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THYROID FUNCTION AND PHYSICAL ACTIVITY AMONG A SAMPLE OF PATIENTS ATTENDING MURJAN HOSPITAL IN HILLA CITY/IRAQ

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ABSTRACT

Introduction*: Physical activity can also enhance thyroid function. Exercising can be challenging when experiencing exhaustion, but it is crucial for managing hypothyroidism.* ***Objective of study****: To determine a correlation between thyroid function and physical activity, as well as anthropometric measurements.* ***Patients and Methods****: A cross-sectional study was conducted on 348 patients with thyroid dysfunction who were attending a diabetes and endocrinology center in AL Hilla City, Iraq. the data collection for five months from march 2023- august 2023.* ***Results:*** *The study shows that a higher proportion of thyroid dysfunction regarding to BMI in obese category was (32.2%) followed by overweight (29.3%), morbid obese (24.4%) and lower proportion in normal weight was (14.9%). with mean (30.92 ±5.42SD). according to waist to hip ratio, a higher percentage (53.2%) at risk followed by (28.7%) average, (12.6%) was good and lower percentage (5.5%) of waist to hip ratio was excellent. The present study found a higher percentage (41.7%) of waist to height ratio was obese followed by (21.0%) was overweight, (19.5%) was healthy and lower percentage was (17.8%). according to physical activity, a higher percentage (50.0%) was low level followed by (46.3%) was moderate level and (3.7%) was vigorous level. A significant association found between anthropometric measurement and thyroid dysfunction except height found no significant, also found significant connection between thyroid dysfunction and international physical activity questionnaire score, and significant connection between thyroid stimulating hormones and family history, anthropometric measurements. And also, significant connection between thyroid function test and thyroid dysfunction.* ***Conclusion:*** *significant association between hypothyroidism and low level of physical activity, obesity and morbid obesity.*

INTRODUCTION

The thyroid is an endocrine gland. Its location is in the inferior, anterior neck, and it is responsible for the formation and secretion of the thyroid hormones as well as iodine homeostasis within the human body[1]. The adult thyroid gland typically has a weight of approximately 25 grams, It is located right below the prominent cartilage protrusion known as the Adam's apple, which is more noticeable in males, The thyroid gland plays a role in swallowing[2]**.** The thyroid gland releases thyroxin (T4) in response to thyroid-stimulating hormone (TSH) produced by the anterior pituitary gland. The T4 that is released is transformed into the more potent tri-iodothyronine (T3) by the action of deiodinase enzymes. The majority of the transformation of T4 to T3 takes place outside

of the thyroid, even though the thyroid gland has the inherent capability to produce T3 [3]**.** These hormones are required for the normal growth, development and function of nearly all tissues, with major effects on oxygen consumption and metabolic rate [4]. Physical activity can also enhance thyroid function. Exercising can be challenging when experiencing exhaustion, but it is crucial for managing hypothyroidism. Exercise is a potent natural remedy that can effectively cure depression, which is a common symptom of hypothyroidism [5]. Thyroid disorder is linked to alterations in body weight and composition, body temperature, and overall energy expenditure both total and at rest [6]. The prevalence of body weight change (BWC) in patients with overt thyroid dysfunction surpasses 50%, making it one of the most prevalent symptoms. Overt hyperthyroidism (OHypo) often leads to weight loss, while overt hypothyroidism (OHypo) is commonly connected with weight gain. Prior research has indicated that certain individuals with hyperthyroidism saw weight gain after receiving appropriate treatment, while hypothyroidism was associated with slight weight reduction after undergoing thyroid hormone replacement therapy

[7]. It is crucial to acknowledge that the transportation of thyroid hormones into the cell requires energy. Therefore, any condition that leads to a decrease in the production of cellular energy (mitochondrial dysfunction) will also result in a decrease in the transportation of thyroid hormones into the cell. This, in turn, causes cellular hypothyroidism, even if the blood tests show normal results. Conditions linked to diminished mitochondrial function and decreased thyroid transport including insulin resistance, diabetes, and obesity [8]and depression[9].Higher body mass index (BMI) and obesity are known factors influencing thyroid function through production of leptin, which influences the hypothalamic-pituitary-thyroid axis[10]**.**

