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RESEARCH ARTICLE

A Comprehensive Analysis of Clinical and Laboratory Characteristics of Thyroid Abnormalities in a Two-Year Outpatient Cross-Sectional Study

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ABSTRACT

Background: The prevalence of thyroid disorders, particularly disseminated Graves' disease and thyroid nodules, is escalating within the general population. Irregular activation of the immune system is a key factor in causing autoimmune thyroid diseases such as Graves' disease and Hashimoto thyroiditis. However, the development of autoimmune disorders is influenced by a combination of environmental factors such as urbanization, pollution, and iodine intake.

Methods and Results: The study involved 204 patients with thyroid disorders at the department of endocrinology in the outpatient clinic over the past 2 years. The data collection of demographical and clinical information included age, gender, clinical features, laboratory tests, and instrumental analysis. The mean age of participants was 44.35±14.29 years, and females comprised 91.2% of the cases. Among them, 46.1% had thyroid nodules, 36.8% presented with Grave's disease, 13.2% with Hashimoto's thyroiditis, and 3.9% with thyroid hyperplasia. The patients with Grave's disease, the average levels of thyroid antibodies were as follows: anti-thyroid stimulating hormone receptor (Anti-TSHR) at 21.91±14.02 IU/L, anti-thyroglobulin (Anti-TG) at 265.91±406.03 IU/ml, and anti-thyroid peroxidase (Anti-TPO) at 319.3±327.1 IU/ml, respectively. Additionally, the mean thyroid enlargement was 29.60±16.08 ml. The participants were categorized based on their geographical region, with the distribution as follows: central region 59.3%, northern region 20.1% western region 10.8%, and eastern region 9.8%.

Conclusion: Thyroid disorders are prevalent in our population, with greater incidence in females than males. The majority of cases (46.1%) involved thyroid nodules, with a peak age of above 30 years among participants. The central region, particularly the capital city (Ulaanbaatar), exhibited the highest prevalence at 59.3%, as highlighted by the distribution of thyroid abnormalities.

Keywords: thyroid dysfunction, hyperthyroidism, hypothyroidism, thyroid antibodies

1. Introduction

Thyroid disorders, particularly Graves' disease, and nodular thyroid disease are experiencing a concerning increase among endocrine disorders worldwide. Understanding the prevalence of thyroid abnormalities is crucial for guiding healthcare policies and interventions effectively. Graves' disease and Hashimoto's thyroiditis, are both common and autoimmune thyroid diseases that are affected by various factors including age, gender, urbanization, air and soil pollution, and iodine consumption (deficiency or adequacy)^{1,2}. On the other hand, Grave's disease represents the most common cause of hyperthyroidism, characterized by autoimmune stimulation of thyroid function. It's primarily mediated by the production of stimulating autoantibodies targeting the thyroid-stimulating hormone receptor (TSHR), known as an anti-TSH-R antibody. That affects thyroid stimulating hormone (TSH) resulting in uncontrolled thyroid hormone synthesis and secretion, leading to hyperthyroidism^{3,4}. Hashimoto's thyroiditis, also known as chronic lymphocytic thyroiditis, occurs as lymphomonocytic inflammation of the thyroid gland, causing progressive destruction of thyroid tissue. This autoimmune process leads to an increase in serum levels of anti-thyroid peroxidase (anti-TPO) and anti-thyroglobulin (anti-TG) antibodies, that are directed against key factors of thyroid hormone synthesis^{5,6}. The current global estimates indicate that approximately two billion individuals are at risk of iodine deficiency, while in 24 countries, iodine-induced hyperthyroidism or other adverse health effects^{7,8}. For instance, data from 2021 provided by UNICEF reveals that 75.1% of the population in Mongolia consumes iodized salt⁹.

Moreover, understanding the biochemical profiles associated with different thyroid disorders is essential for accurate diagnosis and treatment strategies. Parameters such as thyroid-stimulating hormone (TSH) levels and thyroid antibody titers can provide valuable diagnoses, prognostic insights, and recommendations to help clinicians make decisions and patient care¹⁰.

Geographical variations in thyroid disease distribution have also been observed, reflecting differences in environmental factors, genetics, and healthcare access. By identifying regional differences in thyroid prevalence, we aim to understand the impact of sociodemographic and environmental factors on the disease, facilitating interventions and resource allocation. Despite these concerns, there are no studies on the epidemiology of thyroid diseases in Mongolia. Therefore, the main aim of this study is to determine the frequency and clinical characteristics of thyroid disease in the outpatient clinic of First Central Hospital.

