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BAHIRDAR UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF CLINICAL RADIOLOGY

Ultrasound Measurment Of Normal Thyroid Size In Adults

At Tibebe Gihon Hosptal In

Bahirdar, Ethiopia 2024

BY; Endalew Dessie
(MD, YEAR III RADIOLOGY RESIDENT)

A REASURCH THESIS TOBE SUBMITED TO CLINICAL RADIOLOGY DEPARTMENT, SCHOOL OF MEDICINE, COLLAGE OF MEDICEINE AND HEALTH SCINCE IN PARTIAL FULFILMENT OF THE REQUIRMENT FOR THE SPECIALITY PROGRAM IN CLINICAL RADIOLOGY

TITLE OF THE RESEARCH PROJECT	Ultrasound Measurment Of Normal Thyroid Size In Adults At Tibebe Ghion Specialized Hospital In 2024
PRINCIPAL INVESTIGATOR	ENDALEW DESSIE (MD, YEAR III RADIOLOGY RESIDENT) DEPARTMENT OF RADIOLOGY COLLEGE OF MEDICINE AND HEALTH SCIENCES BAHIR DAR UNIVERSITY EMAIL: ENDALEWDESSIE1@GMAIL.COM CELL PHONE: +251-912650620
ADVISORS	Dr AMHA ADMASIE (PHD IN PUBLIC HEALTH) SCHOOLOF PUBLIC HEALTH COLLAGE OF MEDICINE AND HEALTH SCINCES BAHIR DAR UNIVERSITY Tel. +251 911 364739 Email: yetsionamha@gmail.com
	Dr. GENETU BELAY (MD, RADIOLOGIST) DEPARTMENT OF CLINICAL RADIOLOGY COLLAGE OF MEDICINE AND HEALTH SCINCES BAHIR DAR UNIVERSITY Tel. +251 920426780
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Project Area	TIBEBE GHION SPECIALIZED HOSPITAL, BAHIR DAR, ETHIOPIA

DECLARATION

I, the undersigned, declared that this is my original work, has never been presented in this university, and that all the resources and materials used for the research, have been fully acknowledged

Principal Investigator

Name: *Dr. Endalew Dessie (Final year radiology resident)*

Signature: ----------

Date: 22/04/2024

Bahir Dar University

College Of Medicine and Heath Science

School of Medicine Department of Clinical Radiology

Approval of Dissertation/thesis for defense

I hereby certify that I have supervised, read, and evaluated this thesis/dissertation titled "Ultrasound measurement of normal thyroid size in adults at Tibebe Ghion specialized hospital" by Dr. Endalew Dessie prepared under my guidance. I recommend the thesis/dissertation be submitted for oral defense

Advisor's name	Signature	Date
Dr Genet Belay		22/4/2024
Dr Amha Admasie		22/04/2024

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ABSTRACT

Background: Thyroid gland is a butterfly-shaped gland comprising of two lobes right and left, interconnected via a narrow central isthmus.

The thyroid gland is one of the largest endocrine glands in the body and its weighing is about 10-25g. It regulates the rate of metabolism and control the growth and rate of function of many other systems in the body by producing thyroid hormones; principally thyroxin (T4) and triiodothyronine (T3). Its size and shape vary widely in normal individuals. A number of factors are involved in the growth of the thyroid gland, including dietary iodine intake, age, gender, smoking and some anthropometric measures such as weight, height, body mass index (BMI), waist-to-hip ratio , body fat and body surface area. Knowledge about thyroid volume is needed for the evaluation of a number of physiological and pathological factors such as iodine deficiency goiter, thyroiditis, and multinodular goiter.

Objective: To determine the normal size of thyroid gland in adult patients.

Methods; This is a cross sectional study of sonographic measurement of thyroid gland volume on 422 normal (healthy) adults in Tibebe Gion Specialized Hospital. All examinations were performed with linear probe NX2 high resolution frequency (7 -10 Megahertz (MHZ)) Siemens ultrasound. Measurements of each lobes and were obtained in longitudinal (length), transverse (width) and depth (thickness) in centimeters (cm). The weight and heights were obtained. The data obtained were statistically analyzed using SPSS software version 27. Simple tabulation and descriptive statistics using frequency table and variables were analyzed with multiple leaner regression .The results were presented in forms of tables, graphs and chart.

Result; The total mean thyroid volume was 7.44±2.86 cm3 (range of 2.1 -15). For male total mean thyroid volume 7.89cm3±2.99 cm3 (range 2.6 -15). For females total mean thyroid volume 6.87cm3±2.58 cm3 (range 2.1-14.7). The mean right thyroid lobe volume is larger than the left thyroid lobe (irrespective of sex) 3.74± 1.55 cm3 and 3.70± 1.52 cm3 respectively.Hight and weight has positive correlation thyroid volume ,no statistically significant relation seen between thyroid volume and age .

Conclusion; The mean thyroid volume is higher in other African countries but significantly lower than European and Asian countries. Similar has to be done in other parts of the country.

Key words: thyroid volume, thyroid lobe, height, weight.

Contents

ACKNOWLEDGEMENT i
ABSTRACT iv
Abbreviations and Acronyms: x
1. INTRODUCTION 1
1.1 Background 1
1.2 Statement of the problem 2
1.3 Significance of the study 3
1.4 Objective 3
1.1.1 General objective 3
1.1.2 Specific objective 4
2. Literature review 5
2.1 Normal size of thyroid 5
2.2 Anthropometry and thyroid size 7
2.3 Conceptual framework 9
3. METHODS AND MATERIALS 10
3.1 Study area and Study period 10
3.2 Study design 10
3.3 Source Population 10
3.4 Study population 10
3.5 Sample size determination 10
3.6 Sampling procedures 11
3.7 Variable 11
3.7.1 Dependent variables 11
3.7.2 Independent variable 11
3.8 Inclusion and exclusion criteria 11
3.8.1 Inclusion criteria 11
3.8.2 Exclusion criteria 12
3.9 Operational definition 12
3.10 Data Collection methods 12
3.11 Data quality control 13

3.12 Data processing and analysis 13
4. ETHICAL CONSIDERATION 14
5. RESULTS 15
5.1 Sociodemographic characteristics 15
5.2 Mean and total thyroid volume 16
5.3 Thyroid volume and its relationship with anthropometric factors 20
6 DISCUSION 24
7 Limitation of the study 26
8 CONCLUSION AND RECOMMENDATION 27
8.1 Conclusion 27
8.1 Recommendation 27
9 Reference 28
Annex l, Data collection tools 29
Annex ii 30

LIST OF FIGURES

Figure 2-1; figure of conceptual framework.....9
Figure 5-1Pie chart of sex distribution of study subjects. 15
Figure 5-2 A histogram showing normal distribution of the thyroid volume.....17
Figure 5-3; Normal P-P plot showing majority of the data are centered around the line.....17
Figure 5-4 Homoscedasticity.....17
Figure 5-5; Multiline graph for thyroid size and 19
Figure 5-6; Relationship of age and thyroid size.....22
Figure 5-7; Relationship of total thyroid volume and weight 22
Figure 5-8; Relationship of total thyroid volume and height.....23

LIST OF TABLES

Table 5-1; Anthropometric data of respondents 16
Table 5-2Thyroid size for male with Age category 19
Table 5-3;Female thyroid size with age category 19
Table 5-4; Regression model summary 20
Table 5-5; ANOVA 21
Table 5-6; Coefficients table 21
Table 6-1Total thyroid volume percentile 25

Abbreviations and Acronyms:

BMI---------Body Mass Index

ETB--------- Ethiopian Birr

ICCIDD----- International Council for the Control of Iodine Deficiency Disorders

MHZ--------- Megahertz

SPSS--------- Statistics Package for Social Sciences

T3---------- Triiodothyronine

T4---------- Thyroxin

TFT----------Thyroid Function Test

TGSH-------- TibebeGihon Specialized Hospital

TSH----------Thyroid Stimulating Hormone

WHO---------World Health Organization

1. INTRODUCTION

1.1 Background

Thyroid gland is a butterfly-shaped gland comprising of two lobes (right and left) interconnected via a narrow central isthmus(1).