METHODOLOGY

A cross-sectional study was conducted at the Diabetics and Endocrinology Center in Murjan Hospital in Al Hilla, Iraq. The study included a sample of 348 patients with thyroid dysfunction (hyperthyroidism and hypothyroidism), consisting of both male and female individuals aged 18-76 years who were attending the diabetic and endocrinology center. The duration for a duration of 6 months .Patients exhibiting subclinical symptoms and pregnant women were not included in the study. The study received approval. Prior to collecting data, the research obtained the required approvals and official administrative permission. Official permission was granted by the Babel Health Directorate, the Human Development and Training Center, and the Unit of Research. Additionally, official permission was obtained from Murjan Hospital in AL-Hilla City .Obtaining informed consent was a prerequisite for enrolling all participants in the study.Every participant involved in this study underwent a questionnaire to gather comprehensive historical information, underwent a thorough clinical examination, and underwent laboratory examinations[11].

Height: The study examined the vertical measurement of an individual, without shoes, using a stadiometer.

Weight: Participants' weight was measured using a digital weighing machine.

BMI: The body mass index (BMI) was computed using the formula BMI = weight in kilograms divided by height squared in meters. Following the WHO classification, the patients were subsequently categorized into subgroups based on their BM[12].

BMI	Weight status
under18.5	Underweight
18.5 - 24.9	Normal weight
25.0 - 29.9	Overweight
30.0 and above	Obese

Additionally, take measurements of waist circumferences and hip circumferences. When obtaining waist and hip measurements, the patient should stand upright and use a flexible, non-elastic tape that is in direct contact with the skin, but does not compress the soft tissue. The waist-to-hip ratio was calculated by dividing the waist circumference by the hip circumference.

The individuals' physical activity levels were assessed using a validated questionnaire that was based on the International Physical Activity Questionnaire .

Statistical analysis

The statistical significance of variations in distinct percentages (qualitative data) was assessed using the Pearson Chi-square test (χ2-test), with the utilization of Yate's correction or Fisher Exact test when appropriate. Statistical significance was determined based on a P value of 0.05 or less.

RESULTS AND DISCUSSION

Table (1) represents that the distribution of participants with thyroid dysfunction according to anthropometric measures. The results found that 14.9% were normal weight, (29.3%) overweight, (31.3%) obese, and (24.4%) morbidly obese. Across the cohort, the mean BMI was (30.92±5.42S SD) kg/m², ranging from 18.59 to 43.56 kg/m². The individuals averaged (80.1±14.52SD) kg, (161.0±7.15SD) cm height, (98.05±14.17SD) cm waist, and (111.15±11.5792SD) cm hip circumference. (5.5%) had an outstanding waist-to-hip ratio (WHR), (12.6%) had a good one, (28.7%) had an average one, and (53.2%) were at risk. The group's mean WHR was(0.882±0.092SD), ranging from (0.537 to 1.157). Waist-to-Height Ratio (WHtR) categories: (19.5%) healthy, (17.8%) overweight, (21.0%) severely overweight, and (41.7%) obese, with a mean WHtR of (0.610±0.091), ranging from (0.284 to 0.838). also, the results reveal that there is a significant difference between anthropometric measures and thyroid dysfunction, except height no found significant difference with thyroid dysfunction (P>0.05). These results explain that anthropometric measures are higher significantly in patients with hypothyroidism compared to patients with hyperthyroidism.

Table (1): The distribution of participants with thyroid dysfunction according to anthropometric measures.

