To Evaluate the Dimensions of Each Lobe and Total Volume of Thyroid Gland by Ultrasonography Among Pregnant and Non-Pregnant Women in Local Population of Karachi.

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Abstract:

Objective: Objective of the study were to evaluate dimensions of both lobes and calculation of thyroid volume by using ultrasonography (USG) and to compare these parameters between pregnant and non-pregnant in Karachi, Pakistan.

Methodology: It was a clinical cross-sectional study that was conducted at Gynae OPD and Radiology Department, Karachi from October 2016 to December 2018 through consecutive sampling. The study volunteers of reproductive age (14 - 45 years) were included and divided into two groups (pregnant and non-pregnant women). The dimensions of each lobe and calculation of thyroid volume were taken into the account through their standard protocol after following inclusion and exclusion criteria.

Results: The comparisons were made on thyroid gland dimensions, ultrasound outcomes of right and left lobe length, width, depth and volume of thyroid gland. In pregnant women, right lobe length was 2.91 ± 1.05, width was 1.54 ± 0.41 and depth was 2.31 ± 1.41 whereas in non-pregnant women mean right lobe length was 2.50 ± 0.97, width was 1.34 ± 0.51 and depth was 1.68 ± 0.98. The mean difference was considered statistically significant in pregnant women with p-value (< 0.01). In pregnant women thyroid volume was 7.02 ± 3.21 whereas in non-pregnant, it was 5.58 ± 2.41 which was significantly increased in pregnant women with p-value (< 0.01).

Conclusion: Therefore, our study concludes that, in our population at least half of the apparently healthy pregnant females do have some degree of iodine deficiency. The volume of the gland is increased during pregnancy, suggesting iodine deficiency.

Keywords: Pregnant women, thyroid gland, ultrasonography

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Introduction

Thyroid gland is an important endocrine gland in human body[1]. The present perceptive of its anatomical relations, functional status and diseases were exposed by researchers of 17th to 20th centuries[2]. Iodine is a micronutrient, essential for the growth of the thyroid gland which is required for the production of thyroid hormones, tri-iodo-thyronine (T3) and thyroxine or tetra-iodothyronine (T4). These are responsible for body's biochemical processes, normal development, metabolic and neural activity[3]. The thyroid gland becomes distended due to increased size of the gland and obvious during pregnancy due to iodine deficiency, known as pregnancy goitre or iodine deficiency goitre[4].

The thyroid volume is significantly associated with socio-demographic factors (age, height and weight)[5]. Thyroid volume is increased due to lack of iodine and can cause a variety of health and developmental consequences known as Iodine deficiency Disorders (IDD)[6]. When IDD appears in pregnancy, it is related with maternal and foetal hypothyroidism,

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mental impairment, increased neonatal and infant mortality. Ultrasonography (USG) can be used to measure the dimensions of each lobe and calculate the volume of thyroid gland[7].

Thyroid gland plays a vital role all over the pregnancy and can have an effect on health. During pregnancy there is an increased metabolism to meet the demand for energy therefore, increased, thyroid hormones and iodine is required[8]. Determination of thyroid dimensions is important in the diagnosis and management of thyroid disorders and Iodine deficiency disorders (IDD)[9]. According to WHO criteria, the requirement of adequate intake of iodine is about 200 mg iodine/day (range between 200 - 300 mg) in pregnant women for the proper development of foetus[10].

USG is the imaging procedure, which is non-invasive, cost effective and does not require sedation or anesthesia[11]. The WHO has recommended the ultrasound technique in pregnant women, to improve the iodine deficiency goitre. It is also suggested that the USG is the most reliable tool for measuring the size and evaluating the thyroid volume in pregnancy[9].

The size of thyroid gland increases in pregnancy by 20 to 40% in iodine deficient areas because there is increased production of thyroid hormone due to increased requirement by foetus, increased excretion of iodine by kidneys and increased dietary intake of iodine in pregnancy, as developing foetus is utterly dependent on thyroid hormones from mother particularly in first trimester[12].

All the way through pregnancy, the thyroid glands show different degrees of enlargement due to lack of thyroid hormones production, caused by iodine deficiency leading to hypothyroidism[13]. The enlargement of thyroid gland is generally due to dietary iodine deficiency. Therefore, it is important that iodine intake should be increased in pregnancy[14].