The thyroid gland is one of the largest endocrine glands in the body and its weighing is about 10-25g. It regulates the rate of metabolism and control the growth and rate of function of many other systems in the body by producing thyroid hormones; principally thyroxin (T4) and triiodothyronine (T3) (2). Its size and shape vary widely in normal individuals. A number of factors are involved in the growth of the thyroid gland, including dietary iodine intake, age, gender, smoking and some anthropometric measures such as weight, height, body mass index (BMI), waist-to-hip ratio , body fat and body surface area (3). Knowledge about thyroid volume is needed for the evaluation of a number of physiological and pathological factors such as iodine deficiency goiter, thyroiditis, multinodular goiter (3).Enlargement of the thyroid gland may be associated with hyperfunction or hypofunction of the gland. There can be malignant growths of the thyroid gland leading to possible invasion into the neighboring structures giving rise to pressure symptoms and nerve involvement. Morphometry of the thyroid with particular emphasis on its volume is an essential and most important parameter which must be evaluated. It is helpful in the diagnosis and monitoring of various thyroid diseases.

Therefore, accurate estimation of thyroid size is important for the evaluation and management of thyroid disorders(4).

Normal thyroid size can be assessed clinically by clinical examination (inspection and palpation) and by ultrasound. But the sensitivity and specificity of clinical diagnosis is poor as it is very subjective and is influenced by the circumstances of examination, the experience of the examining person and the neck anatomy of the person examined(5). Recent reports define ultrasonography (US) as a more precise method of determining gland volume, and its accuracy as higher than that of clinical examination in establishing the presence of goiter. US volumetric is now considered the most reliable method of determining thyroid volume(6). Ultrasonography with a linear probe is a useful, practical, safe and comparatively cheap method for assessing thyroid volume(3).

As described above the thyroid has two lobes connected by isthmus, by ultrasound the radiologist can measure length width and depth of echo lobe. The total thyroid volume is the sum of the lobe and isthmus is not included in the volume. Volume can be calculated by the volumetric ellipsoid method (height × width × depth ×correction factor 0.524)(7).

Each lobe is cone-shaped and measuring about 5 cm in length, 3 cm in width and 2 cm in depth. Isthmus measures about 1.25 cm in width as well as height, but dramatically varies in size and site. Its thickness varies between 3-5 mm, correlating with various demographic factors. Variations in morphometry include variations in volume, shape and size of the thyroid gland which may differ according to age and gender. The normal limit of thyroid volume (without including the isthmus) is reported as 10-15 mL in females and 12-18 mL in males(1).

However, the use of ultrasonography method for determination of thyroid size becomes effective, if reliable reference data exists for comparison. Unfortunately, such standard reference data is still lacking in our country. Available reference values proposed by different organizations including the World Health Organization (WHO)/International Council for the Control of Iodine Deficiency Disorders (ICCIDD) and recommended European reference values showed great discrepancies. A similar study done in Ghana and Nigeria to measure the volume of normal thyroid glands in children and adults and compare the results with the WHO accepted values revealed that the local values derived were significantly lower than that of the internationally accepted ones. These discrepancies have led to calls for the need to establish specific local reference values(2, 8)

1.2 Statement of the problem

Thyroid gland is one of the most important endocrine gland .Many of the thyroid abnormalities can be detected clinically or by laboratory (doing thyroid function test).Thyroid is enlarged on both hypothyroidism and hyperthyroidism. One of the commonest disease with increased in thyroid size is goiter which is one of the risk factor for malignancy. Goiter is common in iodine depleted countries.

A study done in 2007 0n children age between 6 and 12 years showed that the national total goiter prevalence rate was 39.9% representing more than 4 million children(9). To tackle this problem many African countries are campaigning iodized salt provision for decades(8) .

Another major challenge is not only thyroid size enlargement is sign of many disease but also the size varies to a considerable degree from person to person depending on age, Height, weight, BMI BSA, sex.

According to different articles the thyroid size is also different from different geographic location of the same country (8).

Many of the thyroid size reference values of WHO and text book are done in Europe. The fact that thyroid size is affected by anthropometric factors make the problem worse since European society are taller and bigger than us. Ultrasound is also the easiest, cheapest and fastest method of thyroid examination than thyroid function test and more reliable than physical examination.

Therefore, endemic prevalence of hypothyroidism which is the commonest cause of thyroid malignancy, the lack of local reference value for comparison make this study worth.

1.3 Significance of the study

Ethiopia is one of the endemic areas for goiter which is ether hyperthyroidism or hypothyroidism and risk factor for future malignancy. The advanced Ethiopia's iodized salt program has achieved the coverage to 89 % from the lowest 15 %(10). But to the authors knowledge there is no local reference value for the normal size of thyroid gland. Countries like Ghana believe that national reference value are not enough ,regional reference value is a must(8).

Ultrasound Thyroid size assessment couldn't be replaced by clinical examination and laboratory test. Majority of patients with goiter are euthyroid by laboratory study, palpation and inspection are also not reliable. Thyroid volume greater than the 97th percentile of the population is considered to be goiter. Using standard thyroid normal size reference value from studies done in Europe will defiantly make majority of goitrous patients to fail in the category of normal size. This will delay measures to be taken like iodized salt supplementation.

The disease burden and the lack of local standard comparative reference value makes our study significant and our goal is to narrow this gap and lay fertile ground for future studies.

1.4 Objective

1.1.1 General objective

The objective of the study was to determine the normal size of thyroid gland in adult patents

1.1.2 Specific objective

To identify the discrepancy between local normal thyroid size value and standard reference values

To determine the relationship between thyroid size and anthropometric factors

To identify anthropometric factors that has significant correlation to the normal thyroid size

2. Literature review

2.1 Normal size of thyroid

Retrospective cross-sectional study done on euthyroid461 adults at the Nuclear Medicine Department of Gaziantep 25 Aralik Hospital in Turkey showed that the overall mean thyroid volume in all the patients who were studied was 12.98 ± 2.53 ml. The mean thyroid volume in females and males was 12.09 ± 2.05 ml and 14.53 ±2.55mL, respectively ($p<0.05$). The mean volume of the right and left lobes of the thyroid gland in all of the patients were 7.01 ± 1.94 ml and 5.97 ± 1.76 ml, respectively. In females, the right and the left lobes of the thyroid gland volumes were 6.48 ± 1.84 ml and 5.61 ± 1.58 ml. In males, the right and the left lobes of the thyroid gland volumes were 8.17 ± 1.53 ml and 6.36 ±1.44 ml. The right thyroid lobe volume was greater than the left in all patients of both sexes ($p<0.05$)(4).

A study done in Croatia 2003 on randomly selected female medical students identifies the mean total thyroid volume was 10.68±2.83 mL; and the maximum measured volume was 17.09 ml. Thyroid volume was found to be significantly correlated to body height ($p<0.01$) and body surface area ($p<0.05$). There was no significant linear correlation between thyroid volume and body weight(11).

Across sectional study done by Department of Internal Medicine and Endocrinology in Copenhagen, Denmark identifies the mean thyroid volume to be 18.6 ± 4.5 ml. It also said there was significant difference between the mean thyroid volume of males (19.6 ± 4.7 ml) and females (17.5 ± 4.2 ml)(12).

In Spain 2000 G.C research done on randomly selected adults to see the Determinants of thyroid volume as measured by ultrasonography on healthy adults, on 268 subjects found out thyroid volume was higher in males (9.19 ml) than in females (6.19 ml). Significant correlations were found among thyroid volume and body weight ($P<0.0001$), height ($P<0.0001$), BMI ($P<0´02$)(6).

A case-control study done on 203 patients between 17 and 60 years of age between 2000 and 2011 G.C at the National level to see the relation between thyroid size with anthropometry found the estimated average total thyroid volume to be 6.6 ml; it was non-significantly higher in males (7.3 ml) than in females (6.4 ml)(3).

