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ORIGINAL ARTICLE

Thyroid Volume and Echogenicity by Ultrasound in Obese Type 2 DM Patients

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Abstract

Background: **An increased levels of circulating insulin hormone is correlated with insulin resistance and impacted on thyroid tissue resulting in larger thyroid volume.**

Aim and objectives: **To assess the thyroid volume and thyroid function tests and ultrasonography echogenicity in obese diabetics with type 2 diabetes.**

Subjects and methods: **This research included 60 studied cases, Group (A): including 40 patients: Obese type 2 DM Group (B): including 20 normal persons as a control group They were collected from the outpatient clinics of Al-Hussein University Hospital between January and July 2022.**

Results: **Our result show that There is highly significance difference between group A (obese diabetic patients) and group B (the control group) we also discovered a significant relationship among thyroid volume and Body Mass Index in relation to thyroid volume and thyroid ultrasound echogenicity., waist circumference, glycated HGB and HOMA-IR comparing to group B (the control group).**

Conclusion: **Our findings imply that type II diabetes mellitus patients with obesity have larger thyroid volumes with a highly statistically correlation with BMI, WC, HbA1C, and HOMA-IR.**

Keywords: Body mass index, Obese, Thyroid ultrasound, Thyroid volume, Type 2 DM patients

1. Introduction

Diabetes type II (TIIDM) is a long-lasting, life-long illness characterized initially by insulin insensitivity and then by a sharp decline in pancreatic cell activity, which causes hyperglycemia and a variety of metabolic disorders.[1]

The general population frequently struggles with thyroid dysfunctions. with an estimated prevalence of 6.6%. Those diseases include goiter, thyroiditis, and different types of thyroid cancers.[2]

Thyroid diseases can affect several metabolic disorders such as diabetes mellitus and by far DM is the most prevalent hormonal condition encountered in clinical practice, thus DM and thyroid disease interact and influence each other.[3]

A vicious cycle can be obtained by DM and thyroid disorders together, DM patients are observed with increased circulating insulin which has a direct effect on thyroid gland resulting in increased proliferation in thyroid tissue, on the other hand, in hyperthyroid function of thyroid gland there is a direct increase in glucose level in the blood by increased liver gluconeogenesis and increased gastric absorption of glucose.[2]

Ultrasonography is a convenient affordable and safe method of imaging the thyroid gland. It has upper hand in clinically palpate thyroid tissue, it is faster, relatively cheaper, and sensitive for estimating thyroid gland biometrics and parenchymal abnormality than computerized tomography and magnetic resonance imaging[4]

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Insulin insensitivity in human body is linked to an elevated level of circulating insulin hormone in the blood stream., and this somehow correlated with have shown to a proliferative effect on thyroid gland resulting in larger thyroid biometrics[5]

A lot of studies demonstrated that people with pre-clinical-diabetes and clinical type II diabetes mellitus (T2DM) had an increased thyroid volume and more prevalent incidence of thyroid goiter and probability was significant, moreover, diabetic type II patients treated with metformin as a corner stone treatment for their glycemic control observed small thyroid size and when compared with non-metformin groups[6]

Relatively few studies have clearly correlated a strong linkage between elevated BMI in persons with obesity or overweight and thyroid volume. One study looked into this connection in obese people and discovered a link between TSH, thyroid volume, and BMI in diabetic cases.[7]

Moreover, in another research study, there was a positive correlation between BMI and thyroid volume in both the obese and control groups in a different study that looked at changes in thyroid shape and volume in 880 patients, 327 of whom were obese.[8]

2. Patients and methods

Participants were outpatients' volunteers with type 2 diabetes diagnosed according to ADA and obesity. and other normal volunteers as controls. They were collected from the outpatient clinics of Al-Hussein University Hospital between January and July 2022. Subjects are classified into: Group (A): patients group including 40 patients: Obese type 2 DM Group (B): including 20 normal persons as a control group The protocol was approved by the faculty ethical committee after oral informed permission was given by each participant. The following workup was carried on each participant: comprehensive medical history, with special attention paid to the thyroid gland, Weight, height, body mass index, waist circumference, lab tests for fasting, postprandial, and HbA1C blood sugars, thyroid function (TSH, Ft4), thyroid ultrasonography, and HOMA-IR (fasting plasma glucose minus fasting serum insulin)/405.

