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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

#### **RESEARCH ARTICLE**

# Difference in Weight and Volume of the Thyroid Gland in various age groups in North Indian Population: A Gross Study

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## Manuscript Info

#### Abstract

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#### Manuscript History:

Received: 18 March 2015 Final Accepted: 22 April 2015 Published Online: May 2015

#### Key words:

Thyroid Gland, Weight, Volume

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**Objective:** Due to increasing number of cases of thyroid gland disorders nowadays, there are rising trends of thyroid gland surgeries and interventions which requires comprehensive data regarding the gland. This study was done to find out the changes in the weight and volume of the thyroid gland in different age groups. The age groups were Group A - upto 20 years, Group B -21-50 years and Group C – above 50 years.

**Methods:** The study was conducted on 60 human thyroid glands in the Department of Anatomy in collaboration with Department of Forensic Medicine, Pt. B. D. Sharma Post Graduate Institute of Medical Sciences, Rohtak in North Indian population. The weight was measured by digital weighing balance and the volume was measured by water displacement method.

**Results:** The study revealed that the mean weight of the thyroid gland was found to be in Group A-10.11 $\pm$ 3.90 gm, Group B-15.25 $\pm$ 4.05 gm and Group C-12.95 $\pm$ 2.89 gm. The mean volume of the thyroid gland was found to be in Group A-9.42 $\pm$ 3.43 ml, in Group B-14.23 $\pm$ 3.41 ml and Group C-11.70 $\pm$ 2.49 ml.

**Conclusion:** The study concluded that the mean weight and volume of the thyroid gland was found to be higher in Group B (21-50 years) followed by Group C (above 50 years) followed by Group A (below 20 years).

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# **INTRODUCTION**

The word thyroid gland is Greek, and translated to mean "shield gland" (Lorrence A, 2006).<sup>1</sup> The thyroid gland is brownish-red and highly vascular gland and is placed anteriorly in the lower part of neck at the level with the 5th cervical to the first thoracic vertebrae. It is ensheathed by the pre-tracheal layer of deep cervical fascia forming a capsule.

The thyroid gland consists of right and left lobes connected by a narrow, median isthmus. The isthmus is a fibrous connective tissue which connects the lobes of the thyroid gland in the median plane (Snell  $RS^2$ , 2008, Sinnatamby  $CS^3$ , 2006).

As the isthmus is closely attached to the thyroid cartilage by the pre-tracheal fascia, the thyroid gland moves upwards on swallowing and thereby any thyroid swelling is clinically distinguished from the other swellings of the neck (Chatterjee  $CC^4$ , 1994, Swash M<sup>5</sup> 2002).

Nowadays there is increased number of cases of thyroid gland disorders, which has lead to lot of interventions in neck region. Due to scarcity of literature available regarding weight and volume of thyroid gland in North Indian population in different age groups, this study was conducted.

## **MATERIAL AND METHODS:**

The present study was conducted in the Department of Anatomy in collaboration with the Department of Forensic Medicine, Pt. B.D. Sharma Postgraduate Institute of Medical Sciences, Rohtak. This study was done on 60 human thyroid glands.

#### Selection of cases

#### Inclusion Criteria-

These samples were collected from autopsied bodies from the mortuary of Department of Forensic Medicine undergoing post-mortem in routine, after obtaining proper consent of the relatives, wherever required. Samples were collected from cases within 24 hours after death before appearance of signs of putrefaction.

## Exclusion Criteria-

The following cases were excluded from the study:

- ➤ Hanging
- > Poisoning
- > Any cutting or crushing injury to thyroid gland
- ➢ Known case of thyroid disease
- > Burnt
- > Decomposed

#### **Grouping of the Samples**

Grouping of the samples were done according to age.

- Group A  $\leq$  20 years
- ✤ Group B 21 50 years
- ✤ Group C above 50 years

The human thyroid gland with related structures were collected en-mass. The collected samples were washed gently with tap water. Blood and blood clots were removed. Each sample was tagged with a piece of cloth which bear an identification number along with age and sex of the victim. Then the samples were fixed and preserved in 10% formol saline solution.

## Measurement of the Weight of the Thyroid Gland

The thyroid gland was separated from other structures of the specimen. Excess water was soaked with a bloating paper and the gland was weighed on a digital weighing balance (SARTORIOUS CPA with least count of 0.01 gm) in grams.

#### Measurement of the Volume of the Thyroid Gland

The volume of the whole thyroid gland was measured by fluid displacement method. A jar was filled with water and the thyroid gland was gently placed in the fluid to allow gentle and complete immersion. The displaced fluid was collected in a measuring glass cylinder and volume of the fluid was determined.

