ORIGINAL ARTICLE

Assessment of Thyroid Gland Enlargement Through Clinical Grading and its Correlation with Ultrasonographic Thyroid Volume among Pregnant and Non-Pregnant Women in Local Population in Karachi

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ABSTRACT

Objectives: The aims of this study were to evaluate thyroid gland enlargement using clinical grading methods in both groups, measure thyroid volume through ultrasonography, and determine the correlation between clinical grading and ultrasonographic thyroid volume.

Methodology: This cross sectional study was conducted at the Gynea OPD, Ojha campus, DIMC, DUHS, Karachi from June 2018-May 2020 through consecutive sampling and separated into two groups, Pregnant and Non Pregnant women. The gross examination of thyroid gland was performed and this examination purpose to evaluate the size of thyroid lobes through standard methods of inspection and palpation. The Thyroid volume was measured by ultrasound and then calculated by WHO co-factor V (ml) =0.479*L*W*D by applying inclusion / exclusion standard.

Results: The examination were made on thyroid grading with correlation of total thyroid volume (TTV) among pregnant and non-pregnant women. Thyroid gland was examined by inspection and palpation. The grading (from 0-2) of enlargement of gland was done. 50 pregnant women were examined among which 34 (68%) were found to have Grade 1 while 16 (32%) had no thyroid enlargement (means neither visible nor palpable). On the other hand, in the non-pregnant group, not even a single enlargement was observed. The mean difference was considered significant in pregnant women with p-value (< 0.01). In non-pregnant women, mean TTV was 5.58±2.41, where as in pregnant women, it was 7.02±3.21, which was significantly increased in pregnant women with p-value 0.01*.

Conclusion: The study proposed that physical clinical examination of thyroid gland is a valuable method, and it also finds that even pregnant women who looks healthy in this population may still have some degree of iodine deficiency. The volume of the thyroid gland is enhanced during pregnancy, suggesting an iodine deficiency. A combined approach (clinical + imaging) is recommended for accurate diagnosis in antenatal care.

Keywords: Non pregnant women, pregnant women, thyroid gland, usg imaging

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INTRODUCTION

The thyroid gland is placed superficially in the center of the neck, around the larynx and trachea. It consists of two symmetrical lobes, right and left that are attached by isthmus and located anterior to the second and third tracheal rings. The gland is fixed in place due to its encapsulation within the pretracheal fascia and its attachment to adjacent structures, including the cricoid cartilage and the upper tracheal rings, via the suspensory ligament of Berry[1]. The thyroid gland is modulated by under control of hypothalamic–pituitary-thyroid axis. The hypothalamus secretes thyrotropin releasing hormone (TRH) which act on pituitary gland to activate thyroid stimulating hormone (TSH). The TSH release the thyroid hormone (T3) and (T4). These iodine containing hormones are vital for regular growth and metabolic function. The basic role of gland is to synthesize, store and secretes this two iodine based hormone. The sufficient dietary iodine uptake is required for this process, as iodine is a key component of both T3 and T4.

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Thyroid hormones play a pivotal role in both prenatal and postnatal life, supporting normal physical growth and neurological development during intrauterine life as well as after birth. Once secreted into the bloodstream, thyroid hormones function as chemical messengers that reach in all tissues and organs of the body.

They regulate the metabolism of fats, proteins and carbohydrates at the cellular level. By influencing metabolic rate, oxygen consumption, and energy production, thyroid hormones ensure the proper functioning of cells and support overall homeostasis throughout the body[2]. Iodine is a substance, necessary for the thyroid hormones production.

These hormones play critical role in body's biochemical processes. The thyroid gland becomes enlarged and apparent in pregnancy due to iodine insufficiency, known as pregnancy iodine deficiency goiter or Iodine deficiency Diseases (IDD). The IDD are popular in Pakistan and about 70% of population are at risk of it. A study disclosed that the prevalence of IDD in pregnant women is about 79.8% in Pakistan[3]. When IDD occurs in pregnancy, it is referring to maternal and fetal hypothyroidism, mental disability, increased neonatal and infant fatality rate[4].

