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COMPARATIVE ANALYSIS OF TESTOSTERONE HORMONE LEVELS IN NORMAL AND THYROID PATIENTS IN DISTRICT PESHAWAR

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Abstract
This study aimed to investigate the correlation between serum testosterone levels and thyroid hormones, considering various demographic characteristics of the participants. The research protocols were reviewed and approved by the Research Ethics Committee at Islamia College Peshawar. The study was conducted at the Endocrinology Departments of Hayatabad Medical Complex (HMC) and Khyber Teaching Hospital (KTH) in Peshawar, Pakistan. Blood samples were collected, and serum testosterone levels were quantitatively analyzed using a human testosterone hormone ELISA. The results revealed a higher prevalence of thyroid disorders among women compared to men (80% vs. 20%). However, significant variations in testosterone levels were associated with thyroid disorders. Our findings suggest that thyroid disease is more prevalent among females in Peshawar, possibly influenced by factors such as lactation and breastfeeding.

Keywords: Subclinical Hypothyroidism (SCH 1), Subclinical Hyperthyroidism (SCH 2), Auto Immune Thyroid Disease, Testosterone Levels.

1.0. Introduction

In the realm of endocrinology, the interplay between various hormones often reveals intricate connections within the human body. Among these, testosterone, a key hormone predominantly associated with male reproductive health, manifests its influence not only in the realm of fertility but also in broader physiological functions (Dirlikov et al., 2019). The thyroid gland plays a crucial role in hormonal regulation by secreting two primary hormones: Triiodothyronine (T3) and Thyroxin (T4). T3 constitutes approximately 7% while T4 constitutes the remaining 93% of the total thyroid hormone secretion (Roef et al., 2014). The active form of both hormones is their free form, with free T3 (FT3) exhibiting greater activity compared to free T4 (FT4). FT4 plays a pivotal role in regulating

thyroid secretion, while both FT3 and FT4 serve as indicators of an individual's thyroid health (Wejaphikul et al., 2019). These hormones intricately contribute to the body's growth and metabolism. Consequently, in the absence of thyroid hormones, metabolic functions decline, leading to a reduction in Basal Metabolic Rate (BMR), often falling to 50% below the normal range.
These hormones circulate in the bloodstream in both free and bound forms. The majority, accounting for about 99%, exist in bound forms, with thyroid-binding globulin as the principal carrier for T3 and T4. Additionally, a smaller portion is transported by transthyretin and albumin (Kasper et al., 2015; Silva et al., 2018). It is continually expanding globally but rising quickly in Asia. Various factors such as health status, nutrition, age, gender, body weight, and climate, including disease conditions, influence the production of T3 and T4. Thyroid Stimulating Hormone (TSH), also known as thyrotropin, is released from the anterior pituitary gland. It regulates the thyroid gland's production of T3 and T4 through a negative feedback mechanism. A positive feedback mechanism regulates TSH by Thyroid Releasing Hormone (TRH) from the hypothalamus (Silva et al., 2018).
Thyroid disease stands as one of the most prevalent endocrine disorders globally, affecting nearly 300 million individuals, with a staggering proportion, supposedly more than half, unaware of their condition. Hyperthyroidism and hypothyroidism emerge as significant thyroid disorders, exerting a profound impact across more than 110 countries worldwide (Yadav et al., 2013). Hyperthyroidism is characterized by elevated secretion of T3 and T4, accompanied by an increased T3 ratio and a reduced thyrotropin level. The pathogenesis typically involves damage to thyrocytes, leading to the release of T3 and T4 at supraphysiological levels, or aberrant synthesis of these hormones through a non-destructive process. Variations in thyroid hormone levels have been noted across different genders. Asian women, often engaged in numerous activities and bearing significant domestic responsibilities, may experience unique impacts on their thyroid function (Rakov et al., 2016). Hence, malnutrition is more prevalent among economically disadvantaged and less educated women and their children, placing them at a higher risk of developing conditions such as goitre, anaemia, and other disorders. Additionally, a decrease in thyroid hormone concentration with age is observed in both sexes, with women experiencing greater deprivation of thyroid hormones compared to men. Furthermore, seasonal variations in T3, T4, and TSH levels have been noted, with higher levels of T3 and T4 during autumn and winter compared to spring and summer (Fox et al., 2019).

Abnormalities in receptor genes of the nuclear thyroid hormone cause thyroid hormone resistance, which is unusual and it is the only abnormal condition for which the thyrotropin level is not inhibited. Hypothyroidism incidents were more (2% of 2800) participants reported. The average diagnostic age was 57 years as well as the dysfunction was 10 times greater in females as compared to male. The dysfunction is primarily prevalent in Women over 40 years of age (Helfand & Crapo, 1990).

The prevalence of hyperthyroidism in the general population is lower (2.2%) as compared with hypothyroidism. The severity of mild hyperthyroidism is also noted to be more incident in iodine-deficient areas than “iodine-sufficient areas, and its frequency decreases after the supply of universal salt by salt iodization programs. The overall incidence of hyperthyroidism is calculated to be 2.7% in females while in males 0.7% (Vanderpump, 2011). Hypothyroidism may occur when serum testosterone” (T), sex hormone binding globulin (SHBG) as well and gonadotropin levels drop, especially FSH and LH (Krassas & Perros, 2003).

This research aims to perform a Comparative Analysis of Testosterone Hormone Levels between individuals with normal thyroid function and those diagnosed with thyroid disorders in District Peshawar. Additionally, the study examined variations in thyroid profile regarding age, gender, and seasonal factors among adults with normal thyroid function. The objective is to deliver clinicians with robust data, enabling them to incorporate these factors into their interpretation of thyroid profiling effectively.

