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Original Research Article

Correlation of Sonographically Measured Thyroid Volume with Age, Sex, Height, Weight of Type-I Diabetic Patients with Normal Serum TSH Level and Healthy Control Subjects

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Abstract: To Assess The Sonographically Measured Thyroid Volume In Type-I Diabetic Patients With Normal Serum TSH Level And Healthy Control Subjects And Correlation With On Age, Sex, Height And Body Weight In Both Groups. This prospective study was carried out in the Department of Radiology and Imaging, BlRDEM, Dhaka, Bangladesh during the period of 1st June 2009 to 30th May, 2010, to compared the thyroid volume evaluated by ultrasonography in type I diabetic patients with normal TSH value and healthy control subject and find out the correlation of thyroid volume with age, sex, body weight and height in both groups. For this purpose, 35 consecutive patients having type I diabetes with normal serum TSH level and 35 healthy control subjects were included in this study. Ultrasonography was done in all these patients and healthy control subjects to evaluate the thyroid volume. The following observations and results were obtained in this study: The mean age was 19.7±5.4 years and 19.3±5.9 years in group I and group II respectively, which was almost similar between two groups. Male female ratio was 1:1.3 and 1:1.1 in group I and group II respectively. The mean height and weight were almost similar in both groups.The thyroid volume increased with age in both groups. The mean±SD thyroid volume were 7.9±0.7cc, 8.0±0.5 cc, 9.0±0.4 cc and 9.4±0.3 cc in 10-15 years, 16-20 years, 21-25 years and 26-30 years age group respectively in type I diabetes patients. Similarly, in healthy control subjects the mean thyroid volume were 2.2±1.0 cc, 2.3±0.4 cc, 4.3±0.5 cc and 4.6±0.7 cc in 10-15 years, 16-20 years, 21-25 years and 26-30 years age group respectively. The thyroid volume higher in female in both groups. The mean±SD thyroid volume was 8.3±0.7 cc and 8.6±0.9 cc in male and female respectively in type I diabetes patients. In healthy control subjects the mean±SD thyroid volume was 3.0±1.3 cc and 3.3±1.4 cc in male and female respectively. In this study the mean±SD thyroid volume were 7.8±1.0 cc, 8.4±1.0 cc, 8.6±0.7 cc and 8.7±0.6 cc found in 131-140 cm, 141-150 cm, 151-160 cm and >160 cm respectively in type I diabetes patients. In healthy control subjects mean±SD thyroid volume were 1.4±0.3 cc, 3.1±1.1 cc, 3.2±1.3 cc and 3.7±1.2 cc in 131-140 cm, 141-150 cm, 151-160 cm and >160 cm respectively. The mean±SD thyroid volume was 8.0±0.8 cc, 8.5±0.9 cc and 8.7±0.6 cc in <55 kg, 50 -55 kg and >55 kg weight groups respectively in type I diabetes patients. A significant positive correlation ($r=0.739$, $p<0.001$) was found in type I diabetes patients and ($r=0.744$, $p<0.001$) in healthy control subjects between age and thyroid volume. In this study it can be concluded that sonographically measured thyroid volume in type-I diabetic patients with normal serum TSH level in significantly higher than that of healthy control subjects. The study data also suggests that thyroid volume positively correlates with age, sex, height and body weight in both groups.

Key words: Thyroid Volume, Type-I Diabetic, Serum TSH Level.

INTRODUCTION

Both clinical and animal studies have demonstrated that diabetes mellitus is commonly associated with altered thyroid function as well as thyroid volume. It has been demonstrated in both type-I and type 2 diabetes mellitus but significant alteration of thyroid volume is seen in type-I diabetic patients. In

