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Research Article

Prevalence of Thyroid Dysfunction and Antithyroid Antibodies in North India

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Abstract

Background: Thyroid hormones control metabolism and growth functions. Incidence of thyroid dysfunction – hypothyroidism, hyperthyroidism, and autoimmune disorders are on the rise. There are minimal data reports regarding thyroid disorders prevalence in North India. The present study aims to report their prevalence in the general population.

Methods: The current retrospective study was conducted at a tertiary care institute for five years. Archives of thyroid function tests (Free T3 [FT3], Free T4 [FT4], and Thyroid-stimulating Hormone [TSH]) and antithyroid antibodies (Antithyroid Peroxidase and Anti-thyroglobulin) were screened. Duplicate/repeated test entries and follow-ups were excluded. For data analysis, the study population was grouped into hypothyroid (low FT3, low FT4, and high TSH), hyperthyroid (high FT3, high FT4, and low TSH), and others – including all other biochemical patterns. Statistical analysis was done using the IBM-SPSS software, version 20.

Results: Out of the initially screened 16,884 patients, a total of 12,775 meeting inclusion criteria were included in the study. The overall prevalence of thyroid dysfunction was 24% (3133/12,775). Hypothyroidism was most prevalent, constituting 51% (1603/3133), followed by hyperthyroidism in 26% (819/3133). The majority affected were females – 68% (2136/3133), commonly occurring in the 18–35 years of age range. The prevalence of antithyroid antibodies was 34% (1073/3133), anti-TPO constituted 77.6% (833/1073), and anti-thyroglobulin antibodies 22.4% (270/1073).

Conclusion: The prevalence of thyroid disorders is high in North India. Females in reproductive age group of 18–35 years are commonly affected. Study aids in early recognition of vulnerable populations for timely treatment of thyroid disorders.

Keywords: thyroid function, TSH, autoimmunity, anti-TPO

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1. Introduction

Thyroid gland is an endocrine gland located in the anterior inferior part of neck. The gland regulates the formation and secretion of the thyroid hormones as well as maintaining iodine homeostasis [1]. The thyroid produces approximately 90% inactive thyroid hormone – thyroxine (T4) – and 10% active thyroid hormone – triiodothyronine (T3) [2]. Thyroid hormones are responsible for controlling metabolism, growth, and other metabolic functions. Thyrotropin- releasing hormone (TRH) from the hypothalamus and thyroid-stimulating hormone (TSH) from the anterior pituitary gland work in harmony to maintain the formation and secretion of thyroid hormones [3]. The clinical features manifested in hypothyroidism are: weight gain, slowness of speech, dry skin, coarse and brittle hair, where as those associated with hyperthyroidism are: weight loss, tachycardia, fatigue, tremor, anxiety, disturbed sleep, and heat intolerance [4]. The global prevalence of overt hypothyroidism and subclinical hypothyroidism ranges from 4 to 5% and 4 to 15%, respectively [5].

Thyroid dysfunction disorders pose a significant burden in India, with as many as 42 million people affected in the country [6]. The common thyroid disorders in India are hypothyroidism, hyperthyroidism, Hashimoto thyroiditis, goitre, and iodine deficiency disorders [7]. In India, very limited studies are available that have assessed the nationwide prevalence of thyroid disorders. In an epidemiological study conducted over various parts of the country, the overall prevalence of hypothyroidism was found to be 10.95%, and hyperthyroidism constituted up to 3% [8]. The prevalence of thyroid disorders is highest in the state of Uttar Pradesh, with thyroid disorders constituting up to 27.2%, as stated by Chaudhary *et al*. [9]. In another study by Ahmad *et al.*, in Meerut district of Uttar Pradesh, the prevalence of hypothyroidism was found to be 16% [10].

Autoimmune thyroid disorders are most common among endocrine disorders and also have high prevalence among Indian population [11]. Therefore, for early diagnosis and appropriate treatment of these autoimmune thyroid disorders, study of thyroid antibodies is crucial. Moreover, many epidemiological studies have indicated a high anti-TPO titre in the subclinical hypothyroid patients, and such patients have an increased tendency to convert to overt hypothyroidism. These antibodies are mainly against thyroid peroxidize (TPO), thyroid-stimulating hormone receptor (TSHR), and anti-thyroglobulin [12].

In a developing country like India, there is a deficiency of iodine leading to high prevalence of thyroid dysfunction disorders. In order to control this, National Iodine Deficiency Disease control program is running in the country since 1989 [13].