2.0. Materials and Methods

2.1. Research Study Area

Blood samples and details were taken from patients who attended Hayatabad Medical Complex (HMC) and Khyber Teaching Hospital (KTH) Endocrinology Departments Peshawar, Pakistan. This research included patients belonging to various areas of Peshawar.

2.2. Ethical Considerations

The Research Ethics Committee at the Islamia College Peshawar (ICP) reviewed the research protocols and accepted these. Verbal and written details about the objectives and design of the study were given to the participants. It met the requirements corresponding to informed consent and secrecy.

2.3. Sample Collection

The subjects of the study were categorized into three groups: control, hyperthyroid, hypothyroid, subclinical hypothyroid, and subclinical hyperthyroid. A total of 83 individuals were observed out of which 50 with thyroid disorders. While 33 individuals were normal (control). Individuals from various regions of District Peshawar were considered for inclusion in the study. Both male and female patients aged between 20 and 70 years were included. People with chronic complications such as heart problems, diabetes mellitus (DM), and depression have been removed. Thyroidectomy cases and Patients taking thyroxine were also excluded from this analysis. Blood samples were collected, and the serum samples were stored at -80°C before being analyzed at the Institute of Basic Medical Sciences (IBMS), Khyber Medical University (KMU).

2.4. Questionnaire

The questionnaire underwent development and scrutiny by field experts. Its components encompassed demographic details (such as gender, and age), location information, medical history (including thyroid issues, duration of treatment, T3, T4, and diabetes levels), and family medical background. To gather data, interviews were conducted with patients at the Endocrinology Departments of Hayatabad Medical Complex (HMC) and Khyber Teaching Hospital (KTH) in District Peshawar.

2.5. Physical examination

Subjects underwent evaluation using standardized procedures. Based on the given criteria, the physical examination comprised an assessment of the throat for the presence of goiter, whether nodular or diffuse.

2.6. Diagnosis Criteria

The serum thyroid function tests were reviewed and record during taking patients history. For Thyroid stimulating hormone (TSH), 0.2-4.0uIU/ml was considered as Reference value. While for the determination of free thyroxin (fT4) and free Triiodothyronine (FT3) level, 11.5-22.3 pmol/L and 2.5-5.8 pmol/L were used for reference values respectively. The condition having elevated TSH and low T4 was defined as overt hypothyroidism, normal T4, and elevated thyroid stimulating hormone as in subclinical hypothyroidism, overt hypothyroidism having elevated T4 and low TSH while low TSH and normal T4 as in subclinical hyperthyroidism (Bayer et al., 1985).

2.7. Serum Testosterone Analysis using Enzyme-linked Immunosorbent Assay (ELISA)

The selected. cases. were. examined. for the analysis of testosterone levels by using Enzyme link immunosorbent assay (ELISA). Working agents of testosterone-horseradish peroxidase (HRP) conjugate were prepared. The microtiter well filled appropriately with 10 micro litter of case and control serum. Then 100 µl of Testosterone-HRP conjugate solution was added to the wells properly. Incubated at 37°C for 90 minutes in a plate shaker at 200 rpm. Then rinsed the microtiter well by

using 300 µl of wash buffer. Poured 150 µl of 3,3,5,5 Tetra-methyl-benzidine (TMB); fluorescence reagent per well, Stirred gently for 5 seconds. The plate of the microtiter wells was incubated in a plate shaker for 20 minutes at room temperature. Finally, the reaction was stopped by applying 100 µl of Stop Solution (H_2SO_4) to each well. It was mixed carefully for 30 seconds. It is necessary to ensure that all the blue colours are converted to yellow. Within 15 minutes, the microtiter well reader displayed absorbance at 450 nm (Shrivastav et al., 2003).

A microtiter well reader expressed the absorbance or optical densities of the samples. The concentration of samples was calculated by the following formula.

X= OD of samples/ OD of standard

Where (X) is the concentration of the sample in ng/dL, (n) is the amount taken as standard, and (OD) stands for optical density.

2.8. Statistical Analysis:

The initial data entry was conducted using MS Database version 2007, followed by thorough cleansing and correction using advanced formulas in MS Excel. Subsequently, the data intended for statistical analysis were imported into IBM SPSS version 22. Frequency distributions and mean values ± standard deviation was computed to assess various parameters. The latest versions of these software systems were utilized for generating graphs and tables for data interpretation. Mean values along with standard deviations (Mean ± SD) were presented to facilitate comparison of the variance between the two means.