		Total (n=348)		Hypothyroidism (n=270)		Hyperthyroidism (n=78)		P value
		No	%	No	%	No	%	
BMI (Kg/m2)	Underweight (<18.5)	-	-	-	-	-	-	0.0001*
	Normal (18.5-24.9)	52	14.9	26	9.6	26	33.3	
	Overweight (25-29.9)	102	29.3	78	28.9	24	30.8	
	Obese (30-34.9)	109	31.3	87	32.2	22	28.2	
	Morbid obesity (=>35)	85	24.4	79	29.3	6	7.7	
	BMI (Kg/m2)	30.92±5.42 (18.59-43.56)		31.7±5.1 (18.61-43.56)		28.04±5.44 (18.59-40.40)		0.0001#
	Weight (Kg)	80.1±14.52 (36-117)		82.2±13.6 (43-117)		72.8±15.3 (36-110)		0.0001#
	Height (cm)	161.0±7.15 (131-182)		161.0±7.0 (140-180)		161.0±7.6 (131-182)		0.979
	Waist circumference (cm)	98.05±14.17 (58-129)		99.89±13.64 (58-129)		91.72±14.23 (61-126)		0.0001#
	Hip circumference (cm)	111.15±11.5792 (81-139)		112.66±11.28 (81-139)		105.92±11.14 (82-136)		0.0001#
WHR	Excellent (<0.85M & <0.75F)	19	5.5	16	5.9	3	3.8	0.049*
	Good (0.85-0.89M & 0.75-0.79F)	44	12.6	27	10.0	17	21.8	

	Average (0.90-0.95M & 0.80-0.86F)	100	28.7	79	29.3	21	26.9	
	At Risk (=>0.95M & =>0.86F)	185	53.2	148	54.8	37	47.4	
	Mean±SD (Range)	0.882±0.092 (0.537-1.157)		0.888±0.095 (0.537-1.157)		0.864±0.077 (0.709-1.059)		0.042#
WHtR	Healthy (0.42-0.48M & 0.43-0.52F)	68	19.5	42	15.6	26	33.3	0.001*
	Overweight (0.49-0.53M & 0.53-0.57F)	62	17.8	45	16.7	17	21.8	
	Very overweight (0.54-0.57M & 0.58-0.62F)	73	21.0	60	22.2	13	16.7	
	Obese (=>0.58M & =>0.63F)	145	41.7	123	45.6	22	28.2	
	Mean±SD (Range)	0.610±0.091 (0.284-0.838)		0.622±0.089 (0.284-0.838)		0.571±0.090 (0.394-0.800)		0.0001#
*Significant difference between percentages using Pearson Chi-square test (χ^2-test) at 0.05 level.								
#Significant difference between two independent means using Students-t-test at 0.05 level.								

Table (2) represents a comparison between the hypothyroidism and hyperthyroidism groups according to the comprehensive assessment of physical activity. The results showed a significant difference between the hypothyroidism and hyperthyroidism groups in terms of comprehensive assessment of physical activity (P value < 0.05). These results demonstrate that participants with hyperthyroidism had better physical activity compared to participants with hypothyroidism.

Table (2): Comparison between hypothyroidism and hyperthyroidism group according to overall evaluation of physical activity.

International physical activity questionnaire short form (IPAQ)	Total (n=348)		Hypothyroidism (n=270)		Hyperthyroidism (n=78)		P value
	No	%	No	%	No	%	
Vigorous (>3000)	13	3.7	9	3.3	4	5.1	0.004*
Moderate (600-3000)	161	46.3	113	41.9	48	61.5	
Low (<300)	174	50.0	148	54.8	26	33.3	
IPAQ Score Mean±SD (Range)	780.3±739.9 (17-4506)		727.6±701.3 (17-4452)		962.8±839.8 (33-4506)		0.013#
*Significant difference between percentages using Pearson Chi-square test (χ^2-test) at 0.05 level.							
#Significant difference between two independent means using Students-t-test at 0.05 level.							

In table (3) the present results report that Compared to the hyperthyroidism group, the hypothyroidism group. Regarding the thyroid function test, the results showed that the highest percentage (69.0%) of participants had normal range of TSH and followed by (12.6%) had decrease of TSH, while (18.4%) had increase of TSH. according to thyroid hormones (T3and T4), these results demonstrated that the height proportion of participant (69.0%) had normal range. (18.4%) had decrease while (12.6%) had increase. the average of thyroid function test had a substantially higher mean TSH level (5.052±5.348uIU/ml) with a p-value 0.001, suggesting a significant difference. The mean T4 level was substantially lower in hypothyroidism (94.754±31.723mmol/L) compared to hyperthyroidism (164.858±60.414mmol/L) with a p-value 0.001. The mean T3 level was considerably lower in hypothyroidism (1.449±0.594mmol/L) compared to hyperthyroidism (3.287±1.396mmol/L) with a p-value < 0.001.