In 2007 there was a study done to determine, Normal values of thyroid gland in Isfahan (Iran), an iodine replete area, on 1500 normal adults showed the overall thyroid volume was 9.53 ± 3.68 ml. Males thyroid volume (10.73 ± 3.44 ml) was significantly higher than the females one (7.71 ± 2.63 ml) (P<0.001). The thyroid volume ranges were 3-23.9 ml, 3.6-23.9 ml and 3-14.3 ml in all, males and females, respectively. Thyroid volume values more than 97 percentile of this reference range were 10.14 ml, 11.48 ml and 8.37 ml in all, males and females respectively, and were considered goiter sonographically(13).

A cross-sectional study done between January 2017 and January 2018in 140 Syrian overweight and obese females showed mean thyroid volume was 12.4±7.4 mL, with the highest volume identified in the Obesity Class III group (14.9±10.9 mL). Significant positive correlations were found between thyroid volume and weight, BMI (p<0.05)(14).

A cross sectional study done on 11 subjects in in India to determine the 'Normal thyroid volume and its determinants in healthy middle age and above female population founds that the mean thyroid volume of these subjects was 8.80 + 3.1 ml. The volume of right lobe was found to be (4.65 + 1.8) larger than the left lobe (4.10 + 1.6) and this was statistically significant (p <0.005). The 3rd percentile of TV was 4.58ml and 97th centile of TV was 15.3 ml and volume higher than this can be considered as goiter for this population(5).

A cross sectional study on 1,991 adults in China discovers the medians of thyroid volume in men and women were10.1 (8.3–12.6) mL and 7.5 (6.0–9.4) mL, respectively(15).

A retrospective study performed on 100 routine neck CT scans executed for reasons other than evaluation of the thyroid gland from November 2003 to January 2004 at Uijeongbu St. Mary's Hospital, The Catholic University, Korea the volume of the total thyroid gland was found to be 17.5±6.6 cm 3 (volume of right lobe=8.8±3.1 cm 3, volume of left lobe=7.6±3.0 cm 3). In the study subjects, the length, thickness and volume of the right thyroid lobe were all significantly larger than those of the left lobe (P<0.05). However, there was no significant difference between the width of the right and left lobes (P=0.097)(16).

A community-based study done in Ghana on 284 healthy volunteers aged 18-95 years published in 2020 found out the mean total thyroid volume was 6.8 mL, which was greater in males)7.1 ml) than females (6.6 ml). The right lobe was slightly larger than the left lobe in the total sample (right: 3.4 ml, left: 3.2 ml) and in men (right: 3.7 ml, left: 3.1 ml) and differed significantly

between both sexes (p=0.030). The mean thickness of the isthmus was 0.3 ml, with significant difference between both sexes (p<0.043) (8).

A similar study done in Nigeria in 2020 on 400 healthy adults showed that the mean thyroid volume was 6.03±2.49 (range of 1.38-11.34). The male's thyroid volumes (6.30±2.37) were higher than that of females (5.65±2.61). It also said that the mean right lobe volume was higher than that of the left, and it was statistically significant (2).

A study done on 53 healthy adults in Sudan in 2016 to determine the normal size of thyroid gland by ultrasound concluded that the mean volume of thyroid gland was 5.48±1. 35ml.The Right lobe was greater than the left lobe (the mean volume of right lobe 2.89ml±0.75 and the mean volume of the left lobe was2.58 ±0.76). The mean thyroid volume in male is greater than female (the mean thyroid volume in male was 5.6 ml ±1.29 and in female was 5.36 ±1.40(17).

Another study done in Sudan in 2011 on 100 subjects showed the overall mean thyroid volume in all the patients was 5.425± 2.484 ml. The mean thyroid volume in males and females was 6.441± 2.955 ml and 4.560± 1.566 ml, respectively (p<0.05). The mean volume of the right and left lobes of the thyroid gland in all of the subjects were 2.990± 1.787 ml and 2.435± 1.076 ml, respectively. In females, the right and the left lobes of the thyroid gland volumes were 2.492±0.884 ml and 2.068±0.916ml. In males, the right and the left lobes of the thyroid gland volumes were3.575±2.336 ml and 2.867±1.097 ml. The right thyroid lobe volume was greater than the left in all subjects of both sexes (p<0.05)(18).

2.2 Anthropometry and thyroid size

Retrospective cross-sectional study done on euthyroid patients in Turkey showed thyroid volume (mL) has positive correlation with weight, height and BSA in both male and female. In male subjects, there was strong positive correlation between thyroid volume and subject's height (p<0.00001) and moderate correlation with weight. While in female subjects it showed weak, positive correlation between thyroid volume and subject's height and moderate positive correlation of thyroid volume with weight(4).

A study done on the topic of 'Determinants of thyroid volume in healthy French

Adults 'said that thyroid volume (ml) is positively correlated with weight, height, body mass index and body surface area for both sexes (p=0.0001)(19).

Another study done in Turkey to see 'Determination of Thyroid Volume and Its Relation with Isthmus Thickness' significant correlation was found when BMI, weight, and age were correlated with thyroid volumes and isthmus thickness. There was also a significant correlation between height and thyroid volumes(15).

A cross-sectional study performed from June 2003 until April 2005 in 314 healthy adults aged over 18 years old in Yazd city, Iran to see the, Influence of Physiological Factors on Thyroid Size, discovers the Mean thyroid volume to be 8.34±2.37 ml. Thyroid volume was 8.01-8.67 ml in 95 %of studied persons. The maximum and minimum of thyroid volume was 13.4 and 2.67 ml respectively. Mean of thyroid volume in male and female was 9.08±2.49and 7.93±3.2 ml which the differences between them was significant (P<0.003). The differences between thyroid volume and age was not significant (P=0.079) while differences between thyroid volume and weight was significant (P=0.001).The study also commented on thyroid volume is affected by geographic region, genetic and iodine intake. And concluded by saying consumption of oral iodine is one of the important factors in thyroid volume and function so it is necessary to measure the daily oral iodine consumption and urinary iodine in studies which evaluated the thyroid volume(20).

The Amrita Thyroid Survey of India also showed Age has strong negative correlation (p<0.001) with thyroid volume whereas weight, height, lean body mass, body surface area, triceps skin fold thickness and subscapular skinfold thickness showed significant positive correlations with thyroid volume. BMI and waist circumference did not have any significant correlations. Triceps and subscapular skinfold thickness were showing significant positive correlations (p 0.017& 0.005) with thyroid volume (5).

The above similar study done in Korea found there was a strong negative linear correlation between thyroid volume and age in the study (P=0.018), and a strong positive linear correlation between thyroid volume and height in males(P=0.002), and a strong positive linear correlation between thyroid volume and weight in the, males, and females (respectively, P=0.001; P<0.05, P=0.009)(16).

2.3 Conceptual framework

This conceptual framework was developed after reviewing different related literatures