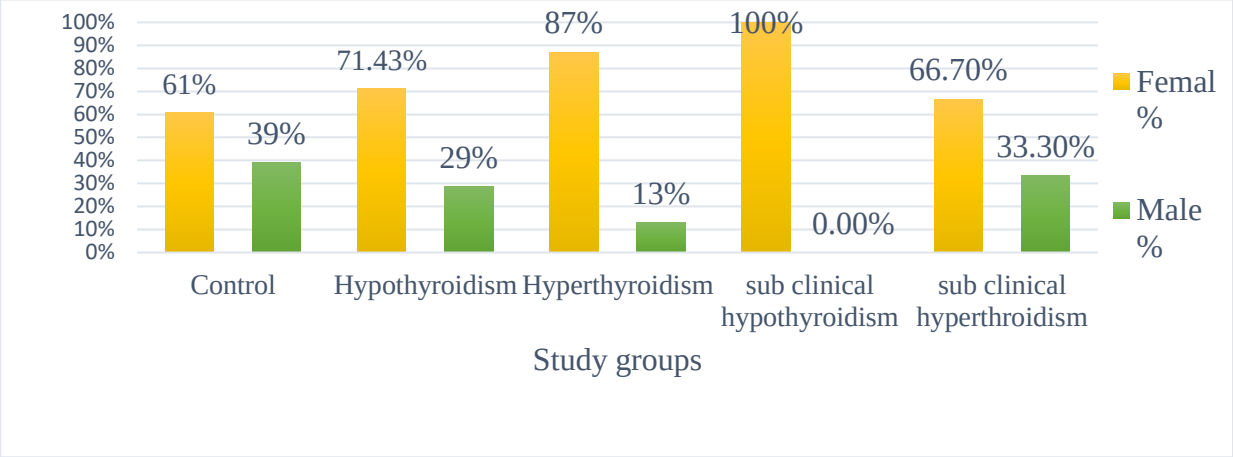
3.0. Results and Discussion

3.1. Gender-wise Distribution of Surveyed Individuals with Thyroid Dysfunction

The results displayed the distribution of thyroid disorders among female and male participants across different study groups. The data indicates a higher prevalence of thyroid disorders among females across all study groups. In the control group, females make up 61% of the participants, indicating a baseline gender distribution skewed towards females. For hypothyroidism, the female prevalence rises to 71.43%, showing an increased impact on females. Hyperthyroidism has an even higher female prevalence at 87%, reinforcing the trend. Subclinical hypothyroidism is observed exclusively in females (100%), indicating no male participants in this group. Subclinical hyperthyroidism shows a significant female prevalence at 66.70%, though the male prevalence here is higher compared to other disorders at 33.30%. The results highlight a clear gender disparity in thyroid disorder prevalence, with women being more affected across all categories. This suggests the need for further investigation into gender-specific factors contributing to this disparity, such as hormonal influences, genetic predispositions, or environmental factors.

Thyroid dysfunction, a prevalent endocrine disorder affecting over 300 million individuals globally, is influenced by factors such as iodine status, gender, autoimmune conditions, and environmental exposures (Rousset et al., 2015). Studies consistently show higher prevalence rates of thyroid disorders, particularly hypothyroidism, among females compared to males, attributed to hormonal and genetic factors (Sharma & Sharma, 2012). Our findings are consistent with literature indicating a higher prevalence of thyroid disorders, particularly hyperthyroidism, in females (Alam Khan et al., 2002). The incidence of hyperthyroidism (26%) was notably higher than that of hypothyroidism (24%), contrasting with previous studies suggesting a higher incidence of hypothyroidism (Baral et al., 2002; Doifode & Fernandes, 2001; Mukherjee & Ghosh, 1985). Gender has long been recognized as a crucial epidemiological factor in thyroid diseases, with contemporary gender medicine providing new insights into this field (Castello & Caputo, 2019). The observed gender disparity highlights females' heightened susceptibility to thyroid disorders compared to males, influenced by factors such as hormonal fluctuations, genetic predispositions, and environmental exposures (Vanderpump & Tunbridge, 2005). This higher prevalence among females underscores the need for personalized diagnostic and therapeutic approaches that account for gender-specific differences in disease manifestation and progression.

A study showed that the overall prevalence of hyperthyroidism is 1.3%, with higher rates in females (2.7%) than males (0.7%), primarily attributed to Graves' disease (Hollowell et al., 2002; Vanderpump, 2011). Contrary to some previous findings, this study did not observe significant effects of thyroid dysfunction on testosterone levels in both males and females (Tayal et al., 2009; Zähringer et al., 2000). These findings underscore pronounced gender differences in thyroid dysfunction prevalence and suggest a need for further research into hormonal interactions in thyroid disorders.



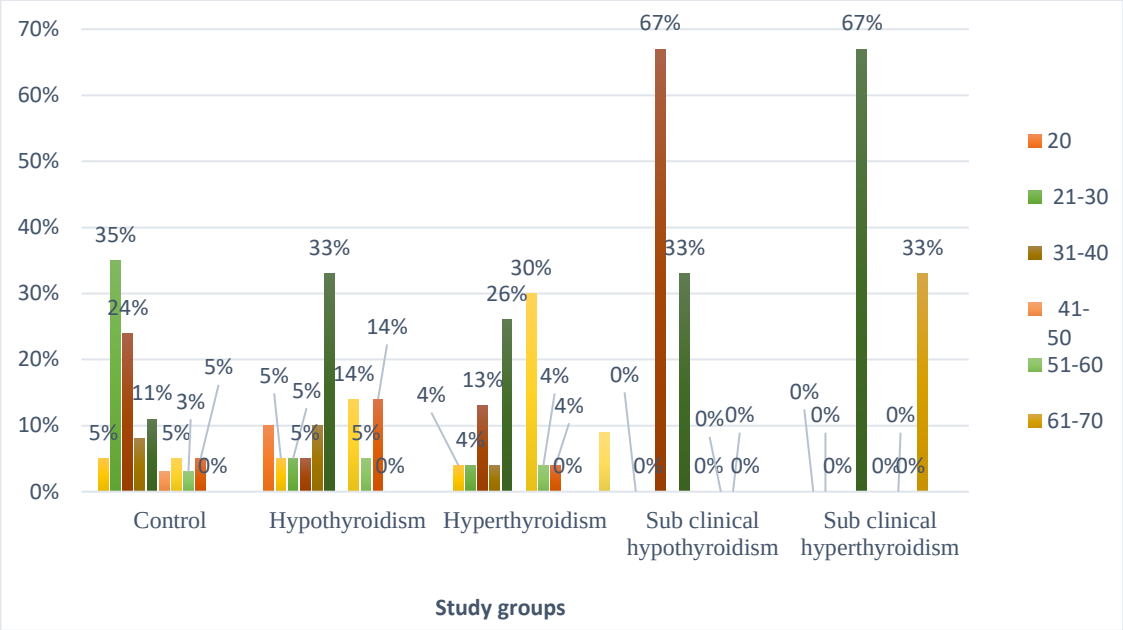
3.2. Age-wise distribution of Surveyed Individuals with Thyroid Dysfunction

