

Sonographic Normal Thyroid Gland Volume in Healthy Adults in Erbil

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Abstract

Background and Objectives: To find a normal reference value of thyroid gland volume in healthy adults of Erbil population and to correlate the obtained values with age, sex, height, weight, body mass index (BMI) and body surface area (BSA) and to compare the local values with those described in the literature.

Methods: A total of 200 healthy subjects were studied, B- mode sonography was used to measure the total thyroid volume by combining the volume of both the lobes obtained by using the formula for the prolate ellipsoid.

Results: The overall mean thyroid volume in all the subjects was 7.3 ± 3.46 mL. The mean thyroid volume in females and males was 6.66 ± 3.68 mL and 8.25 ± 2.87 mL, respectively ($p \leq 0.001$). The mean volume of the right and left lobes of the thyroid gland in all of the patients were 4.02 ± 1.94 mL and 3.27 ± 1.6 mL, respectively. Positive correlation was found among thyroid volume and body weight ($r=0.403$, $p \leq 0.001$), height ($r=0.243$, $p \leq 0.001$), BMI ($r=0.338$, $p \leq 0.001$), and BSA ($r=0.405$, $p \leq 0.001$).

Conclusion: The study has determined the sonographic normal thyroid volume of healthy adults in Erbil. The highest correlation was found with BSA.

Keywords: Sonography; Thyroid Gland Volume; Adults; Erbil

Introduction

The thyroid is a vital endocrine gland located within the anterior cervical region. It has two lobes connected by an isthmus. Its size, volume, and shape vary with age and sex,^{1,2} the limits of normal thyroid volume are 10-15 ml for females and 12-18 ml for males.³⁻⁵

Sonography with a linear probe is a simple technique to check thyroid anatomy in addition to the abnormalities in the gland structure, echogenicity, and volume.⁴⁻⁶

Thyroid gland volume (TGV) is important for the present practice: it identifies the enlargement of the gland (goitre) and its response to suppressive treatment, it aids in rigorous calculation of the radioiodine dose,⁶ evaluating the efficacy of levothyroxine therapy⁷ and for correct evaluation of the gland mass in cases of minimally invasive surgery.^{8,9}

Several factors are known to be involved in the regulations of TGV and different reports of TGV normal range are presented from different populations.¹⁰⁻²⁵ Studies from the neighbouring countries like Turkey and Iran reported mean TGV of 12.98 ± 2.53 and 9.53 ± 3.68 ml respectively.

^{10, 11} Mean TGV was reported $8.55 \text{ ml} \pm 1.82$ from Sudanese normal subjects and they confirmed that their values were less than other studies.¹² A report from France calculated mean TV of 13.3 and 8.9 ml in males and females, respectively.¹³ It is an identical finding of nearly all the studies that total TGV in healthy adults is larger in males than in females, asymmetry of the gland is additionally very frequent and the right lobe is larger than the left

lobe in both genders.¹⁰⁻¹⁴ Many previous studies showed that TGV to be positively correlated with weight, height, body mass index (BMI) and body surface area (BSA). It was suggested the necessity for population-specific references for thyroid volumes and its determinants in each area,¹⁰⁻²⁵ in our population, the normal volume of the thyroid gland has not been established till date and we depend on WHO data as a reference for evaluating the gland volume. The aim of this study was to find a normal reference value of thyroid volume in healthy adults of Erbil population so that to apply the size criteria for goitre. The goals were to correlate the obtained values with age, sex, height, weight, BMI, and BSA and to compare the local values with those described in the literature.

Subjects and Methods

This was a descriptive cross-sectional study conducted in Hawler Medical University, College of Medicine during the period from September 2016 to July 2017.

The study included a convenience sample of two hundred healthy adult subjects of Erbil residents, a city in the Kurdistan region of Iraq, excluding smokers, pregnant women, those delivered during the last 12 months, lactating mothers, history of thyroid disease or surgery or family history of thyroid disease, those having chronic disease or on drugs causing goitre and those clinically having goitre. Being in euthyroid state was assured by testing their serum thyroid stimulating hormone (TSH) level and only those with normal TSH participated in the study.

The ethics committee of the college of medicine, Hawler medical university approved the study and verbal informed consent of the study participants was obtained.

