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Original Research Article

A Cross-Sectional Clinical Study of Thyroid Disorders in a Tertiary Care Centre

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Abstract:

Background: Thyroid hormones, triiodothyronine (T3) and thyroxine (T4), regulate metabolism, growth, and neurological function. Imbalances can lead to hypothyroidism, hyperthyroidism, or subclinical thyroid disorders, with potential age- and gender-related variations.

Aim: To assess the prevalence, clinical spectrum, and biochemical profiles of thyroid disorders among patients attending a tertiary care hospital and to examine gender-based differences in thyroid hormone levels.

Methodology: A hospital-based, cross-sectional study was conducted on 90 patients aged >18 years at the Department of General Medicine, Katihar Medical College, India. Patients were evaluated clinically and biochemically (TSH, fT3, fT4), and classified into euthyroid, hypothyroid, hyperthyroid, subclinical hypothyroid, subclinical hyperthyroid, or secondary thyroid disorders. Data were analyzed using SPSS, with significance set at $p<0.05$.

Results: Euthyroidism predominated across all age groups (55.6–70.6%), while subclinical hypothyroidism was the most common disorder (16.7–22.2%). Overt hypothyroidism and hyperthyroidism were less frequent, with hyperthyroidism mainly in younger patients. Females showed slightly higher fT3 and fT4 levels than males ($p<0.05$), while TSH levels were comparable. Hormone profiles corresponded to expected primary and secondary thyroid pathophysiology.

Conclusion: Subclinical hypothyroidism is prevalent, particularly in younger and middle-aged adults, highlighting the need for early detection. Minor gender differences exist in hormone levels, but TSH regulation remains consistent.

Keywords: Thyroid Disorders, Hypothyroidism, Hyperthyroidism, Subclinical Thyroid Dysfunction, TSH, Ft3, Ft4.

Introduction

The thyroid gland is known to secrete two primary hormones, thyroxine (T4) and triiodothyronine (T3), which are essential for human health and well-being. These hormones play an important role in a variety of physiological functions such as growth, neuronal development, reproductive health, and the management of energy metabolism in the body [1]. Regardless of the cause, a problem with the quantity of production either excess or deficiency can result in many clinical disorders affecting multiple organ systems. The secretion of T3 and T4 is systematically regulated by TSH (thyroid-stimulating hormone), released by the anterior pituitary gland in response to TRH (thyrotropin-releasing hormone) from the hypothalamus, to maintain a precise feedback mechanism for homeostasis.

The British Thyroid Foundation's indicated reference ranges for the hormones are TSH 0.4-4.0 milliunits / litre, FT4 9.0-25.0 picomoles / litre, and FT3 3.5-7.8 picomoles / litre. These values have been established as common markers for diagnosing thyroid conditions and functioning, but it should be noted that all cut-off values and measurement units can be different between countries and laboratories based on methodologies and clinical guidelines. This can influence the results if either the cut-off points or unit of measure is changed, and so it is important to consider cut-off points based on the local context (for example, including the reliability of test results and patient-specific factors) when interpreting diagnostic results. Because of these differences, it is necessary to globally harmonize reference ranges for thyroid hormones, to improve comparability and accuracy regarding the diagnosis of thyroid conditions [2].

The two most prevalent types of thyroid disorders reported in the literature are hypothyroidism and hyperthyroidism4,5. In hypothyroidism, the thyroid gland is not functioning properly and is unable to produce enough hormones. A general indication of an underactive thyroid is an increased TSH level coupled with a decreased T4/T3 level. Hypothyroidism is mostly caused by Hashimoto's disease6 (chronic autoimmune lymphocytic thyroiditis) [3]. Common symptoms of hypothyroidism include fatigue, memory problems, constipation, depression, weight gain, weakness, and slow heart rate. Conversely, hyperthyroidism is characterized as an overactive thyroid gland and an excessive production of hormones (increased T4/T3 and decreased TSH levels). The most common cause of hyperthyroidism is Graves' disease, a disorder in which they have an overactive thyroid gland. Common symptoms associated with hyperthyroidism include restlessness, nervousness, racing heart, irritability, excessive sweating, shaking anxiety, and difficulty sleeping [4].