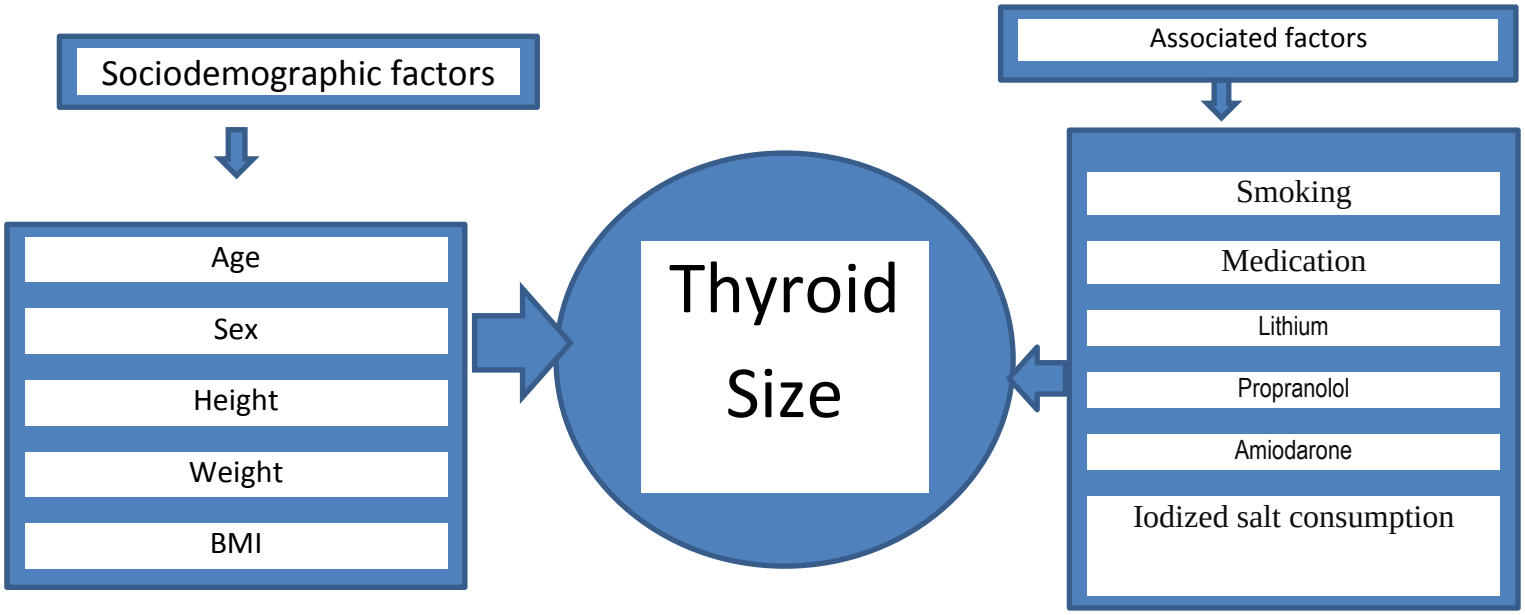


Figure 2-1; figure of conceptual framework

3. METHODS AND MATERIALS

3.1 Study area and Study period

The study was conducted at TGSH between from December 2023 - February2024. TGSH is found in Bahir Dar, the capital city of Amhara region and 578km North West from Addis Ababa. The city has 3 sub cities and 16 Kebeles. The total population of the city is 649,429 as of 2012 survey. The city has two referrals, one district hospital, 4 private hospitals, six higher clinics and health centers owned by government and private sectors. TGSH is a teaching university hospital established in 2018 and has more than 350 beds for inpatient management. The hospital serves more than 8 million peoples from parts of Amhara and BenshangulGumuz as in patient and outpatient treatment.

It is the training center for undergraduate and a wide spectrum of postgraduate programs. The radiology department has 11 radiologists, 33 residents and 7 radiology technologists and 3 nurses. The radiology department has 7 ultrasound machines and more than hundred patents are scanned per day.

3.2 Study design

Institutional based cross sectional descriptive study method was conducted

3.3 Source Population

The source population is all patients who come to TGSH

3.4 Study population

All patients who are sent to ultrasound examination, both in patients and at outpatient clinic

3.5 Sample size determination

The sample size will be calculated using a single population formula. Since there is no study available in this area, 50% (0.5) prevalence will be used with 95% confidence level (1.96), level of precision 5%. Using Epi info version 7 and based on the above assumptions. The estimated sample by adding the 10% none response rate the sample size will be 422

n = Z2 p (1-p) / w2

Where n = Desired sample size.

z = Standard deviation, using set at 1.96, which correspond to 95% confidence level.

p = Proportion in target population estimated to have a particular characteristic and 50% (0.5) is used.

q = 1.0 – p

w = degree of accuracy desired, usually set at 0.05

Therefore n=1.96 x1.96 x0.5x0.5/0.025=384.

After adding 10% non-respondent rate the total sample = 422

3.6 Sampling procedures

All patients who were sent to ultrasound examination was selected by lottery method. Every patient had offered a rolled paper which was labeled as 0(zero) and 1(one).Patients who picked a rolled paper with 1 (one) was selected. This procedure had continued until the sample size was reached.

3.7 Variable

3.7.1 Dependent variables

Total thyroid volume, each thyroid lobe -length, width, and thickness

3.7.2 Independent variable

Age, sex, weight, height, body mass index (BMI)

3.8 Inclusion and exclusion criteria

3.8.1 Inclusion criteria

All adult patients who were sent to ultrasound room for any form of ultrasound examination and fulfilling the following criteria were included

Patients who consented to have the procedure (sonographic evaluation of thyroid gland and interview)

 Patients referred for ultrasound examination, other than thyroid ultrasound scan.

 Patients 18 years and above

3.8.2 Exclusion criteria

Patients with the following conditions were excluded

Female during menstruation, pregnancy or who have delivered within the last twelve (12) months, Subjects with anterior neck swelling, Subjects who did not consent to participate in the study, younger than 18 years, patients with known thyroid disease and patients with history of previous thyroid surgery, smokers.

3.9 Operational definition

Normal thyroid size: length-4.5cm-6cm, width1.3 cm -1.8 cm - cm, depth1.6 cm -1.8 cm, Total thyroid volume 7.7–25 cm3 in men and in women of 4.4–18 cm3

Total thyroid volume greater than 97th percentile of population mean is goiter

Total thyroid volume less than 3rd percentile of population mean is small

Body mass index (BMI) (Kg/m2) was calculated from weight/height square

 Underweight < 20 kg/m2

 Normal weight 20-25kg/m2

 Overweight >25kg/m2

3.10 Data Collection methods

Data collection tool (a checklist) was developed based on objective of study and available literature, in such a way that all the necessary variables to be assessed are included.

The procedure was explained to all participants, and informed consent were taken. A data sheet (appendix I&II) had been completed for all participants in which weights and heights were obtained by the participants climbing a weighing and height scale. The participants were asked questions as stated in the questionnaire.

Patients were examined in supine position with a pillow placed under the shoulders to aid in the extension of the head. All examinations were performed using Siemens, a real-time ultrasound machine fitted with a 7-10MHZ linear transducer. Ultrasound gel was applied over the anterior

neck (thyroid area) and the transducers were applied directly on the skin over the thyroid area. Images of each lobe were taken in transverse and longitudinal planes. Longitudinal (length) as well as transverse (width) and thickness (AP) were measured in centimeters (cm). For measurement of thyroid length, the probe was placed longitudinal in the midline of the neck to obtain sagittal views of the larynx; the probe was then moved obliquely to find the maximum length of the thyroid gland, just medial to the carotid vessels. The transverse views were obtained by using the trachea and carotid vessels as a landmark.

The right and left thyroid volume data were obtained and analyzed separately. The machine automatically calculates each thyroid using the formula of volumetric ellipsoid method (height × width × depth ×correction factor 0.524. And the total thyroid volume was calculated manually by adding the right and left lobe volume.

3.11 **Data quality control**

Since the procedure was done by final year residents measurement error were not be expected. Data was collected by hospital allocated physicians. Completeness and consistency of the collected data was checked on daily bases during data collection by the principal investigator.. Individual records with incomplete data were excluded. Data entry was done by standardized and consistent procedures with clear instructions to ensure data quality.

3.12 **Data processing and analysis**

Data were entered manually into SPSS sent for analysis using SPSS version 27**.**Simple tabulation and descriptive statistics using and frequency table were done .Data normality was checked by kurtosis, Q-Q plot and histogram. Pearson product-moment and partial correlations were used to explore relationship between thyroid size and sex, age, height, weight and BMI. Leven's test of equal variance assumption is non-significant therefor homogeneity of variance is full filed .Independent T test and on way ANOVA was done for mean comparison. Independent variables having a p value less than 0.05 in the analysis are considered as a significant association.

4. ETHICAL CONSIDERATION

We received, permission and approval letter from TGSH hospital management and research review committee of Bahir Dar University College of medicine and health science before conducting the study. Confidentiality of the information were assured and collected anonymously.