The current study highlights the prevalence of thyroid disorders and antithyroid antibodies mainly in North India. The study will serve as an aid to identify vulnerable age groups for thyroid disorders and early management of the disease while also strengthening the input for National Iodine Deficiency Disease control program currently operating in the country.

2. Materials and Methods

This retrospective study was conducted on a five-year archives (September 2018–August 2023) of a Tertiary Medical Care Institute – Rama Medical College, Uttar Pradesh – with the approval of

ethical committee. A total of 16,684 test results of patients who had undergone thyroid function tests (Free T3, Free T4, and TSH) and antithyroid antibodies (antithyroid peroxidase and antithyroglobulin) were screened for the study.

Archived results of all males and females above the age of 18 years were retrieved. All untreated, newly diagnosed patients with thyroid dysfunction were included in the study. Duplicate/repeated test result entries and follow-up patients on treatment were excluded. A total of 12,775 test results were gleaned for this study. Details of patients' demography, results of thyroid function tests and antithyroid antibodies were collated and analyzed.

The patient population with biochemical evidence of any of the thyroid dysfunction patterns (I–VI) listed below were included. For data analysis, the study population were grouped as: (1) Hypothyroid (low FT3, low FT4, and high TSH); (2) Hyperthyroid (high FT3, high FT4, and low TSH); and (3) Others that included the biochemical patterns from III–VI from the following list.

Different biochemical patterns of thyroid function test included in the study are [14]: (I) Low FT3, low FT4, and high TSH (Hypothyroid group);

(II) High FT3, high FT4, and low TSH (Hyperthyroid group);(III) Low TSH and normal FT4 and/or FT3;(IV) High TSH and normal FT4 and/or FT3;(V) Low FT4 (and/or low FT3) within appropriately normal or low TSH; and

(VI) High FT4 (and/or FT3 within appropriately normal or high TSH.

Following the American Thyroid Association, FT3 range value of 2.30–4.20 pg/ml was taken as normal, FT4 range value of 0.89–1.76 ng/dl and TSH range value up to 5 mili IU/ml were taken as normal. Anti-TPO antibody was assessed using two-step immune enzymatic (sandwich) assay. Anti-TPO value of ≥35 IU/ml was taken as positive and <35 as negative. The cut-off value for anti-thyroglobulin was taken as 125 IU/ml [15].

Statistical analysis was done using the Statistical Package for Social Sciences (IBM - SPSS software, version 20.0). Descriptive data were presented as Mean ± SD and percentage.

3. Results

A total of 12,775 samples were submitted to the institute for thyroid function test (FT3, FT4, and TSH) and presence of thyroid antibodies (anti-thyroperoxidase and anti-thyroglobulin). Out of the total 12,775 patients, the prevalence of thyroid dysfunction was found to be 24% (3133/12,775) and 76% were euthyroid (Figure **1**).

More than two-third of the patients (68% [2136/3133]) with thyroid dysfunction were females, whereas males constituted 32% (997/3133) (Table 1). Hypothyroidism (51%, 1603/3133) was the most common thyroid dysfunction seen, followed by hyperthyroidism (26%, 819/3133) and others 23% (Table 1).Autoimmune thyroiditis was present in 34.2% (1073/3133) of the patients with thyroid dysfunction, and raised anti-TPO was reported in 77.6% (833/1073) and anti-thyroglobulin in 22.4% patients (240/1073) (Figure **2**).

3.1. Age distribution pattern

In the current study, female and male patients were divided into three age groups – (I) 18 to 35 years, (II) 36 to 55 years, and (III) >55 years. The majority of female patients with hypothyroidism (64%) were in the age group 18–35 years, while the least (5%) were >55 years of age (Table 1). Similar trends were seen among male population with maximum male

hypothyroid patients (42%) recorded among 18–35 years age group (Table 1).

Furthermore, the majority of primary cases of female hyperthyroid (70%) were also reported in the age group 18–35 years (Table 1). Male patients with hyperthyroidism were also common in the 18–35 years age group (42%; Table 1).

The distribution of raised anti-TPO antibodies was maximum among females (95%, 787/833) as compared to males (5%, 46/833). Majority of the patients (both male and female) with raised anti-TPO levels were from 36–55 years age group (46% and 61%, respectively). However, maximum levels of anti-thyroglobulin were among female >55 years of age (37.3%) and males in the age group 36–55 years (48%; Table 2).

3.2. Gender distribution Pattern

Out of the total 1603 reported patients of hypothyroidism, majority were females (51%) and male hypothyroid patients made up to 36%. Similar trend showing female predominance (75%) was seen among hyperthyroid patients (Table 1).