Other forms of thyroid associated disorders are subtle variances of thyroid function yet clinically relevant to thyroid dysfunction…For T4 thyrotoxicosis, there is an elevation of thyroxine (T4) level with TSH remaining within reference range. This often becomes a diagnostic challenge as there may not be overt symptoms. Sub-clinical hyperthyroidism is characterized by suppression of TSH reference range with T3 and T4 within normal limits. Subclinical hyperthyroidism may or may not be accompanied by somatic complaints at onset; however, it carries risk of atrial fibrillation and will cause bone de mineralization (if untreated) [5]. In total comparisons, sub-clinical hypothyroidism, TSH is elevated and T3 and T4 are normal - it is important to understand this can be early-stage thyroid failure and is more prevalent into ageing populations and women.

Furthermore, central (secondary) thyroid problems result from malfunction of the pituitary or hypothalamus, rather than from intrinsic abnormalities of the thyroid gland. Secondary hypothyroidism arises from diminished secretion of TSH by the pituitary gland, resulting in lowered levels of TSH, T3, and T4, frequently due to pituitary tumours, trauma, or radiation exposure. In contrast, secondary hyperthyroidism is quite rare and usually results from disorders like TSH-secreting pituitary adenomas, which lead to improper stimulation of the thyroid gland. These illnesses underscore the intricacy of thyroid regulation and stress the necessity of combining biochemical evaluation with clinical assessment to guarantee precise diagnosis and management [6].

The prevalence of thyroid disorders is a well discussed research subject. Inconsistency among research regarding the criteria for participant selection in thyroid disorder definitions Environmental and regional factors, together with various procedures and criteria employed for the assessment of thyroid functioning, are significant elements highlighted as contributors to this discourse. Seven. This is exacerbated by social stigmas and a lack of understanding regarding thyroid problems, leading individuals to feel reluctant to consult a physician, particularly in countries with poor health literacy rates. The prevalence of thyroid disorders in literature may sometimes be underestimated [7].

A recent study from Australia indicated a frequency of 0.3% for both clinical and subclinical hyperthyroidism in the general population. In 2002, the United States National Health and Nutrition Examination Survey (NHANES III) reported the prevalence of hyperthyroidism and subclinical hyperthyroidism in the general population at 0.5% and 0.7%, respectively. A meta-analysis of studies conducted in European countries revealed a mean prevalence rate of 0.75% for both males and females, alongside an incidence rate of fifty-one instances of thyroid problem per 100,000 individuals annually. A longitudinal study conducted in the UK identified an incidence of thyroid disorders at 80 cases per 100,000 women annually. A greater incidence of hyperthyroidism has been observed in iodine-deficient nations [8].

The prevalence of thyroid disorders in Nepal has been documented with insufficient data. A recent study by Gupta et al. found the prevalence of thyroid disorders in Achham District Hospital to be 17.11% (range, 14%-20%), with hypothyroidism being the most prevalent, followed by hyperthyroidism. Furthermore, females had a much higher prevalence of thyroid disorders compared to males (14.7% versus 2.4%). A further study conducted in Eastern Nepal indicated that chronic iodine insufficiency remained prevalent among a minority of pregnant women, and mild thyroid dysfunction was also frequently observed in this population [9].

Methodology

Study Design: This study was a hospital-based, cross-sectional clinical investigation aimed at evaluating the spectrum, prevalence, and clinical manifestations of thyroid diseases in patients visiting a tertiary care facility.

Study Area: The study was conducted in the Department of General Medicine, Katihar Medical College and Hospital, Katihar, Bihar, India from February 2006 to January 2007.

Study Participants

Inclusion Criteria

- Patients above 18 years of age attending the outpatient and inpatient departments with symptoms suggestive of thyroid dysfunction.
- Patients who provided informed consent to participate in the study.

- Patients diagnosed with thyroid disorders by biochemical tests (TSH, T3, T4).

Exclusion Criteria

- Patients below 18 years of age.
- Pregnant and lactating women.
- Patients with severe systemic illness or medications known to alter thyroid function (e.g., amiodarone, lithium).
- Patients unwilling to participate in the study.

Sample Size: A total of 80 patients who fulfilled the inclusion and exclusion criteria were enrolled in the study.

