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Morphometric features of the thyroid gland: a cadaveric study of Turkish people

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Background: *Although racial and ethnic variations in the morphology of anatomical structures are defined well, the size, shape, and weight of the thyroid gland have not previously been reported in Turkish people. This study provides data about the morphometric features of the thyroid gland, thyroid lobes, and pyramidal lobe, and highlights some anatomical variations in people from the Marmara region in Turkey.*

Material and methods: *The material for the present study consisted of thyroid glands obtained from 75 male and 15 female adult cadavers aged between 18 and 80 years. A dissection was carried out and the thyroid glands were exposed. The glands were weighed and measured according to the various age groups of the patients.*

Results: *A pyramidal lobe was found to be present in 57.8% of the cadavers (52/90). During midline dissection of the neck 2 males out of 90 cadavers, giving an incidence of 2.22%, did not show an isthmus. The mean thyroid weight was 26.11 ± 8.14 g. In males it was 26.93 ± 7.96 g while in females it was 21.93 ± 7.98 g.*

Conclusions: *This is the first reported morphometric study on cadaveric thyroid glands from Turkey and it highlights individual and ethnic/racial variations. In order to perform safe and effective surgery and for the accurate diagnosis of thyroid disorders, knowledge of normal anatomy and the variations of the thyroid gland are essential.* (Folia Morphol 2011; 70, 2: 103–108)

Key words: anatomy, cadaver, morphometry, thyroid gland, pyramidal lobe

INTRODUCTION

The size and shape of the thyroid gland may alter remarkably with age, gender, physiological condition, race, and geographical location. It may be larger and heavier in females than in males, and it hypertrophies during menstruation and pregnancy [5].

It is reported that the weight of thyroid gland is less in Jamaicans and Japanese compared to Ameri-

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cans and Europeans [7]. Harjeet et al. [6] measured the thyroid of Indian subjects and found out that the mean weight of the thyroid glands in adults were smaller than in western Caucasian and Japanese subjects. This reduction may be attributed to the generalised reduction in body size. Hegedus et al. [8] have demonstrated the relationship between thyroid volume, as estimated by ultrasound, and body weight, age, and sex in normal subjects. The weight of the gland is usually 25 g but varies, being slightly heavier in females, and enlarging during menstruation and pregnancy. He also noted that the thyroid volume was significantly higher in the autumn and winter than in the summer. Ueda [19] correlated thyroid gland volume (estimated by ultrasound) with height, weight, body surface, and age in children of 6 months to 15 years. He did not find a significant difference in thyroid volume between males and females over this age range.

In the routine examinations of workers who are exposed to radiation, to give full protection against the accompanying hazards, the standard weight, size, and shape of the thyroid should be known. Furthermore, knowledge of variations of the thyroid is substantial for surgeons dealing with head and neck surgery. Therefore, training and understanding of the thyroid anatomy and its associated anatomical variations are obligatory in order not to overlook these anomalies in differential diagnosis.

Although racial and ethnic variations in the morphology of the anatomical structures are well known, there is no consensus on the size, shape, and weight of the thyroid gland and no studies have been reported from Turkey. This study was performed to highlight the morphometric features of the thyroid gland, thyroid lobes, and pyramidal lobe in Turkish people and contribute additional data to the literature.

MATERIAL AND METHODS

A total of 90 thyroid glands collected from 75 male and 15 female adult cadavers aged between 18 and 80 years were included in the present study. The subjects were from the most populated part of Turkey called Marmara, which is located in the northwest region. The autopsies were performed within 48 h of death and during this period the bodies were kept in a cold chamber at 4°C. At autopsy the usual procedure of separating the organs was followed [16].

With the informed consent of the relatives of the deceased, the cadavers were preserved in 10% formol-saline solution.

Gross and fine dissection was carried out and the thyroid gland was separated from its bed, dried with a sponge and blotting paper, and then weighed on a digital balance (Denver Instrument APX-200 accuracy 0.01 g). No attempt was made to remove the parathyroid glands as their weight was described to be negligible [17]. The measurements of the gland were taken with the help of digital vernier callipers in 75 male and 15 female specimens.

The Ethics Committee of the Council of Forensic Medicine of Istanbul, Turkey approved the study.

Statistical analysis

Statistical analyses were performed using NCSS 2007 and PASS 2008 statistical software (Kaysville, UT, USA). Descriptive statistics were calculated as the mean ± SD and frequency. For comparing quantitative data, parameters showing normal distributions were compared using Oneway ANOVA test, and parameters which did not show normal distributions, groups were compared using the Kruskal-Wallis test also Mann-Whitney U test used to compare the difference in gender groups. The χ^2 test was used for categorical data analysis. Statistical significance was defined as $p < 0.05$.

