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PREVALENCE AND CLINICAL PROFILE OF THYROID DISORDERS BY AGE AND GENDER IN A PAKISTANI POPULATION: A RETROSPECTIVE STUDY

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ABSTRACT

Background: The thyroid gland produces hormones vital for metabolic rate, growth, and development, influencing functions such as digestion, cardiovascular health, and brain development. Thyroid disorders, including autoimmune conditions like primary hypothyroidism and Graves' disease, pose significant public health challenges globally, with prevalence rates of 5% to 10%. In Pakistan, hypothyroidism and hyperthyroidism rates are reported at 4.1% and 5.1%, respectively.

Objectives: This study aimed to examine the clinical profile of thyroid dysfunction concerning age and gender.

Methodology: A retrospective analysis was conducted from April to December 2020 at Jinnah Postgraduate Medical Centre in Karachi, Pakistan. Patient records of thyroid profiles (TSH, T3, and T4) were analyzed according to American Thyroid Association guidelines, utilizing R Studio (2024.04.0).

Results: The sample included 290 males and 1,050 females, with mean ages of 38.84 ± 16.02 years for males and 37.30 ± 12.65 years for females. Euthyroidism was the most prevalent condition (54%), more common in males (57%) than females (53%). Hyperthyroidism was more prevalent in females (22% vs. 14% in males), while overt hypothyroidism was higher in males (3.4% vs. 1.3% in females). Significant differences in thyroid disorder prevalence by gender and age were noted ($p < 0.001$).

Conclusion: The findings underscore the need for targeted screening and tailored treatment strategies, particularly for older males at heightened risk for severe thyroid conditions.

Keywords: Thyroid disorders, Prevalence, Age and gender, Pakistani population, Retrospective study

INTRODUCTION

Thyroid diseases represent a major public health issue globally, ranking as the second most prevalent endocrine disorder ranges from 5% to 10%. In Pakistan, the prevalence of hypothyroidism is found in 4.1% of the population, while hyperthyroidism affects 5.1%. Additionally, subclinical hyperthyroidism and subclinical hypothyroidism have prevalence rates of 5.8% and 5.4%, respectively [1, 2]. The thyroid gland is responsible for the secretion of two principal hormones: Triiodothyronine (T3) and Thyroxin (T4). In terms of concentration, T3 accounts for approximately 7% and T4 for 93% of total thyroid hormone secretion. Both hormones circulate in the blood in free and bound forms, with about 99% existing as bound forms. The primary carrier for these bound forms is thyroid binding globulin, while transthyretin and albumin transport smaller amounts [3].

The free forms of these hormones are biologically active, with free T3 (FT3) being more potent than free T4 (FT4) [4]. FT4 plays a crucial role in regulating thyroid secretion, and both FT3 and FT4 serve as indicators of an individual's thyroid health. These hormones are essential for growth and metabolism; thus, a deficiency in thyroid hormones can lead to a significant decrease in metabolism, with basal metabolic rate (BMR) dropping to 50% below normal levels [5]. Furthermore, thyroid hormones are vital for proper brain development [6]. The synthesis of T3 and T4 requires iodine and a protein known as thyroglobulin. Several factors, including age, sex, body weight, nutrition, climate, and health conditions, influence the production of T3 and T4. Thyroid Stimulating Hormone (TSH), also known as thyrotropin, is released from the anterior pituitary gland and regulates the production of T3 and T4 via a negative feedback mechanism [7]. TSH itself is modulated by Thyroid Releasing Hormone (TRH) from the hypothalamus through a positive feedback mechanism [8]. Measurement of TSH is a reliable method for assessing thyroid gland function and serves as a screening tool for thyroid disorders [9].

The incidence of thyroid disorders varies based on gender, age, race, and geographical location, often influenced by dietary iodine intake [10]. Nearly one-third of the global population lives in areas with iodine deficiency, which is recognized as a leading cause of thyroid dysfunction worldwide [11]. Thyroid diseases are classified into hyperthyroidism and hypothyroidism based on gland function.