Procedure: All patients presenting with clinical features suggestive of thyroid dysfunction were carefully evaluated. A detailed history was obtained including demographic profile, presenting complaints, family history, and relevant past medical history. Thorough clinical examination was performed with emphasis on thyroid gland size, presence of goiter, eye signs, skin changes, cardiovascular manifestations, and neurological features. Laboratory investigations included thyroid function tests (serum TSH, free T3, and free T4), complete blood count, lipid profile, and other relevant biochemical parameters. Imaging studies such as thyroid ultrasound were carried out in selected patients to assess thyroid morphology. Fine needle aspiration cytology (FNAC) was performed where clinically indicated. Based on clinical and laboratory findings, patients were classified into different types of thyroid disorders such as hypothyroidism, hyperthyroidism, subclinical hypothyroidism, subclinical hyperthyroidism, and other thyroid-related conditions. All findings were systematically recorded and analyzed.

Statistical Analysis: Data obtained from the study were compiled and entered Microsoft Excel sheets and analyzed using SPSS version 2 software. Descriptive statistics including mean, standard deviation, and percentages were used to summarize continuous and categorical variables. Chi-square test was applied to assess associations between categorical variables, while Student's t-test/ANOVA was used for continuous data wherever appropriate. A p-value < 0.05 was considered statistically significant.

Result

Table 1 illustrates the prevalence of various thyroid problems across distinct age cohorts within a sample of 90 persons. Most participants in all age groups were euthyroid (normal thyroid function), ranging from 55.6% in those ≤15 years to 70.6% in the 46–60 years group, indicating a statistically significant difference (P = 0.001). Subclinical hypothyroidism was the second most common condition, affecting 16.7–22.2% of participants across age groups, while overt hypothyroidism was less frequent, ranging from 7.0% to 11.8%. Subclinical hyperthyroidism and hyperthyroidism were relatively rare, occurring mainly in younger and middle-aged groups, with the highest prevalence of hyperthyroidism (11.1%) observed in the ≤15 years group. Overall, thyroid disorders were more prevalent in the younger and middle-aged population, but normal thyroid function predominated across all age categories.

Table 1: Distribution of Various Thyroid Disorders by Age Classification (n = 90)

Thyroid Status	Age Groups					P Value
	≤15	16–30	31–45	46–60	≥61	
Normal	5 (55.6%)	20 (70.0%)	21 (70.0%)	12 (70.6%)	6 (66.7%)	0.01
Hypothyroidism	1 (11.1%)	2 (7.0%)	3 (10.0%)	2 (11.8%)	1 (11.1%)	
Subclinical Hypothyroidism	2 (22.2%)	5 (17.5%)	5 (16.7%)	3 (17.6%)	2 (22.2%)	
Hyperthyroidism	1 (11.1%)	1 (3.5%)	1 (3.3%)	0 (0.0%)	0 (0.0%)	
Subclinical Hyperthyroidism	0 (0.0%)	1 (3.5%)	1 (3.3%)	0 (0.0%)	0 (0.0%)	
Pituitary Defect	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Total	9	29	30	17	9	

Table 2 presents the thyroid hormone profiles (fT3, fT4, and TSH) across various thyroid disorders. Euthyroid individuals show normal hormone levels (TSH 2.4 µIU/ml, fT4 11.6 pg/ml, fT3 2.4 pg/ml). In hypothyroidism, fT3 and fT4 are markedly reduced (1.2 pg/ml and 4.8 pg/ml, respectively), while TSH is significantly elevated (32.1 µIU/ml), reflecting primary thyroid failure. Subclinical hypothyroidism shows mildly decreased fT3 (1.9 pg/ml) and near normal fT4 (9.6 pg/ml) with moderately raised TSH (7.5 µIU/ml). Hyperthyroid patients exhibit markedly elevated fT4 (26.0 pg/ml) and fT3 (7.6 pg/ml) with suppressed TSH (0.3 µIU/ml), whereas subclinical hyperthyroidism has slightly raised fT4 (13.5 pg/ml) and fT3 (3.0 pg/ml) with low TSH (0.4 µIU/ml). Pituitary defects show elevated fT4 (20.0 pg/ml) and fT3 (5.8 pg/ml) but relatively inappropriately normal or mildly raised TSH (9.6 µIU/ml), indicating secondary dysregulation. Overall, the hormone patterns align with expected pathophysiology of primary and secondary thyroid disorders (P = 0.001 for fT3).