Table (3): Comparison between thyroid function test for hypothyroidism and hyperthyroidism groups

Thyroid function test		Total (n=348)		Hypothyroidism (n=270)		Hyperthyroidism (n=78)		P value
		No	%	No	%	No	%	
TSH (uIU/ml)	Decrease	44	12.6	-	-	44	100.0	0.0001*
	Normal range	240	69.0	206	85.8	34	14.2	
	Increase	64	18.4	64	100.0	-	-	
	Mean±SD (Range)	4.181±5.018(0.00-45.900)		5.052±5.348 (1.10-45.90)		1.215±1.499 (0.00-4.40)		0.0001#
T4 (mmol/L)	Decrease	64	18.4	64	100.0	-	-	0.0001*
	Normal range	240	69.0	206	85.8	34	14.2	
	Increase	44	12.6	-	-	44	100.0	
	Mean±SD (Range)	110.668±49.624 (26.40-345.1)		94.754±31.723 (26.40-138.30)		164.858±60.414 (79.00-345.1)		0.0001#
T3 (mmol/L)	Decrease	64	18.4	64	100.0	-	-	0.0001*
	Normal range	240	69.0	206	85.8	34	14.2	
	Increase	44	12.6	-	-	44	100.0	
	Mean±SD (Range)	1.866±1.143 (0.20-6.60)		1.449±0.594 (1.30-6.60)		3.287±1.396 (1.30-6.60)		0.0001#
*Significant difference between percentages using Pearson Chi-square test (χ^2-test) at 0.05 level.								
#Significant difference between two independent means using Students-t-test at 0.05 level.								

In table (4), the results of this study indicate that the participants with a family history of hypothyroidism have higher TSH levels compared to those who have hyperthyroidism (4.756±4.804 vs.0.979±1.177, p=0.0001). The participants without a family history of hypothyroidism have higher TSH levels compared to those who have hyperthyroidism (4.989±6.137vs. 0.799±1.319, p=0.0001). In addition, obese hypothyroid participants (30-34.9) have higher TSH levels than those in the normal weight (4.576±4.722 vs. 0.587±1.047, p=0.0001). Similarly, obese hyperthyroid individuals have higher TSH levels than those in the normal weight category (0.992±1.055 vs. 0.857±1.350, p=0.005). Additionally, waist-to-hip ratio (WHR) is associated with TSH levels, with 'excellent' and 'good' individuals having significantly lower TSH levels than 'average' and 'at risk' individuals (p=0.039 and p=0.007, respectively).

Table (4): Comparison between thyroid stimulating hormone and family history, BMI, WHR, WHtR

		TSH (uIU/ml)		
		Hypothyroidism (n=270)	Hyperthyroidism (n=78)	
Family history	Yes	4.756±4.804	0.979±1.177	0.0001#
	No	4.989±6.137	0.799±1.319	0.0001#
	P value	0.726	0.527	
BMI (Kg/m2)	Underweight (<18.5)	-	-	
	Normal (18.5-24.9)	4.715±4.953	0.857±1.350	0.0001#
	Overweight (25-29.9)	4.576±4.722	0.587±1.047	0.0001#
	Obese (30-34.9)	5.007±6.598	0.992±1.055	0.005#
	Morbid obesity (=>35)	5.031±4.894	1.910±1.776	0.126
	P value	0.947	0.129	
WHR	Excellent (<0.85M & <0.75F)	5.156±3.605	0.387±0.540	0.039#
	Good (0.85-0.89M & 0.75-0.79F)	3.726±3.801	0.980±1.540	0.007#
	Average (0.90-0.95M & 0.80-0.86F)	5.330±5.527	0.478±0.805	0.0001#
	At Risk (=>0.95M & =>0.86F)	4.786±5.800	1.130±1.296	0.0001#
	P value	0.609	0.235	