Inclusion criteria: All patients who are diabetic and obese are included except who met exclusion criteria.

Patient was excluded if BMI below 18, patient with history of drug intake that interfere with thyroid function like amiodarone and lithium, patient with clinical or subclinical hypothyroidism or hyperthyroidism, pervious use of anti-thyroid or thyroid hormone replacement therapy.

History and clinical assessment that includes BMI Anthropometric measures: A flexible measuring tape used to measure the waist circumference, calibrated weighing scale for the weight, and a stadiometer for the height kilograms (kg), and meters (m), respectively. The formula that used to compute the mass index (BMI) (kg/m^2) = $weight/height^2$. blood samples were drawn for 8 h for lab tests including diabetes profile (fasting blood glucose, 2-hours postprandial blood glucose, HbA1c and fasting insulin) and thyroid profile including (TSH, Free T4) Assessment of Insulin insensitivity by the Homeostasis Model (HOMA-IR) The HOMA-IR index was used to determine insulin resistance. Level of fasting glucose (measured in mmol/l) Level of fasting insulin (measured in IU/ml)/405 was used to compute the HOMA-IR value.

Studies offer slightly varying ranges for HOMA-IR, but they all conclude that human body becomes more insulin resistant as HOMA-IR increases. Overall, if HOMA-IR is under 1, it is considered an adequate insulin sensitivity. Values above 1.9 indicate the onset of insulin resistance, however levels above 2.9 indicate the seriousness of the condition. Sonographic procedure: the subjects examined to measure the TV using a real-time, grayscale 7.5 MHz linear transducer. With the subject lying supine on the couch, a sandbag placed under each shoulder to hyperextend the neck in a comfortable position. After applying coupling gel over the anterior aspect of the neck, the transducer placed directly over the gel. Using anatomical landmark of the common carotid artery and the internal jugular vein, the thyroid gland identified. The normal gland has a medium-level homogeneous echo texture. The cranio-caudal dimension (length) of each lobe measured in the longitudinal plane, and the transverse and anteroposterior dimensions (width and thickness) obtained in the transverse scanning plane, respectively. To improve reproducibility and minimize intra-observer errors in the measurement the mean of three values obtained for each lobe, and the volume calculated using the Ellipsoid formula: Volume = Length $\times$ Width $\times$ Thickness $\times$ 0.479. The total volume of the thyroid gland obtained by the addition of the volume of each lobe. The isthmus contributes little to the total TV; hence, it was excluded from the calculation other pathologies such as nodules were sought.

3. Results

Table 1.

Table 1. Comparison of BMI and WC between studied groups.

	Group A ($N = 40$)	Group B ($N = 20$)	T	*P* value
BMI (kg/m^2)				
Mean ± SD	34.7 ± 3.2	23.8 ± 1.4	13.5	<0.001
WC (cm)				
Mean ± SD	103.9 ± 7.5	74.6 ± 3.3	16.7	<0.001

Table 2. Comparison of HbA1C and HOMA-IR between studied groups.

	Group A ($N = 40$)	Group B ($N = 20$)	T	*P* value
HbA1C (%)				
Mean ± SD	9.2 ± 1.6	4.6 ± 0.5	12.1	<0.001
HOMA-IR				
Mean ± SD	3.7 ± 0.9	1.2 ± 0.4	11.4	<0.001

Highly Statistically Significant is displayed in this table. **(P<0.001)** increased BMI in group A (34.7 ± 3.2 kg/m^2) when compared with group B (23.8 ± 1.4 kg/m^2). Highly statistically significant **(P<0.001)** increased WC in group A (103.9 ± 7.5 cm) when compared with group B (74.6 ± 3.3 cm) Table 2.

