

ORIGINAL ARTICLE

QUANTITATIVE ASSESSMENT OF THYROID GLAND VOLUME AMONG THE ETHNIC GROUPS OF KARACHI POPULATION

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ABSTRACT

Objectives: Thyroid gland volume varies from population to population. In this study mean thyroid gland volume among the ethnic groups in Karachi population was determined.

Methods: A prospective cross-sectional study was carried out in the Radiology Department of Ziauddin University Hospital Clifton Karachi, from January 2013 to in May 2014. Healthy subjects aged 21 years and above were recruited through convenient sampling. Serum thyroid stimulating hormone was evaluated in order to recruit euthyroid subjects. Ultrasonography of 416 euthyroid subjects was performed to determine the thyroid gland volume.

Results: Mean thyroid volumes reported were as follow: In Urdu speaking it was reported to be 5.47 ± 2.29 ml, in Sindhi 6.44 ± 3.23 ml, in Pathan 6.52 ± 3.07 ml, in Punjabi 7.02 ± 4.28 ml, in Hazarah 7.05 ± 3.91 ml and in Balochi 7.56 ± 4.52 ml. Mean thyroid volumes were significantly different among all the ethnic groups (P-Value 0.015).

Conclusion: Mean total thyroid gland volumes, right and left lobe volumes were found to be significantly different among the ethnic groups that exist in Karachi population. Long term variations in the level of intake of iodine among the ethnic groups may have resulted alterations in genotype that probably has resulted in significant variation in the mean TGV among the ethnic groups.

KEYWORDS: Ethnic Groups, Reference Values, Thyroid Gland, Thyrotropin, Ultrasonography.

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INTRODUCTION

Anatomically Thyroid gland (TG) lies in the anterior triangle of neck. It is encapsulated and consists of two lobes which extend from fifth cervical to first thoracic vertebrae. The two lobes of TG are connected to each other by means of isthmus anteriorly¹. TG secretes thyroid and calcitonin hormones. Thyroid hormones maintain the ideal level of metabolism in tissues and calcitonin hormone controls level of calcium in circulation².

Mean thyroid gland volume (TGV) is highly variable. Many factors are known to influence TGV such as

age, gender, anthropometric parameters, genetic makeup of population and environmental factors³⁻⁷. After urinary iodine level evaluation, World Health Organization (WHO) suggests TGV as an important indicator for iodine status of a population⁸. Serum thyroid stimulating hormones (TSH) and thyroid hormones level are also very well-known factor that regulates TGV^{9, 10}.

Mean TGV reported in different regions of world is as follow: In Karachi population mean TGV reported was 6.29 ± 2.9 ml¹¹, among Sudanese 6.44 ± 2.44 ml¹², among Cubans 6.6 ± 0.26 ml¹³, among Nepalese 6.629 ± 2.5 m⁷, among Chinese 12.92 ± 3.9 m⁵,

among Iranians $8.34 \pm 2.37 \text{ ml}^3$ among Nigerians $8.55 \pm 1.82 \text{ ml}^4$, among Danish $11.9\text{-}13.6 \text{ ml}^6$ and among Turkish subjects was $12.98 \pm 2.53 \text{ mL}^{14}$

In our neighboring country Iran, Moghadam RN reported mean TGV of $8.34 \pm 2.37 \text{ ml}$ in 314 healthy euthyroid adults of Yazd Iran³, Abidi et al. in 2008 reported mean TGV of $9.53 \pm 3.68 \text{ ml}$ among the 200 healthy adults of Isphan Iran¹⁵. Ahidjo et al. in 2002 reported mean TGV of about $8.55 \text{ cm}^3 \pm 1.82$ in Maiduguri, North-Eastern Nigeria⁴ and Alazigha N in 2015 reported The mean TGV $6.81 \pm 2.18 \text{ cm}^3$ in South geopolitical zone of Nigeria¹⁶. Ertan et al in 2015 reported mean TGV of $12.98 \pm 2.53 \text{ mL}$ in subjects of Tekirdag city Turkey¹⁴. Seker et al. reported mean TGV of $13 \pm 6.27 \text{ ml}$ in Turkish population of Ankara¹⁷. Authors suggested the influence of genetic and environmental factors especially daily iodine intake levels that accounts most for the regional variations in TGV.