4. Discussion

The current study reports the prevalence of various thyroid dysfunction disorders in a clinical setting in addition to measuring the occurrence of antithyroid antibodies in affected individuals.

Thyroid hormones play an important role in the development and maintenance of normal metabolic processes throughout life. Thyroid dysfunction affects the functioning of various systems – gastrointestinal tract, fertility, cardiovascular and central nervous system [16]. Therefore, it is of real significance to report their prevalence in general population and take the necessary preventive and corrective measures to treat thyroid dysfunction. Various etiological factors for thyroid dysfunction are hereditary causes, dietary deficiency of iodine, drugs and radiation exposure, stressful life events, infectious agents, and geographical conditions, for example, sub-Himalayan region of India is affected [17, 18]. The prevalence rate of thyroid disorders in a specific area can be correlated with etiological factors, and definite preventive measures can be taken. In the current study, the overall prevalence of thyroid disorders was 24%. Most of the thyroid disorders showed female predominance (68%). Gopaliah *et al.*, in their Indian study, reported prevalence of thyroid disorders as 16% with majority population being females [19]. Similarly, Gedam *et al.* at a tertiary hospital in Mumbai reported a prevalence of thyroid disorders in 14.5% population with majority of female patients [20]. In North India, Gairola *et al.* conducted a study in Uttarakhand state and found the prevalence of thyroid dysfunction disorders as 40% [21]. Gopal *et al.* in their study across the country reported the prevalence range for thyroid disorders varying from 8 to 39% (from Jammu and Kashmir to Tamil Nadu) [22]. This high prevalence rate of thyroid disorders in our study can be contributed to the proximity of our location to Himalayan region population and being a tertiary center that attends to rural population from nearby and far mountain regions.

In the current study, the affected population were mainly females of 18–35 years. These findings corroborated previous studies by Gairola *et al.* and Kumar *et al.* who reported thyroid dysfunction mainly in females of 21–35 years [21, 23]. Recently, Poojary *et al.* also reported similar findings in their study with affected female population of 55% and male population of 45% [24]. The age group affected the most with thyroid

Table 1: Prevalence of thyroid dysfunction in females and males.

Case distribution in female age group (yrs)	**Hypothyroid (low FT3, FT4, & high TSH)**	**Hyperthyroid (high FT3, FT4, & low TSH)**	**Other thyroid dysfunction**
18–35 1324 (62%)	662 (64%)	436 (70%)	226 (46%)
36–55 534 (25%)	315 (31%)	126 (21%)	93 (19%)
>55 278 (13%)	48 (5%)	58 (9%)	172 (35%)
Total females (2136)	1025	620	491
Case distribution in male age group (yrs)	**Hypothyroid (low FT3, FT4, & high TSH)**	**Hyperthyroid (high FT3, FT4, & low TSH)**	**Other thyroid dysfunction**
18–35 408 (41%)	297 (51%)	84 (42%)	27 (12%)
36–55 349 (35%)	243 (42%)	36 (18%)	70 (32%)
>55 240 (24%)	38 (7%)	79 (40%)	123 (56%)
Total males (997)	578	199	220

Table 2: Prevalence of antithyroid antibodies in females and males.

Female age group (yr)	**Anti-TPO antibody**	**Anti-TG antibody**
18–35	317 (40%)	72 (32%)
36–55	362 (46%)	69 (31%)
>55	108 (14%)	84 (37%)
Total females	787	225
Male age group (yrs)	**Anti-TPO antibody**	**Anti-TG antibody**
18–35	7 (15%)	4 (26%)
36–55	28 (61%)	7 (48%)
>55	11 (24%)	4 (26%)
Total males	46	15

dysfunction involves females of reproductive age. Reasons for this reproductive age group preponderance are increased physiological demand in the reproductive age group, low iodine content of the diet resulting from iodine-deficient soil in this region, nutritional deficiency mainly deficient in iron along with other micronutrient deficiency (e.g., selenium), and presence of goitrogens in diet [25]. Additionally, autoimmune thyroid dysfunction is more common in women of reproductive age group. This female predominance can be attributed to sex differences in immune function, presence of antithyroid antibodies in women as well as B-cell and T-cell infiltration leading to autoimmune etiology in females of childbearing age [26].