The thyroid gland has superficial location in the body. It is an appropriate organ for its size and volume to be measured by USG. To evaluate the glandular size (normal and enlarged), USG is the most accurate technique that provides correct information about dimensions of lobes and volume of the gland[15,16]. The dimensions can be measured as longitudinal or cranio-caudal (length), transverse (width) and anterio-poterior (depth) image and the volume can be calculated by multiplying L, W and D with a WHO-recommended correction factors (0.479).

This study was performed for the awareness of iodine deficiency goitre during the pregnancy because the low levels of iodine based thyroid hormones have a negative impact on both mother and foetus. Unfortunately, many women remain unaware of hypothyroidism until the size of the thyroid gland is increased and become apparent as goitre. So, there was a need to carry out a study to identify pregnant women suffering from thyroid hormone and iodine deficiency to avoid the resultant problems in the foetus.

Patients and Methods

It was a cross- sectional study. In this study both pregnant and non-pregnant women of reproductive aged (14 - 45 years) were included through convenient sampling from October 2016 to December 2018. Patients were recruited from gynae OPD according to inclusion and exclusion criteria. Verbal and written consents, proper history were taken from all included patients. Patients with history of thyroidectomy, ectopic thyroid gland, goitre or any thyroid dysfunction were excluded. Non pregnant (attended gynae OPD for other reasons or who were not having thyroid disease), individuals with clear thyroid ultrasound were included in the study.

These women were shifted to radiology department for thyroid sonography to measure the size of each lobe and volume of thyroid gland. Ultrasound was performed under the supervision of radiologist by GE Voluson S6 using a linear high frequency (7.5 MHz) probe. This procedure took about 15 - 20 minutes. All patients were examined in supine position with their neck hyperextended and pillow under

their shoulder. The cranio-caudal, medio-lateral and antero-posterior diameter of each lobe were noted, that represent the length, depth and width of thyroid gland respectively.

According to WHO-recommended correction factor these measurements were multiplied with (0.479) to calculate the volume. The left and right thyroid lobes dimensions were then summed up to evaluate the total thyroid volume by using formula, V(ml)=0.479 (L×W×D).

The study was approved by the ethical review committee and BASR committee. Open Epi website was used to calculate the sample. All data were recorded by non probability consecutive sampling technique. P-value of <0.05 was considered statistically significant, 99% confidence interval used to calculate the sample size which was 100. All data were analysed by using SPSS version 23. Descriptive statistics were used to analyses the means and standard deviations of thyroid volume among pregnant and non-pregnant. Independent sample t-test was applied to compare dimensions of each lobe and thyroid volume between two groups.

Results

A total number of 100 women were included (50 were pregnant and 50 were non-pregnant). Mean and standard deviation (SD) were calculated in both groups and independent sample t-test was used to compare both groups. All p-values less than 0.05 were considered significant.

Discussion

There are numerous physiological changes that take place in thyroid gland to enhance the thyroid size, volume and thyroid hormones in pregnancy as there is increase in requirement for iodine, energy and to adapt the metabolic and hormonal modifications by the maternal organs[17]. The thyroid gland volume (TGV) is variable between different populations. The variations that occur in thyroid gland are due to iodine deficiency in pregnancy[18]. Since 1987, the inaccurate estimation of thyroid size by inspection and palpation is mainly replaced by determination of TGV by USG[19,20].

In this study, we assessed the changes in size and volume of the thyroid gland in relation to normal pregnancy. We found a significant increase in size of right, left lobe of thyroid gland and total thyroid volume in pregnant as contrast to non-pregnant. The reason for this enlargement is increased TSH levels in response to low thyroid hormones levels which leads to hypertrophy of thyroid follicles and collection of colloids as a result of decreased hormone synthesis may be due to deficient dietary intake of iodine.

Like our findings, a study conducted by K. Suzy A. Rhman Saad in 2018, found significant changes in the size of each lobe of thyroid gland[21]. The thyroid size is not sufficient to be detected by physical examination or by palpation of the gland but should be evaluated by USG[22]. In the same way, a study done in 2015, by Henrietta OC et.al, revealed that there was an increase in thyroid volume during pregnancy that may be develop iodine deficiency goitre[16]. If there is increase in TGV during pregnancy it is well-known as pregnancy goitre. It is essential to know the normal physiological limits of thyroid volume to differentiate it from further thyroid problems[23].

