	2.648 \pm 0.656	0.501
	Obesity	2.609 \pm 0.586	
	Skinny	2.265 \pm 0.684	

In group examines of obesity, morbid obesity and BMI, no communications found among these indices and T3 which is consistent with the study [24] and [25]. The results of the study differed with [26] and [27] Moderately elevated TSH hormone concentrations, associated with T3 values slightly above the superior typical range, are often seen in obese individuals, T3 enhances thermogenesis and energy utilization and shows a key role in modifiable food eating, glucose and fat breakdown; Since weight loss is linked with reducing TSH and T3, the resulting drop in inactive energy outflow may give to difficulty upholding mass loss [28] and [29]. The basic structure of thyroid hormone is T4, which has a longer half-life than human T3, at a ratio of 14:1. T4 is converted to active T3 inside cells by the enzyme 5'-deiodinase, which is three to four times more potent than T4 [30] Therefore, the current study focused on T3.

In table 6, Means \pm standard deviations of T3 and age of different groups: T3 hormone level had non-significantly results (P > 0.05) with age groups. Age group (20-30) were: obesity group (3.256 \pm 1.23) nmol/L, while in the skinny group (2.336 \pm 0.68) nmol/L, it reached compared to the control group (2.669 \pm 1.88) nmol/L while the other age group (31-40) were: obesity group (2.285 \pm 1.06) nmol/L, while in the skinny group (2.160 \pm 0.69) nmol/L it reached compared to the control group (2.612 \pm 1.25) nmol/L.

Table 6: Means \pm standard deviations of T3 and age of different groups

T3 & Age (nmol/L)	Groups	Mean \pm S.D	P-Value
20-30	Control	2.669 \pm 1.88	0.443
	Obesity	3.256 \pm 1.23	
	Skinny	2.336 \pm 0.68	
31-40	Control	2.612 \pm 1.25	
	Obesity	2.285 \pm 1.06	

The hormone shows a direct correlation with body mass index and an inverse correlation with age. The results of the study are consistent with the results of the current study [31] and [32]. Laboratory studies show that the action of thyrotropin its many receptors in adipose tissue stimulates the variation primary adipocytes into lipid cells, the development of adipose tissue to form lipids in body regions, and is inversely related to body mass and activity level for age groups [33].

Conclusion This study marks showed that BMI increased in obese individuals and decreased in Underweight individuals or in lean individuals. Both TSH hormone and T3 hormone Were elevated within the clinical limits range. It was shown that age has a relationship with the body mass index and TSH hormone, while no significant association was observed between age and T3 hormone levels.