5. RESULTS

5.1 Sociodemographic characteristics

A total of 450 patients were scanned among those 28 of them are incomplete and discarded. Therefore 422 patients were included in the study, more than half of them are males (234, 55.5%) and the remaining 45.5% (188) are females. The mean age of patients is 39.9 with SD of 14.54. The maximum age is 80 and the minimum age is 18. Among the participants the maximum height was1.85 while the minimum is 1.44 with mean of 1.66±0.073. Interims of BMI mean 21.66 ±2.95, maximum 32 and the minimum 14.86. Figure 5-1 shows sex of respondents below

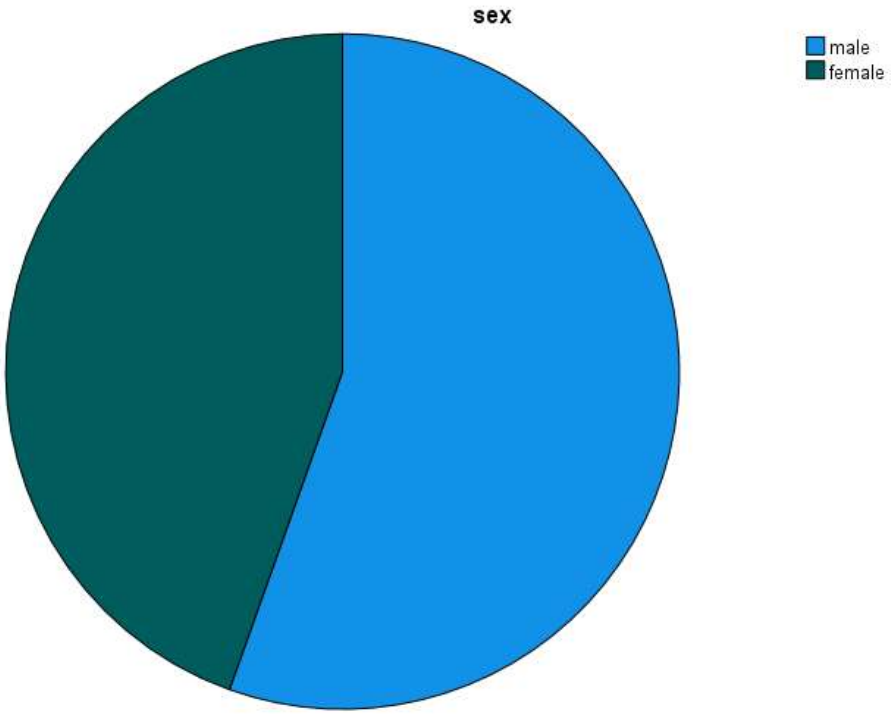


Figure 5-1Pie chart of sex distribution of study subjects.

Table 5-1; Anthropometric data of respondents

		Age	height	Weight	BMI
Total sample=422					
Mean		39.8744	1.6634	59.9265	21.6701
Median		35.0000	1.6700	59.0000	21.3382
Mode		34.00	1.70	56.00	20.00[a]
Std. Deviation		14.54686	.07285	8.35022	2.83731
Range		62.00	.41	45.00	13.53
Minimum		18.00	1.44	39.00	16.20
Maximum		80.00	1.85	84.00	29.73
Percentiles	25	29.0000	1.6100	54.0000	19.5991
	50	35.0000	1.6700	59.0000	21.3382
	75	48.2500	1.7200	66.0000	23.6639

Source SPSS

5.2 Mean and total thyroid volume

Since our data is a continuous data linearity and homoscedasticity were tested and satisfied and the results are displayed in graph 5-2, 5-3 and 5-4.

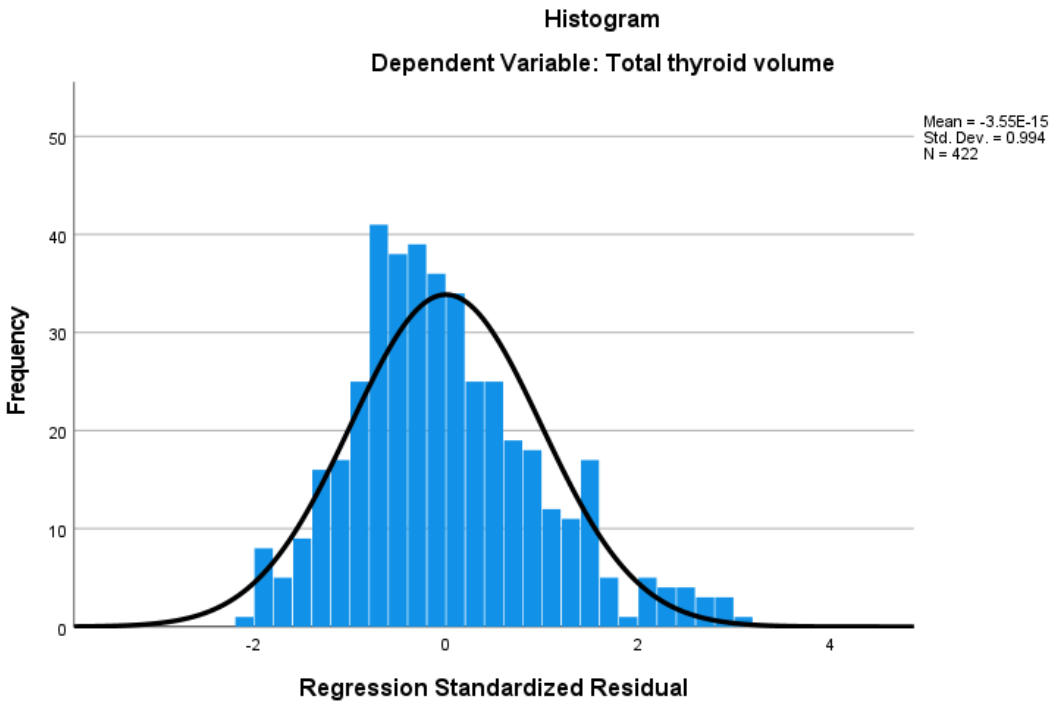


Figure 5-2 A histogram showing normal distribution of the thyroid volume

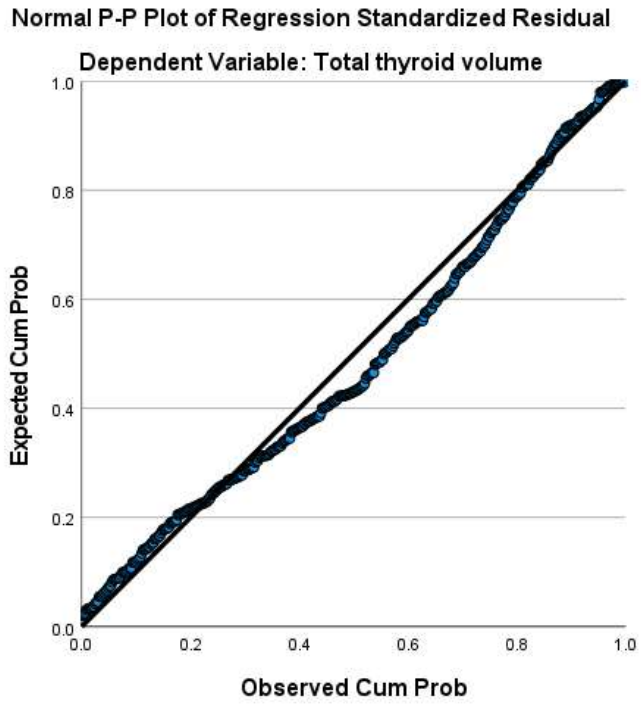


Figure 5-3; Normal P-P plot showing majority of the data are centered around the line