Statistically Significant is presented in this table. **(P value <0.001)** increased HbA1C in group A (9.2 ± 1.6%) when compared with group B (4.6 ± 0.5%). Highly statistically significant **(P-value <0.001)** increased HOMA-IR in group A (3.7 ± 0.9) when compared with group B (1.2 ± 0.4) Table 3.

When compared to group B (4.06 0.6), there was a statistically significant ($P = 0.001$) increase in thyroid volume in group A (7.1 1.8). When compared to group B (0 patients, 0%), group A had a statistically significant difference (16 patients, 40%) higher percentage of heterogeneous thyroid glands Table 4.

Group A contained:

(1) Thyroid volume and BMI have a positive connection ($r = 0.57$) that is highly statistically significant (P value 0.001).
(2) Thyroid volume and WC have a positive connection ($r = 0.43$) that is statistically significant (P value = 0.006).
(3) There is a strong positive connection (r = 0.95) between thyroid volume and HbA1C (P value 0.001).

Table 4. Thyroid volume and other investigated parameters were correlated across all studied groups.

Variables	Group A		Group B	
	r	*P* value	*r*	*P* value
Thyroid volume vs age	0.04	0.793	−0.13	0.575
Thyroid volume vs BMI	0.57	<0.001	0.05	0.236
Thyroid volume vs WC	0.43	0.006	0.06	0.432
Thyroid volume vs HbA1C	0.95	<0.001	0.03	0.756
Thyroid volume vs TSH	0.07	0.657	0.02	0.926
Thyroid volume vs FT4	0.02	0.915	−0.03	0.899
Thyroid volume vs HOMA-IR	0.97	<0.001	0.12	0.498

(4) There is a strong positive connection ($r = 0.97$) between thyroid volume and HOMA-IR, which is statistically significant (P value 0.001).

Figs. 1–3.

4. Discussion

Insulin Resistance (IR) in is associated with worrisome outcomes and morbidities the most dangerous is cardiovascular morbidity and mortality as a result of hyperglycemia, dyslipoproteinemia, arterial hypertension, obesity, thrombosis, and smoking. In patients with metabolic syndrome, IR is associated with higher thyroid gland biometrics and an increase in the incidence of single thyroid nodules. Few studies were conducted to address this association.[9]

Patients with insulin resistance had statistically more thyroid gland hypertrophy and nodules. It is unclear how thyroid volume, nodule formation, and disorders of glucose metabolism are related. The thyroid gland is one of the corner stone endocrinal glands which is located in the neck covered by the thyroid cartilage that secretes hormones that control development, growth and expansion of human cells and tissues by controlling the metabolic rate.[10]

Increased thyroid gland volumes in IR patients with hyperglycemia and glucose metabolic disorders (GMD) cause clinic-pathological and structural alterations in the thyroid gland. Insulin resistance is linked to GMD, and it is well-known that compensatory hyperinsulinemia and insulin resistance are key factors in the development of diabetes.[11]

The main results of this study were as following: Our study showed that there was no statistically

Table 3. Comparison of thyroid U/S between studied groups.

	Group A ($N = 40$)		Group B ($N = 20$)		Stat. test	*P* value
Thyroid volume						
Mean ± SD	7.1 ± 1.8		4.06 ± 0.6		**T = 7.09**	**<0.001 HS**
Thyroid echogenicity						
Homogenous	24	60%	20	100%	**$X^2 = 10.9$**	**0.001 S**
Heterogeneous	16	40%	0	0%		