WHtR	Healthy (0.42-0.48M & 0.43-0.52F)	4.198±3.684	0.793±1.315	0.0001#
	Overweight (0.49-0.53M & 0.53-0.57F)	5.060±5.522	0.509±1.080	0.001#
	Very overweight (0.54-0.57M & 0.58-0.62F)	4.423±4.178	0.956±1.020	0.004#
	Obese (=>0.58M & =>0.63F)	5.229±6.387	1.273±1.350	0.005#
	P value	0.653	0.277	
#Significant difference between two independent means using Students-t-test at 0.05 level.				
^Significant difference among more than two independent means using ANOVA test at 0.05 level.				

Discussion

According to body mass index (BMI), The current study showed the highest rates of patients of total the sample of thyroid dysfunction falls in obese category (31.3%) with a higher proportion (32.2.5) of hypothyroidism patients being obese and lower percentage of hypothyroidism (6.9%) being normal weight .whereas the major proportion (33.3%) of hyperthyroidism falls in the normal range with a significant association between the mean of hypothyroidism and the mean of hyperthyroidism P v=0001. These finding were accordance with a study reported by[13] in Tehran which found (36%) of thyroid dysfunction were obese .another study done by[14] in India who shows (31%) thyroid dysfunction patients were obese . meta-analysis of the 22 studies indicated that the obesity was significantly associated with the increased risk overt hypothyroidism , However, meta-analysis of studies on hyperthyroidism showed no significant association between obesity and an increased risk of hyperthyroidism[15] . The process by which obesity causes hypothyroidism involves the release of adipokines and inflammatory cytokines by the adipose tissue in obese people. These substances may contribute to the alteration of thyroid function by generating persistent low-grade inflammation in the thyroid tissue of obese individuals [16] [17] a study conducted in Iraq study that found significant connection between the mean of hypothyroidism and the mean of hyperthyroidism[18].

Relating to height in current study that found the mean of height patients with thyroid dysfunction was (161.0±7.15SD) and also found non-significant connection between the mean of hypothyroidism and the mean of hyperthyroidism. This agrees with across sectional study carried out in Egypt done by [19] that found the mean of height in elderly patients with thyroid dysfunction was (160.5±12.7 SD).in addition ,a study in Spain that showed non-statistically significant the mean of height and thyroid dysfunction [20].

The present study demonstrated that the mean of weight was (80.1± 14.52SD) , the mean of waist circumferences was (98.05±14.17SD),the mean of hip circumferences was (111.15±11.579SD)and the mean of waist to hip ratio was (0.882±0.092SD). also found significant connection between thyroid dysfunction and all of them. These results accordance with other reported studies, A study done by[19] in Egypt on 126 elderly patients that found the mean of weight was (96.5 ± 30SD). these differences may be due to of variation sample sizes of both studies. A cross- sectional study done in Indonesia [21] that stated the mean of waist to hip ratio was (0.82±0.06SD) and also found positive connection between thyroid dysfunction and WHR. another study[22] in India that showed the mean waist circumference was (92.82 ± 13.6SD) and also in same study found that positive association between waist circumferences and thyroid dysfunction, A study conducted in Manila, Philippines by[23], demonstrated that the mean of waist-to-hip ratio was (0.94±0.07 SD).Furthermore, a study in India revealed that the mean of hip circumferences and the mean of waist to hip ratio were (99.44 ± 4.68SD) (0.80±0.09SD) respectively [24]. A study conducts in Brazil [25] that appear significant relationship between the mean of waist circumferences and thyroid dysfunction.