The distribution in the control group shows a fairly even spread among younger and middle-aged participants, with the highest concentration in the 31-40 years range. There is a strong prevalence of hypothyroidism in the 31-40 years age group, similar to the control group, indicating that this age group is notably affected by hypothyroidism. Hyperthyroidism also affects the 31-40 years age group predominantly, followed closely by the 21-30 years age group, suggesting these age groups are more susceptible. Subclinical Hypothyroidism primarily affects older adults, particularly those aged 51-60 years, with no younger participants represented.

Subclinical Hyperthyroidism is also most prevalent in the 31-40 years age group, followed by younger and older age groups, indicating a broader age range but still focusing on middle age. The results highlight age-related trends in thyroid dysfunction, with middle-aged individuals (particularly those aged 31-40 years) being the most affected across most categories. Subclinical hypothyroidism shows a notable deviation, affecting older adults (51-60 years) predominantly. This age-wise distribution suggests a need for targeted screening and intervention strategies in these age groups to manage and mitigate thyroid-related health issues effectively.

The prevalence of thyroid disorders tends to increase with age, particularly affecting older women, although diagnostic challenges persist in elderly populations (Boelaert, 2013). Hypothyroidism, primarily autoimmune in origin, is more prevalent than hyperthyroidism, which is less common but still significant in clinical practice (Baral et al., 2002). Studies consistently show that thyroid disorders are more severe and prevalent among females, especially in the age group of 31-40 years, likely due to heightened estrogen and progesterone activity during this period (Hollowell et al., 2002; Iddah et al., 2013; Swain et al., 2005; Vanderpump, 2011).

Conversely, thyroid disorders are less frequent in younger and older adults, possibly influenced by changes in reproductive hormone dynamics and geriatric factors. These findings underscore the complex interplay of gender, age, and environmental factors in thyroid dysfunction, highlighting the need for tailored diagnostic and management strategies based on individual characteristics and regional health contexts.



Area-wise distribution of Surveyed Individuals with Thyroid Dysfunction

The results demonstrate the distribution of thyroid dysfunction among different study groups categorized by gender and area (rural and urban). Female subjects in rural areas show a high prevalence of all thyroid dysfunctions, with hyperthyroidism being the most common (75%).

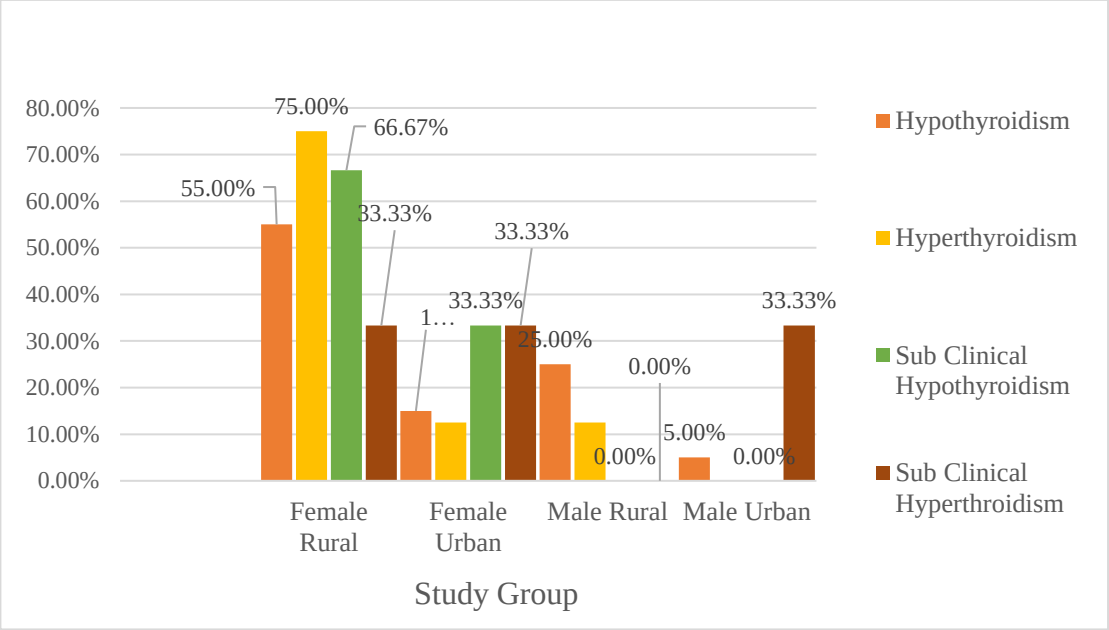
This indicates a significant burden of thyroid issues among rural females. Urban females also display a substantial prevalence of thyroid dysfunctions, though the percentages are more evenly distributed across the conditions, each around 25-33.33%. This suggests a diverse impact of thyroid disorders in urban female populations. Thyroid dysfunctions are almost non-existent in the male urban group, with only a small percentage (5%) experiencing hyperthyroidism.