Karachi is largest cosmopolitan city of Pakistan. People from all over the Pakistan reside here for better jobs and business opportunities, lifestyle modification, medical facilities, education facilities and so on^{18, 19}. Reference range of normal TGV among euthyroids has been established worldwide. Regional variations in TGV within the same country are also a very well documented.

To the best of our knowledge so far no study conducted that determine the reference range of TGV among the different ethnic groups that exists in a multiethnic Karachi population. Objectives of this study were to determine mean TGV among the different ethnic groups that exists in Karachi population and to determine whether the changes in mean TGV among the ethnic groups are significant.

METHODS

This was a cross sectional study that was carried out in the Radiology Department of Ziauddin University Hospital, Karachi. This study was permitted by the ethical committee of Ziauddin University and was started in January 2013 and completed in May 2014. Participants were gathered through the convenient sampling. Every participant was asked questions related to demographic profile, personal

history, past history, medical and drug history which was noted in proforma. Physical examination of TG was performed and sign and symptoms of thyroid diseases were noted.

The study included apparently healthy subject's age 21 years and above. Euthyroid, subjects were recruited with serum TSH level falling within the normal range b/w 0.23 to 4.0 $\mu\text{U/mL}$ (as recommended by laboratory).

Exclusion criteria of the study include subjects taking drugs causing goiter especially lithium, carbamazepine, phenytoin and oral contraceptive, individual with palpable or visibly enlarged TG, palpable thyroid nodules on physical examination. Exclusion criteria of the study also included previous or current history of thyroid disease or thyroid surgery, pregnancy, lactation and females with history of delivery during the last 12 months as hormonal changes vary TGV. Subjects in whom thyroid nodule, heterogeneity, agenesis or any other anomaly of thyroid gland was discovered during ultrasonography were also omitted from the study.

Ultrasonography of thyroid was performed by single sonologist. Length, width and depth of each lobe of thyroid gland were taken. Volume of TG was calculated by WHO recommended formula: Volume of each lobe (ml) = Length (cm) x Width (cm) x Depth (cm) x 0.479 (0.479 = correction factor) Total volume was the sum of two thyroid lobes. Isthmus dimensions were not included in TGV as approved by W.H.O20. Data was analyzed on SPSS version 21. Means and standard deviations were derived by descriptive stats. Kolmogorov-Smirnov test was applied to check the normality. As the data fulfills the normality assumptions ANOVA was applied to determine the difference of TGV among the different ethnic groups.

RESULTS

Descriptive statistics for mean thyroid gland volumes is shown in Table 1 among the ethnic groups and Table 2 representing the significance in mean thyroid gland volume among the ethnic groups.

Table 1: Descriptive statistics for right Lobe volume, left Lobe volume and total thyroid volume among different ethnic groups.

Ethnicity N=416	Thyroid volumes	Mean ml	Std. Deviation ±	Minimum ml	Maximum ml
Urdu Speaking n=120	Rt.lobe	2.84	1.29	0.717	6.75
	Lt Lobe	2.63	1.159	0.367	7.84
	Total Volume	5.47	2.29	1.153	13.79
Sindhi n=45	Rt lobe	3.36	1.84	0.91	9.51
	Lt lobe	3.08	1.99	1.18	10.65
	TotalVolume	6.44	3.23	2.26	17.25
Pathan n=149	Rt lobe	3.39	1.93	0.96	10.93
	Lt lobe	3.13	1.41	0.403	7.03
	TotalVolume	6.52	3.07	2.18	16.64
Punjabi n=80	Rt lobe	3.71	2.67	0.49	14.55
	Lt lobe	3.31	2.92	0.39	11.29
	TotalVolume	7.02	4.28	1.03	24.75
Hazarah n= 17	Rt lobe	3.76	2.22	1.78	9.20
	Lt lobe	3.29	1.79	1.15	6.75
	TotalVolume	7.05	3.91	3.24	15.8
Baloch n=5	Rt lobe	3.65	2.02	1.41	5.89
	Lt lobe	3.91	2.55	1.33	6.49
	TotalVolume	7.56	4.52	2.74	12.37

Rt lobe=right lobe, Lt lobe=left lobe, mL=milliliters

Table 2: ANOVA analysis determining the significant difference in total thyroid volume, right and left lobe volume among the ethnic groups of Karachi population. * Correlation is significant at the 0.05 .