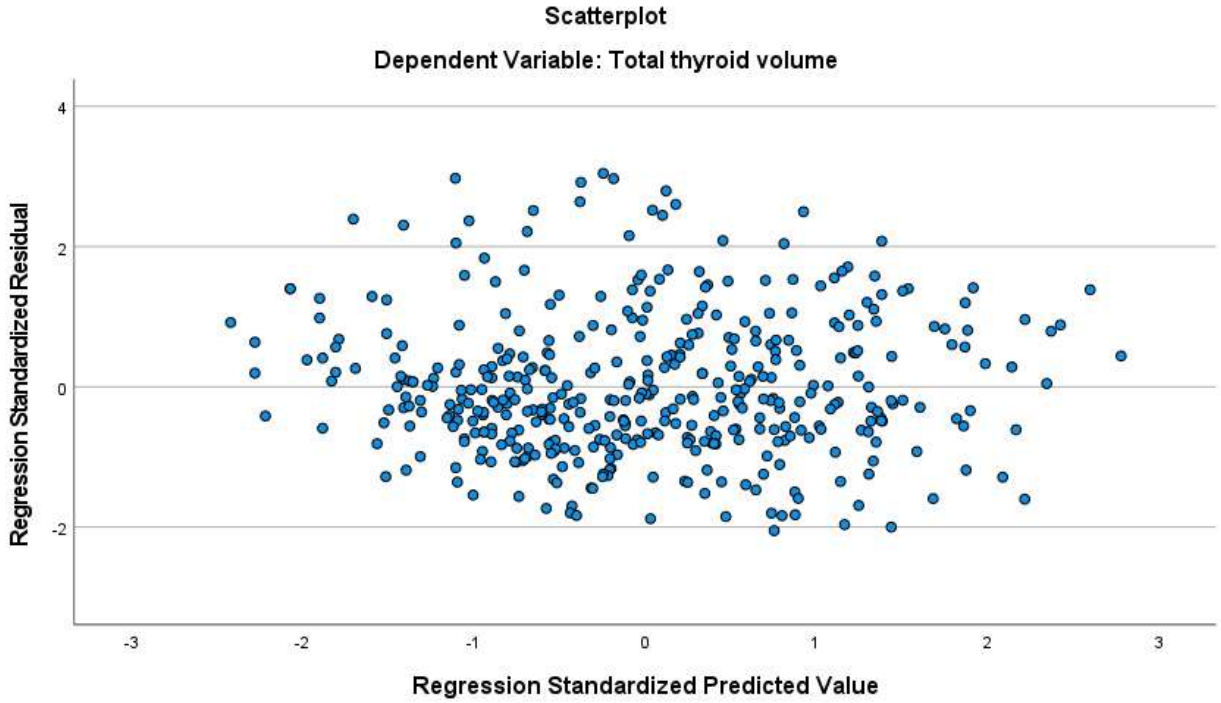


Figure 5-4 Homoscedasticity

The total mean thyroid volume was 7.44±2.86 cm3 (range of 2.1 -15). There is steady increment of total thyroid size from age <20 up to the age of 30-49 then shows decrement in thyroid volume as increase in age. The lowest total mean volume of 6.52 cm3 was seen in <20 years age groups, whereas the highest of 7.84 cm3 was noted on 30-39 years age groups and there was no statistically significant size difference between different age groups and total thyroid volume (p value= 0.111). Multiline variable graph 1 shows categorical age and total thyroid volume relationships.

For males the mean right thyroid lobe volume was 3.98±1.61 cm3and mean left thyroid lobe 3.90±1.60 with total mean thyroid volume 7.89cm3±2.99 cm3(range 2.6 -15). The lowest volume of 2.6±.3.13cm3 was seen in 40-49years age groups and the highest of 15±3.41cm3 in30-39years age group. For females mean right thyroid lobe3.42±1.40 cm3 and mean left thyroid volume was 3.44±1.38 cm3 total mean thyroid volume 6.87cm3±2.58 cm3 (range 2.1-14.7). The lowest is 2.1cm3 in 21-29 years and the highest was 14.7cm3 in 40-49 years of age. By independent sample T test there is statistically significant total thyroid mean difference between male and female, t (420) =3.740, p value = 0.001, given alpha value 0.05.

The mean right thyroid lobe volume is larger than the left thyroid lobe (irrespective of sex) 3.74± 1.55 cm3 and 3.70± 1.52 cm3respectively. For right thyroid lobe the highest mean value in male was 4.22±1.81 cm3 and in females 3.63±1.27 cm3 age 30-39 for both case. The lowest mean value in males was 3.6±1.57 cm3 and in females 3.1±1.31cm3 at age <20 for both case.

In the left thyroid lobe the largest mean value is 4.25±1.853 cm3 and 3.65±1.41 cm3 for males (age 30-39) and females (age 40-49) respectively.

There is no consistent or steady increment of thyroid lobe size across different age groups in both sex and one way ANOVA test result comparing mean total thyroid volume for categorical age show no statistically significance , F (4, 117)=1.889, p value 0.111,given alpha value is 0.05 . Table 5-2 and 5-3 will show the right and left thyroid lobe size in different age groups for male and female respectively.

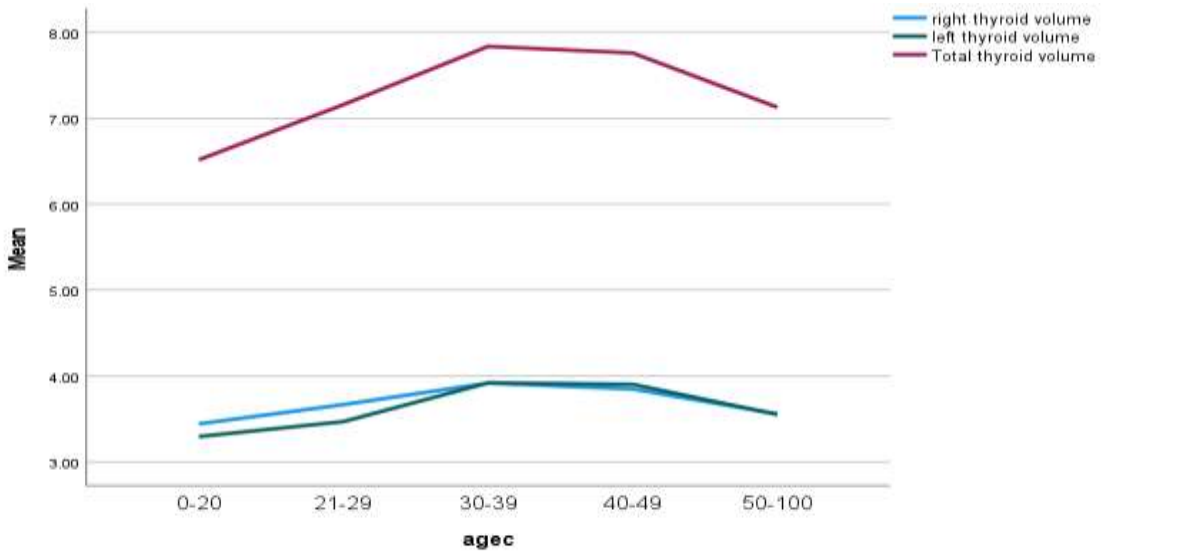


Figure 5-5; Multiline graph for thyroid size and

Table 5-2Thyroid size for male with Age category

Age	Right lobe mean	Left lobe mean
0-20	3.6±1.57	3.1±1.31
21-29	4.09±1.54	3.89±1.59
30-39	4.22±1.81	4.25±1.85
40-49	4.01±1.68	4.03±1.62
50-100	3.72±1.43	3.59±1.30

Table 5-3;Female thyroid size with age category

Age	Right lobe mean	Left lobe mean
0-20	3.3±1.53	3.45±2.27
21-29	3.17±152	2.98±1.49
30-39	3.63±1.27	3.62±1.16
40-49	3.53±1.68	3.65±1.41
50-100	3.31±1.26	3.48±1.30

5.3 Thyroid volume and its relationship with anthropometric factors

This study was done to determine if thyroid volume in adults is influenced by anthropometric and demographic factors. The hypothesis was age, sex, height, weight and BMI positively predicted change in thyroid volume. To test this hypothesis Pearson correlation and multiple linear regression was used.