A specially designed questionnaire was used for data collection including age, gender, weight, and height of the participants and the data about ultrasound examination of their thyroid gland.

Each thyroid sonography was performed by one of the two radiologists who have more than 15 years' experience and any intra or interobserver variability was solved by taking the opinion of a third radiologist, a grey scale real-time ultrasound machine general electric (GE) Healthcare Voluson S8 was used fitted with a wide band linear transducer 4-12 MHz, it needed no preparation, the subject in supine position; the neck was exposed with removal of clothes and any jewellery if there, the neck was hyper extended and the shoulders supported with a pillow. Ultrasound gel was applied over the thyroid area; those with neck swelling were not included in the study. The left and right thyroid lobes were assessed separately with the subject's head turned away from the side under examination. Longitudinal and transverse scans of each thyroid lobe were performed, any thyroid with a nodule or abnormal echogenicity were excluded from the study, normal vascularity was assessed by shifting to colour Doppler mode and any thyroid with abnormal vascularity was not included in the study.

Measurement of the thyroid lobe involves three measurements: the length, width, and depth. For measurement of thyroid length, the probe was placed longitudinally in the midline of the neck to get sagittal views of the larynx then the probe was moved obliquely to obtain the maximum thyroid length just medial to the carotid vessels. The transverse views were obtained by using the trachea and carotid vessels as landmarks. The width and depth were measured on transverse section of the lobe: the width is the distance between the most lateral point of the lobe and the acoustic shadowing of the trachea and the depth is the maximum anteroposterior distance in the middle third of the lobe.³ The volume of each lobe was calculated automatically by the machine using the formula for a prolate ellipsoid^{26,27} where $\text{volume(ml)} = \text{length(cm)} \times \text{width(cm)} \times \text{depth(cm)} \times c$, c is constant and equals 0.523

which has been set in the machine.²⁸ Total thyroid volume was obtained by adding the volume of both the lobes.

Participants' weight in kilograms and height in meters were recorded then BMI and BSA were obtained by using known formulas:^{29, 30}

$BMI = \text{weight in Kg} / (\text{height in m})^2$

$BSA (m^2) = ((\text{height in cm} \times \text{weight in kg}) / 3600)$

A pilot study was performed on ten subjects to determine the reliability of the questionnaire. The pilot study samples were selected from the same setting.

The Statistical Package for Social Sciences (SPSS, Chicago, IL, USA), version 18) and Microsoft excel program was used for data entry and analysis. Two approaches were used; descriptive and analytic. The descriptive approach included calculation of frequencies, percentages, means, S.Ds. while in the second approach; Independent sample t-test was used to compare the difference between the mean volumes of two lobes and in relation to gender. ANOVA test was used to compare TGV between more than two age-groups. Pearson's correlation test (r) was used to assess the strength of correlation between TGV and weight, height, BMI, and BSA. P value ≤ 0.05 regarded as statistically significant.

Results

Characteristics of the study population: Of the 200 studied subjects, 120 (60%) were females and 80 (40%) males, representative of healthy population according to thyroid clinical, laboratory and sonographic results. The mean age of the subjects was 37.65 ± 12.35 years with a range of 20–70 years. The majority were in overweight (42.5%), followed by normal (40%), and then obese (15%) and low (2.5%) BMI groups.

Thyroid volume: The overall mean thyroid volume in all the subjects was 7.3 ± 3.46 mL with the minimum of 2.4 and maximum of 24.79. The mean thyroid volume in females and males was 6.66 ± 3.68 mL and 8.25 ± 2.87 mL, respectively ($p \leq 0.001$). The mean volume of the right and left lobes of the thyroid gland in all of the patients were 4.02 ± 1.94 mL and 3.27 ± 1.6 mL, respectively. In females, the right and the left lobes of the thyroid gland volumes were 3.68 ± 2.05 mL and 2.97 ± 1.69 mL. In males, the right and the left lobes of the thyroid gland volumes were 4.53 ± 1.65 mL and 3.71 ± 1.35 mL. The right thyroid lobe volume was greater than the left in all patients of both sexes ($p < 0.05$). Table 1 shows each lobe and total gland volume in all, female and male participants.