The thyroid glands show several level of enlargement due to deficiency of thyroid hormones production and iodine, leading to hypothyroidism[5]. The large size of thyroid gland is mostly due to dietary iodine inadequacy and if it occurs during pregnancy, it may cause harmful effect in the growing fetus. Hence, it is essential that the consumption of iodine should be enhanced in pregnancy[6]. For this reason, adequate iodine intake is required according to WHO criteria and ICCIDD has recommended the dose of 200 mcg iodine/day (range between 200-300 mcg) in pregnant women for the fetal evolution[7]. USG is the imaging technique that provides accurate information and the most specific method for measuring the thyroid volume[8].The thyroid gland is an appropriate organ for the examination with USG due to its superficial location in the body.

The determination of thyroid volume during pregnancy is evidential in the diagnosing and controlling of thyroid condition and iodine deficiency disorders (IDD)[9]. It can be explored through with physical examination by assessing the grading of thyroid enlargement and by ultrasonography to measure the thyroid volume[10]. Hence, to evaluate the grading of gland and to measure the thyroid volume by USG among two groups, to avoid harmful consequences in the fetus.

Thyroid gland enlargement can be accessed via different methods, each method important for diagnosis. Physical examination for grading involves inspection and palpation, classifying the thyroid into grades based on visibility and feel. It is easy, ready and cost-effective, making it helpful for screening. When thyroid volume is assessed by clinical grading, it provide only an approximate estimate. Although easygoing to use and widely available, clinical grading is less accurate and is usually confirmed by ultrasound for a precise assessment.

Thyroid enlargement is common clinical finding and is usually evaluated through physical examination. In regions like Karachi, where iodine deficiency still persists, thyroid disorders may be more prevalent, especially in pregnant women due to increased physiological requirement. Pregnant women are more assailable to thyroid changes due to high hormonal and metabolic demands. These changes can modify thyroid size and function, making accurate assessment important for both maternal and fetal health. Although Ultrasonography is a reliable procedure for measuring thyroid volume, its availability may be limited in many healthcare settings. Therefore, It is important to see how closely the results of clinical examination match those of ultrasound. The study purpose is to find out how consistent the physical examination is and whether it can be used as a easy and useful screening procedure rather of ultrasound in the local population.

METHODOLOGY

ERC/IRB Approval: This study was conducted after approval of Institutional Review and Ethics Board (IREB) from DIMC, DUHS, 2018 with Ref No. IRB-1064/DUHS/Approval/2018/82.

This cross-sectional study was done in two years, from June 2018-May 2020, at the Gynea department during antenatal checkup and the Radiology Department, Ojha campus, Dow university of health sciences (DUHS), Karachi through consecutive sampling. The total sample size of 100 women was calculated by using OpenEpi software and divided into two groups (A and B). Among the recruits, 50 were pregnant women (in the first and second trimesters) and 50 were non-pregnant controls of reproductive age (14–45 years)y. Non-pregnant women who visited the gynecology OPD for other reasons and those women whose thyroid gland was clearly visible on ultrasonography were included in the study. Participants with a history of thyroidectomy, Verbal Informed consent was taken from each participants. The basic clinical assessment implicated, gross examination of thyroid gland, which was performed in the Gynae OPD by trained healthcare professionals. This examination purpose to evaluate the size of thyroid lobes through standard methods of inspection and palpation. The palpation of thyroid gland was done in seated position with slightly extended

neck and movements of the gland were noted during deglutition. The enlargement of gland was classified by using the World Health Organization (WHO) grading system, which provide a standard approach for assessing goiter:

- **Grade 0**: No goiter is present; the thyroid gland is neither palpable nor visible upon clinical examination.
- **Grade 1**: The thyroid gland is enlarged and palpable but not visibly enlarged; it moves up and down during the act of deglutition (swallowing).
- **Grade 2**: The thyroid gland is both palpable and visibly enlarged, seen prominently in the middle of the neck region.

This clinical grading provided an essential baseline for correlating physical findings with ultra-sonographic measurements of total thyroid volume (TTV), conducted subsequently in the Radiology Department. The Ultrasonography of thyroid gland was carried out under the supervising of a highly experienced radiologist. The imaging method were concluded by using linear probe at a frequency of 7.5 MHz via GE Voluson S6 ultrasound machine, at Radiology department. The each lobe of thyroid gland was examined in two planes, transverse and longitudinal. The dimensions (length, width, and depth) of both the right and left thyroid lobes were carefully measured. The Total thyroid volume (TTV) was then calculated via the ellipsoid formula for each lobe and summed accordingly. The isthmus was not included in the volume calculation. To evaluate the volume of each lobe, the WHO-recommended formula was applied, V (ml) = 0.479 × L × W × D (L= length, W= width D= depth). This correction factor (0.479) provides a standardized technique for calculating thyroid volume. The volume of each lobe were sum up to calculate the Total Thyroid Volume (TTV) for each participants.