2. Materials and methods

This population-based cross-sectional study was conducted at the Department of Endocrinology in the Outpatient Clinic of the First Central Hospital in Ulaanbaatar, Mongolia. The Health Ethics Committee of First Central Hospital provided approval for the study protocol, and all participants informed consent statements. The data were collected for two years between the periods from February 2015 to February 2017.

The study enrolled the patients diagnosed with thyroid disorders based on clinical manifestations, laboratory tests, and

instrumental assessments. Inclusion criteria involved participants who voluntarily completed comprehensive laboratory and instrumental evaluation. Moreover, participants were required no clinical or laboratory evidence of chronic disease including liver disease, renal disease, metabolic syndrome, or active malignancy. Conversely, exclusion criteria covered individuals with incomplete laboratory and instrumental tests, those with co-morbidities, or blood disorders, individuals taking certain medications that could induce thyroid dysfunction, and those who declined participation.

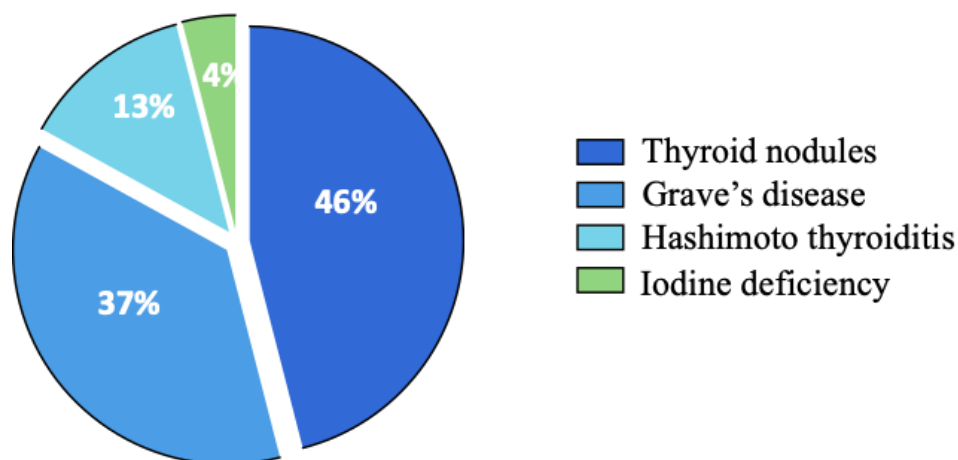
Serum thyroid hormone analysis (T3, free T4, TSH) was performed using radioimmunoassay and electrochemiluminescence methodologies. The quantification of thyroid-specific antibodies, including Anti-TPO, Anti-TG, and Anti-TSHR, were assessed by a fully automatic immunological analyzer "Cobas e411" in Roche, Germany, at the laboratories of First Central

Hospital, UB-Songdo, and Mobio Hospital. The structural assessment of the thyroid gland was conducted by ultrasound machine "Mindray" at the First Central Hospital. All aspects of data cleaning and editing were done manually and with the computer. Demographic and baseline characteristics of the patients were presented in terms of means and standard deviation (SD), while categorical data were expressed as percentages. The statistical analysis was performed by SPSS 20.0 software.

3. Results

The study includes a total of 204 patients with thyroid abnormalities, aged between 18-86 years (mean age: 44.35 ± 14.29). Among these cases, 94 (46.1%) were diagnosed with thyroid nodules, 75 (36.8%) with Grave's Disease (GDs), 27 (13.2%) with Hashimoto's Thyroiditis (HTs), and 8 (3.9%) with iodine deficiency disorders (Figure 1).