Table 1: Comparison of Mean Thyroid Gland Volume in All, Males and Females

Variables	Total Participants	Female	Male	P-Value
	Mean \pm SD.	Mean \pm SD.	Mean \pm SD.	
Right Lobe Volume(mL)	4.02 ± 1.94	3.68 ± 2.05	4.53 ± 1.65	0.002
Left Lobe Volume (mL)	3.27 ± 1.6	2.97 ± 1.69	3.71 ± 1.35	0.001
Total Gland Volume(mL)	7.3 ± 3.46	6.66 ± 3.68	8.25 ± 2.87	0.001

P-value of <0.05 is significant

Age specific reference values and the percentile: Figure 1 shows the reference values of total thyroid volume for different age groups and the percentile of TGV in all normal participants. In this reference range, TGV of 97th percentile was 16.07mL.

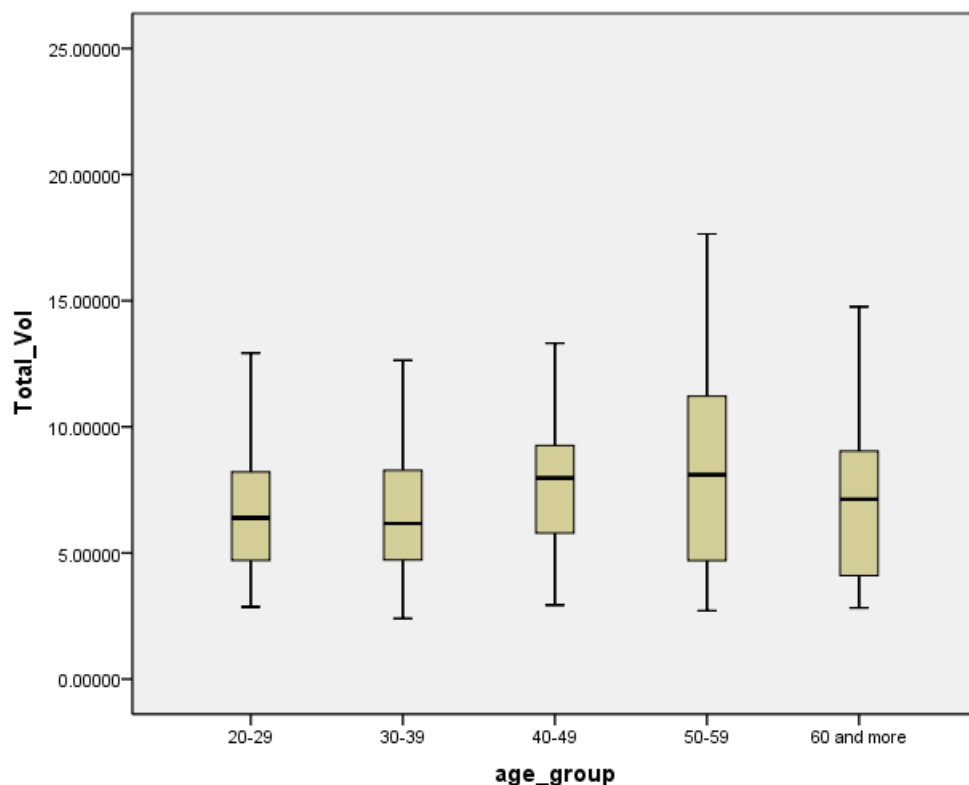
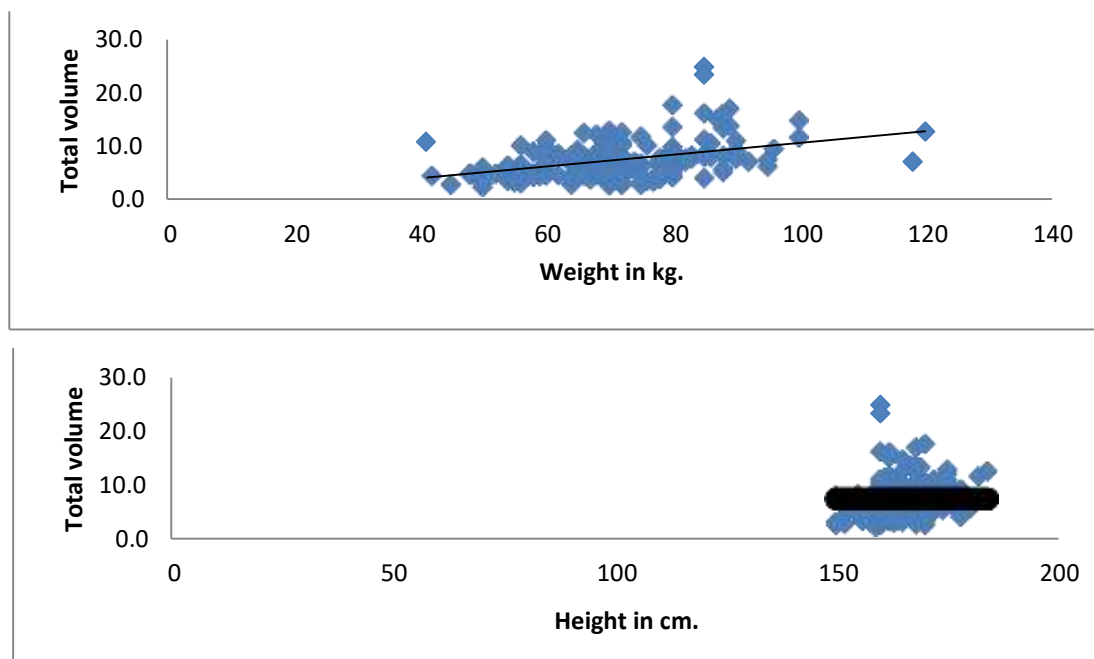