References

- [1] Kopp, P., Cooper, D. S., & Braverman, L. E. (2020). Werner and Ingbar's The Thyroid: A Fundamental and Clinical Text.
- [2] - De Vito, P., Incerpi, S., Pedersen, J. Z., Luly, P., Davis, F. B., & Davis, P. J. (2011). Thyroid hormones as modulators of immune activities at the cellular level. *Thyroid*, 21(8), 879-890.
- [3] Shahid, M. A., Ashraf, M. A., & Sharma, S. (2018). Physiology, thyroid hormone.
- [4] Ramadan, O. I. (2022). Structural variations and distributions of human Body follicles. *Jordan Journal of Applied Science-Natural Science Series*, 16, 9-14.
- [5] -Hisao Fujita, 2008. Fine Structure of the Thyroid Gland.
- [6] Vora, T. K., & Karunakaran, S. (2017). Thyrotropic pituitary adenoma with plurihormonal immunoreactivity. *Neurology India*, 65(5), 1162-1164.
- [7] Sorrenti, S., Baldini, E., Pironi, D., Lauro, A., D'Orazi, V., Tartaglia, F., ... & Ulisse, S. (2021). Iodine: Its role in thyroid hormone biosynthesis and beyond. *Nutrients*, 13(12), 4469.
- [8] Wilson, S. A., Stem, L. A., & Bruehlman, R. D. (2021). Hypothyroidism: Diagnosis and treatment. *American family physician*, 103(10), 605-613.
- [9] Lee, S. Y., & Pearce, E. N. (2023). Hyperthyroidism: a review. *Jama*, 330(15), 1472-1483.
- [10] Cruz-Loya, M., Chu, B. B., Jonklaas, J., Schneider, D. F., & DiStefano III, J. (2022). Optimized Replacement T4 and T4+ T3 Dosing in male and female hypothyroid patients with different bmis using a personalized mechanistic model of thyroid hormone regulation dynamics. *Frontiers in endocrinology*, 13, 888429.
- [11] - Youssef, M. R., Reisner, A. S., Attia, A. S., Hussein, M. H., Omar, M., LaRussa, A., ... & Kandil, E. (2021). Obesity and the prevention of thyroid cancer: impact of body mass index and weight change on developing thyroid cancer-pooled results of 24 million cohorts. *Oral Oncology*, 112, 105085
- [12] Quddus, M. A., Islam, M. S., Begum, M. M. N., Narju, S. P., & Hossain, N. M. Evaluation of Body Mass Index in The Normal Individuals Compared with Hypothyroid Patients.
- [13] Anjaneya Prasad, V. (2013). Subclinical hypothyroidism in obese patients in rural general hospital. *IOSR J Dent Med Sci*, 5, 8-10.
- [14] Laurberg, P., Knudsen, N., Andersen, S., Carlé, A., Pedersen, I. B., & Karmisholt, J. (2012). Thyroid function and obesity. *European thyroid journal*, 1(3), 159-167.

- [15] Chooi, Y. C., Ding, C., & Magkos, F. (2019). The epidemiology of obesity. *Metabolism*, 92, 6-10.
- [16] Reinehr, T. (2010). Obesity and thyroid function. *Molecular and cellular endocrinology*, 316(2), 165-171.
- [17] Kim, H.J.; Bae, J.C.; Park, H.K.; Byun, D.W.; Suh, K.; Yoo, M.H.; Kim, J.H.; Min, Y.K.; Kim, S.W.; Chung, J.H. Triiodothyronine Levels Are Independently Associated with Metabolic Syndrome in Euthyroid Middle-Aged Subjects. *Endocrinol. Metab. (Seoul)* 2016, 31, 311–319.
- [18] Park, S.B.; Choi, H.C.; Joo, N.S. The relation of thyroid function to components of the metabolic syndrome in Korean men and women. *J. Korean Med. Sci.* 2011, 26, 540–545.
- [19] Ma, S., Wang, Y., Fan, S., Jiang, W., Sun, M., Jing, M., ... & Wu, D. (2025). TSH-stimulated hepatocyte exosomes modulate liver-adipose triglyceride accumulation via the TGF- β 1/ATGL axis in mice. *Lipids in Health and Disease*, 24(1), 1-13.
- [20] García-Solís, P., García, O. P., Hernández-Puga, G., Sánchez-Tusie, A. A., Sáenz-Luna, C. E., Hernández-Montiel, H. L., & Solis-S, J. C. (2018). Thyroid hormones and obesity: a known but poorly understood relationship. *Endokrynologia Polska*, 69(3), 292-303.
- [21] Bremner AP, Feddema P, Leedman PJ, Brown SJ, Beilby JP, Lim EM, et al. Age-related changes in thyroid function: A longitudinal study of a community-based cohort. *J Clin Endocrinol Metab* (2012) 97:1554–62.
- [22] Mele, C., Mai, S., Cena, T., Pagano, L., Scacchi, M., Biondi, B., ... & Marzullo, P. (2022). The pattern of TSH and FT4 levels across different BMI ranges in a large cohort of euthyroid patients with obesity. *Frontiers in Endocrinology*, 13, 1029376.
- [23] Santini F, Marzullo P, Rotondi M, Ceccarini G, Pagano L, Ippolito S, et al. Mechanisms in endocrinology: the crosstalk between thyroid gland and adipose tissue: signal integration in health and disease. *Eur J Endocrinol* (2014) 171:R137–52. doi: 10.1530/EJE-14-0067.
- [24] Reinehr, T., & Andler, W. (2002). Thyroid hormones before and after weight loss in obesity. *Archives of disease in childhood*, 87(4), 320-323.
- [25] Zhang, Y., Zhou, S., Liu, S., Wang, Y., Zhou, H., Wang, J., ... & Wang, X. (2024). Association between night eating frequency and thyroid function and sensitivity: a cross-sectional study from the NHANES database. *Frontiers in Endocrinology*, 15, 1489459.
- [26] Reinehr, T. (2010). Obesity and thyroid function. *Molecular and cellular endocrinology*, 316(2), 165-171.
- [27] Gradek-Kwinta, E., Slowik, A. & Dzedzic, T. The use of anticholinergic medication is associated with an increased risk of stroke-associated pneumonia. *Aging Clin Exp Res* 34, 1935–1938 (2022).
- [28] Reinehr, T. (2010). Obesity and thyroid function. *Molecular and cellular endocrinology*, 316(2), 165-171.
- [29] Mario Rotondi, Flavia Magri, Luca Chiovato, Thyroid and Obesity: Not a One-Way Interaction, *The Journal of Clinical Endocrinology & Metabolism*, Volume 96, Issue 2, 1 February 2011, Pages 344–346.
- [30] Galton, V. A., & Hernandez, A. (2023). Thyroid hormone metabolism: a historical perspective. *Thyroid*, 33(1), 24-31.
- [31] Zupo, R., Castellana, F., Sardone, R., Lampignano, L., Paradiso, S., Giagulli, V. A., ... & De Pergola, G. (2020). Higher muscle mass implies increased free-thyroxine to free-triiodothyronine ratio in subjects with overweight and obesity. *Frontiers in endocrinology*, 11, 565065.
- [32] V. van de, C. Annenienke, R.T. Netea-Maier, F. de Vegt, H.A. Ross, F.C. Sweep, L.A. Kiemeny, J.W. Smit, A.R. Hermus, M. den Heijer, Associations between thyroid function and mortality: the influence of age. *Eur. J. Endocrinol.* 171, 183–191 (2014).
- [33] Sorisky A, Bell A, Gagnon A. TSH receptor in adipose cells. *Horm Metab Res.* 2000;32:468–74.