RESULTS

Thyroid gland was examined by inspection and palpation in both groups. Among non-pregnant women (n=50), all participants (100%) had Grade 0 thyroid enlargement, indicating no detectable goiter on clinical examination. In contrast, among pregnant women (n=50), only 16 (32%) had Grade 0, while the majority, 34 (68%), had Grade 1 enlargement, suggesting mild thyroid swelling detectable on palpation but not visible. None of the participants in either group showed Grade 2 enlargement. A p-value of < 0.05 was considered statistically significant in both groups. These findings show that thyroid enlargement was found in pregnant women, as shown in figure I.

The comparison of total thyroid volume (TTV) between the two groups showed that pregnant women had a higher mean TTV (7.02 ± 3.21) compared to non-pregnant controls (5.58 ± 2.41). This difference was statistically significant (p=0.01), indicating that thyroid volume is significantly increased in pregnant women compared to non-pregnant women as shown in figure II.

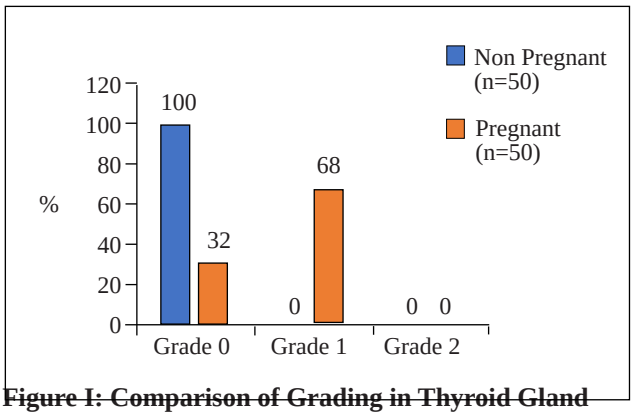

Figure I: Comparison of Grading in Thyroid Gland Enlargement Between Two Groups

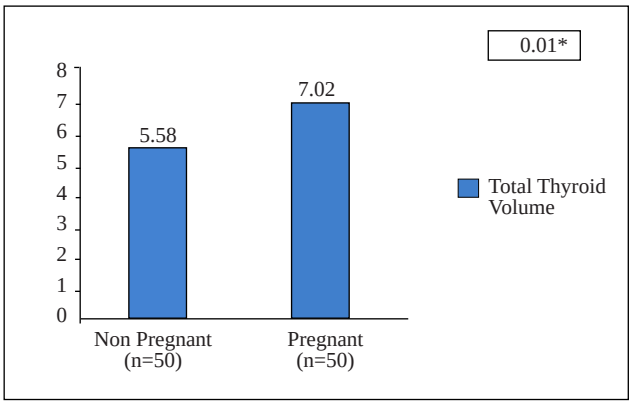

Figure II: Comparison of Total Thyroid Volume Between Pregnant and Non Pregnant Women

DISCUSSION

It has been generally known that the recognized stimulators of thyroid gland secretions in pregnancy are TSH, hCG and iodine. There are various physiological alteration that happen in thyroid gland to increase the thyroid size, volume and thyroid hormones in pregnancy as there is addition need for iodine and energy to meet the metabolic and hormonal modifications by the maternal organs[11]. The thyroid gland volume (TGV) is adjustable among several populations. The variations that occur in thyroid gland are because of iodine deficiency in pregnancy[12]. After 2023, the inappropriate calculation of thyroid size by inspection and palpation is primarily replaced by determination of TGV by USG[13].

USG is the first line imaging modality for the determination of thyroid size and calculation of thyroid volume. If there is decrease iodine for the synthesis of thyroid hormones, most likely it increases the risk of

maternal thyroid hypo function in the iodine-deficient women. However, even in iodine sufficiency, there are some reports on thyroid enlargement throughout pregnancy[14]. The iodine status is a universal health concern, mainly in underdeveloped countries and importance should be given to diagnosis at the community level due to the advanced effect on fetal neurological development and pregnancy outcomes. Thyroid gland need iodine and amino acid tyrosine to make thyroid hormones, which keep the level of metabolism in the tissues that is optimal for their regular function[15].

The thyroid hormones T3 and T4 has an essential role in regulating the physiological processes. During intrauterine life, insufficient levels of thyroid hormone due to maternal iodine deficiency can lead to serious consequences such as cretinism, low birth weight, and developmental delays.