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2000, according to World Health Organization, at least 171 million people worldwide or 2.5% of population suffer from diabetes. It's incidence is increasing rapidly and it is estimated that by the year 2030, this number will be almost double. The greatest increase in prevalence is, however, expected to occur in Asia and Africa by 2030. The centers for Disease Control termed this change an epidemic. About 5%-6% of diabetes cases are type-I [1]. Several small studies in Bangladesh indicated 0.75%-1.0% type-I diabetics in age>15 yrs [2]. Last study made at 1992 where incidence rates is 4.2 and prevalence rate is 1.5% [3]. Type-I diabetes is a slowly progressive T cell-mediated autoimmune disease associated with other disorder including thyroid, gastric, adrenal autoimmunity. Latent autoimmunity against thyroid were found 16% [4]. According to dept. of Epidemiology and Biostatistics only 389 diabetic subjects were registered at BIRDEM, a referral center, throughout the year 1960, this figure increased to 1181, 2363, 9641 and 15188 in the year 1970, 1980, 1990 and 2000, respectively. All this figures indicate that the magnitude of health problems related to diabetic in Bangladesh has been increasing rapidly. The thyroid is an endocrine gland, situated in the lower part of the front & side of the neck. It regulates the basal metabolic rate. It maintains the level of metabolism in the tissues that is optimal for their normal function. The principal hormones secreted by the thyroid are thyroxine (T4) and triiodothyronine (T3). T3 is more active than T4. Thyroid hormones stimulate the O_2 consumption of most of the cells in the body, help regulate lipid and carbohydrate metabolism, and are necessary for normal growth and maturation. The thyroid stimulating hormone (TSH) of the anterior pituitary controls thyroid function. Thyroid disorder is one of the major health hazards in many countries, including Bangladesh. In Bangladesh, it is seen mainly in the northern parts and along the belt of the Jamuna river [5]. One study carried out at the BSMMU, Dhaka, showed that, among the thyroid disorders, simple diffuse goiter was the most common thyroid disorder and constituted 29.96 percent of the total cases, followed by nontoxic solitary nodule 26.80 percent, Graves' disease 16.58 percent, hypothyroidism 10.12 percent, non-toxic multinodular goiter 8.4 percent, toxic adenoma 3.39 percent, toxic multinodular goiter 3.12 percent, thyroid cancer 2.58 percent and thyroiditis 1.56 percent. All categories of thyroid disorders were more common among the female subjects [5]. Two different surveys designed specifically for goiter revealed that the prevalence rates of goiter in our population was 10.5 percent (Report on National Goiter Prevalence of Bangladesh 1981-82) and 47.1 percent, [6] at an interval of 12 years. The thyroid volume in vivo can be measured accurately by ultrasongraphy, provided no retrosternal extension of the thyroid exists [7]. The normally homogeneous texture of the thyroid, its clearly defined surrounding structures, and its relatively superficial location makes it an ideal structure for evaluation by high frequency ultrasonography. The thyroid gland is more echogenic than its surroundings due to its numerous connective tissue interfaces of blood vessels and stroma. The internal jugular vein and carotid artery are constant easily identified posterolateral landmarks. Ultrasonography is noninvasive and relatively inexpensive when compared to most other imaging techniques. There is no radiation exposure and therefore it can be safely used in pregnant women and children. High frequency (7.5-10.0 MHz) probes emit sound waves that attenuate rapidly with increasing depth [8]. The association between type-I diabetes mellitus and thyroid volume alteration has long been reported. Overt or sub-clinical hypothyroidism on autoimmune origin are frequently occurring in diabetic patient as a late effect of thyroiditis which may be some time detectable on basis of clinical and laboratory evidence of hypothyroidism or may pass undiagnosed. Extensive epidemiological study are available on clinical and laboratory evaluation of thyroid gland with or without thyroid disease but morphological evaluation of thyroid has always been limited to physical examination [9].

MATERIALS AND METHODS

This prospective study was carried out in the Department of Radiology and Imaging, BIRDEM, Dhaka, Bangladesh during the period of 1st June 2009 to 30th May, 2010. This study patients aged between 10 years to 30 years. Demographic data were collected from each participant at the time of physical examination including age, sex, height and body weight. In addition, all the relevant medical records were checked to ensure that selected cases had no pathological abnormalities that could affect the thyroid volume. The patients were examining in supine position with hyper extended neck and acoustic gel was applied between skin and the probe to improve the quality of ultra-sonographic image [9].

This was allowed a careful evaluation of thyroid morphology and measurement of the three maximum diameter of each lobe: antero-posterior (AP), latero-lateral (LL) and cranio-caudal (CC). The inter-observer variability of the ultrasonographic measurements was 10%. Using the mean value of two determinations, we estimated the volume of each lobe with the formula [10]. Among 65 patients, 30 patients were excluded due to detection of abnormality in thyroid sonography (thyroid calcification in 6 cases, solitary nodular goiter in 2 cases, multinodular goiter in 3 cases, history of taking iodine containing medicine 8 cases, type-I diabetic patients with pregnancy in 5 cases, 2 patients gave the history of taking oral contraceptives, 4 patients came form goiter endemic area). The researcher herself evaluated the findings of sonography which were reviewed by two radiologists without prior knowledge of the interpretations of the other to eliminate bias. Finally 35 patients were selected as a group I where 20 are female and 15 are male. Then 35 healthy control subjects were included in the study

as a group II where 18 are female and 17 are male matched with age and sex of group- I.

Inclusion Criteria:

- Clinically diagnosed type-I diabetic patients (age group 10-30 years) with normal TSH level referred to radiology department.

Exclusion Criteria:

- Consumption of oral contraceptives.
- Recent intake of iodine-containing medicine.
- If any thyroid calcification, solitary noduler and multinoduler goiter on ultrasonography.
- Pregnancy.

Procedure of the ultrasonic measurement of thyroid:

All participants must be answered appropriate questionnaires concerning previous thyroid disease and medication, iodized salt consumption. The subject were examining in supine position with hyper extended neck and acoustic gel was applied between skin and the probe to improve the quality of ultra-sonographic image [9]. This was allowed a careful evaluation of thyroid morphology and measurement of the three maximum diameter of each lobe: antero-posterior (AP), latero-lateral (LL) and cranio-caudal (CC). The inter-observer variability of the ultrasonographic measurements was 10%. Using the mean value of two determinations, we estimated the volume of each lobe with the formula [10].

Procedure:

Thyroid size was estimated by palpation by one expert examiner. Thyroid ultra-sonography was performed and interpreted by the same experienced using the Siemens Antars sonoline or Medison sonoace 8000 live (prime) equipment with a 7.5 MHz linear probe. Volume = Antero-posterior (AP) X latero- lateral (LL) X Cranio-caudal (CC) X 0.52. Total thyroid volume as the sum of the two lobes (isthmus was not considered). The presence, number and dimensions of nodules were also registered, whereas no attempt was made to consider the echogenicity of the thyroid gland (hyper-or-hypo-echoic pattern) in the absence of nodules. The thyroid status was confirmed by hormonal assay that is normal serum TSH level. At first, thyroid volume in control subjects measured by ultrasonogram and arranged the volume according to the age group than the thyroid volume in type-I diabetic patients was measured and compared.