Thyroid Volumes	P-Value
Right lobe volume	0.049*
Left lobe volume	0.017*
Total Thyroid Volume	0.015*

DISCUSSION

Karachi is largest cosmopolitan city of Pakistan. People from all over the Pakistan reside here^{18, 19}. Objectives of this study were to determine mean TGV among the different ethnic groups in Karachi population and to determine whether the changes in mean TGV among the ethnic groups are significant.

In this study mean TGV varies significantly among the different ethnic groups that exists in Karachi population. Hensen et al. in 2004, while studying the genetics and environmental causes for the variation in TGV among healthy Danish twins reported that genetic factors accounts for 71% of the variations of individual difference in TGV²¹. Teumer et al.

in 2011 in his genome wide association study reported four loci associated with TGV and goiter risk²². Tarnoki AD in 2015 while studying on twins concluded that genetic and environmental factors both are important in controlling TGV²³. We also suggest that variation in TGV among the ethnic groups in our study is probably due to genetic variation.

In this study, smallest mean TGV was found in Urdu speaking population. This is probably due to excessive intake of iodine rich food by this group. Urdu speaking population is the pioneer of urban Karachi population and relishes an easy excess to iodine rich sea food²⁴. National Nutrition Survey (NNS) in 2011 reported adequate iodine intake and no iodine deficiency in urban areas of Pakistan. Urban population of Pakistan is not only aware of the

adverse health outcomes due to the of lack of iodization but uses iodized product as requisite²⁵. However, in the rural areas, intake of iodine was inadequate. According to NNS 2011, rural areas of Punjab and Sindh provinces were the areas of mild to moderate iodine deficiency and the main cause of iodine deficiency was heavy rain fall and flooding, which washed away the iodine from soil²⁵.

The study also reported increased mean TGV in Hazarah and largest mean TGV among Baloch. These areas were previously known as the areas of severe iodine deficiency. International Council for the Control of Iodine Deficiency Disorders (ICCIDD) and National Nutrition Survey (NNS) in 2011 reported that there was severe iodine deficiency in mothers as well as in the school going children of Balochistan, Azaad Jammu and Kashmir and Gilgit and Baltistan²⁵. Adequate knowledge about the use of iodized salt was present but the use of iodized salt was low because of price, availability and adverse propaganda against the use of iodized products. It was also reported that mill owners in those areas fooled people by supplying normal salt in the name of iodized salt²⁵. We suggest, that variations in level of intake of iodine among the ethnic groups may have resulted alteration in their genotype that has ultimately resulted in significant variation in the mean TGV among the ethnic groups.

Unequal sample size and very small sample size especially for Baloch group are the limitations of this study. Large scale future studies with equal sample size from all the provinces of Pakistan would have given more appropriate results and better picture of mean TGV among the ethnic groups of Pakistan.

CONCLUSION

Mean total thyroid gland volumes, right and left lobe volumes were found to be significantly different among the ethnic groups that exist in Karachi population. Long term variations in the level of intake of iodine among the ethnic groups may have resulted alterations in genotype that probably has resulted in significant variation in the mean TGV among the ethnic groups.