تقييم العلاقة بين هرمونات الغدة الدرقية ومؤشر كتلة الجسم لدى الأشخاص النحيفين والبدناء في مدينة بغداد

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الخلاصة:

أجريت هذه الدراسة في بغداد، العراق، على مدى فترة زمنية تمتد من 1 نوفمبر 2024 إلى 25 فبراير 2025 بين الأفراد في بغداد، العراق. تأخذ هذه الدراسة 90 عينة دم (مصل) تم جمعها وتقسيمها إلى ثلاث مجموعات (30 عينة من المجموعة السيطرة، و30 عينة من المجموعة النحافة و30 عينة من مجموعة السمنة) من المجتمع مع إرفاق المعلومات الشخصية؛ تم إجراء تحليل هرمون الغدة الدرقية باستخدام تقنية Finecare. في كلية التقنية الطبية/ جامعة الفراهيدي/ بغداد. تظهر النتائج فروق معنوية كبيرة في مؤشر كتلة الجسم (BMI) ($P < 0.05$) وهرمون تحفيز الغدة الدرقية (TSH) ($P < 0.05$) في حين لم تكن هناك فروق مع هرمون ثلاثي يودوثيرونين (T3) ($P > 0.05$) بين مجاميع الدراسة. أظهر العمر زيادة معنوية مع مؤشر كتلة الجسم (BMI) ($P < 0.05$) وهرمون TSH ($P < 0.05$) في حين لم يكن له دلالة إحصائية مع هرمون T3 ($P > 0.05$).

معلومات البحث:

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الكلمات المفتاحية:

Thyroid stimulating hormone
TSH, triiodothyronine
hormone T3, body mass index
BMI, obesity, skinny body.

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