This indicates a very low occurrence of thyroid issues among rural males as compared to urban males who possessed hypothyroidism (33.33%) and subclinical hypothyroidism (33.33%), as well as subclinical hyperthyroidism (33.33%). Thyroid dysfunction is notably higher among females, particularly in rural areas, compared to males. Rural females show the highest prevalence, especially for hyperthyroidism and subclinical hypothyroidism.

Urban individuals (both male and female) show a more balanced distribution of thyroid dysfunctions, while rural males have a minimal prevalence.

The higher prevalence of hypothyroidism among females in rural areas compared to urban areas and the lower prevalence among males, particularly in urban areas, highlights a gender-specific distribution. Similarly, the higher prevalence of hyperthyroidism among females in rural areas aligns with existing literature suggesting a higher prevalence of thyroid disorders among women.

absence of reported cases of hyperthyroidism among males in urban areas raises questions about potential disparities in access to healthcare or environmental factors influencing thyroid function (Gong et al., 2024; Korobova et al., 2022). Geographic variations in iodine intake and dietary habits also contribute to thyroid dysfunction patterns (Swain et al., 2005).



3.3. Serum Testosterone Hormone Level (mg/dL) in the Surveyed Individuals

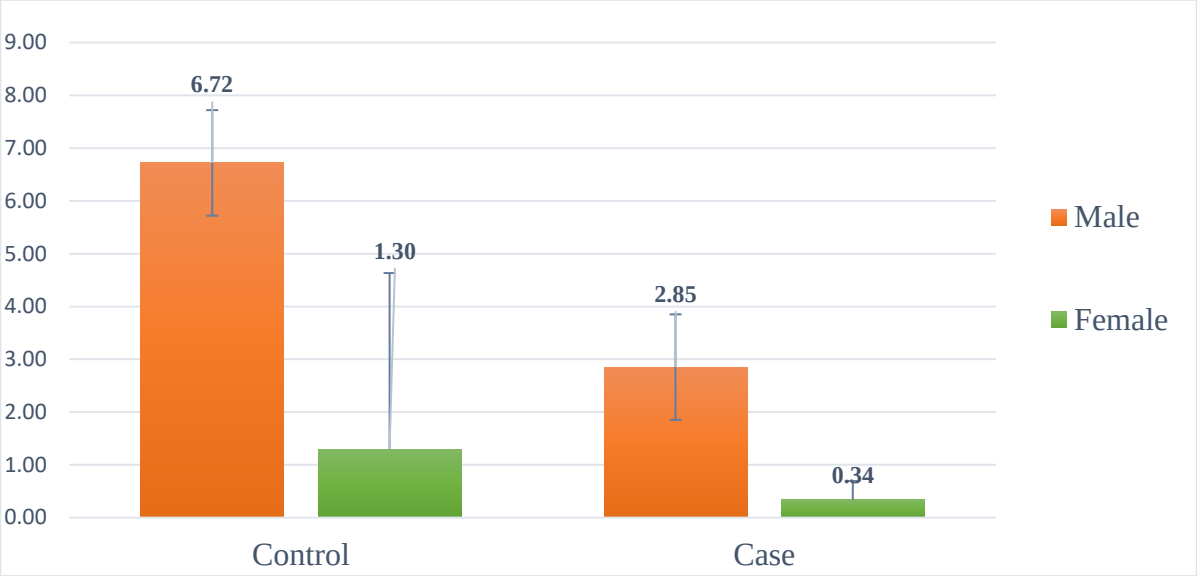
In this study, we investigated testosterone levels in the Control and Case Groups. The Control Group's mean testosterone levels were 6.72 ng/dL (SD = 2.38) for males and 1.30 ng/dL (SD = 3.34) for females. In contrast, the Case Group showed significantly lower levels: 2.85 ng/dL (SD = 1.55) for males and 0.34 ng/dL (SD = 0.36) for females.

The study demonstrates that thyroid disorders are associated with lower testosterone levels in both males and females. This effect is particularly pronounced in females, where testosterone levels are significantly reduced compared to their male counterparts and to females without thyroid disorders. The findings underscore the impact of thyroid dysfunction on hormone regulation, suggesting the need for targeted management strategies to address testosterone imbalances based on gender and thyroid health status.

The Control Group's female participants had a mean testosterone level of 1.30 ng/dL, notably higher than the 0.34 ng/dL observed in the Case Group's females. This suggests distinct physiological or environmental factors affecting testosterone levels, such as hormonal regulation, lifestyle, or underlying health conditions (Shimizu et al., 2007). The study highlights a clear divergence in testosterone levels between healthy males and females, revealing a bimodal distribution without overlap.

The lower limit of testosterone levels in healthy males is approximately four to five times higher than the upper limit in healthy females, with no gradual transition between typical male and female levels (Clark et al., 2019).

include differences in hormonal regulation, lifestyle factors such as diet and exercise, or underlying health conditions that impact testosterone production in females (Shimizu et al., 2007). Present results indicate a noticeable divergence in the range of testosterone levels between healthy and morbid participants.