Figure 1: Thyroid volume in different decades in all normal participants.

Thyroid volume and subject's built: Pearson's correlation coefficient (r) showed positive correlation among total thyroid volume and participants' weight, height, BMI and BSA as shown in figures 2. The highest correlation was found with BSA ($r = 0.405$, $p \leq 0.001$).



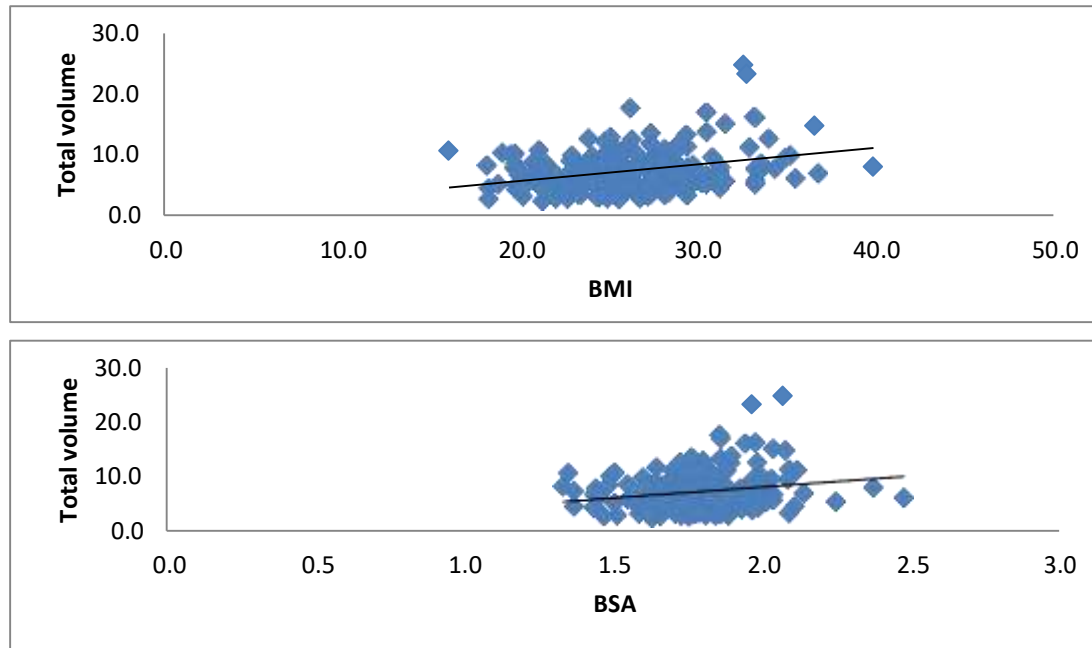


Figure 2: Scatter plots and the estimated lines of total thyroid volume (mL) against the participants' weight ($r=0.403$, $p\leq 0.001$), height ($r=0.243$, $p\leq 0.001$), BMI ($r=0.338$, $p\leq 0.001$), and BSA ($r=0.405$, $p\leq 0.001$)