Subclinical thyroid disease is biochemically characterized by conditions such as subclinical hyperthyroidism, where serum TSH levels are low or undetectable, while T3 and FT4 concentrations remain normal. Conversely, subclinical hypothyroidism occurs when serum TSH levels are elevated, yet serum thyroid hormone levels are within the normal range [12]. Thyroid dysfunction has significant implications for health outcomes [13]. The spectrum of thyroid dysfunction can range from subclinical to overt disease, potentially leading to severe acute thyroid derangements.

If untreated, thyroid dysfunction can severely affect overall health and is associated with substantial morbidity. Hypothyroidism is linked to conditions such as hypertension, dementia, cardiovascular and cerebral events, and dyslipidemia; if not addressed, it can progress to myxedema coma. Subclinical hypothyroidism is associated with cardiovascular morbidity and mortality, with risks being TSH-dependent. Similarly, both subclinical hyperthyroidism and hyperthyroidism are connected to an increased risk of heart failure, atrial fibrillation, bone loss, fractures, and dementia [14].
Although thyroid disorders are common, identifiable, and typically easily treatable, failure to diagnose or treat them can lead to serious adverse outcomes. Therefore, timely evaluation, differentiation of thyroid disorder types, and appropriate management are essential. The ultimate goal of establishing routine screening programs is to provide timely and effective treatment, prevent complications, and reduce the morbidity and mortality associated with these diseases [15].

METHODOLOGY

This retrospective study utilized data collected from laboratory software reports, focusing on demographic information, including age, gender, and thyroid profiles, specifically the results of T3, T4, and TSH tests. The sample included all cases of thyroid profile tests with complete demographic and result records for individuals aged 13 years and older.

Serum concentrations of free T3 and T4, along with TSH levels, were measured, with normal reference ranges established as follows: T3: Adult: 0.80-2.00 ng/ml; T4: 4.2-14.0 µg/100 ml; and TSH: 0.27-4.2 µIU/ml. Serum TSH concentrations were determined using an immunoradiometric assay. Elevated TSH levels indicated hypothyroidism, while suppressed TSH levels suggested hyperthyroidism. Subclinical hypothyroidism was characterized by elevated TSH levels with normal free T4, whereas subclinical hyperthyroidism was defined by suppressed TSH levels alongside normal free T4. The collected data were analyzed using R Studio, and the chi-square test was employed to evaluate the association of thyroid disease with age and gender. A p-value of <0.05 was considered statistically significant. Ethical approval for the study was obtained from the Institutional Review Committee of Jinnah Postgraduate Medical Centre, Karachi.

RESULTS

Demographic Characteristics

This study included a total sample of 1,342 individuals, comprising 290 males (22%) and 1,050 females (78%). The mean age for males was 38.84 years (SD = 16.02), while the mean age for females was 37.30 years (SD = 12.65). The median age for both genders was 38 years, and the mode age was 45 years. The 95% confidence intervals for the mean ages were 1.85 for males and 0.77 for females, indicating a slight variation in the age distribution between the genders.

Thyroid Hormone Levels

In females, the mean serum free T3 level was found to be 1.82 ng/mL (SD = 2.17). The mean T4 level averaged 5.39 µg/mL (SD = 3.73). The average TSH level was 3.53 µIU/mL (SD = 10.91), indicating significant variability among female participants. In males, the mean serum free T3 level was 1.48 ng/mL (SD = 1.46). The mean T4 level was observed at 5.32 µg/mL (SD = 2.77). The average TSH level for males was 4.41 µIU/mL (SD = 14.25), reflecting considerable variability among male participants Table: 1.

Table:1 Distribution of Thyroid Patients by mean & SD (n= 1342)

Characteristic	Overall (N = 1,342)	Female (N = 1,051)	Male (N = 291)	p-value
Age				<0.001
13-30	469 (35%)	366 (35%)	103 (35%)	
31-48	605 (45%)	494 (47%)	111 (38%)	
49-66	239 (18%)	175 (17%)	64 (22%)	
67-85	29 (2.2%)	16 (1.5%)	13 (4.5%)	

Note: 1 n (%) 2 Pearson's Chi-squared test

Age Distribution of Participants

The age distribution analysis revealed significant differences between genders ($p < 0.001$). Participants were grouped into four age categories: 13-30, 31-48, 49-66, and 67-85 years. Among the youngest group (13-30 years), 35% of both females and males were represented equally. In the 31-48 age group, females comprised 47% compared to 38% of males. In the 49-66 age group, males accounted for a higher proportion (22%) than females (17%). In the oldest group (67-85 years), males were also more prevalent, comprising 4.5% compared to only 1.5% of females. These findings suggest notable genderrelated differences in age distribution, particularly in the older age categories. Table.2.