3.4. Gender-wise Serum Testosterone Hormone Level (mg/dL) in the Surveyed Individuals with Thyroid Dysfunction

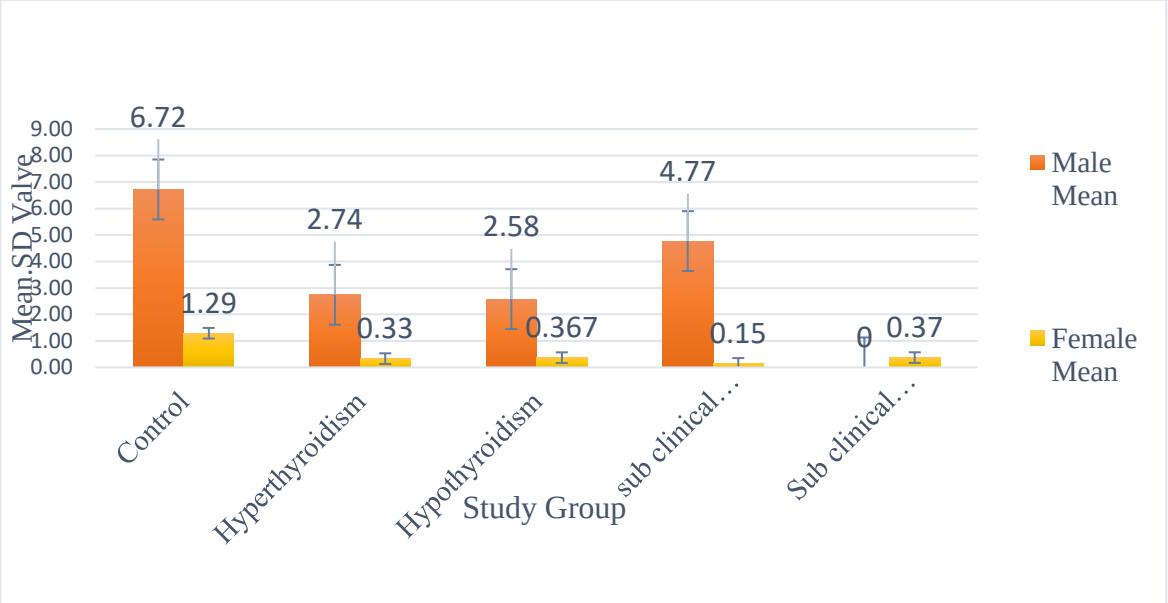
The results demonstrate gender impact on testosterone levels in individuals with various thyroid disorders as compared to a control group. In the control group, males had a mean testosterone level of 6.72 ng/dL (SD = 2.38) and females 1.29 ng/dL (SD = 3.33).

Hyperthyroid individuals had lower testosterone levels, with males averaging 2.74 ng/dL (SD = 0.33) and females 0.33 ng/dL (SD = 0.33). Hypothyroid individuals also had reduced levels, notably in females (mean = 0.367 ng/dL, SD = 0.45). Subclinical hyperthyroid males had elevated testosterone (mean = 4.77 ng/dL), while females had very low levels (mean = 0.15 ng/dL, SD = 0.007). Subclinical hypothyroid females had extremely low testosterone (mean = 0.37 ng/dL, SD = 0.22). These results highlight the complex interplay between thyroid function and testosterone regulation, underscoring the need for tailored approaches in managing hormone imbalances based on gender and thyroid status.

These findings highlight the relationship between thyroid disorders and testosterone levels, showing significant gender differences. Hyperthyroidism consistently lowered testosterone levels, indicating a potential suppressive effect (Dunn & Dunn, 2001; Krassas & Perros, 2003). Hypothyroidism similarly reduced testosterone, particularly in females (Canaris et al., 2000). Males with subclinical hyperthyroidism had unexpectedly high testosterone, suggesting a compensatory mechanism (Jannini et al., 2000), whereas females had very low levels.

Subclinical hypothyroid females also had very low testosterone, akin to overt hypothyroidism (Saran et al., 2016). Normal thyroid function is crucial for reproduction, affecting SHBG and sex steroids in both genders (Franjić, 2021).

Thyrotoxicosis and hypothyroidism negatively impact male reproduction, including erectile issues (Ceccarelli et al., 2006). Elevated TRH-stimulated TSH response is linked to lower pregnancy rates, with 0.2% of infertile women showing increased TSH levels (Shalev et al., 1994). Hypothyroidism, less common in men, reduces SHBG and testosterone concentrations, which can improve with levothyroxine therapy. Early-treated congenital hypothyroid boys show normal development and adult height (Cavaliere et al., 1988).



3.5. Age-wise Serum Testosterone Hormone Level (mg/dL) in the Surveyed Individuals with Thyroid Dysfunction

The Control group has the highest mean standard deviation, especially among participants under the age of 30, with a serum testosterone concentration of 5.59 mg/dL. For ages 41-50, it is around 1.88 mg/dL, and for ages 51-60, it decreases to 1.54 mg/dL. Data for individuals aged 70 or older is unavailable.