In correlation analysis we run the SPSS to see the association between total thyroid volume with independent variables (sex, age, height, weight and BMI)

Height, weight and BMI had statistically significant positive Pearson correlation with total thyroid volume (r=0.371, p=0.01, r=0.449, p=0.01, r=0.224, p=0.01 respectively) while sex has statistically significant negative Pearson correlation(r= -0.180, p=0.01) ,age has no significant correlation with thyroid size(r=-0.009, p=0.852) graph 5-3,5-4and 5-5 and will show relationship of total thyroid volume with age, weight and height respectively.

In Multiple regression analysis the above variables (age, sex, height, weight and BMI) for the total thyroid volume the result showed that approximately 24.7 % of change in total thyroid volume is explained by those 5 variables in multiple regression model. The overall regression model significantly explained total thyroid volume with ANOVA F 5(416) =27.286, p =0.01.

The coefficients table in regression model shows that total thyroid =6.659 +(-0.015)(age)+(-0.073)(sex)+(-3.706)(height) +0.289 (weight)+(-0.445)(BMI) with all variables p value > 0.05 therefore assuming other variables held constant there was no single factor affecting total thyroid volume significantly with 95% confidence interval. The regression analysis tables are displayed below.

Table 5-4; Regression model summary

Model	R	R R	Adjusted R Square	Std. Error of the Estimate
1	.497[a]	.247	.238	2.49710

a. Predictors: (Constant), BMI, sex, age, height, weight

Table 5-5; ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	850.701	5	170.140	27.286	.000[b]
	Residual	2593.980	416	6.236		
	Total	3444.681	421			

a. Dependent Variable: Total thyroid volume

b. Predictors: (Constant), BMI, sex, age, height, weight

Table 5-6; Coefficients table

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.659	18.867		.353	.724
	age	-.015	.008	-.075	-1.734	.084
	sex	-.073	.273	-.013	-.267	.790
	height	-3.706	11.385	-.094	-.326	.745
	weight	.289	.153	.842	1.882	.061
	BMI	-.445	.417	-.442	-1.068	.286

