

## A Postmortem Study on the Volume of the Human Thyroid Gland

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### Abstract

The present study was designed to find out the difference in volume of the thyroid gland of Bangladeshi people in relation to age and sex and to compare with previous local and foreign studies. It was a Cross-sectional descriptive type of study. The hospital based study was conducted in the Department of Anatomy, Dhaka Medical College, Dhaka, from January to December 2008. The present study was performed on 60 post mortem human thyroid gland (39 of male and 21 of female) collected from unclaimed dead bodies which were in the morgue under examination in the Department of Forensic Medicine, Dhaka Medical College, Dhaka. The samples were divided into three age-groups including group A (10-20 years), group B (21-50 years) & group C (>50 years) and the volume of the thyroid glands were measured by fluid displacement method and recorded. No difference was found in mean volume of the thyroid gland between male and female. However, significant difference was found in between age groups. The volume of the gland was found to increase from early childhood and puberty up to 50 years of age and then decreased.

### Introduction

The thyroid gland is a notably labile gland that varies greatly in size<sup>1</sup>. We have only a few studies on human organs especially in their gross anatomy e.g. studies on morphological variations of the thyroid gland in different age groups in Bangladeshi people. We mainly depend on foreign text and literatures. However, we need our own standard baseline from which we can compare the morphological parameter like volume of the thyroid gland, whether there is any difference in respect of age and sex<sup>2</sup>. Moreover, the estimation of the size of the thyroid gland is important for the evaluation and management of the thyroid disorders<sup>3</sup>. However, a strong correlation was found between the volume of the thyroid gland calculated by ultrasonography and the volume assessed after dissection of the gland and immersion in water<sup>4</sup>. In the present study, the thyroid glands were collected from cadavers through a meticulous dissection. Then their surfaces were dried by a blotting paper and volumetric measurements were taken after immersion in water to get a more accurate result. The result of the present study can be used as a standard reference volume for the thyroid gland of Bangladeshi people and to determine the abnormalities in pathologic conditions in both goiter endemic and non-endemic zones.

### Materials and Methods

A cross-sectional descriptive type of study was designed and done in the Department of Anatomy,

Dhaka Medical College, Dhaka, from January to December 2008, based on collection of 60 human thyroid glands from the unclaimed dead bodies that were under examination in the Department of Forensic Medicine, Dhaka Medical College, Dhaka. All the samples were collected within 24-36 hours of death without any sign of putrefaction, from medicolegal cases excluding hanging, poisoning, any cutting or crushing injury to the thyroid gland and known case of thyroid disease.

#### Grouping of the samples:

The samples were divided into three age-groups i.e. Group A (10-20 years), Group B (21-50 years) & Group C (>50 years) (Table-I), according to Brown, Al-Moussa and Beck (1986)<sup>5</sup>.

**Table-I:** Grouping of the sample of the present study (n = 60)

Group	Age limit in years	Number of samples	
		Male	Female
A	10-20	08	05
B	21-50	24	10
C	>50	07	06

#### Measurement of volume of the thyroid gland:

Volume of each thyroid gland was measured by applying the fluid displacement method following Brown, Al-Moussa and Beck (1986)<sup>5</sup>. A measuring cylinder (250 ml) and a beaker (250 ml) were taken. After placing the gland into the measuring cylinder, water is gradually added to it by the beaker containing 250 ml of water. The measuring cylinder was exactly filled upto 250 ml marking.

The remaining portion of water in the beaker, indicating the amount of displaced fluid by the gland, was noted down. Thus, the volume of thyroid gland (i.e. the amount of displaced water) was measured in ml.

*Statistical processing of data:*

The collected data were processed and statistical analyses were done by unpaired Student's 't' test and one-way ANOVA test. All the statistical analyses were done by using the SPSS 11.0 version.

**Results**

The results of the present study are given in Table: II.

**Table-II:** Volume of the thyroid gland in male and female of different age group

Group/ Sex (n)	Volume (ml) Mean±SD	P value	Group (n)	Volume (ml) Mean±SD	P value
<b>Group A</b>					
Male (8)	16.75±1.28 (15.00-18.00)	>0.10ns	Group A (13)	16.92±1.04 (15.00-18.00)	A vs B <0.01**
Female (5)	17.20±0.45 (17.00-18.00)				
<b>Group B</b>					
Male (24)	21.63±6.44 (13.00-39.00)	>0.50ns	Group B (34)	21.62±5.89 (13.00-39.00)	A vs C >0.05ns
Female(10)	21.60±4.60 (17.00-30.00)				
<b>Group C</b>					
Male (7)	15.43±2.76 (13.00-20.00)	>0.50ns	Group C (13)	15.85±3.08 (12.00-21.00)	B vs C <0.001***
Female (6)	16.33±3.61 (12.00-21.00)				

Figures in parentheses indicate range. Comparison between sex done by unpaired Student's 't' test and between different age group by One-way ANOVA (PostHoc), ns = not significant, \*\*/\*\* = significant.