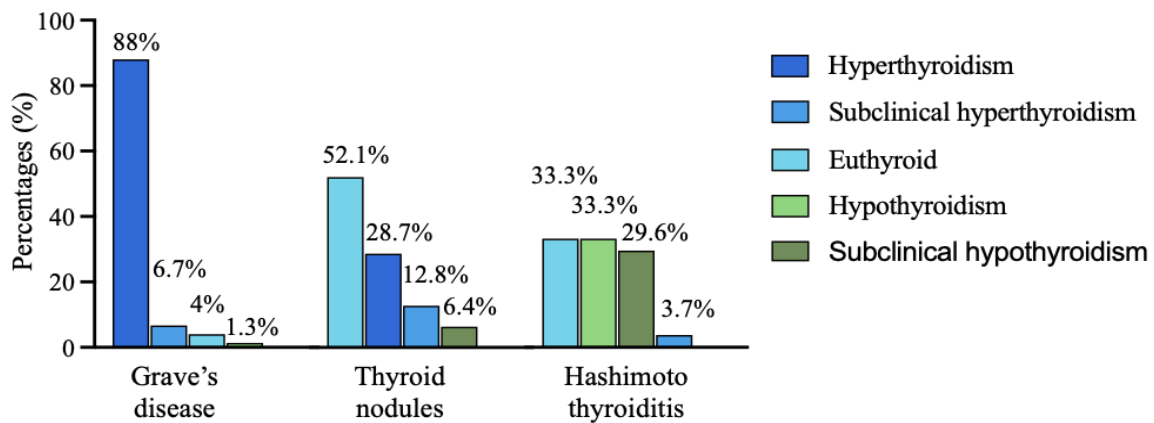
Figure 1. Identification of percentages of thyroid abnormalities. This figure illustrates the distribution of thyroid disorders among participants in the outpatient clinic in the past 2 years. The results highlighted the majority of cases were thyroid nodules.



We identified among the observed cases of Grave’s disease, hyperthyroidism was 66 (88%), subclinical hyperthyroidism was 5 (6.7%), euthyroid was 3 (4%), and drug-induced hypothyroidism was 1 (1.3%) respectively. Further analysis of thyroid status in individuals with thyroid nodules, hyperthyroidism 27 (28.7%), subclinical hyperthyroidism 12

(12.8%), and euthyroid 49 (52.1%), subclinical hypothyroidism 6 (6.4%). In the context of Hashimoto thyroiditis, the study identified 9 (33.3%) cases in the euthyroid state, 8 (29.6%) with subclinical hypothyroidism, 9 (33.3%) hypothyroidism, and 1 (3.7%) with subclinical hyperthyroidism (Figure 2).

Figure 2. Frequency distribution of included patients based on their diagnostic outcomes. The bar chart illustrates the prevalence of thyroid status in patients with Grave’s disease, thyroid nodules, and Hashimoto thyroiditis. Hyperthyroidism is predominant in Grave’s disease while thyroid nodules and Hashimoto thyroiditis exhibit a varied distribution of thyroid statuses.



In patients with Grave’s disease presenting with hyperthyroidism, the average TSH level was 0.025 ± 0.039 uIU/ml. The antibody level showed the following averages: Anti-TG 265.91 ± 406.03 IU/ml, Anti-TPO 319.3 ± 327

1IU/ml, Anti-TSHR 21.91 ± 14.02 IU/L. Additionally, the average volume of the thyroid gland in these individuals was 29.6 ± 16.08 ml (Table 1).

Table 1. Characteristics of thyroid parameters in main thyroid disorders

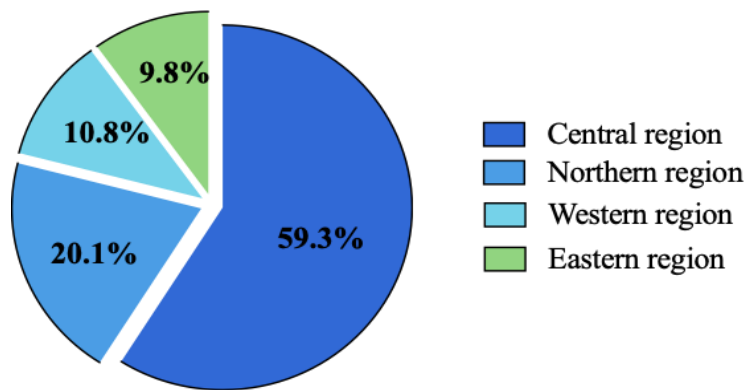
Groups	GD (hyperthyroidism)	TN (euthyroid)	HT (hypothyroidism)
TSH (μ IU/ml)	0.025 ± 0.03	1.55 ± 0.98	32.51 ± 30.17
Anti-TG (IU/L)	265.91 ± 406.03	139.12 ± 582.75	637.34 ± 329.24
Anti-TPO (IU/ml)	319.31 ± 327.10	57.83 ± 163.95	850.91 ± 276.82
Anti-TSHR (IU/L)	21.91 ± 14.02	-	-
Thyroid volume (ml)	29.60 ± 16.08	17.18 ± 14.40	22.10 ± 16.55