RESULTS

Our study included dissections of thyroid glands in 90 adult human cadavers. The mean age of the cadavers was 44.03 ± 18.4 years ranging between 18 and 80 years. Out of 90 cadavers 75 were males (83.3%) and 15 were females (16.7%). A pyramidal lobe was found to be present in 57.8% of the cadavers (52/90); 43 of 75 male cadavers showed a pyramidal lobe while it was found in 9 cases out of 15 females (Table 1).

The localisation of the pyramidal lobe based on the origin of the thyroid gland is shown in Table 2. It branched off more frequently from the left part of the isthmus than from the right or the midline. There was no age or sex difference in pyramidal lobe

Table 1. Pyramidal lobe according to age and sex

		Pyramidal lobe		p
		Not found (n = 38)	Found (n = 52)	
Age	18–30 year	7 (18.4%)	19 (36.5%)	0.169
	31–50 year	17 (44.7%)	19 (36.5%)	
	51–80 year	14 (36.8%)	14 (27%)	
Sex	Male	32 (84.2%)	43 (82.7%)	0.849
	Female	6 (15.8%)	9 (17.3%)	

Chi-square test; sex and age differences not significant

Table 2. Pyramidal lobe localisation

Pyramidal lobe extending from:	
Left part of the isthmus	21 (40.3%)
Middle of the isthmus	14 (27.1%)
Right part of the isthmus	17 (32.6%)
Total	52 (100%)

localisation ($p > 0.05$) (Table 2). The mean length of the pyramidal lobe was 2.01 (±0.8) cm ranging between 0.80 and 4 cm.

During midline dissection of the neck 2 males out of 90 cadavers, giving an incidence of 2.22%, did not show an isthmus (Fig. 1), and one of the pyramidal lobes extended from the midline and crossed over to the right side (Fig. 2).

The mean thyroid weight was 26.11 ± 8.14 g. In males it was 26.93 ± 7.96 g while in females it was 21.93 ± 7.98 g. In both males and females there was no statistically significant difference in thyroid weight between the various age groups ($p > 0.05$) (Table 3).

Although in the 18–30 year old group and in the 51–80 year old group there was no significant difference between thyroid weight and gender ($p > 0.05$), in the 31–50 year old group the thyroid weight of the males was statistically significantly more than females ($p < 0.05$).

The thyroid weight [g] in various heights of the cadavers in both sexes is shown in Table 4. The thyroid weight [g] in various weights of the cadavers in both sexes is shown in Table 5.

There was a statistically significant correlation between the weight of the male subjects and the thyroid weight ($r = 0.282$, $p = 0.014$). In females there was no statistically significant correlation between thyroid weight and height or weight of the cadavers ($p > 0.05$) (Table 6). The length, width,

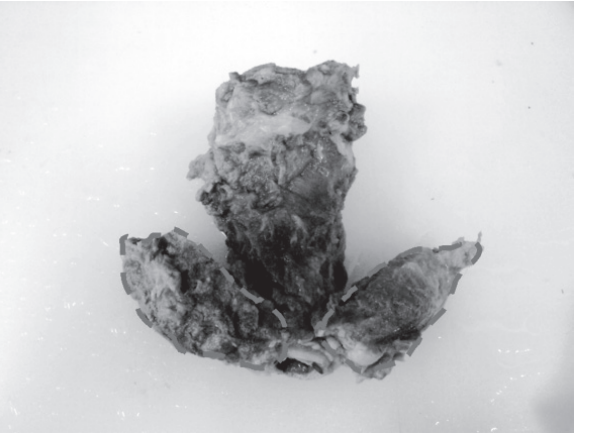

Figure 1. Isthmus was not observed macroscopically.