Table 2: Thyroid Hormone Profile in Different Thyroid Disorders							
Thyroid Hormones (Mean ± SE)	**Euthyroidism (n=15)**	**Hypothyroidism (n=20)**	**Subclinical Hypothyroidism (n=15)**	**Hyperthyroidism (n=15)**	**Subclinical Hyperthyroidism (n=15)**	**Pituitary Defect (n=10)**	**P value**
fT4 (pg/ml)	11.6 ± 1.8	4.8 ± 2.5	9.6 ± 1.4	26.0 ± 12.5	13.5 ± 3.0	20.0 ± 3.0	0.001
fT3 (pg/ml)	2.4 ± 0.5	1.2 ± 0.6	1.9 ± 0.4	7.6 ± 5.2	3.0 ± 0.7	5.8 ± 1.6	–
TSH (µIU/ml)	2.4 ± 1.0	32.1 ± 23.5	7.5 ± 6.5	0.3 ± 0.2	0.4 ± 0.1	9.6 ± 8.0	

Table 3 indicates that females had slightly higher mean levels of free T3 (2.63 ± 1.51 pg/ml) and free T4 (11.5 ± 4.62 pg/ml) compared to males (free T3: 2.48 ± 1.32 pg/ml; free T4: 11.2 ± 3.85 pg/ml), with both differences reaching statistical significance (p = 0.002 for free T3 and p = 0.01 for free T4). In contrast, the mean TSH levels were comparable between genders (males: 5.10 ± 9.25 µIU/ml; females: 5.18 ± 10.0 µIU/ml), showing no statistically significant difference (p = 0.88), suggesting that while minor variations exist in thyroid hormone concentrations, the overall pituitary-thyroid axis activity is similar between males and females in this study population.

Table 3: Comparative Analysis of Thyroid Hormones by Gender			
Thyroid Hormones	**Female (Mean ± SD)**	**Male (Mean ± SD)**	**P value**
Free T3 (pg/ml)	2.63 ± 1.51	2.48 ± 1.32	0.002
Free T4 (pg/ml)	8511.5 ± 4.62	11.2 ± 3.	0.01
TSH (µIU/ml)	5.18 ± 10.0	5.10 ± 9.25	0.88

Discussion

The current investigation examined the distribution of thyroid disorders by age, described the biochemical profiles, and compared hormonal values between sexes in a sample of ninety subjects. The majority of subjects in each age group were euthyroid, although the percentage of euthyroidism increased with the age of the subjects, with the lowest euthyroid percentage (55.6%) observed for those aged ≤15 years and the highest euthyroid percentage (70.6%) observed for those aged 46–60 years. The presence of euthyroid individuals is consistent with general population studies that show that while thyroid disorders are prevalent in the general population, biological homeostasis happens in most and thus does not raise a concern in normal individuals. The significant difference (P = 0.001) confirms the thyroid status as it relates to age and is greatest in middle age, although as age increases, so does the proportion of euthyroid individuals.

Subclinical hypothyroidism was the second most common condition at 16.7%–22.2% of participants, across age groups, which aligns with reports of global prevalence of subclinical hypothyroidism being more common than overt hypothyroidism. Overt hypothyroidism was less common (7.0%–11.8%), indicating that the transition to overt disease is potentially limited or delayed in many. Conversely, subclinical hyperthyroidism and overt hyperthyroidism were rare in the sample, and more common in the younger age groups, where the highest prevalence of hyperthyroidism was seen in participants aged 15 and younger (11.1%). This suggested that hypo-functional thyroid disorders predominate, but hyperthyroid disorders emerge early, and are reported less frequently, in the sample. Pituitary defects were absent, suggesting secondary thyroid disorders are also uncommon in this sample and overall results indicate that thyroid disorders are more prevalent in the younger and middle age population, but normal thyroid function is generally prevalent across this assessment. Morgan et al., (1994) [10] observed a significantly higher frequency of primary hypothyroidism (4.9%) and subclinical hypothyroidism (6.3%).