Statistical Analysis Of Data:

All the relevant collected data were compiled on a master chart first. Then organized by using scientific calculator and standard statistical formulae. Percentages were calculated to find-out the proportion of the findings. Further statistical analysis of the results were done by computer software devised as the statistical packages for social scientist (SPSS). The results were presented in Tables and Figures. The significant differences were measured by unpaired t tests, X^2 test and Pearson's correlation coefficient (r) test. The relationship of all dimensions with sex, age, height & weight were statistically analyzed. The values were expressed as the frequency, percentage, distribution and mean ±SD. P values <0.05 was considered as statistically significant.

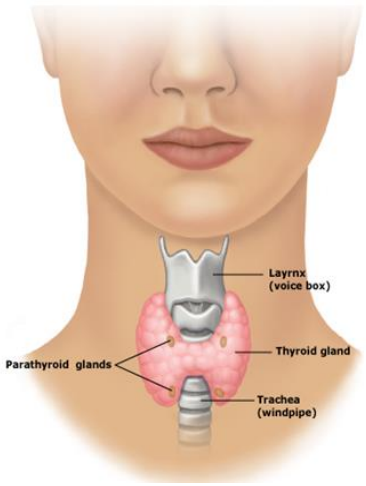


Figure 1: Showing the anatomy of the thyroid gland

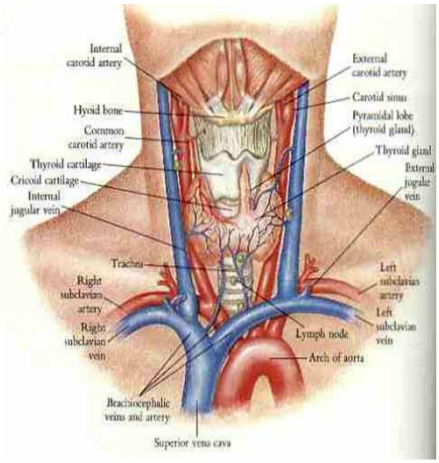


Figure 2: The relation and blood supply of the thyroid gland.

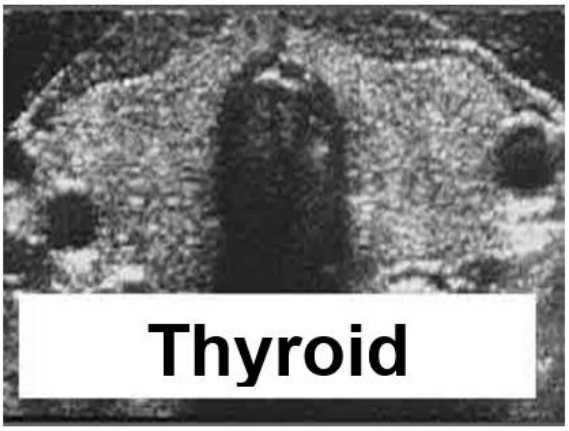


Figure 3: Normal USG appearance of thyroid gland

Figure 4: Thyroid ultrasound uses high frequency sound wave to make a picture of the thyroid gland

Observations And Results

The study included 70 subjects out of which 35 patients having type-I diabetes, with normal TSH level and 35 healthy subjects ranged from 10 to 30 years. They were divided into four age groups. The mean age was 19.7 with standard deviation (SD) ±5.4 years in group I. In group II the mean age was 19.3 years with standard deviation (SD) ±5.9 years. The thyroid volume in cc was measured by ultrasonography as well as compare the thyroid volume in both groups (I and II) and height, body weight are also taken and finally find out the correlation between thyroid volume with age, sex, height and body weight in both groups. Maximum number was found in the age group of 16-20 years in groups. The mean age difference was not statistically significant (p>0.05) in unpaired t-test. The results are shown in the table 1.

Table 1: Age distribution of the study subjects (n=70).

Age in years	Group I (n=35)		Group II (n=35)		P value
	n	%	n	%	
10-15	9	25.7	7	20.0	
16-20	12	34.3	13	37.1	
21-25	8	22.9	9	25.7	
26-30	6	17.1	6	17.2	
Mean±SD	19.7	±5.4	19.3	±5.9	0.737^{NS}
Range (min-max)	(10	-30)	(10	-30)	

Group I: Patient with type-I diabetes, with normal TSH level
Group II: Healthy control
NS= not significant
P value reached from unpaired t-test

This study was carried out in 70 subjects. They were divided into male and female groups. Out of which 42.9% were male and rest 57.1% were female patients in group I. In group II 48.6% were male and rest 51.4 were female. The difference was not statistically significant (p>0.05) regarding the gender incidence in chi square test. Male female ratio was 1:1.3 and 1:1.1 in group I and group II respectively and 1:1.2 in the whole study subjects. The results are shown in the table 2 figure 5.