a. Dependent Variable: Total thyroid volume

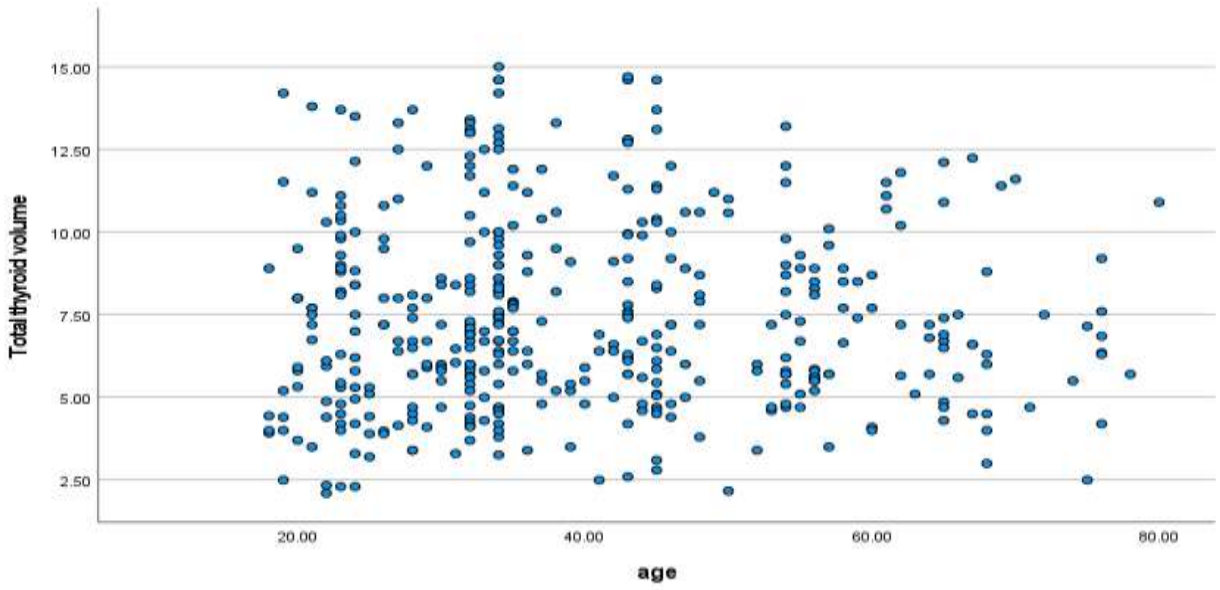


*Figure 5-6; **Relationship of age and thyroid size***

Source SPSS

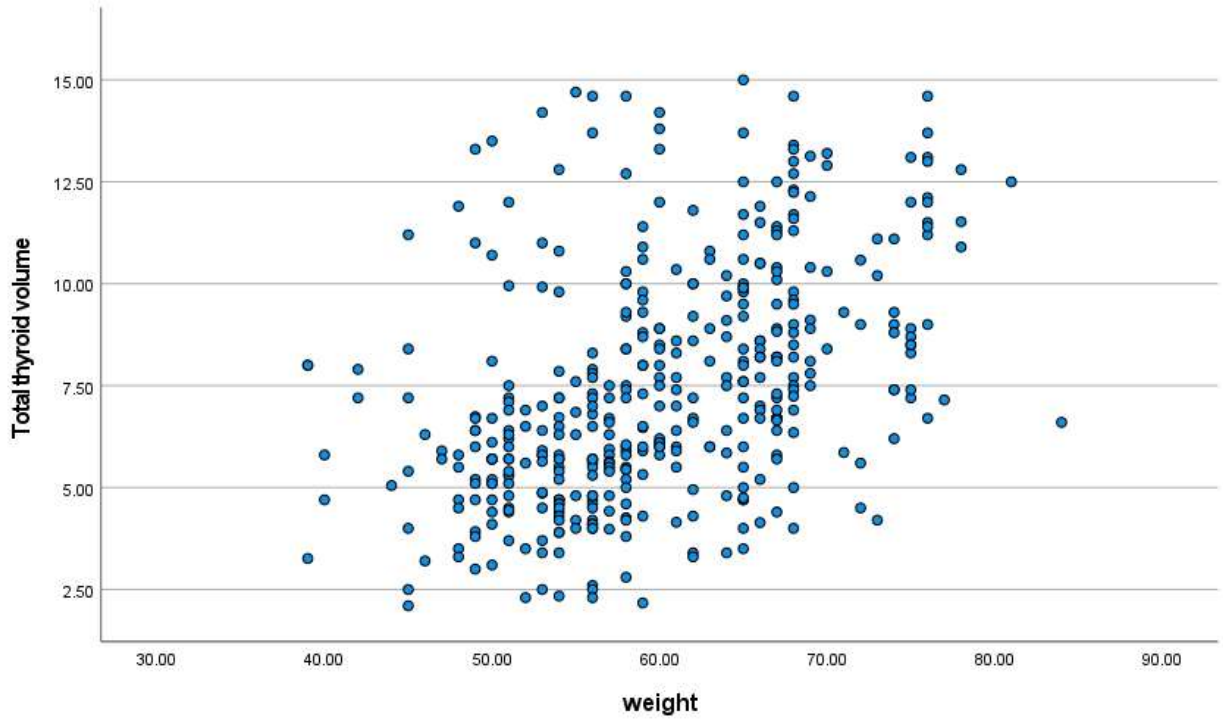


*Figure 5-7; **Relationship of total thyroid volume and weight***

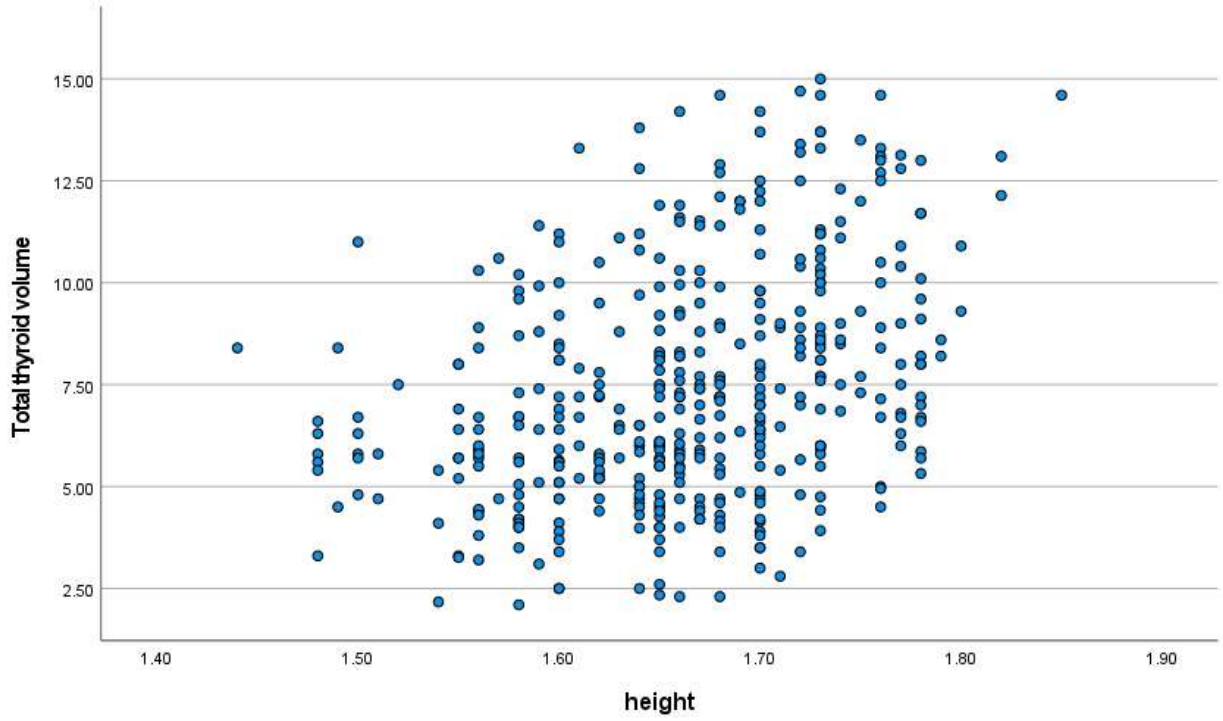


Figure 5-8; Relationship of total thyroid volume and height

6 DISCUSION

The knowledge of the normal thyroid volume is essential in evaluating diseases affecting the thyroid gland. A normogram of thyroid volume in our environment is important to serve as a reference point in managing patients with thyroid pathologies. WHO recommends to use population mean percentile to classify thyroid gland as small and goiter. Since thyroid size is different from place to place late alone from countries to countries.

This study showed that the mean thyroid volume was lower than the values recorded in other countries for example mean thyroid volume is 18.6 ± 4.5 ml in Denmark, 12.98 ± 2.53 ml in Turkey, 9.53 ± 3.68 ml in Iran (4, 12, 20). This study also shows the thyroid volume was found low when compared to thyroid volume done only in females subjects in some countries, in India study done only in meddle aged and above female subjects the mean thyroid volume was 8.80 + 3.1 ml, a similar study in Croatia on female medical students the mean thyroid volume was 10.68±2.83 mL(11).

Even if there is no similar studies in our countries as the author's knowledge for comparison, the mean thyroid volume in this study showed that it is higher in value when compared with other African countries; In Ghana the mean thyroid volume was 6.8 mL in study done on 284 healthy volunteers, in Nigeria it was6.03±2.49 ml, in Sudan two different studies on healthy individuals showed 5.48±1. 35ml and 5.425± 2.484 ml (2, 17, 18).

In this study the mean thyroid volume is larger in males than females. Similar studies done both in African and other countries showed males have larger thyroid volume than females. Like for example in Sudan, the mean thyroid volume in males and females was 6.441± 2.955 ml and 4.560± 1.566 ml, respectively. A similar study in done in Turkey showed the mean thyroid volume in females and males was 12.09 ± 2.05 ml and 14.53 ±2.55mL, respectively. Majority of the studies showed statistically significant difference between male and female thyroid volume our study also showed male and female have statistically significant different mean thyroid volume.The explanation for the size difference in mean thyroid volume between male and female due to the fact that males have higher body mass index and are taller than females and height and weight have a positive correlation with mean thyroid volume.

Even though the difference is not statistically significant the right thyroid lobe is larger in volume than the left thyroid lobe (p value=0.490Wilcoxon signed ranks Test**).**Similar studies done in different countries showed similar conclusion, and the attribution to right thyroid lobe has larger volume is may be due to hyper vascularity, the left position of esophagus may have negative effect on left thyroid volume.

In this study the thyroid volume increase as height and weight increase and it was statistically significant. Similar studies done by other investigators in different countries showed that height and weight has significant effect on thyroid size. Like for example a study done in Turkey showed thyroid volume (mL) has positive correlation with weight, height. A similar study in Korea showed a strong positive linear correlation between thyroid volume and height in males (P=0.002), and a strong positive linear correlation between thyroid volume and weight in the, males, and females (respectively, P=0.001; P<0.05, P=0.009)(16).

Thyroid volume increment was not steady and consistent with age in this study and positive correlation was not demonstrated. The association between them is variable from study to study. A study done in Nigeria said there is steady thyroid size increment as the age increase but no statistically significant. Another study in Korea found there was a strong negative linear correlation between thyroid volume and age in the study (P=0.018).

Table 5-7Total thyroid volume percentile

Total thyroid volume

N	Valid	422
	Missing	0
Percentiles	3	3.1690
	25	5.4000
	50	6.9500
	75	9.2000
	97	13.5620

Generally since goiter is defined as thyroid size greater than 97thpercentile (13.562ml) of the above mean thyroid volume values are considered as goiter. Size less than the 3rd percentile (3.169ml) of the above mentioned mean thyroid volume are considered small.

7 Limitation of the study

Ultrasound examination is an operator dependent procedure, the same patent may have different thyroid size value when measured by different physicians

There are multiple factors which has direct and indirect effect on thyroid volume like certain medication, nutritional status, consumption of iodized or non-iodized -salt etc. which are not included in this study.

8 CONCLUSION AND RECOMMENDATION

8.1 Conclusion

The mean thyroid volume is lower than other European counties but higher than African countries.

The mean thyroid volume in female was significantly lower than male's

The right thyroid lobe volume is larger than the left thyroid lobe.

Height, weight and BMI has positive correlation with thyroid volume while age has no significant relation with thyroid volume.

8.1 Recommendation

TO Ethiopian radiologic society and endocrine surgeons

- Both our studies and others showed that thyroid volume in Africa is significantly lower than countries in Europe or Asia and thyroid size has strong correlation with height and weight. We believe people in Nigeria or Sudan are relatively taller and heavier than us
- Even if majorities of Ethiopians are consuming iodized salt this result still needs further study to find the real factor why Ethiopians have larger thyroid size than African countries that were revived in this study.
- Our study and similar studies done in other African countries showed that thyroid volume is significantly lower than thyroid volume of Asian and European countries. Using European standard values to classify thyroid gland pathologies will be misleading .According to WHO thyroid gland volume greater than 97^{th} percentile of the mean population is goiter. Since thyroid volume is different from place to place every country is recommended to have their own standard reference .Therefore to use this mean as a standard reference values we recommend similar has to be done both in this institution and other parts of the country.

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Annex **l, Data collection tools**

1, Age----------: Sex----------: ID/Code----------

2, Weight---

3, Height----

4, BMI---

5, thyroid lobe (R)

A, length---

B, Width---

C, thickness---

D, Volume

6, Thyroid size (L)

A, length---

B, Width----

C, thickness---

D, volume

Annex ii

Yes or no questions;

1, Do you have known thyroid disease

A, Yes B, No

2, Do you have history of thyroid surgery; A Yes B, No

3, Are currently pregnant; A, Yes B, No

4, Have you ever felt excessive coldness or hotness; A, Yes B, No

5, Are you a smoker A, Yes B, No