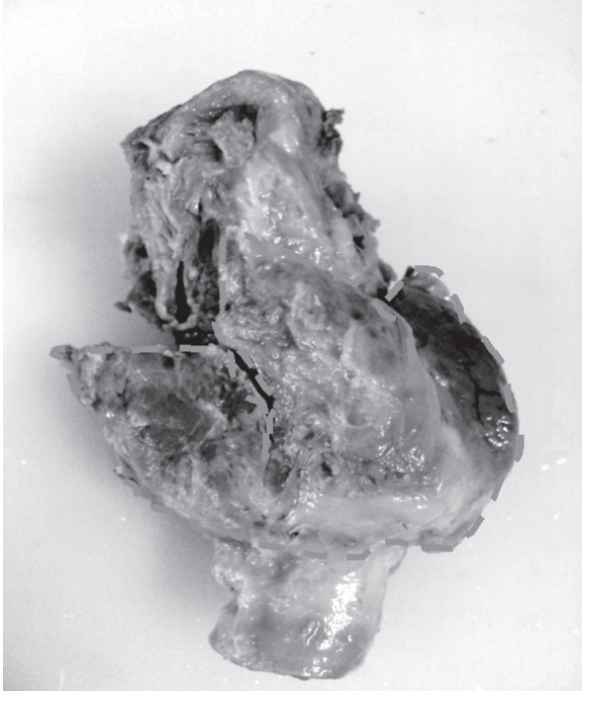

Figure 2. Macroscopically pyramidal lobe extending from the midline and crossing over to the right side.

Table 3. Thyroid weight according to age groups

Age (years)	Thyroid weight [g]				p^{+++}
	n	Males (mean ± SS)	n	Females (mean ± SS)	
18–30	22	26.27 ± 9.78	4	25.50 ± 10.53	0.268
31–50	32	26.97 ± 7.35	4	16.50 ± 3.31	0.001**
51–80	21	26.76 ± 6.21	7	23.0 ± 7.64	0.151
		$^{+}p = 0.950$		$^{++}p = 0.169$	

$^{+}$Oneway ANOVA test; $^{++}$Kruskal-Wallis test; $^{+++}$Mann-Whitney U test; **$p < 0.05$ significant value

Table 4. Thyroid weight [g] in various heights of the cadavers in both sexes

Sex	Height [cm]	N	Thyroid weight	
			Min–Max	Mean ± SS
Males	150–160	7	16–40	27.00 ± 8.62
	161–170	28	14–41	24.89 ± 7.53
	171–180	31	13–40	26.81 ± 7.45
	181–192	9	19–44	31.78 ± 7.85
Females	150–160	5	16–38	22.40 ± 8.84
	161–170	8	12–41	21.38 ± 9.05
	171–180	2	23–23	23.00 ± 0.00

Table 5. Thyroid weight [g] in various weights of the cadavers in both sexes

Sex	Weight of the cases [kg]	N	Thyroid weight	
			Min–Max	Mean ± SS
Male	40–60	8	16–31	22.88 ± 5.61
	61–70	26	14–39	27.38 ± 7.21
	71–80	29	15–44	29.21 ± 7.90
	81–90	6	22–40	30.00 ± 6.45
	91–116	6	13–39	26.67 ± 9.45
Female	40–60	3	16–38	24.67 ± 11.71
	61–70	6	18–41	25.00 ± 8.36
	71–80	5	12–19	16.40 ± 2.96
	91–116	1	23–23	23.00

and thickness of the left and the right lobes are shown in Table 7. As shown in Table 8, in males and female cases there was no statistically significant difference in thyroid length and thyroid width according to age groups ($p > 0.05$).

Table 6. Correlation between thyroid weight and height and weight of the cadavers in both sexes

	Thyroid weight			
	Males		Females	
	r	p	r	p
Height	0.172	0.139	–0.161	0.566
Weight	0.282	0.014*	–0.252	0.365

r — Pearson correlation coefficient; there was a statistically significant correlation between weight of the male subjects and the thyroid weight ($r = 0.282$, $p = 0.014$); *$p < 0.05$ significant value

Table 7. The length, width, and thickness of the left and the right lobes in cm

	Mean ± SS	Min–Max	Mode
Left lobe length	5.21 ± 1.03	2.5–8.0	5
Left lobe width	2.90 ± 0.71	1.5–5.0	2.5
Left lobe thickness	2.33 ± 0.55	1.0–4.0	2.5
Right lobe length	5.26 ± 0.96	2.5–8.0	5
Right lobe width	2.97 ± 0.77	1.5–6.0	3
Right lobe thickness	2.39 ± 0.54	1.0–4.0	2

DISCUSSION

In the present study we observed that the isthmus was absent in 2 male cases out of 90 cadavers. Yüksel et al. [22] from Turkey described a case of a female cadaver in which they observed the absence of the isthmus. Berker et al. [2] from Turkey reported haemiagenesis of the thyroid gland. In their study, they found agenesis of the isthmus in 30% of their patients. From Turkey again, Sagiroglu et al. [15] reported absent isthmus in 7 subjects in a total of 25 cadavers of psychiatric patients. In his study he explained that the anomalies were due to the use of drugs such as lithium for treating the