Table-2: Sex distribution of the study subjects (n=70)

Sex	Group I (n=35)		Group II (n=35)		P value
	n	%	n	%	
Male	15	42.9	17	48.6	0.631^{NS}
Female	20	57.1	18	51.4	

NS= not significant
P value reached form chi square test

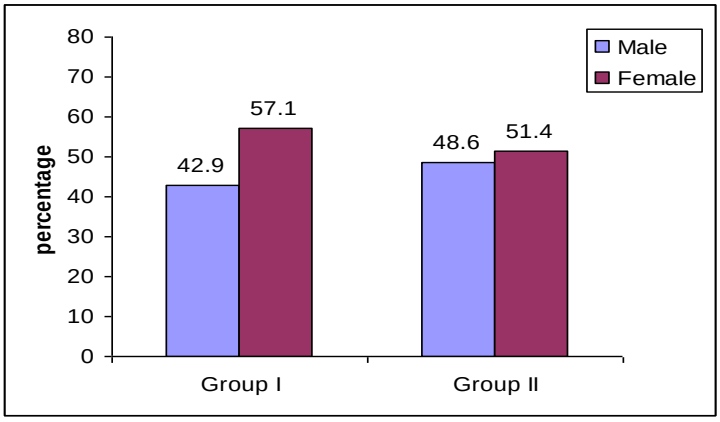


Figure 5: Bar diagram showing sex distribution of the study subjects

The mean height was 152.8±9.6 cm with ranged from 132.1 to 167.6 cm in group I. In group II the mean height was 154.2±8.4 cm with ranged from 137.2 to 167.6 cm. The mean height difference was not statistically significant (p>0.05) in unpaired t-test. The results are shown in the table 3 and figure 6.

Table-3: Mean height distribution of the study subjects (n=70)

	Group I (n=35)		**Group II (n=35)**		**P value**
	Mean	±SD	Mean	±SD	
Height (cm)	152.8	±9.6	154.2	±8.4	0.502^{NS}
Range (min-max)	(132.1	-167.6)	(137.2	-167.6)	

NS= not significant
P value reached from unpaired 't' test

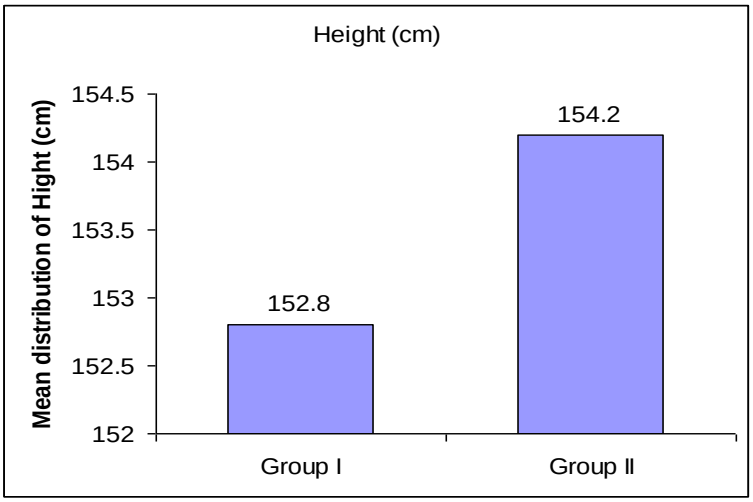


Figure 6: Bar diagram showing mean height distribution of the study subjects

The mean weight was 52.4±5.4kg with ranged from 44 to 61 kg in group I. In group II the mean weight was 55.5±8.3 kg with ranged from 35 to 67 kg. The mean weight difference was not statistically significant (p>0.05) in unpaired t-test. The results are shown in the table 4 and figure 7.

Table-4: Mean weight distribution of the study subjects (n=70)

	Group I (n=35)		**Group II (n=35)**		**P value**
	Mean	±SD	Mean	±SD	
Weight (kg)	52.4	±5.4	55.5	±8.3	0.072^{NS}
Range (min-max)	(44	-61)	(35	-67)	

NS= not significant
P value reached from unpaired 't' test

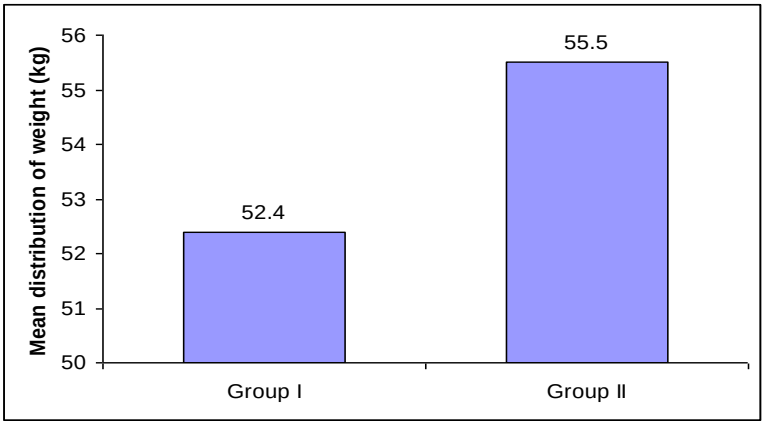


Figure 7: Bar diagram showing mean weight distribution of the study subjects

The thyroid volume increased with age in both groups. In 10-15 years age group, the mean±SD thyroid volume was 7.9±0.7 cc varied from 6.5 to 8.4 cc in group I and 2.2±1.0 cc varied from 1.2 to 3.5 cc in group II. In 16- 20 years age group, 8.0±0.5 cc varied from 7.3 to 9.1 cc in group I and 2.3±0.4 cc varied from 1.5 to 2.7 cc in group II. In 21- 25 years age group, 9.0±0.4 cc varied from 8.5 to 9.7 cc in group I and 4.6±0.5 cc varied from 3.9 to 5.4 cc in group II. In 26-30 years age group and 9.4±0.3 cc varied from 9.1 to 9.8 cc and 4.3±0.7 cc varied from 3.5 to 5.6 cc in group II. The difference of thyroid volume was statistically significant (p<0.001) in unpaired test. Their thyroid volume distribution depicted in the following table 5.