To the best of our knowledge so far, no study determined the dimensions of each lobe and total volume of thyroid gland by using USG among pregnant and non-pregnant in local population.

This study gives the overview of dimensions of each lobe and total volume of thyroid gland among pregnant and non-pregnant in local population. Evaluation of total thyroid volume between both groups in local population would help us to determine the iodine deficiency in pregnant women. It can be prevented by early detection of iodine in urine during pregnancy. The knowledge of thyroid lobes dimensions and volume is essential to be reorganized as these measures are significantly affected by environment, nutrition and lifestyle during pregnancy. This was a cross-sectional study. There

Table 1. Mean Comparison of Right Lobe Length, Width and Depth between Pregnant and Non-Pregnant Women

Parameters	Pregnant	Non-Pregnant	
Right lobe	Mean ± SD	Mean ± SD	p-value
Length	2.91 ± 1.05	2.50 ± 0.97	0.04*
Width	1.54 ± 0.41	1.34 ± 0.51	0.03*
Depth	2.31 ± 1.41	1.68 ± 0.98	0.01*

*p<0.05 was considered significant using Independent Sample t-test.
Left lobe dimensions (length, width and depth):

Figure 1. shows the comparison of right and left lobe dimensions of thyroid gland among two groups. This graph is showing that the length, width and depth of each lobe was significantly increased in pregnant women. Total thyroid volume (TTV) :

In pregnant women, the mean left lobe length was 3.14 ± 0.93, width was 1.50 ± 0.35 and depth was 2.27 ± 1.37 whereas in non pregnant women the mean left lobe length was 2.58 ± 0.85, width was 1.28 ± 0.28 and depth was 1.65 ± 0.98. The mean difference was considered statistically significant with p-value <0.05 as shown in Table 2 and Figure 1. represents the mean and standard deviations of left lobe dimensions among pregnant and non pregnant in local population, Karachi. Length, width and depth were found significantly increased in pregnant women with p-value < 0.05.

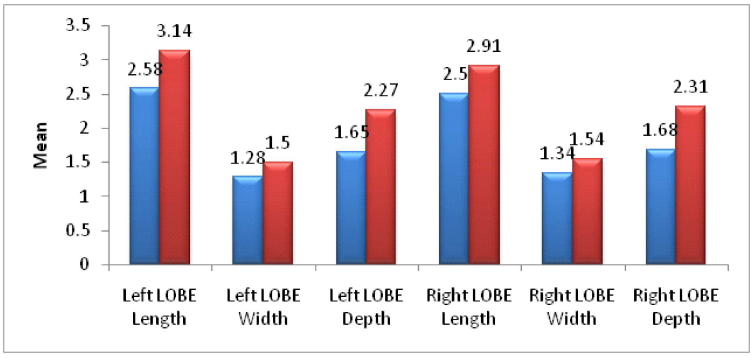

Fig 1. Mean comparison of right and left lobes dimensions between pregnant and non pregnant women

Table 2. Mean Comparison of Left Lobe Length, Width and Depth between Pregnant and Non Pregnant Women

Parameters	Pregnant	Non-Pregnant	
Right lobe	Mean ± SD	Mean ± SD	p-value
Length	3.14 ± 0.93	2.58 ± 0.85	0.01*
Width	1.50 ± 0.35	1.28 ± 0.28	0.01*
Depth	2.27 ±1.37	1.65 ± 0.98	0.01*

*p<0.05 was considered significant using Independent Sample t-test

In pregnant women, mean total thyroid volume was 7.02 ± 3.21 whereas in non pregnant women, it was 5.58 ± 2.41. The mean difference was considered statistically significant with p-value 0.01 as shown in table Table 3 and figure Fig 2.

Table 3. Mean comparison of TTV between Pregnant and Non-Pregnant Women

Parameters	Pregnant	Non-Pregnant	
Total thyroid volume	Mean ± SD	Mean ± SD	p-value
	7.02 ± 3.21	5.58 ± 2.41	0.01*

Figure 2. .Shows the comparison Comparison of Total Thyroid Volume which was significantly increased in pregnant women with p-value 0.01* increased in pregnant women with p-value 0.01*.