Table:2 Distribution of Thyroid Patients by Gender and Age Group (n = 1342)

Gender	T3 (ng/mL)	T4 (µg/dL)	TSH (µIU/mL)
Female	1.82 ± 2.17	5.39 ± 3.73	3.53 ± 10.91
Male	1.48 ± 1.46	5.32 ± 2.77	4.41 ± 14.25

Thyroid Disorder Distribution

The distribution of thyroid disorders revealed significant gender differences among the participants. Euthyroidism was the most prevalent condition, observed in 54% of participants, with a slightly higher proportion of males (57%) compared to females (53%). Hyperthyroidism was more common in females (22%) than in males (14%). Hypothyroidism rates were similar between genders, affecting 6.9% of females and 5.8% of males. However, overt hypothyroidism was more frequent in males (3.4%) than in females (1.3%). Subclinical hyperthyroidism was observed in 8.2% of the total population, with minimal gender differences (8.4% in females and 7.6% in males). Subclinical hypothyroidism was rare, affecting only 0.8% of participants and exclusively observed in females (1.0%). Euthyroid Sick Syndrome (ESS) was diagnosed in 8.8% of the overall population, with a higher prevalence in males (12%) compared to females (7.8%). These results highlight the gender-specific variations in thyroid disorders within the study population. Table.3

Table 3: Distribution of Thyroid Disorders by Gender (n = 1,342)

Characteristic	Overall (N 1,342)	=	13-30 (N 469)	=	31-48 (N 605)	=	49-66 (N 239)	=	67-85 (N = 291)
Thyroid Disorder									
Euthyroidism	719 (54%)		262 (56%)		328 (54%)		118 (49%)		11 (38%)
Hyperthyroidism	270 (20%)		108 (23%)		117 (19%)		41 (17%)		4 (14%)
Hypothyroidism	90 (6.7%)		25 (5.3%)		50 (8.3%)		14 (5.9%)		1 (3.4%)
Overt Hypothyroidism	24 (1.8%)		1 (0.2%)		16 (2.6%)		6 (2.5%)		1 (3.4%)
Subclinical Hyperthyroidism	110 (8.2%)		30 (6.4%)		47 (7.8%)		29 (12%)		4 (14%)
Subclinical Hypothyroidism	11 (0.8%)		6 (1.3%)		3 (0.5%)		2 (0.8%)		0 (0%)
Euthyroid Sick Syndrome (ESS)	118 (8.8%)		37 (7.9%)		44 (7.3%)		29 (12%)		8 (28%)

Note: 1 n (%) 2 Pearson's Chi-squared test

Age Group Distribution of Thyroid Disorders

The age distribution of thyroid disorders in the study population (N = 1,342) revealed significant variations ($p < 0.001$). Females constituted the majority across all age groups, particularly in the 31-48 age group (82%) and the lowest in the 67-85 age group (55%). Euthyroidism was the most common thyroid condition, affecting 54% of participants, with decreasing prevalence across age groups, from 56% in the youngest group (13-30) to 38% in the oldest group (67-85). Hyperthyroidism was present in 20% of participants, most frequent in the 13-30 age group (23%) and declining to 14% in those aged 67-85. Hypothyroidism, affecting 6.7% overall, was most common in the 31-48 age group (8.3%).