Table-5: Mean distribution of thyroid volume according to age of the study subjects.

Age in	Group I (n=35)				Group II (n=35)				P
Years	Mean±SD		Range (min-max)		Mean±SD		Range (min-max)		value
Average									
10-15	7.9	±0.7	(6.5	-8.4)	2.2	±1.0	(1.2	-3.5)	0.001[S]
16-20	8.0	±0.5	(7.3	-9.1)	2.3	±0.4	(1.5	-2.7)	0.001[S]
21-25	9.0	±0.4	(8.5	-9.7)	4.6	±0.5	(3.9	-5.4)	0.001[S]
26-30	9.4	±0.3	(9.1	-9.8)	4.3	±0.7	(3.5	-5.6)	0.001[S]

S= significant
P value reached from unpaired t-test

The thyroid volume higher in female in both groups. In male patients the mean±SD thyroid volume was 8.3±0.7 cc varied from 7.0 to 9.5 cc in group I and 3.0±1.3 cc varied from 1.3 to 5.1 cc in group II patients. Similarly, in female patients the mean±SD thyroid volume was 8.6±0.9 cc varied from 6.5 to 9.8 cc and 3.3±1.4 cc varied from 1.2 to 5.6 cc in group I and group II respectively. The difference of thyroid volume was statistically significant (p<0.001) in unpaired test. Their thyroid volume distribution depicted in the following table 6.

Table-6: Mean distribution of thyroid volume according to gender of the study subjects

Sex	Group I (n=35)				Group II (n=35)				P
	Mean±SD		Range (min-max)		Mean±SD		Range (min-max)		value
Male	8.3	±0.7	(7.0	-9.5)	3.0	±1.3	(1.3	-5.1)	0.001[S]
Female	8.6	±0.9	(6.5	-9.8)	3.3	±1.4	(1.2	-5.6)	0.001[S]

S= significant
P value reached from unpaired t-test

The thyroid volume increased with height in both groups. In 131-140 cm height group, the mean±SD thyroid volume was 7.8±1.0 cc varied from 7.4 to 9.2 cc in group I and 1.4±0.3 cc varied from 1.2 to 1.8 cc in group II.

In 141-150 cm height group, the mean±SD thyroid volume was 8.4±1.0 cc varied from 6.5 to 9.7 cc in group I and 3.1±1.1 cc varied from 1.4 to 4.6 cc in group II. In 151-100 cm height group, the mean±SD thyroid volume was 8.6±0.7 cc varied from 7.3 to 9.8 cc in group I and 3.2±1.3 cc varied from 1.4 to 5.4 cc in group II. In >160 cm height group, the mean±SD thyroid volume was 8.7±0.6 cc varied from 7.8 to 9.5 cc in group I and 3.7±1.2 cc varied from 2.1 to 5.6 cc in group II. The difference of thyroid volume was statistically significant (p<0.001) in unpaired test. Their thyroid volume distribution depicted in the following table 7.

Table-7: Mean distribution of thyroid volume according to height of the study subjects

Height	Group I (n=35)				Group II (n=35)				P
Cm	Mean±SD		Range (min-max)		Mean±SD		Range (min-max)		value
Average									
131-140	7.8	±1.0	(7.4	-9.2)	1.4	±0.3	(1.2	-1.8)	0.001[S]
141-150	8.4	±1.0	(6.5	-9.7)	3.1	±1.1	(1.4	-4.6)	0.001[S]
151-160	8.6	±0.7	(7.3	-9.8)	3.2	±1.3	(1.4	-5.4)	0.001[S]
>160	8.7	±0.6	(7.8	-9.5)	3.7	±1.2	(2.1	-5.6)	0.001[S]

S= significant
P value reached from unpaired t-test

The thyroid volume increased with weight in both groups. In <50 kg weight group, the mean±SD thyroid volume was 8.0±0.8 cc varied from 6.5 to 9.7 cc in group I and 1.6±0.6 cc varied from 1.2 to 3.0 cc in group II. In 50-55 kg weight group, the mean±SD thyroid volume was 8.5±0.9 cc varied from 7.3 to 9.8 cc in group I and 2.6±0.9 cc varied from 1.5 to 3.5 cc in group II. In >55 kg weight group, the mean±SD thyroid volume was 8.7±0.6 cc varied from 7.8 to 9.5 cc in group I and 3.9±1.1 cc varied from 2.1 to 5.6 cc in group II. The difference of thyroid volume was statistically significant (p<0.001) in unpaired test. Their thyroid volume distribution depicted in the following table 8.

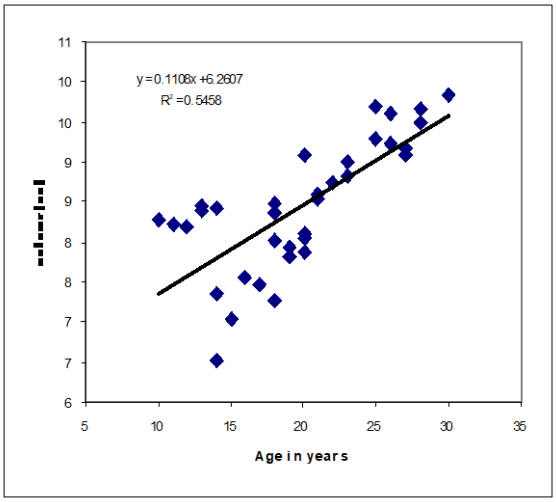
Table-8: Mean distribution of thyroid volume according to weight of the study subjects