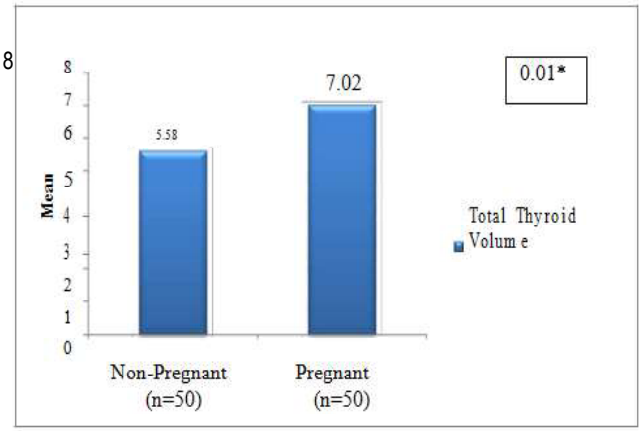

Fig 2. Comparison of Total Thyroid Volume which was significantly increased in pregnant women with p-value 0.01*

was a problem in recruiting elder and obese ladies as control. We have included only those women who had normal thyroid scan and did not have any thyroid disorder. Objectives of this study were to evaluate the dimensions of each lobe and volume of thyroid gland by using USG among pregnant and non-pregnant women that exist in Karachi, Pakistan and to determine whether these measurements vary significantly among both groups.

Researchers have exposed that iodine deficiency in pregnancy may result in poor maternal and neonatal outcomes. It may lead to spontaneous abortions, congenital anomalies, low birth weight, placental abnormalities in pregnancy and goitre, impaired mental function, low IQ and stunted growth in childhood[24].

Conclusion

According to the study results, we conclude that there was a significant variation in mean TTV among pregnant women. This may be the result of deficient intake of dietary iodine during pregnancy in our population. These women and their foetuses are at risk of maternal and fetal hypothyroidism. Gynaecologists or clinicians who care for pregnant females are advised to recommend adequate dietary iodine intake and this essential micronutrient during preconception and pregnancy. Thyroid profile must be assessed carefully of all pregnant females at their antenatal visits to prevent the irreversible pregnancy outcomes in the early stage of foetal development.

Conflict of Interests

Authors have no conflict of interests and received no grant/funding from any organization.

References

1. Lin Z, Yang Z, He B, Wang D, Gao X, Tam SY et al. Pattern of radiation-induced thyroid gland changes in nasopharyngeal carcinoma patients in 48 months after radiotherapy. PloS one 2018 Jul 9;13:e0200310[doi:10.1371/journal.pone.0200310]

2. Konig F, Andersson M, Hotz K, Aeberli I, Zimmermann MB. Ten repeat collections for urinary iodine from spot samples or 24-hour samples are needed to reliably estimate individual iodine status in women. J Nutr 2011;141:2049-54. [doi: 10.3945/jn.111.14407]

3. Delshad.H. Iodine nutrition in pregnancy [Online]. An Thyroid 2018 ;3:20. Available from: https://aot.amegroups.com/article/view/4448/5384#:~:text=Adequate%20iodine%20nutrition%20during%20pregnancy,and%20lactation%20need%20iodine%20prophylaxis. Accessed on 11th March 2021.

4. WangZ, Mingluan X, Wenming Z, Guangming M, Zhe M, Wang Y et al. Iodine Deficiency in Zhejiang Pregnant Women in the Context of Universal Salt Iodization Programme. Sci Rep 2018; 8:8835.[doi: 10.1038/s41598-018-26942-z]

5. Yetubie M, Haidar J, Kassa H, Fallon F. Socioeconomic and demographic factors affecting body mass index of adolescents students aged 10-19 in Ethiopia. Int J Biomed Sci 2010;6:321.

6. Kandhro GA, Kazi TG, Uddin S, Kazi N, Afridi HI, Arain MB, et al. Evaluation of the Iodine Concentration in Serum and Urine of Hypothyroid Males Using an Inexpensive and Rapid Method [Online]. Pakistan Journal of Analytical & Environmental Chemistry 2009;10:9. Available from: http://www.pjaec.pk/index.php/pjaec/article/view/24. Accessed on: 11th March 2021.

7. Ahmed RG. Hypothyroidism and brain development [Online]. J Anim res nutr 2017;2:13. Available from: https://animalnutrition.imedpub.com/hypothyroidism-and-brain-development.pdf. Accessed on: 11th March 2021.