**STATISTICAL METHODS-** All the data regarding the measurements of weight and volume of thyroid gland was put in tabulated form by using Microsoft excel worksheets and statistical results were obtained by applying One way Anova Test.

#### **RESULTS:**

In the present study, the average weight and volume of the thyroid gland in different age groups was observed to be  $12.77\pm4.17$  grams and  $11.75\pm3.67$  ml respectively.

Age Groups (years)	Number of specimens	Weight (gm) Mean±SD	p-value
A(≤20)	20	10.11±3.91	0.00*
B(21-50)	20	15.25±4.05	
C(>50)	20	12.95±2.89	
Total	60	12.77±4.17	

Table 1. Age wice	distribution	of Woight of the	Thuroid Clond
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\* Significant

Weight of the thyroid gland in group A (age upto 20 years) varied from 1.26 gm to 18.44 gm (mean value  $10.11\pm3.90$  gm), in group B (age 21-50 years) varied from 10.28 gm to 26.74 gm (mean value  $15.25\pm4.05$  gm) and in group C (age above 50 years) varied from 8.34 gm to 19.44 gm (mean value  $12.95\pm2.89$  gm). When the mean values of group A, B and C were compared with each other, **the difference was found to be statistically significant (p-value < 0.05).** 

Table-2: Age-wise distribution of Volume of the Thyroid Gland					
	Aga Groups	Number of specimens	Voluma (ml)		

Age Groups (years)	Number of specimens	Volume (ml) Mean±SD	p-value
A(≤20)	20	9.42±3.43	0.00*
B(21-50)	20	14.23±3.41	
C(>50)	20	11.70±2.49	
Total	60	11.75±3.67	

\* Significant

Volume of the thyroid gland in group A (age upto 20 years) varied from 1.5 ml to 16 ml (mean value  $9.42\pm3.43$  ml), in group B (age 21-50 years) varied from 9.5 ml to 22 ml (mean value  $14.23\pm3.41$  ml) and in group C (age above 50 years) varied from 8 ml to 18 ml (mean value  $11.70\pm2.49$  ml). When the mean values of group A, B and C were compared with each other, **the difference was found to be statistically significant (p-value<0.05)**.

## **DISCUSSION:**

Thyroid gland is a very important endocrine gland which is concerned with rate of metabolism, blood calcium level and affects on growth and development in mammals (Ganong WF, 2005).<sup>6</sup>

The estimation of the size of the thyroid gland is important for evaluation and management of the thyroid disorders (**Greenwood et al., 1985**).<sup>7</sup>

During the first 20 years of life, the volume of the thyroid gland rises in a linear fashion. With senescense the volume of the gland becomes reduced due to reduced mean size and volume of the thyroid follicle (**Roberts PF**, **1974**).<sup>8</sup>

**Brown et al.**<sup>9</sup> (1986) reported that thyroid volume increased with age during childhood and adolescence, remained fairly constant in younger adults and declined more slowly in older people.

**Enayetullah**  $M^{10}$  (1996) and **Begum**  $M^{11}$  (2004) in their studies on Bangladeshi people and **Harjeet et al**<sup>12</sup> (2004) on Northwest Indians also reported the similar observation.

The weight of the gland was found to increase from early childhood and puberty upto 50 years of age and then it decreases (**Nurunnabi et al., 2010**)<sup>13</sup>

**Herman and Lacka**<sup>14</sup> (2006) reported that by age 70 years, the weight of the thyroid gland is about 20-30% less than that at the age 20 years due to atrophy of 40% of follicles and loss of about 30-40% of total number of follicles. The average weight of the normal thyroid gland depends almost entirely on the age of the patient and is not consistently affected by sex or their usual geographic residence (Mortensen et al.,<sup>15</sup> 1955).

Mahne et al<sup>16</sup> (2007) and Avdeenko & Khmel<sup>17</sup> (2001) reported that the maximum weight of the thyroid gland was at the age 25-35 years, slightly decreased at the age 40-49 years and then followed by a considerable weight loss from the age of 61-70 years and onwards. Khatun M<sup>18</sup> (1991) reported highest mean weight of the thyroid gland in Group C (21-40 years), lesser in Group B (11-20 years) and Group D (41-65 years) and lowest in Group A (5-10 years). Greep et al<sup>19</sup> (1973), Kelly et al<sup>20</sup>(1984), Hoyes et al<sup>21</sup> (1985) reported the average weight of normal

Greep et al<sup>19</sup> (1973), Kelly et al<sup>20</sup>(1984), Hoyes et al<sup>21</sup> (1985) reported the average weight of normal thyroid gland between 15-20 gm, Fawcett et al<sup>22</sup> (1994) reported the average weight of normal thyroid gland between 25-40 gm, Langer P<sup>23</sup> (1999) reported the weight of the normal thyroid gland between 20-25 gm which is *higher* than the present study (12.77±4.17 gm).