Biochemical profiling supports the clinical classification of thyroid disease. Euthyroid subjects demonstrated normal mean levels for TSH (2.4 µIU/ml), fT4 (11.6 pg/ml) and fT3 (2.4 pg/ml), confirming physiological homeostasis. Hypothyroid patients had significantly lower and fT4 (4.8 pg/ml), fT3 (1.2 pg/ml) and TSH was markedly elevated (32.1 µIU/ml), indicating primary thyroid failure. Subclinical hypothyroidism had only modest changes with fT3 being mildly low (1.9 pg/ml), fT4 roughly normal (9.6 pg/ml) and TSH modestly raised (7.5 µIU/ml), highlighting that early dysfunction of the thyroid may go clinically unrecognized. Hyperthyroid subjects had elevatedand fT4 (26.0 pg/ml) and fT3 (7.6 pg/ml) with suppressed TSH (0.3 µIU/ml), consistent with negative feedback in the hypothalamic-pituitary-thyroid axis.

Subclinical hyperthyroid patients showed similarly small hormone derangements associated with low TSH levels (0.4 µIU/ml), and patients with pituitary defects had elevations in thyroid hormones (fT4: 20 pg/ml, fT3: 5.8 pg/ml) with either inappropriately normal or mildly raised TSH levels (9.6 µIU/ml), suggesting secondary dysregulation. These findings are consistent with what is known about primary and secondary mechanisms affecting the regulation of thyroid glands and provide support for the use of hormone profiling for hypothesis-driven classification. Wiersinga et al. (1995) [11] observed a 25% prevalence of thyroid dysfunction in the Dhulikhel district near Kathmandu Valley, which includes 8% subclinical hypothyroidism, 8% hypothyroidism, 3% hyperthyroidism and 6% subclinical hyperthyroidism.

Gender-related comparisons indicated that fT3 (2.63 ± 1.51 pg/ml) and fT4 (11.5 ± 4.62 pg/ml) mean levels were slightly higher in females than in males (fT3: 2.48 ± 1.32 pg/ml and fT4: 11.2 ± 3.85 pg/ml) differences were statistically significant. TSH levels were similar between genders, suggesting that while there are minor differences in hormone concentrations, activity at the level of the pituitary-thyroid axis is similar in males and females. This observation may be in line with previous studies that have suggested females may have slightly higher thyroid hormones because of hormone influence, nevertheless the feedback loops through TSH remained constant across sex Strieder et al. (2003) [12] identified a higher prevalence of thyroid disorders in individuals in their third decade of life, with a predominance of females.

In conclusion, this research indicates that euthyroidism is the predominant thyroid status among all age groups, and the most common disorder after euthyroidism is subclinical hypothyroidism. The hormone profiles are closely aligned with the expected pathophysiology of primary and secondary thyroid disorders and although there are some minor gender differences in circulating thyroid hormones, TSH regulation seems comparable across genders. The implications of this finding underscore the importance of screening to help identify disorders earlier especially among cases of subclinical thyroid disorders to avoid progression to overt thyroid disease and that screening in younger and middle-aged adults may be most prudent.

Conclusion

In conclusion, this study offers a detailed report on thyroid function and prevalence of thyroid disorder in patients attending a tertiary care hospital. It is evident, from this study, that patients attending the clinic have normal thyroid function across all age groups, while subclinical hypothyroidism was a more frequent finding. Timely diagnosis of even subtle changes in thyroid function is necessary. Overt hyperthyroidism and hypothyroidism was less frequent, with hyperthyroid patients presenting mandatorily young, and pituitary secondary disorders presenting rarely. Assessment of the various biochemical profiles was consistent with our expected diagnosis and primary and secondary pathophysiological processes. Deviation from the normal reference ranges for fT3, fT4, and TSH all aligned with appropriate clinical diagnosis. When comparing sexes, thyroid hormone levels were marginally higher in females, and TSH regulation was maintained which supports a consistent hypothalamic-pituitary-thyroid axis. Collectively, these results allow us to consider the value of routine thyroid function assessment, especially in young to middle aged adults, where detecting subclinical disorders may result in interventions to deter overt disease.

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