8. Stagnaro. Green A, Abalovich M, Alexander E, Fereidoun A, Mestman J, Negro R, et al. Guidelines of the American Thyroid Association for the diagnosis and management of thyroid disease during pregnancy and postpartum. Thyroid 2011; 21: 1081-1125. [doi: 10.1089/thy.2011.0087]

9. Untoro J, Mangasaryan N , de Benoist B, Darnton-Hill I. Reaching optimal iodine nutrition in pregnant and lactating women and young children: programmatic recommendations. Public Health Nutr 2007;10:1527-1529. [doi: 10.1017/s1368980007705360]

10. Abel MH, Korevaar TIM, Erlund I, Villanger GD, Caspersen IH, Arohonka P, et al. Iodine Intake is Associated with Thyroid Function in Mild to Moderately Iodine Deficient Pregnant Women. Thyroid. 2018;28:1359-1371. [doi: 10.1089/thy.2018.0305]

11. Gyamfi D, Wiafe YA, Danquah KO, Adankwah E, Amissah GA, Odame A. Urinary iodine concentration and thyroid volume of pregnant women attending antenatal care in two selected hospitals in Ashanti Region, Ghana: a comparative cross-sectional study. BMC Pregnancy Childbirth. 2018;18:166. [doi: 10.1186/s12884-018-1820-3]

12. Armstrong M, Asuka E, Fingeret A. Physiology, Thyroid Function. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021. Available from:https://www.ncbi.nlm.nih.gov/books/NBK537039/. Accessed on: 11th March 2021.

13. Sahay RK, Nagesh VS. Hypothyroidism in pregnancy. Indian J Endocrinol Metab 2012;16:364. [doi: 10.4103/2230-8210.95667]

14. Smith A, Eccles-Smith J, D'Emden M, Lust K. Thyroid disorders in pregnancy and postpartum. Aust Prescr 2017;40:214. [doi: 10.18773/austprescr.2017.075]

15. Parkkunam.J, Thiagarajan B. Role of ultrasound in thyroid disorders [Online]. Online Journal of Otolaryngology 2015;36:710-714. Available from: https://www.alliedacademies.org/articles/role-of-ultrasound-in-thyroid-disorders.pdf. Accessed on: 11th March 2021.

16. Henrietta OC, Anthony CU, Thomas A. Thyroid volume by ultrasound in asymptomatic gravid and non-gravid controls in a negroid population in Nigeria [Online]. Journal of Experimental and Clinical Anatomy 2015;14:116. Available from: https://www.jecajournal.org/article.asp?issn=1596-2393;year=2015;volume=14;issue=2;spage=116;epage=119;aulast=Henrietta. Accessed on: 11th March 2021.

17. Berghout, A. and W. Wiersinga. Thyroid size and thyroid function during pregnancy: an analysis. Eur J Endocrinol 1998;138:536-542.[doi: 10.1530/eje.0.1380536.]

18. Muktyaz H, Birendra Y, Dhiraj S, Arun SK. Anatomical variations of thyroid gland and its clinical significance in North Indian population [Online]. Global J Biol Agric Health Sciences 2013;2:12-6. Available from:https://www.longdom.org/articles/anatomical-variations-of-thyroid-gland-and-its-clinical-significance-in-north-indian-population.pdf. Accessed on: 11th March 2021.

19. Thilly, C.H., F. Delange, and J.B. Stanbury. Epidemiologic surveys in endemic goitre and cretinism. 1980: 157-179.

20. Smyth PP. Variation in iodine handling during normal pregnancy. Thyroid 1999;9:637-42. [doi: 10.1089/thy.1999.9.637]

21. Saad SK. Variations in Thyroid Diameters during Normal Pregnancy. 2017-2018.

22. Gyamfi D, Wiafe YA, Danquah KO, Adankwah E, Amissah GA, OdameA.Urinary iodine concentration and thyroid volume of pregnant women attending antenatal care in two selected hospitals in Ashanti Region, Ghana: a comparative cross-sectional study. BMC pregnancy and childbirth 2018;18:166.[doi: 10.1186/s12884-018-1820-3]

23. Brander, A. and L. Kivisaari. Ultrasonography of the thyroid during pregnancy. J Clin Ultrasound 1989;17: 403-406. [doi: 10.1002/jcu.1870170604]

24. Fereja M, Gebremedhin S, Gebreegziabher T, Girma M, Stoecker BJ. Prevalence of iodine deficiency and associated factors among pregnant women in Ethiopia. BMC pregnancy and childbirth 2018;18:257. [doi: 10.1186/s12884-018-1905-z]