**Banna et al**<sup>24</sup> (2010) reported the average weight of the normal thyroid gland as  $13.27\pm5.82$  gm, which is *similar* to the present study.

**Enayetullah**<sup>10</sup> (**1996**) reported the average weight of thyroid gland in Group A ( $\leq 20$  years) is 5.97 $\pm 3.55$  gm, Group B (21-40 years) is 17.85 $\pm 6.75$  gm and Group C (41-78 years) is 14.35 $\pm 5.86$  gm.

De Groot et al<sup>25</sup> (2001), Kumar et al<sup>26</sup> (2004), Keele et al<sup>27</sup> (2005) reported the weight of normal thyroid gland between 15-25 gm, which is higher than the present study. Begum M<sup>11</sup> (2004) reported the average weight of the thyroid gland in Group A (below 20 years) is

**Begum M**<sup>11</sup> (2004) reported the average weight of the thyroid gland in Group A (below 20 years) is 8.18 $\pm$ 3.32 gm, Group B (21-50 years) is 15.96 $\pm$ 5.06 gm and Group C (above 50 years) is 13.56 $\pm$ 3.60 gm which is similar to the present study in Group A, Group B and Group C.

**Banna et al**<sup>24</sup> (2010) reported the mean average weight of the thyroid gland  $13.27\pm5.82$  gm,  $8.65\pm5.43$  gm in Group A ( $\leq 20$  years),  $14.9\pm5.30$  gm in Group B (21-50 years) and  $14.53\pm3.61$  gm in Group C (>50 years) which is similar to the present study in different age groups.

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 (Shabana et al., 2006).<sup>28</sup>

**Hagedus et al**<sup>29</sup> (**1983**), **Gomez et al**<sup>30</sup> (**2002**) reported the average volume of the thyroid gland to be  $18.5\pm4.5$  ml,  $13\pm6$  ml respectively which is *higher* than the present study ( $11.75\pm3.67$  ml).

**Oberhofer et al**<sup>31</sup> (1989), **Berghout et al**<sup>32</sup> (1987) and **Banna et al**<sup>24</sup> (2010) reported the average volume of thyroid gland to be 13.35 ml,  $10.7\pm4.6$  ml and  $11.62\pm4.76$  ml respectively, which is *similar* to the present study.

**Yokoyama et al**<sup>33</sup> (**1986**) reported to have mean thyroid volume of  $13.4\pm4.1$  ml (range 5.9-22.9 ml).<sup>41</sup>

Ueda<sup>34</sup> (1990) showed a strong correlation of thyroid volume with height, weight, body surface area and age.

**Hsiao and Chang**<sup>35</sup> (1994) and **Moghadam et al**<sup>36</sup> (2011) reported the average volume of thyroid gland  $7.7\pm3.3$  ml and  $8.34\pm2.37$  ml respectively which is lower than the present study.

**Begum et al**<sup>37</sup> (2005) reported the highest mean volume  $15.84\pm4.92$  ml in 21-50 years age group which is similar to the present study.

**Banna et al**<sup>24</sup> (2010) reported the mean average volume  $11.62\pm4.76$  ml,  $8.27\pm4.60$  ml in Group A ( $\leq 20$  years),  $12.71\pm4.24$  ml in Group B (21-50 years) and  $13.33\pm5.97$  ml in Group C (>50 years).

**Nurunnabi et al**<sup>38</sup> (**2012**) reported mean volume of thyroid gland  $16.92\pm1.04$  ml in Group A (10-20 years),  $21.62\pm5.89$  ml in Group B (21-50 years) and  $15.85\pm3.08$  ml in Group C (>50 years) which is higher than the present study.

## **CONCLUSION:**

The present study found that the mean weight and volume of the thyroid gland was found to be higher in Group B(21-50 years), followed by Group C(>50 years), and then by Group A(<20 years) which means that most active age group is Group B. This may be correlated ultrasonographically to help radiologist to give an accurate diagnosis about any abnormality of the gland. Surgeons will also get benefitted by the study as they will be aware of the normal weight and volume of the thyroid gland.

## **ACKNOWLEDGEMENT:**

Praise is to the Almighty God, who made me able to carry out the present study successfully. Thanksgiving is a pleasant job, but it is nonetheless difficult where one sincerely tries to put them in words.

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