Overt hypothyroidism had a low overall prevalence (1.8%), being most prominent in the 31-48 and 49-66 age groups (2.6% and 2.5%, respectively). Subclinical hyperthyroidism was observed in 8.2% of participants, with the highest occurrence in the 49-66 (12%) and 67-85 (14%) age groups. Subclinical hypothyroidism was rare (0.8%) and absent in the oldest group. Euthyroid Sick Syndrome (ESS) was present in 8.8% of participants, with the highest prevalence in the oldest age group (28%). These findings indicate that the prevalence of thyroid disorders varies significantly with both age and gender, with older participants showing a higher frequency of more severe thyroid conditions. Table.4

Table 4: Age Group Distribution by Thyroid Disorders (n = 1,342)

Thyroid Disorder	Female (N = 1,051)	Male (N = 291)	Overall (N = 1,342)
Euthyroidism	553 (53%)	166 (57%)	719 (54%)
Hyperthyroidism	230 (22%)	40 (14%)	270 (20%)
Hypothyroidism	73 (6.9%)	17 (5.8%)	90 (6.7%)
Overt Hypothyroidism	14 (1.3%)	10 (3.4%)	24 (1.8%)
Subclinical Hyperthyroidism	88 (8.4%)	22 (7.6%)	110 (8.2%)
Subclinical Hypothyroidism	11 (1.0%)	0 (0%)	11 (0.8%)
Euthyroid Sick Syndrome (ESS)	82 (7.8%)	36 (12%)	118 (8.8%)

DISCUSSION

Demographic characteristics, thyroid hormone levels, and the prevalence of thyroid disorders

This study provides a comprehensive overview of the sample of 1,342 individuals. The gender distribution observed in our study, with females constituting 78% of the participants, is consistent with previous research that indicates a higher prevalence of thyroid disorders in women [16]. The mean ages for males (38.84 years) and females (37.30 years) suggest a relatively middle-aged population, aligning with findings from, which reported that thyroid dysfunction is common in middle-aged individuals, especially women [2]. The age distribution analysis demonstrated significant differences between genders, particularly in the older age groups (67-85 years), where males represented a higher proportion. This finding is consistent with the results of reported study, which suggested that older men are more likely to be diagnosed with thyroid disorders due to a combination of physiological and healthcare-seeking behaviors [17].

In our analysis of thyroid hormone levels, females exhibited higher mean serum free T3 (1.82 ng/mL) and T4 levels (5.39 µg/mL) compared to males, who had mean levels of T3 at 1.48 ng/mL and T4 at 5.32 µg/mL. This observation aligns with previous studies [18, 19], which suggest that sex differences in thyroid hormone levels may be influenced by factors such as the menstrual cycle, pregnancy, and menopause, with estrogen playing a crucial role in modulating thyroid function. Furthermore, the higher average TSH levels observed in males (4.41 µIU/mL) compared to females (3.53 µIU/mL) may indicate a compensatory mechanism for the lower T3 levels in males. The distribution of thyroid disorders within our population revealed euthyroidism as the most prevalent condition (54%), consistent with the literature [20].

The higher prevalence of hyperthyroidism among females (22%) compared to males (14%) corroborates findings from several epidemiological studies [21,22], which also noted that autoimmune hyperthyroidism is significantly more common in women. Conversely, the rates of hypothyroidism were similar between genders, with females affected at 6.9% and males at 5.8%. However, overt hypothyroidism was more frequent in males (3.4% vs. 1.3% in females) similar to previous finding [23].

The age group distribution of thyroid disorders also yielded significant findings, particularly with respect to euthyroidism and hyperthyroidism, which showed decreasing prevalence with age. The

higher prevalence of Euthyroid Sick Syndrome (ESS) in the older age group (28%) emphasizes the impact of chronic illnesses on thyroid function.

The low overall prevalence of subclinical hypothyroidism (0.8%) and its exclusive occurrence in females could suggest a need for further investigation into gender-specific mechanisms affecting thyroid hormone regulation.

CONCLUSION

This study highlights the significant gender and age related disparities in the prevalence of thyroid disorders within the population. It underscores the need for gender-specific and age-appropriate screening and management strategies to address these variations in thyroid health. The findings emphasize the importance of continued research in understanding the underlying mechanisms contributing to these differences, which could lead to more tailored and effective treatment approaches for thyroid disorders in diverse populations.

Ethical approval: Ethical approval for the study was obtained from the Institutional Review Committee of Jinnah Postgraduate Medical Centre, Karachi.

Author's Contributions: All authors were involved in conducting the study and have reviewed and approved the final version of the manuscript.

Conflict of Interest: The authors declare that there are no conflicts of interest associated with this study.

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