TSH: Thyroid stimulating hormone, *Anti-TG*: Thyroglobulin antibodies, *Anti-TPO*: Thyroid peroxidase antibodies, *Anti-TSHR*: Thyroid stimulating hormone receptor antibodies. All values are presented as mean \pm SD.

The regional distribution of patients with thyroid disease in the current study demonstrated significant variability across different areas. A total of 204 patients were included in the analysis, with the central region accounting for

the majority with 121 (59.3%) cases. The northern region comprised 41 (20.1%) cases, the western region had 22 (10.8%) cases, and the eastern region exhibited 20 (9.8%) cases (Figure 3).

Figure 3. Geographic distribution of thyroid diseases. The pie chart shows, that among the study participants, the central region of Mongolia exhibited a significantly higher prevalence of thyroid abnormalities during the study period.



4. Discussion

The main findings of our study present epidemiology and clinical characteristics of thyroid abnormalities among 204 participants. The prevalence of thyroid nodules, diagnosed in 46.1% of cases, emphasizes the significance of this condition in our study of individuals. Additionally, we observed a variety of thyroid disorders, including Grave's disease (36.8%) and Hashimoto thyroiditis (13.2%). The American Association of Thyroid glands, the American Association of Endocrinology, and the European Association of Endocrinology have recommended thyroid ultrasound as a primary diagnostic tool for nodular thyroid disease^{11, 12}. Furthermore, the result of a recent study in Vietnam reported a similar prevalence of thyroid nodules (48.4%) to our current study (46.1%)¹³.

TSH is the most significant parameter in assessing thyroid function and diagnosing

Grave's disease¹⁴, while thyroid antibodies (anti-TSHR, anti-TG, anti-TPO) are necessary for differential diagnoses. In patients with Grave's disease, anti-TSHR is a key marker for diagnoses and evaluating treatment effectiveness (active or inactive), with reported increases ranging from 98-100%^{15,16}. Grave's disease cases revealed a predominance of hyperthyroidism, consistent with the autoimmune nature of the condition, and subclinical hyperthyroidism and euthyroid states were also observed. Interestingly, drug-induced hypothyroidism was identified in a small subset of patients, highlighting the importance of medication history in thyroid disease management. In our study, Hashimoto thyroiditis cases demonstrated a range of thyroid states, with a significant proportion presenting with hypothyroidism. Therefore, anti-TG and anti-TPO levels are elevated in patients with Hashimoto thyroiditis, consistent

with several other studies^{17,18}. Our previous study reported an average level of anti-TG and anti-TPO in patients with Hashimoto thyroiditis was much higher than in patients with Grave's disease¹⁹.

One of the studies represented thyrotoxicosis as the most common thyroid disorder in Mongolia, accounting for 56.2% from 2011 to 2020²⁰. Furthermore, the regional distribution of thyroid disease cases highlights geographical variability, with the central region exhibiting the highest prevalence²¹. Previous observational studies have shown that hypothyroidism is more commonly observed in iodine-deficient regions in the central region of Mongolia^{22,23} was similar in our study results. This observation may reflect environmental or genetic factors influencing thyroid health in specific geographic areas^{24,25}. Other Chinese researchers have highlighted that TSH levels were high in the north, and west regions, while patients from the south and east areas of China had low TSH²⁶. The researchers concluded that geographical factors, including topography, climate, and soil composition, influence TSH levels.

Further studies are warranted to elucidate the distributed characteristics and underlying mechanisms of thyroid diseases in these regions.

Conclusion

Thyroid nodules among participants highlight the significant prevalence of approximately 46,1% of individuals. A high prevalence of thyroid dysfunction is evident among females, with 91.2% exhibiting abnormalities, and within the central region. These findings contribute

to the importance of targeted screening and management strategies, particularly in high-risk populations and regions, to effectively address thyroid-related health conditions.

Conflict of Interest Statement:

The authors have no conflicts of interest to declare

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