There was found no difference in mean volume of the thyroid gland between male and female in any age group. However, significant difference was found in between age groups (Table-II). The weight of the gland was found to increase from early childhood and puberty up to 50 years of age and then decreased.

**Discussion**

In 1974, Rasmussen and Hjorth were the first to describe that the size of the thyroid gland could be estimated in vivo by ultrasonic scanning<sup>6</sup>. Hegedus et al. (1983)<sup>6</sup> measured the volume of the thyroid gland in 271 subjects (139 males and 132 females) aged 13-92 years by ultrasonic scanning technique and observed its relationship to body weight, age and sex. They found the mean volume to be 18.6±4.5 ml, and a significant difference between male (19.5±4.7 ml) and female (17.5±4.2 ml). The

gland was found larger in males due to increased body weight. An echographic study of the thyroid was performed in Germany by Olbricht et al. (1983)<sup>7</sup> on 542 persons with thyroid glands normal to palpation. The thyroid volume in men ranged between 9 and 38 ml, in females between 6 and 25 ml; median 16.7 ml and 13.5 ml, respectively. The sex difference was significant. Brown, Al-Moussa and Beck (1986)<sup>5</sup> studied 107 subjects age ranging from 1 day to 93 years and found that the thyroid volume increased with age during childhood and adolescence, remained stable in young adults and declined in older subjects. The change in volume was said to be due to consequence of the changes in size of the acini of the gland. According to Yokoyama et al. (1986)<sup>8</sup>, in Japan, 57 normal healthy subjects were examined (11 males and 46 females, age range 37-74 years) by a high resolution ultrasonic scanner and found to have a mean thyroid volume of 13.4±4.1 ml (range 5.9-22.9 ml). Ueda (1990)<sup>9</sup> attempted to establish normal values for paediatric thyroid gland volume by the real-time ultrasound scanner in 300 children having an age range of 8 months-15 years. The study showed a strong correlation of thyroid volume with height, weight, body surface area and age. No significant differences were observed between males and females in each height group. The thyroid volume among the Chinese, studied by Hsiao and Chang (1994)<sup>10</sup>, was found 7.7±3.3 ml. Enayetullah (1996)<sup>11</sup> observed that the volume of the thyroid glands under study were quite variable with considerable overlapping of values among different age groups. The mean highest volume was found in group B (21-50 years) and the lowest in group A (3½-20 years). Begum et al. (2005)<sup>12</sup> also found the highest mean volume 15.84±4.92 ml in 21-50 years age group. Lee et al. (2006)<sup>13</sup> found the mean volume of total thyroid gland including isthmus to be 17.55±6.6 cm<sup>3</sup> by studying the neck computed tomography scans of 100 adult Korean (57 males and 43 females). Sultana et al. (2007)<sup>14</sup> showed that the highest mean volume 22.27±6.37 ml in group B (19-45 years), greater volume was found in males (21.63 ml) than that of females (18.5 ml), but not statistically significant. She also found correlation between increasing volume of the gland with the increasing height of the individual. The present study has shown that the volume of the thyroid increases with age, and after 50 years again gradually decreases. The results of the present study were found to be similar to Olbricht et al<sup>7</sup>, Ueda<sup>9</sup>, Enayetullah<sup>11</sup>, Begum et al<sup>12</sup>, Lee et al<sup>13</sup>, Sultana et al<sup>14</sup>, but higher than that of Yokoyama et al<sup>8</sup>, Hsiao and Chang<sup>10</sup>. With advancing age, the volume of the thyroid gland rises in a linear fashion, because of increasing size and amount of

follicles and with senescence, the volume is reduced, mainly due to significant reduction in mean size and volume of the thyroid follicles<sup>15</sup>.

*Conclusion:* Further studies in living bodies with larger sample and high technical backup e.g. 3D/4D ultrasound scanner, MRI, both in goiter endemic and non-endemic zones, are recommended.

*Ethical clearance:* This research work was approved by the Ethical Review Committee of Dhaka Medical College, Dhaka.

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