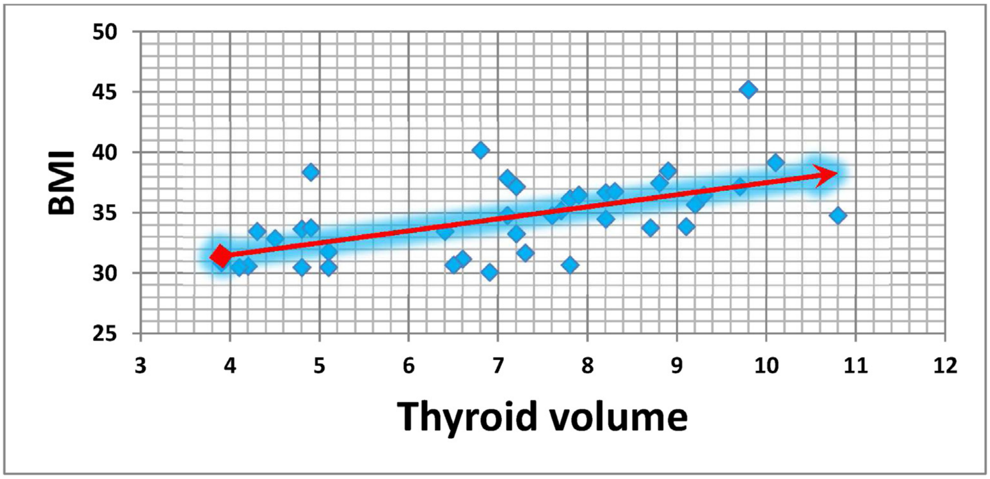

Fig. 1. Positive correlation between thyroid volume and BMI in group A.

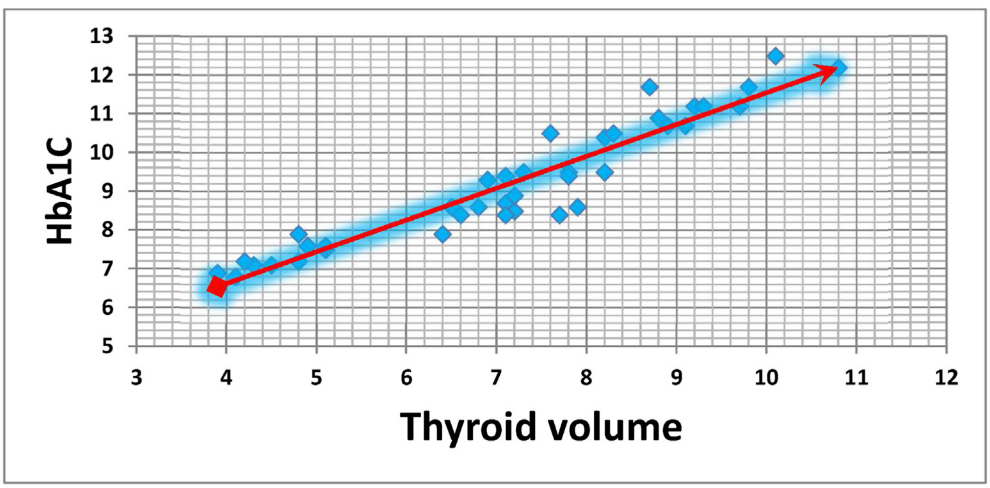

Fig. 2. In group A, there is a positive correlation between thyroid volume and HbA1C.