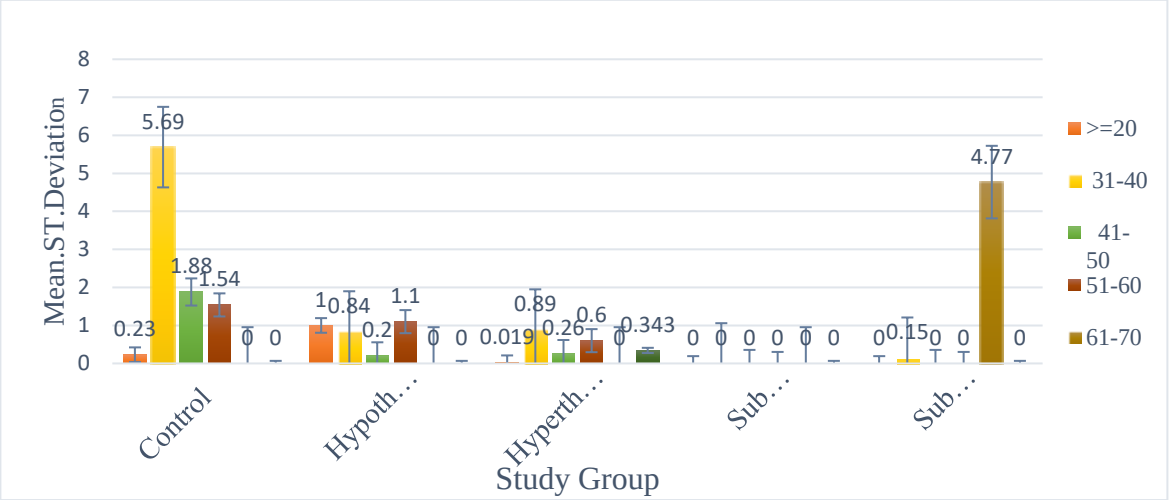
Hypothyroidism has lower mean standard deviation values, while hyperthyroidism shows moderate values. Subclinical hypothyroidism and hyperthyroidism have even lower mean standard deviations. The high variability in testosterone levels in the Control group for individuals ≤20 years is likely due to pubertal development, lifestyle, and genetics.

The decreasing pattern of mean standard deviation with age suggests more consistent testosterone levels as adults age. The absence of data for those 70 or older limits understanding of testosterone variations in the elderly.

The study indicates that serum testosterone levels exhibit high variability in younger individuals, likely due to factors such as pubertal development, lifestyle, and genetics. As age increases, this variability decreases, suggesting more stable testosterone levels in older adults. Thyroid conditions further influence this variability, with hypothyroidism and subclinical thyroid disorders showing lower variability compared to hyperthyroidism.

Hypothyroidism shows consistent testosterone suppression across age groups with lower mean standard deviation values (Wagner et al., 2008). Hyperthyroidism shows moderate values due to hypermetabolism and hormonal feedback dysregulation (Chiamolera & Wondisford, 2009).

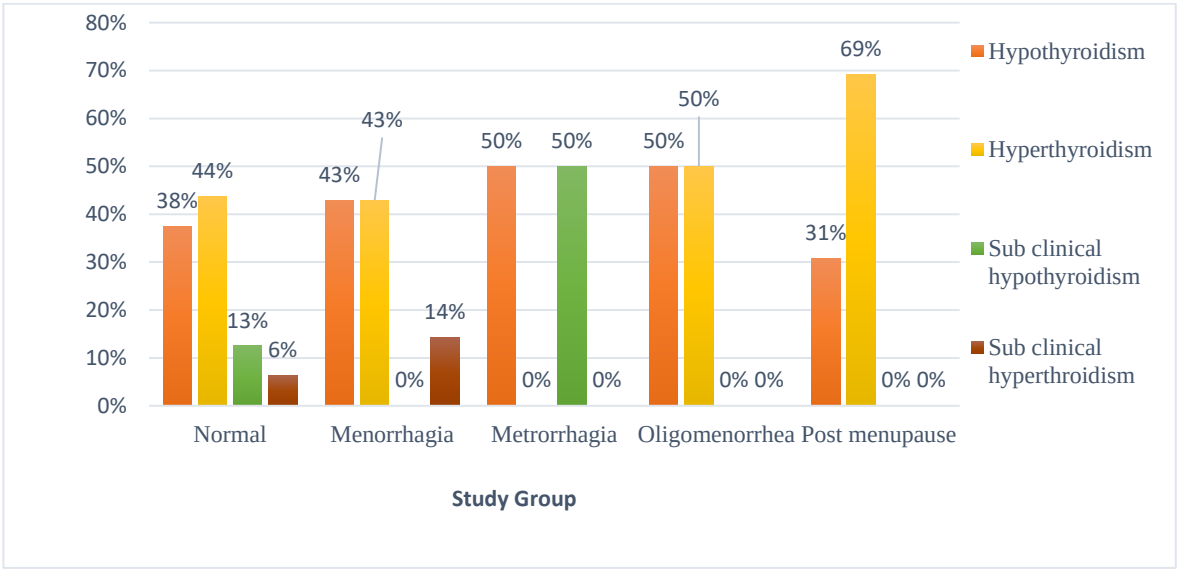
Subclinical hypothyroidism and hyperthyroidism show even lower mean standard deviations, suggesting stable testosterone levels compared to overt thyroid disorders. Minimal mean standard deviation in subclinical hyperthyroidism, especially in older age groups, requires further investigation (Morenas et al., 2024).



3.6. Effect of Menstrual Disorders on Thyroid Dysfunction among Female Participants

The study sheds light on the prevalence of menstrual irregularities concerning thyroid function, revealing that both Menorrhagia (excessive menstrual bleeding) and Oligomenorrhea (infrequent menstruation) are significantly present in individuals with either hypothyroid or hyperthyroid conditions, with rates of 43% and 50%, respectively. This suggests a strong correlation between thyroid dysfunction and menstrual irregularities. Furthermore, Metrorrhagia (irregular bleeding) was specifically observed in cases of hypothyroidism and subclinical hypothyroidism, indicating a unique pattern of menstrual disturbance associated with low thyroid function.