Discussion

Accurate estimation of thyroid volume is important for the evaluation and management of thyroid disorders.³ Thyroid volume values may vary in smokers and in conditions such as pregnancy, lactation, and some chronic illnesses. That is why these subjects were excluded from our study.^{13, 31-35}

Most populations are now determining their own reference values for normal TGV.^{11-14, 18-26} Mean thyroid volume combined for both lobes and genders obtained from our population was 7.3 ± 3.46 mL, there was no previous local study for comparison in our country. Mean TGV of healthy adults was noted to be as 12.98 ± 2.53 mL in Gaziantep/Turkey,¹⁰ 9.53 ± 3.68 mL in Isfahan/Iran¹¹, 8.55 ± 1.82 mL in Nigeria,¹⁷ 10.68 ± 2.83 mL in Croatia²² and 8.2 mL in Spain,²³ our obtained value was less than the previously mentioned values but it was higher than Sudanese, Pakistani, Nepalese and Cuban populations.^{12, 20, 21, 24} This difference could be related to food intake habit and geographical region.

Thyroid volume among the Chinese studied by Hsiao and Chang²⁵ was 7.7 ± 3.3 mL, and this was near to the value of our population (7.3 ± 3.4 mL).

Similarly to all previous studies, we found that the gland volume to be greater in males (8.25 ± 2.87 mL) compared to females (6.66 ± 3.68 mL). This difference between both genders was statistically significant ($p < 0.05$) and is due to that the structural anatomy is larger in males than that in females.¹⁰⁻¹⁸ In the study of Aydın O et al. and Kayastha P et al there was no statistically significant TGV difference regarding gender.^{19, 21}

The right thyroid lobe volume was greater than the left with significant statistical difference in both genders ($p < 0.05$). These findings were similar to other studies¹⁰⁻²⁸ and it was related to the position of the oesophagus.³⁶

TGV increased with increasing age till age of 59 years and it decreased thereafter in agreement with Kamran M et al²⁰ who studied Karachi population.

Our study showed positive correlation of TGV with the participants' height, weight, BMI and BSA. This was observed by many other researchers.^{10, 12-14, 18, 19-22, 24, 25, 37, 38} The highest correlation was found with BSA ($r = 0.405$, $p \leq 0.001$) in agreement with studies of Şahin E et al¹⁰ Adibi A et al,¹¹ Barrère X et al¹³ Gomez JM et al¹⁴ Şeker S et al¹⁸ Kamran M et al²⁰ Kayastha, P et al²¹ Ivanac et al²² and Turcios S et al.²⁴

Most of the recent reports suggest that thyroid volume is significantly correlated with body weight and body mass index and it was concluded that weight loss may affect thyroid volume and function.^{37, 38}

Limitations of the study:

The size of our sample was small because of several exclusion criteria and using hormonal study that was not possible to perform for more subjects but it falls in the range of the sample size of other studies.^{12, 13}

Other tests like urinary iodine excretion and TPO-antibody were not studies because these are not available in this region however studied by other researchers.

The study was limited to the use of 2 dimensional ultrasound due to the limited availability of the three dimensional ultrasonography in this region. A study found no statistically significant difference between the 2 methods.³⁹

Conclusion

The mean \pm SD thyroid gland volume obtained in our population (7.3 ± 3.4 mL) was in the lower range of the values reported in previous studies. The volume of the right lobe of the gland was greater than the left in both sexes. The mean thyroid volume in the males was higher than in the females and the highest correlation was found with BSA.

Conflict of interests

The authors report no conflict of interests, and the work was not supported or funded by any drug company.

Authors' Contributions

S.N. Dawood performed study conception, conducted study design, data interpretation and collection, supervision of data analysis, revision and final approval of the paper with oral presentation at the 1st scientific conference of the college of medicine. M.G. Sedeq conducted data collection, interpretation and drafting and final approval of the paper. S.M. Othman performed data analysis, revision and final approval of the paper.

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