Table 8. The length and width of the thyroid gland according to age groups in both sexes in cm

		Age			p
		18–30 (mean ± SS)	31–50 (mean ± SS)	51–80 (mean ± SS)	
Males	Thyroid length	7.56 ± 1.41	7.68 ± 2.09	7.85 ± 2.21	0.857
	Thyroid width	5.24 ± 1.00	5.71 ± 1.21	5.45 ± 1.06	0.259
Females	Thyroid length$^+$	6.62 ± 0.75	6.37 ± 1.25	6.28 ± 0.91	0.855
	Thyroid width$^+$	5.0 ± 1.0	4.62 ± 0.85	4.93 ± 0.53	0.857

Oneway ANOVA test; $^+$Kruskal Wallis test

patients, but as a limitation of his study, he had not examined the patients prior to the use of drugs.

Harjeet et al. [6] observed failure of the isthmuses to fuse in the midline in 7.9% of the cases. They also mentioned the studies of Williams et al. [20] from the UK who reported an absent isthmus in only 0.024% of cases in autopsy series. Won and Chung [21] reported that in 3% of the cases, the isthmus was missing. Braun et al. [4] showed that the isthmus did not exist in 4 cases from the 58 cadavers they studied. The incidence of agenesis of the thyroid isthmus has been reported as 5% to 10% by Pastor et al. [13], and from 8% to 10% by Marshall [12]. Joshi et al. [10] reported that the isthmus was absent in 16.66% of their cases. In our study we demonstrated that 57.8% (52/90) of the cases had a pyramidal lobe. In the literature the frequency of the pyramidal lobe greatly varies. Marshall [12] observed pyramidal lobe in 43% of 60 glands, and Kaplan [11] recorded it in 80% of patients at his operations. Ranade et al. [14] reported the presence of a pyramidal lobe in 58% of 105 cadavers. Blumberg [3] found a pyramidal lobe in 60–65%, usually being situated on the left side. Joshi et al. [10] from India reported that the pyramidal lobe was present in 37.77% cases and found that 47.05% arose from the left lobe. In our cases pyramidal lobe was commonly located on the left side, which concurs with the statements recorded in the textbooks of anatomy and surgery [11]. The pyramidal lobe represents the vestige of the thyroglossal duct, which usually deviates to the left caudally [14]. Hollinshead [9] underlined that the pyramidal lobe should not be overlooked, because of its common occurrence and varying extent as a potential risk for recurrence after surgery. Therefore, surgeons should investigate the thyroid tissue and the whole anterior neck region in detail very carefully.

In the present study the mean thyroid weight was 26.11 ± 8.14 g. In males it was 26.93 ± 7.96 g while in females it was 21.93 ± 7.98 g, and there was a statistically significant correlation between the weight of the male subjects and the thyroid weight. As the weight of the male cases increased, so did the thyroid weights. Snyder et al. [17] reported the weight of the gland to be 17.5 ± 6.8 g in males and 14.9 ± 6.7 g in females. Williams et al. [20] delineated it to be 25 g in males and a little more in females. In Japanese adults between the ages of 20 to 50 years, the gland weighed about 18 g in males and 1–2 g less in females [1, 18].

In our study, contrary to observations recorded in textbooks of anatomy [20], there was no evidence to show that the gland weighs a little more in females than in males. In fact in our cases, in the 31–50 year old group the thyroid weight of the males was statistically significantly more than that of the females.

In the present study we have demonstrated that the mean length, width, and thickness of the left lobe is 5.21 ± 1.03, 2.90 ± 0.71, and 2.33 ± ± 0.55 cm, respectively, while the mean length, width, and thickness of the right lobe is 5.26 ± ± 0.96, 2.97 ± 0.77, and 2.39 ± 0.54, respectively. Joshi et al. [10] reported the average length of the right lobe as 4.32 cm, and the left lobe as 4.22 cm. The thickness of the right lobe was reported as 1.13 cm, and the left lobe as 1.18 cm. Although the thyroid glands obtained from our cases seems to be heavier and bigger compared to the literature, further studies are needed to validate our results in a larger study with an equal number of men and women.

CONCLUSIONS

This is the first reported morphometric study on cadaveric thyroid glands from Turkey and it highlights individual and ethnic/racial variations. In order to perform safe and effective surgery as well as diagnosis of thyroid disorders, knowledge of normal anatomy and the variations of the thyroid gland are essential.

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