Weight	Group I (n=35)				Group II (n=35)				P
Kg	Mean±SD		Range (min-max)		Mean±SD		Range (min-max)		value
Average									
<50	8.0	±0.8	(6.5	-9.7)	1.6	±0.6	(1.2	-3.0)	0.001[S]
50-55	8.5	±0.9	(7.3	-9.8)	2.6	±0.9	(1.5	-3.5)	0.001[S]
>55	8.7	±0.6	(7.8	-9.5)	3.9	±1.1	(2.1	-5.6)	0.001[S]

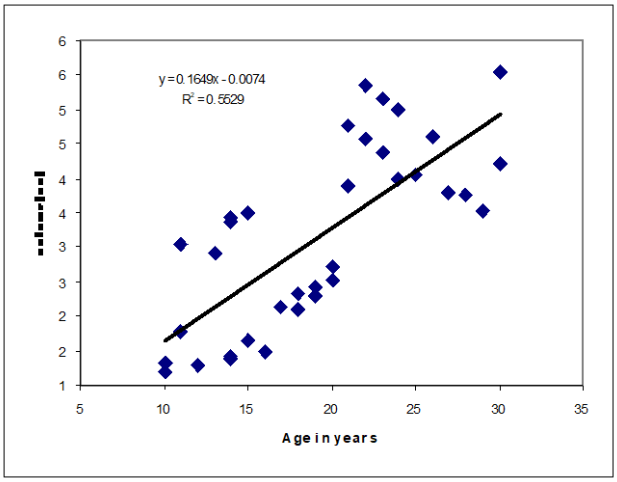
S= significant

P value reached from unpaired t-test

Age of 70 cases was expressed in years and thyroid volume was measured by cc in both groups. Significant positive correlations were found between age and thyroid volume. The values of Pearson's correlation coefficient were 0.739 and 0.744 in group I and group II respectively, which shows significant (p<0.05) correlations. Therefore, there was a significant positive linear correlation between age and thyroid volume (Figure 8). When age increases by one unit than the thyroid volume expected to increased 6.37 cc of type-I diabetic patients and in healthy subjects it increased 0.1575 cc. Here the thyroid volume more increased in type-I diabetic patients than healthy control which may be due to the patients having type-I diabetic.



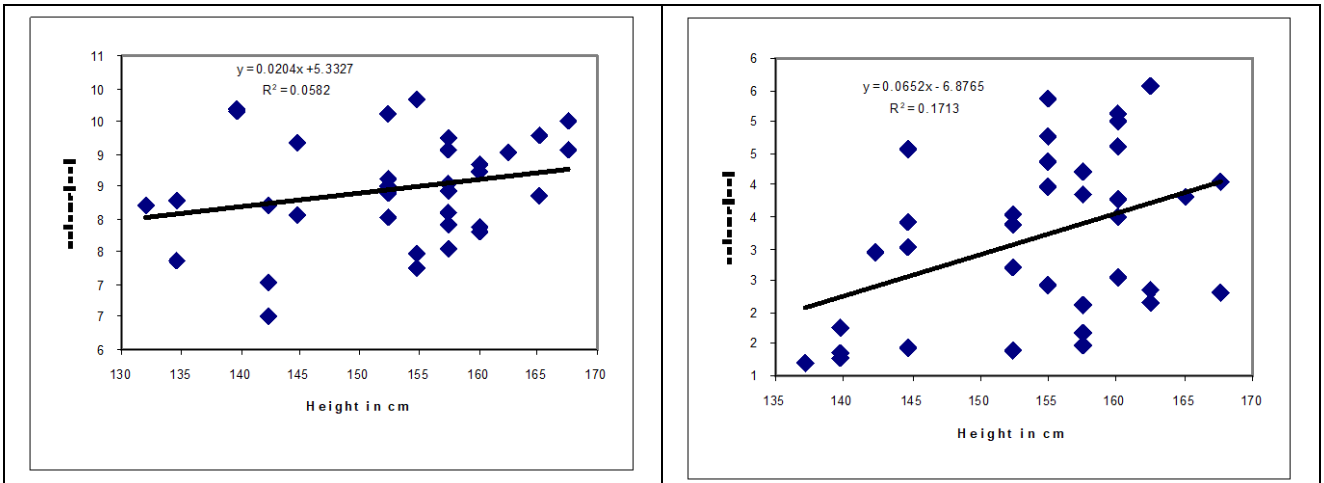
Group I: Significant positive correlation (r=0.739)



Group II: Significant positive correlation (r=0.744)

Figure 8: The scatter diagram shows positive relationship (r=0.739, p<0.05 in group I and r=0.744, p<0.05 in group II) between age and thyroid volume