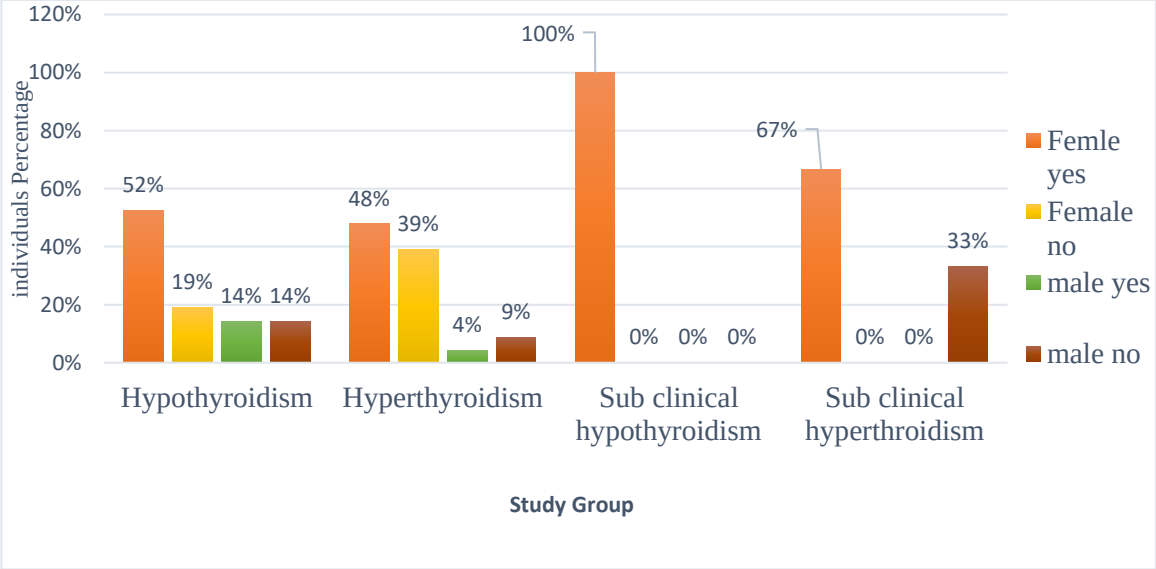
The variation in menstrual patterns due to thyroid dysfunction may be influenced by factors such as pubertal development, lifestyle choices, and genetic predispositions. Moreover, the study discusses hormonal stabilization across different age groups, as evidenced by the decreasing mean standard deviation of testosterone levels with age. This trend reflects a more consistent hormonal environment in adulthood. However, the study also acknowledges a significant limitation: the absence of data for individuals aged 70 or older. This gap restricts understanding how testosterone levels and possibly other hormonal variations manifest in the elderly. This area warrants further research to provide a comprehensive view of hormonal health across the lifespan (Ramya et al., 2017).



3.7. Effect of Stress Full Events on Thyroid Dysfunction in the Surveyed Individuals

The study revealed that a majority of female individuals exposed to stressful conditions experienced specific complications related to thyroid dysfunction (Table 2.9). These complications included

hypothyroidism, hyperthyroidism, subclinical hypothyroidism (SCH 1), and subclinical hyperthyroidism (SCH 2). Among the surveyed females,52% had a recorded history of hypothyroidism during stress, whereas no cases of subclinical hypothyroidism were observed in males. Similarly, 48% of females exhibited hyperthyroidism under stress, while males had 23 cases of hyperthyroidism with no subclinical hyperthyroidism cases recorded for either gender. All females with hypothyroidism (100%) showed subclinical hypothyroidism during stress, and no male individuals exhibited subclinical hypothyroidism. In terms of subclinical hyperthyroidism, 67% of females were affected, and one male individual (33%) was recorded with subclinical hyperthyroidism. Among females surveyed, 52% experienced hypothyroidism during periods of stress, whereas no cases of subclinical hypothyroidism were observed in males. This suggests a pronounced vulnerability of females to hypothyroid conditions exacerbated by stress. Hyperthyroidism was also notably prevalent among stressed females, with 48% affected, compared to 23% of males. Notably, subclinical hyperthyroidism affected all surveyed females (100%), while only one male individual (33%) showed signs of this condition under stress. These findings underscore the impact of stress on thyroid function, particularly in female subjects. The study findings highlight significant gender disparities in the manifestation of thyroid dysfunction under stressful conditions. Female individuals, in particular, exhibited a higher prevalence of various thyroid disorders compared to males when exposed to stressors. Further research could explore the underlying mechanisms that contribute to these gender disparities and potential therapeutic interventions to mitigate the adverse effects of stress on thyroid health in vulnerable populations.



4.0. Conclusion

The study found that thyroid disorders are significantly more common in women than in men, with a prevalence of 80% compared to 20%. While thyroid disorders can potentially impact menstrual regularity, notable differences in testosterone levels associated with thyroid conditions were also observed. These results suggest that thyroid disease is more widespread among females in Peshawar, possibly due to factors like lactation and breastfeeding. Moreover, the study highlights that menstrual irregularities are considerably more common in patients with thyroid dysfunction, with both hyperthyroidism and hypothyroidism being linked to endocrine, sexual, and reproductive changes. To effectively address thyrotoxicosis and hypothyroidism-related infertility, collaboration among andrologists, endocrinologists, gynaecologists, and general physicians is essential. Furthermore, the study identifies a positive association between thyroid disorders, stressful events, and iodine deficiency. Thus, we deduced that thyroid function could affect testosterone levels. The relationship between testosterone and thyroid hormones is interconnected. Both hyperthyroidism and

hypothyroidism can impact testosterone levels. High levels of testosterone can decrease thyroid function, while low levels of testosterone can lead to an overactive thyroid. In a nutshell, significant variation in serum testosterone levels were found in patients with thyroid dysfunction in this study.

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