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REFERENCES

1. Moore KL, Dalley AF, Agur AM. Clinically oriented anatomy; Lippincott Williams & Wilkins; 2013.

2. Hall JE. Guyton and Hall textbook of medical physiology e-Book: Elsevier Health Sciences; 2015.
3. Moghadam RN, Shajari A, Afkhami-Ardekani M. Influence of physiological factors on thyroid size determined by ultrasound. *Acta Med Iran* 2011;49(5):302-4.
4. Tahir A, Ahidjo A, Yusuph H. Ultrasonic Assessment Of Thyroid Gland Size In Maiduguri, Nigeria. *West Afr J Ultrasound* 2002;3(1).
5. Ying M, Yung DM. Asymmetry of thyroid lobe volume in normal Chinese subjects: association with handedness and position of esophagus. *Anat Rec (Hoboken)* 2009;292(2):169-74.
6. Rasmussen LB, Ovesen L, Bülow I, Jørgensen T, Knudsen N, Laurberg P, et al. Relations between various measures of iodine intake and thyroid volume, thyroid nodularity, and serum thyroglobulin. *Am J Clin Nutri* 2002;76(5):1069-76.
7. Kayastha P, Paudel S, Shrestha D, Ghimire R, Pradhan S. Study of thyroid volume by ultrasonography in clinically euthyroid patients. *J Instit Med* 2010;32(2):36-43.
8. Disorders ICfCoLD. Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers. Geneva: World Health Organization. 2007.
9. De Felice M, Postiglione MP, Di Lauro R. Minireview: thyrotropin receptor signaling in development and differentiation of the thyroid gland: insights from mouse models and human diseases. *Endocrinology* 2004;145(9):4062-7.
10. Panicker V, Wilson S, Spector T, Brown S, Falchi M, Richards J, et al. Heritability of serum TSH, free T4 and free T3 concentrations: a study of a large UK twin cohort. *Clin Endocrinol* 2008;68(4):652-9.
11. Kamran M, NH, MA, FA, FR, NZ, et al. Correlation of Thyroid Gland Volume with Age and Gender in a Subset of Karachi Population. *Pak J Med Dent* 2014;3(2):26-32.
12. Yousef M, Sulieman A, Ahmed B, Abdella A, Eltom K. Local reference ranges of thyroid volume in Sudanese normal subjects using ultrasound. *J Thyroid Res* 2011;1-4.
13. Turcios S, Lence-Anta JJ, Santana J-L, Pereda CM, Velasco M, Chappe M, et al. Thyroid volume and its relation to anthropometric measures in a healthy Cuban population. *Eur Thyroid J* 2015;4(1):55-61.
14. Şahin E, Elboğa U, Kalender E. Regional reference values of thyroid gland volume in Turkish Adults. *Srp Arh Celok Lek* 2015;143(3-4):141-5.
15. Adibi A, Sirous M, Aminoroaya A, Roohi E, Mostafavi M, Fallah Z, et al. Normal values of thyroid gland in Isfahan, an iodine replete area. *J Res Med Sci* 2008;13(2):55-60.
16. Alazigha N, Ugboma E, Nwankwo C, Agi C. Sonographic Measurement Of The Volume Of The Normal Thyroid Gland In Adults In Braithwaite Memorial Specialist Hospital, Port Harcourt. *Nigerian Health J* 2015;15(3).
17. Şeker S, Taş İ. Determination of thyroid volume and its relation with isthmus thickness. *Eur J Gen*

Med 2010;7(2).

18. Yusuf H. Conflict dynamics in Karachi: US Institute of Peace; 2012.

19. Ali Budhani A, Gazdar H, Kaker SA, Bux Mallah H. The Open City: social networks and violence in Karachi. 2010.

20. Organization WH. Assessment of iodine deficiency disorders and monitoring their elimination: a guide for programme managers. 2007.

21. Hansen PS, Brix TH, Bennedbaek FN, Bonnema SJ, Kyvik KO, Hegedüs L. Genetic and environmental causes of individual differences in thyroid size: a study of healthy Danish twins. *J Clin Endocrinol Metabol* 2004;89(5):2071-7.

22. Teumer A, Rawal R, Homuth G, Ernst F, Heier M,

Evert M, et al. Genome-wide association study identifies four genetic loci associated with thyroid volume and goiter risk. *Am J Hum Gene* 2011;88(5):664-73.

23. Tarnoki AD, Tarnoki DL, Speer G, Littvay L, Bata P, Garami Z, et al. Genetic and environmental influence on thyroid gland volume and thickness of thyroid isthmus: a twin study. *Arch Endocrinol Metabol* 2015;59(6):487-94.

24. Verkaaik O. *Cosmopolistan. Gendering Urban Space in the Middle East, South Asia, and Africa*: Springer; 2008. p. 207-28.

25. https://www.unicef.org/pakistan/Annual_Report_2011.pdf.