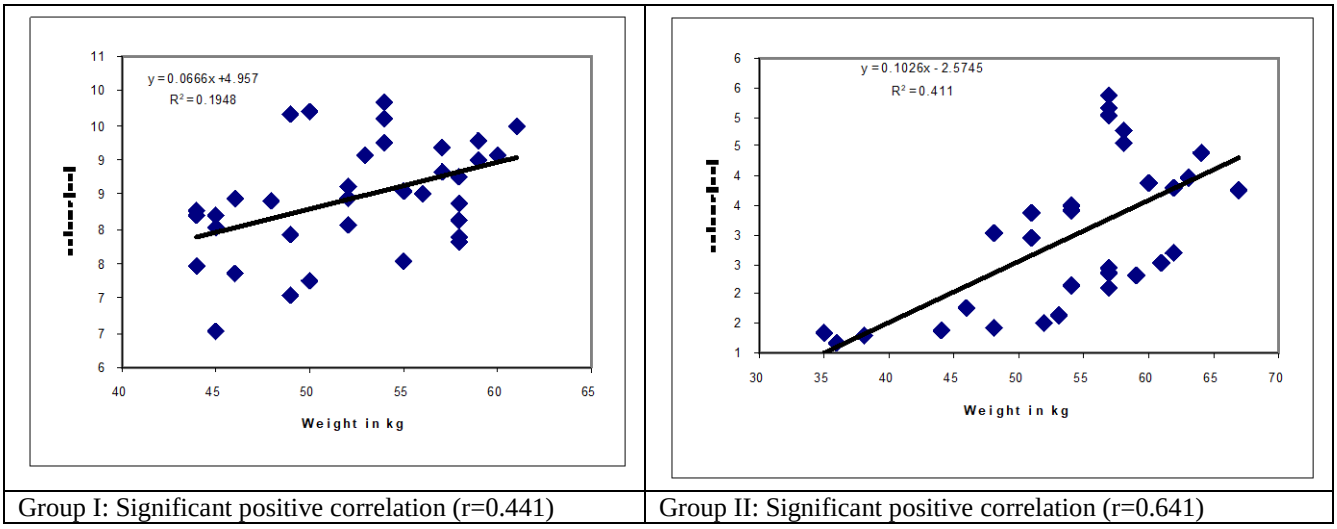
Height of 70 cases was expressed in cm and thyroid volume was measured by cc in both groups. Significant positive correlations were found between height and thyroid volume. The values of Pearson's correlation coefficient were 0.241 and 0.414 in group I and group II respectively, which shows significant (p<0.05) correlations. Therefore, there was a significant positive linear correlation between height and thyroid volume (Figure 9).



Group I: Significant positive correlation (r=0.241) | Group II: Significant positive correlation (r=0.414)

Figure 9: The scatter diagram shows positive relationship (r=0.241, p<0.05 in group I and r=0.414, p<0.05 in group II) between height and thyroid volume

Weight of 70 cases was expressed in kg and thyroid volume was measured by cc in both groups. Significant positive correlations were found between weight and thyroid volume. The values of Pearson's correlation coefficient were 0.441 and 0.641 in group I and group II respectively, which shows significant (p<0.05) correlations. Therefore, there was a significant positive linear correlation between weight and thyroid volume (Figure 10).



Group I: Significant positive correlation (r=0.441) | Group II: Significant positive correlation (r=0.641)

Figure 10: The scatter diagram shows positive relationship (r=0.441, p<0.05 in group I and r=0.641, p<0.05 in group II) between weight and thyroid volume

Significant positive correlations were found between age, height and weight with thyroid volume. The values of Pearson's correlation coefficient between age with thyroid volume were higher in both groups (r=0.739 in group I and r=0.744 in group II; p<0.001) than height (r=0.241 in group I and r=0.414 in group II; p<0.001) and weight (r=0.441 in group I and r=0.641 in group II; p<0.001). However, the values of Pearson's correlation coefficient of height and weight were comparatively higher in group II.

Table-9: Comparison between Pearson's correlation coefficients of ultrasonographically measured thyroid volume and age, height and weight of the study subjects (n=70)

	Group I	Group II
Age	0.739	0.744
Height	0.241	0.414
Weight	0.441	0.641

DISCUSSION

A total of 35 patients having type-I diabetes with normal TSH value age ranging from 10 to 30 years and 35 healthy control subjects were included in the