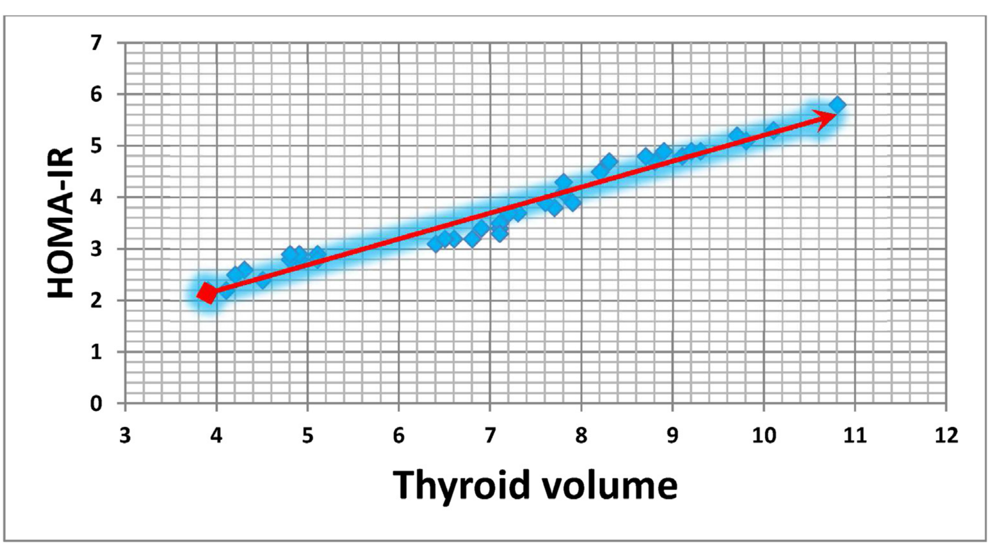

Fig. 3. Correlation between thyroid volume and HOMA-IR in group A.

significant difference between obese diabetic group and control group as regard TSH and free T4.[4]

Our results were in agreement with study of **Duran et al., 2014**[12] as they reported That TSH and free T4 levels were similar in all groups.

In contrary to our results, study of **Anil et al., 2013**[4] as they reported that, mean TSH level in the diabetes group was higher than the control group.

Our results were in contrast to the study of **Johari et al., 2018**[13] as they reported that TSH levels significantly increased in the diabetic group when compared to the control group, and they significantly increased in the obese and diabetic groups when compared to the control and diabetic patients.

Furthermore fact, when FT4 levels was compared to those of control and diabetic patients, the obese and diabetic obese groups revealed different significant fluctuations. While there was a very significant drop in FT4 in the obese and obese diabetic groups compared to the diabetic patients, there was a highly significant increase in FT4 in diabetes individuals in comparison to the control group.

Our study and **Duran et al., 2018**[12] study the number of patients were much less than **Anil et al., 2013**[4] and **Johari et al., 2018** 14 and this may explain the difference between studied in thyroid function test Ethnicity is another important issue that may explain the differences between studies in thyroid function test.

Our results showed that in obese diabetic patient there were highly statistically significant Positive correlation between thyroid volume and BMI, thyroid volume and waist circumference and this well correlated with **Khassawneh et al., 2020**[14] who found that there was high correlation between obesity and thyroid volume.

Also, in the study of **Nduka & Adeyekun, 2016,**[15] correlation values of thyroid volume and obesity markers both BMI and WC were very significant.

Our results showed that there was highly significant correlation between insulin resistance done by HOMA-IR equation and thyroid function.

Our results were supported by study of **Bahaaeldin et al., 2018**[16] as they showed that thyroid gland size and volume were larger in patients with insulin resistance by HOMA-IR equation and statistically results were significant.

In addition, the previous, there was a significant correlation between thyroid volume and FBS, fasting insulin, and HOMA-IR were demonstrated by **MOHSEN et al.,2017**[17]

Our results showed that there were heterogenous thyroid by ultrasound in obese diabetic group in contrast to homogenous thyroid in neck ultrasound in the control group and these results were similar to **Anil et al., 2013**[4] who showed the same results.

In the study of **Duran et al., 2014,**[12] thyroid volume and heterogenous echogenicity was correlated with insulin resistance by HOMA-IR equation and diabetes group although non-significant results and or correlation were found in the control group and this similar to our study which showed same results.

On the other hand, **Buscemi et al., 2018**[9] revealed that there is no significant correlation between diabetic patients and prediabetic patients in echogenicity or thyroid volume by neck ultrasound and they mentioned that their results against most of literatures and explained this by no control group in their study and young age of their diabetic and prediabetic groups and that they did not include obesity as condition in any group of their study.

4.1. Conclusion

Our findings imply that type 2 DM patients with obesity have a markedly enlarged thyroid volume. The relationship between thyroid volume and BMI, WC, HbA1C, and HOMA-IR was highly statistically significant, further studies are required for determination of clinic-pathological impact of this positive correlation.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

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Conflicts of interest

There are no conflicts of interest.

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