After birth, thyroid hormones continue to influence metabolism, energy production, and overall homeostasis. These hormones function as chemical messengers, carried via the bloodstream to target cells throughout the body. They regulate the metabolic activity of nearly all cells, influencing basal metabolic rate, protein synthesis, lipid metabolism, and carbohydrate utilization. By enhancing mitochondrial activity and oxygen consumption, thyroid hormones ensure that the cells meet their energy needs efficiently. Furthermore, they contribute to cardiovascular health, gastrointestinal motility, reproductive function, and thermoregulation[16]. In our study, the grading of thyroid gland on gross examination showed no enlargement of gland in non-pregnant women (grade-0). While enlargement was observed in pregnant women which showed 68% of females having enlargement (grade-1) and 32% of which showed no enlargement (grade-0). We found increased size in pregnancy due to increase demand of thyroid hormones which utilizes iodine for its synthesis. This may be the reason of enlargement of thyroid gland. A study done on thyroid gland enlargement in 2019, observed that pregnant women had 70% visible and palpable enlargement of the thyroid gland[17]. In 2022, conducted a study on enlargement of thyroid gland (goiter) by inspection and palpation in pregnancy. They found 23% enlargement of thyroid gland in pregnant women and 19% in controls[18]. In 2024, a study done on thyroid gland enlargement by inspection and palpation. They observed 70% enlargement of thyroid gland in pregnant and 38% in controls[19]. In the present study, we evaluated the changes in thyroid volume in corresponding to normal pregnancy.

We also found a significant increase in TTV in pregnant group than controls. Corresponding to our findings, a study done by Ollero MD, Toni M, in 2019, found significant changes in the size of thyroid lobes[20,21]. The thyroid size is not sufficient to be noticed by physical examination or by palpation of the gland but should be assessed by USG.

Similarly, a study done in 2023, reported increase in thyroid gland volume in asymptomatic pregnant women that might develop iodine deficiency goiter. They also found a change in thyroid volume among pregnant and non-pregnant controls due to dietary iodine insufficiency during pregnancy[22].

The study was conducted on enlargement of thyroid gland by inspection and palpation in pregnancy. We found 23% enlargement of thyroid gland in pregnant women and 19% in controls[23]. So, Gynecologist must perform thyroid examination to evaluate thyroid grading during pregnancy to prevent maternal from adverse consequences. The research is also done on the thyroid volume to assess the iodine levels in pregnancy to prevent them from adverse mental and fetal consequences.

Numerous studies have established that iodine deficiency in pregnancy is related to harmful maternal and neonatal consequences. Inadequate iodine levels can contribute to complications such as spontaneous abortions, congenital anomalies, low birth weight, impaired cognitive development in the fetus, and placental abnormalities. These consequences highlight the critical importance of ensuring adequate iodine intake during pregnancy for both maternal health and fetal development[24,25].

To the best of our knowledge, there was no research conducted to examined the clinical grading of thyroid gland enlargement in correlation with total thyroid volume (TTV) as measured by ultrasonography (USG) in both groups, in our local population. By valuating and comparing total thyroid volume in both women groups, this research contributes valuable vision into the prevalence of iodine deficiency among pregnant women. The findings may help in distinguishing at-risk populations and investigate the routine thyroid evaluation and iodine supplementation for the antenatal care to prevent health complications related to thyroid diseases.

CONCLUSION

The authors advocate for increased awareness among healthcare providers, particularly gynecologists involved in antenatal care, to recognize the risks associated with iodine deficiency. As a preventive strategy, they recommend that iodine sufficiency be ensured not only during pregnancy but also in the preconception phase, to mitigate the risk of thyroid gland hypertrophy and associated maternal- fetal complications. The study concludes that thyroid gland enlargement is more common in pregnant women compared to non-pregnant women. Pregnant women also showed a significantly

higher total thyroid volume (TTV) than non-pregnant controls, indicating that clinical examination remains a useful screening tool. However, ultrasonography provides a more accurate and objective assessment and should be used for confirmation when available.

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Authors' Contribution: **HA** conceived the study, prepared the manuscript, and handled correspondence. **SF** and **FN** provided guidance and reviewed the manuscript. **AA, TS, ZA**, and **HJ** performed the in vitro quality tests and contributed to data collection. All authors reviewed and approved the final manuscript.

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