study of same age group. The present study findings were discussed and compared with previously published relevant studies. Hegedus *et al*., [7] have shown in their series, the age ranged of the healthy volunteers was 13 to 29 years which closely resemble with the present study where the mean age of the patients having type I diabetic 19.7±5.4 years and 19.3±5.9 years in healthy control ranged from 10 to 30 years in both groups. Most (34.3% in group I and 37.1% in group II) number was found in the age group 16-20 years. The mean age difference was not statistically significant (p>0.05). On the other hand, Gomez *et al*., [11] observed higher mean age in their study, which were 26.8±5.1years and 25.7±5.2 years in the patients having type I diabetic and healthy control respectively. In our country Parvin (2007) shown in her work, the male female ratio was almost 1:1, which is consistent with the present study, where the current study observed male female ratio 1:1.3 in group I, 1:1.1 in group II and 1:1.2 in the whole study subjects. Hegedus *et al*., [7] and Gomez *et al*., [11] found in their studies that the male female ratios were 1:1 and 1.2:1 respectively. The results of the present study closely resemble with the above studies. In this current study it was observed that the mean height was 152.8±9.6 cm and 154.2±8.4 cm in group I and group II respectively. The mean weight was 52.4±5.4kg in group I and 55.5±8.3 kg in group II. The mean height and weight were almost similar in both groups and the difference were not statistically significant (p>0.05). Parvin (2007) obtained almost similar height and weight in here study. Hegedus *et al.*, [7] and Gomez *et al*., [11] observed higher mean height in patients having type I diabetes, which may due to higher body surface area in their study patient. In this study it was observed that the thyroid volume increased with age, height and weight and also found higher thyroid volume in female in patients having type I diabetes and healthy control subjects. In this study it was observed that the mean±SD thyroid volume of the patients having type I diabetes was 7.9±0.7 cc varied from 6.5 to 8.4 cc in 10-15 years age group, 8.0±0.5 cc varied from 7.3 to 9.1 cc in 16- 20 years, 9.0±0.4 cc varied from 8.5 to 9.7 cc in 21- 25 years and 9.4±0.3 cc varied from 9.1 to 9.8 cc in 26- 30 years age groups, which indicates that the mean thyroid volume increased with different age group in the patients having type I diabetes. Similarly, the mean±SD thyroid volume was observed in the healthy control was 2.2±1.0 cc varied from 1.2 to 3.5 cc in 10-15 years age group, 2.3±0.4 cc varied from 1.5 to 2.7 cc in 16- 20 years age group, 4.3±0.5 cc varied from 3.9 to 5.4 cc in group II in 21-25 years age group and 4.6±0.7 cc varied from 3.5 to 5.6 cc in 26- 30 years age group, which also indicates that the mean thyroid volume increased with different age group in the healthy control subjects . The difference of thyroid volume was significantly (p<0.001) higher in the patients having type I diabetes with compared to healthy control in different age groups. Which are closely resembled with Hansen *et al*., [12] and Hegedus *et al*., [7] where they observed thyroid volume significantly increased with different age groups. In this current series it was observed in patients having type I diabetes the mean±SD thyroid volume was 8.3±0.7 cc varied from 7.0 to 9.5 cc and 8.6±0.9 cc varied from 6.5 to 9.8 cc in male and female patients respectively. Similarly, in healthy control subjects the mean±SD thyroid volume was 3.0±1.3 cc varied from 1.3 to 5.1 cc in male subjects and 3.3±1.4 cc varied from 1.2 to 5.6 cc in female subjects. The difference of thyroid volume was significantly (p<0.001) higher in the patients having type I diabetes with compared to healthy control in male and female. Similar findings obtained by Bianchi *et al*., [9] where they found thyroid volume significantly increased in type-I diabetes patients with compared to healthy control in males and females. However the authors reported that thyroid volume higher in male subjects. Similar findings obtained by Hansen et al. [12] which is not consistent with the current study. This may be due to the study done in Western Country where there study population had higher body surface area. In this study the mean±SD thyroid volume was found in 131-140 cm height group was 7.8±1.0 cc varied from 7.4 to 9.2 cc, in 141-150 cm height group was 8.4±1.0 cc varied from 6.5 to 9.7 cc, in 151-100 cm height group was 8.6±0.7 cc varied from 7.3 to 9.8 cc and more than 160 cm height group was 8.7±0.6 cc varied from 7.8 to 9.5 cc among the patients having type I diabetes. Similarly, in the healthy control subjects mean±SD thyroid volume was found in 131-140 cm height group was 1.4±0.3 cc varied from 1.2 to 1.8 cc, in 141-150 cm height group was 3.1±1.1 cc varied from 1.4 to 4.6 cc, in 151-100 cm height group was 3.2±1.3 cc varied from 1.4 to 5.4 cc and more than 160 cm height group was 3.7±1.2 cc varied from 2.1 to 5.6 cc. Parvin (2007) and Gomez *et al*., [11], found that thyroid volume significantly increase with height and body weight as well as in type I diabetes patients, which is closely resembled with the present study. In this study it was also observed that the mean±SD thyroid volume was 8.0±0.8 cc varied from 6.5 to 9.7 cc, 8.5±0.9 cc varied from 7.3 to 9.8 cc and 8.7±0.6 cc varied from 7.8 to 9.5 in <55 kg, 50 -55 kg and >55 kg weight groups respectively in patients having type I diabetes. Similarly, in health control subjects it was observed that the mean±SD thyroid volume was 1.6±0.6 cc varied from 1.2 to 3.0 cc, 2.6±0.9 cc varied from 1.5 to 3.5 cc and 3.9±1.1 cc varied from 2.1 to 5.6 cc in less than 55 kg, 50-55 kg and more than 55 kg weight groups respectively. The difference of thyroid volume was significantly (p<0.001) higher in the patients having type I diabetes with compared to healthy control in different height and weight groups. The results of the present study is consistence with Hegedus *et al*., [7] and Gomez *et al*., [11] studies. A significant positive correlations (r=0.739, p<0.001 in patients having type I diabetes and r=0.744, p<0.001 in healthy control subjects) were found between age and thyroid volume in this study, which differ with Parvin (2007) and Gomez *et al*., [11] studies, which may due to the older patients were

enrolled in their study. Similarly, a significant positive correlations (r=0.241, p<0.05 in patients having type I diabetes and r=0.414, p<0.05 in healthy control subjects) were found between height and thyroid volume. Furthermore it was also found a significant positive correlations (r=0.441, p<0.05 in patients having type I diabetes and r=0.641, p<0.05 in healthy control subjects) were found between weight and thyroid volume. The results obtained in the present study strongly resemble with Parvin (2007) and Gomez *et al*., [11] which indicate that thyroid volume significantly increase with height and body weight as well as in type I diabetes patients.

Limitation of the study

According to standard statistical formula, a large sample size should have been taken to reflect the picture of whole population. However, due to shortage of time and resource the sample size was very small.

CONCLUSION

In this study it can be concluded that sonographically measured thyroid volume in type-I diabetic patients with normal serum TSH level in significantly higher than that of healthy control subjects. The study data also suggests that thyroid volume positively correlates with age, height and weight. The thyroid volume is higher in females than males in both groups. However, further study can be undertaken by including higher number of study subjects.

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