4.1. Hypothyroidsim

The current study recorded the prevalence of hypothyroidism as 51%. The findings of our study are similar to other Indian studies such as those by Janitkar *et al.* [27] and Chandey *et al.* [28] who reported majority cases of hypothyroidism (67% and 60%, respectively) among females of

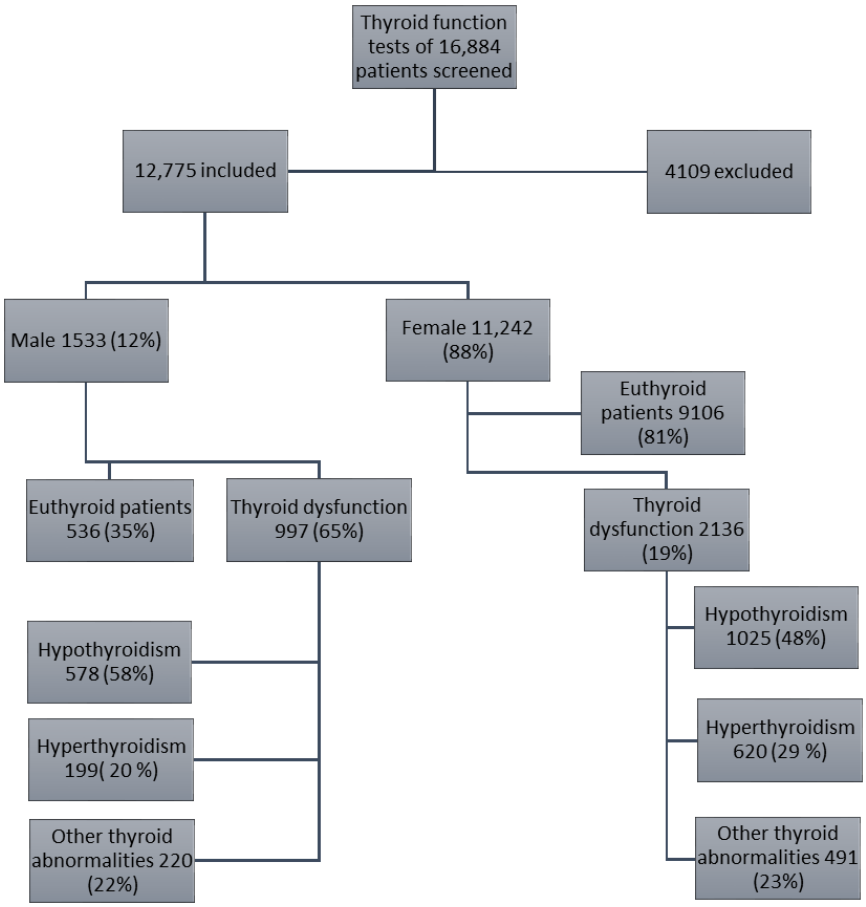

Figure 1: Prevalence of various thyroid disorders.

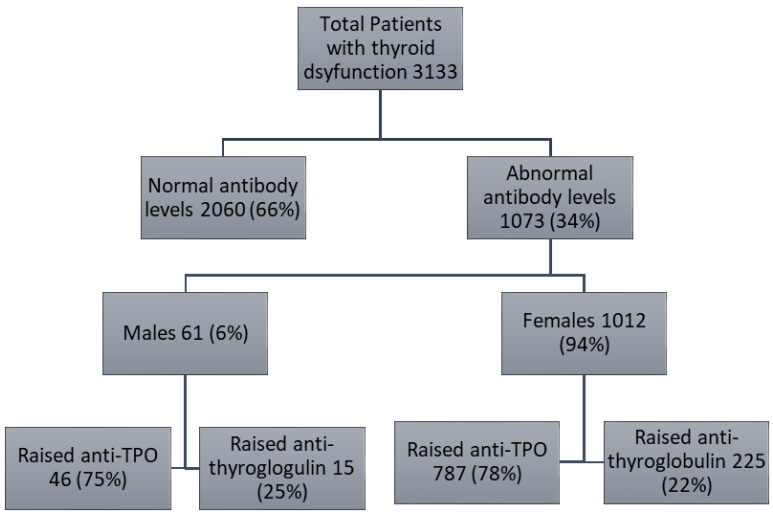

Figure 2: Prevalence of antithyroid antibodies.

reproductive age. The prevalence of hypothyroidism varies across the nation with high rate in Cochin and Kolkata, which ascertains the fact that it is not only prevalent in Himalayan region but also in plain fertile areas. This finding may be due to the presence of cyanogenic food items, agricultural and industrial contaminants that disrupts the thyroid receptor, thus affecting their

function [25, 29]. Clinical screening, along with laboratory confirmation with thyroid function tests should be carried out in females of reproductive age group for early diagnosis and treatment of hypothyroidism.