Regarding to waist to height ratio, in current study found a higher percentage of hypothyroidism full in category >0 .5 was (45.5%) and a higher percentage of hyperthyroidism full in healthy category <0.5 (33.3%), and found positive correlation between thyroid dysfunction and WHtR .This results is agree with the study done in India [26] found higher percentage (46.47 %) of

patients with hypothyroidism had WHtR more than 0.5 .while found higher percentage (16.66%) patients with hyperthyroidism had WHtR less than 0.5 ,and also found significant association between WHtR and hypothyroidism ,hyperthyroidism

The results of the present study indicate that a higher proportion (50.0%) of patients with thyroid dysfunction were physically inactive nevertheless (46.3%) were active. That agrees with a study conducted by***(Zeleke, et al., 2023)***, who found a higher prevalence of physical inactivity(51.6%) compared with (48.4%) were active .

The current study showed that individuals diagnosed with hypothyroidism exhibit reduced levels of physical activity. The results of this study are consistent with other several studies, the findings of a study conducted in Warsaw/Poland which found that patients with hypothyroidism tend to have a reduced ability to engage in physical activity and participate in sports. This may be attributed to the effects of hypothyroidism on the lungs, heart, and muscles, which can lead to decreased exercise tolerance. Additionally, the study concluded that engaging in physical exercise may have beneficial effects on thyroid function, depressive symptoms, and cognitive abilities in individuals with hypothyroidism[28]. furthermore, a study conducted in China found individuals with hypothyroidism that the occurrence rate was lower among those who engaged in physical exercise compared to those who did not [29] . A study conducted by [30] in Egypt found that aerobic exercises led to a significant increase in the levels of T4 and T3 hormones, while simultaneously decreasing the level of TSH hormone in individuals with hypothyroidism.

According to thyroid function test The current study showed that positive connection between distribution, mean of TSH, T4, and T3 hormones and thyroid dysfunction .these finding consistence with a study conducted in Nepal by[31] and Another study done in Iraq[32] they showed that significant connection between distribution TSH,T3,T4 and hypothyroidism, hyperthyroidism.

According to comparison of thyroid stimulating hormones (TSH), thyroid hormones (T3, T4) and anthropometric measurements (BMI, waist to hip ratio, waist to height ratio) the present study demonstrated that a positive association between thyroid hormones, thyroid stimulating hormones and anthropometric measurements. These finding is similar with other reported studies done in Tehran [33] and India [34] they found positive association between thyroid stimulating hormone(TSH) and body mass index(BMI)**.** The Netherlands study .significant association between body mass index and thyroid hormones and thyroid stimulating hormones [35] a study conducts by [36] in Belgium which revealed that positive connection between thyroid stimulating hormone and waist to hip ratio, BMI. Across-sectional study showed that positive association between thyroid stimulating hormone and waist to height ratio[37]. Another across-sectional study done by IRAN found that positive association between mean of BMI and low and high TSH and non-association between waist to hip ratio and TSH [38]. [39]in India found significant association between thyroid hormones and mean waist to hip ratio and mean of body mass index.[40] It was postulated that the association between TSH and body weight observed was caused by signals from adipose tissue which influenced the central regulation of thyroid function through stimulation of TRH by down-regulating the thyroid function in the states of energy deficits,. This result is different with other study done in Bulgaria and Turkey found non-significant association between BMI and TSH[41] [42].

according to family history and correlation with thyroid hormones, thyroid stimulating hormones. in present study found that significant association with thyroid hormones and family history this finding agree with study done by [43]. Heritability studies indicate that around 67% of circulating TSH and TSH concentrations are determined by genetics, implying a genetic foundation for heterogeneity within individuals .These findings suggest that individual thyroid function set points are mainly genetically derived comparison between thyroid function and family history[44] .

Potential methodological limitations of our study, we note that the results of cross-sectional studies do not establish causal relationships. However, they do reveal associations among variables that can suggest potential mechanisms of action and that are useful for generating hypotheses that merit further investigation in intervention studied.

CONCLUSION

Significant association between hypothyroidism and low level of physical activity, obesity and morbid obesity.

Recommendations:

Patients with a familial propensity to thyroid dysfunction should be recommended to undertake screening tests and take preventive measures, due to their substantial genetic susceptibility to the disease and Recommending patients to engage in physical activity is vital for enhancing thyroid function and essential for managing thyroid dysfunction, especially hypothyroidism.

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