4.2. Hyperthyroidism

The overall prevalence rate of hyperthyroidism was 26%. The current study reports slightly higher prevalence rate of hyperthyroidism (26%) as compared to other Indian studies by Gairola *et al.*, Deshmukh *et al.*, Bose *et al.*, and Abraham *et al*. who observed low prevalence of hyperthyroidism (21%, 5%, 15%, 18%, respectively), however, the affected population in all the studies was females of reproductive age, which is similar to our study [21, 30–32]. Nevertheless, the prevalence rate for hyperthyroidism varies across the country, with as low as 3% reported by Unnikrishnan *et al.* in Cochin [6]. Gender distribution pattern in the current study was similar to other Indian case studies where females aged 20–40 year were affected three times to that of male population [6, 22]. Variability in etiological factors account for different prevalent rates for hyperthyroidism across India. Various contributory factors include endogenous abnormalities of serum FT3- and FT4-binding proteins and peripheral resistance to T3 and T4 along with secondary factors such as use of medications such as dopamine, selenium deficiency, low serum TSH levels during pregnancy and psychiatric illness [32].

Thyroid dysfunction in pregnancy comes with a risk of affecting the newborn child. This directly results in cretinism, a consequence which is totally preventable but unfortunately gets inherited to next generation [12].

Measuring the levels of anti-TPO autoantibodies is reported to be significant in diagnosing autoimmune thyroid diseases and predicting their clinical course [33]. In the current study, out of the total patients tested for TFTs, antithyroid antibodies were positive in 34% patients which is slightly higher as compared to other Indian studies by Ganie *et al.* (13.4 %) in sub-Himalayan region and Unnikrishnan *et al.* (20%) across various southern states [17, 34]. This can be due to difference in ethnicity and genetic predisposition to formation of autoantibodies among various populations. Besides this, these variations can be due to analytic variations like lack of international standards and use of different cut-offs to define positivity in different parts of the country [17].

Antithyroid peroxidase antibody (77.6%) was three times more positive than anti-thyroglobulin antibodies (22.4%) highlighting their significance and female population showed predominance over males. These observations were similarly recorded by Indian authors Jayashankar *et al.* (80%) and Mohanty *et al*. (74%) in their studies [35, 36]. The findings of the current study also correlated with an international study by Bjoro *et al.* among Norwegian inhabitants where female population of 21–40 years was affected with autoimmune thyroiditis [37]. The current study validates that antithyroid antibodies are found positive in females of reproductive age (18–35 year) with autoimmune thyroiditis. Ghoraishian *et al.* and Swain *et al.* also reported elevated levels of antithyroid antibodies among similar age group [38, 39]. Elevated anti-TPO levels are associated with many antenatal complications. Therefore, pregnant females with anti-TPO positive status are to be vigilantly monitored for early detection and treatment of various antenatal complications and further ruling out autoimmune thyroiditis [12].

However, our study has few limitations like clinic-radiological correlation was not taken into account, which if done, could have further strengthened the results. Second, direct correlation of thyroid dysfunction and the iodine levels of the selected population were not done as there was no testing performed for iodine levels in the salt samples of the region or urinary excretion of iodine.So, we suggest that larger multicenter epidemiological studies be conducted in the region to find the prevalence rate of thyroid dysfunction and identify the etiological factors, so that taking more effective preventive measures could result in further strengthening of the National Iodine Deficiency Disorders Control Programme.

5. Conclusion

The current study highlights the fact that the prevalence rate of thyroid dysfunctional disorders is high among North Indian population. Females are affected more than males and dysfunctional disorders are most commonly observed in the third decade of life. Thyroid function tests and antithyroid antibody analysis is pivotal for prompt identification of at-risk population and timely treatment.

Declarations

Acknowledgements

None.

Ethical Considerations

This retrospective study was conducted on five-years archives (September 2018–August 2023) of a tertiary medical care institute, Rama Medical College, Uttar Pradesh after the approval of ethical committee. The letter number IEC/PATH/21 granted permission to conduct the present study.

Competing Interests

None.

Availability of Data and Material

All presented in this article shall be available upon reasonable request to the corresponding author.

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None.

Abbreviations and Symbols

T3: Triiodothyronine

T4: Tetraiodothyronine

FT3: Free Triiodothyronine

FT4: Free Tetraiodothyronine

TSH: Thyroid-stimulating hormone

TRH: Thyrotropin-releasing hormone

Anti TPO: Antithyroid peroxidase antibodies

TSHR: Thyroid-stimulating hormone receptor

TFTs: Thyroid function tests

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