

Thyroid Dysfunction and Prevalence of Both Clinical and Subclinical Form of Hypothyroidism and Hyperthyroidism in District Swabi, Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

Thyroid dysfunction is one of the most prevalent endocrine abnormalities, varies with age and gender. The study objective is to find thyroid dysfunction and the occurrence of clinical and subclinical hypothyroidism and hyperthyroidism in people of district Swabi, Khyber Pakhtunkhwa, Pakistan. Blood samples were taken from 104 people, and information was gathered via questionnaire. CLIA kit, Auto Bio Diagnostics LTD, China was used to detect TSH, T3, and T4 quantitatively by using Chemiluminescence Immunoassay (CLIA). Out of 104 individuals, 64 were females and 40 were males. A total of 24 people (23.04%) were affected by thyroid dysfunction, with 7 (17.5%) men and 17 (26.5%) women suffering from clinical and subclinical forms of hypothyroidism and hyperthyroidism, respectively. The occurrence of subclinical hypothyroidism was found to be the highest, with 10 cases (9.6%) recorded, followed by subclinical hyperthyroidism with 7 cases (6.7%), clinical hyperthyroidism with 4 cases (3.84%), and clinical hypothyroidism with 3 cases (2.9%). The study also revealed that the highest incidence of thyroid dysfunction occurred among individuals aged 31-40, with 6.73% affected, followed by those aged 41-50, with 5.8% affected. To conclude the women were more probable than men to have thyroid dysfunction in the area of District Swabi, and older people were more probable to have it than younger people. Iodine deficiency is the most typical cause, whereas in females, breastfeeding and pregnancy were the typical reasons.

Article Information

The article was presented in 42nd Pakistan Congress of Zoology (International) held on 23-25th April 2024, organized by University of Azad Jammu & Kashmir, Muzaffarabad, Pakistan.

Authors' Contribution

M conducted the survey, laboratory work, and data analysis, utilized software and prepared the results. M wrote the manuscript according to the journal guidelines. MR proofread the manuscript for English language, reviewed the manuscript before submission.

Key words

Thyroid dysfunction, Hypothyroidism, Hyperthyroidism, TSH

INTRODUCTION

The thyroid gland in vertebrates functions as an endocrine gland and is located in the neck region of humans. It consists of two lobes linked by a thin tissue band known as the thyroid isthmus. The gland is situated below the Adam's apple and has a spherical structure called the thyroid follicle, which functions as the fundamental unit of the thyroid gland. The composition of this follicle consists of cells known as follicular cells or thyrocytes, and may sometimes contain Para follicular cells that surround a lumen filled with colloid (Hall and Guyton, 2011). In adult

humans, the thyroid gland weighs approximately 25 g, and it is typically larger in women than in men. During pregnancy, the gland tends to become wider. Each lobe of the gland measures approximately 5 cm in length, 3 cm in width, and 2 cm in thickness, while the isthmus is about 1.25 cm in both height and width (Gray and Standring, 2008; Bogart and Ort, 2007). The thyroid gland produces three hormones: triiodothyronine (T3), thyroxine (T4), and the peptide hormone calcitonin. Thyroid hormones control growth and development in children while also influencing protein synthesis and metabolic rate. Calcium homeostasis requires calcitonin. Thyroid-stimulating hormone (TSH), which is secreted by the anterior pituitary gland, stimulates the secretion of the two thyroid hormones. The hypothalamus is responsible for the production of thyrotropin-releasing hormone (TRH), which controls TSH (Hall and Guyton, 2011). The hypothalamus discharges TRH into the hypothalamic-hypophyseal portal system of the anterior pituitary gland. TRH activates the thyrotropin cells in the anterior pituitary to release TSH. The peptide hormone TRH is synthesized by the cell bodies located within the periventricular nucleus

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1013-3461/2024/0017 \$ 9.00/0



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(PVN) of the hypothalamus and these cell bodies extend their neurosecretory neurons into the hypophyseal portal circulation, where TRH can collect before reaching the anterior pituitary (Braun and Schweizer, 2018). According to (Bauer, 2013), thyroid disease refers to a medical illness that impairs the thyroid gland's ability to function. It can happen to anyone, regardless of age or gender, although its frequency fluctuates in various regions as well as in various age and sex groups (Lamfon, 2008).

Due to a lack of iodine doses, incidences of thyroid issues have been reported in more than 110 countries around the world, exposing 1.6 billion people at risk. Africa, Asia, and Latin America make up the majority of these, along with other emerging countries. About 20 million people who live in iodine-deficient areas in Pakistan, among whom 8 million suffer from some form of iodine deficiency and about 1 million have mental issues (Lotfi *et al.*, 1996). Under or over secretion of hormones are the key features of thyroid disorders, which are distinguished by distinct symptoms and signs in both conditions. Underbalanced thyroid function or thyroid gland hypertrophy might have an impact on these conditions (Alam *et al.*, 2002). The primary disorders of the thyroid gland are endocrine diseases, where certain endocrine glands directly react to metabolic glands while others respond to hormones produced by the pituitary gland (Kasper *et al.*, 2015). Among all chronic problems, thyroid abnormalities are one of the more common. Their symptoms differ greatly from region to region and are highly calculated by the level of iodine in the diet. For the definition of overt hypothyroidism and subclinical hypothyroidism, the specimen selection process used, the impact of age, sex, genetic inheritance, and lifestyle exposures, the numerous methods used to evaluate thyroid hormones, and the comparative insufficiency of epidemiology are just a few of the drawbacks of randomized trials of thyroid issues (Vanderpump, 2005). Iodine deficiency affects nearly one-third of the global population (Zimmermann *et al.*, 2008). Mostly people with thyroid abnormalities in iodine-rich countries suffer from autoimmune diseases that can extend between primary necrotic hypothyroidism to Hashimoto's thyroiditis to graves disorder thyrotoxicosis. The incidence and transmission of thyroid antibodies in many primarily Caucasian communities were documented by inter investigations in Europe, the United States, and Japan (Vanderpump, 2005). Hollowell *et al.* (2002) reported that thyroid dysregulation rises the possibility of ischemic (decreased blood flow and oxygen), neurological problems, arthritis, dyslipidemia (imbalance of lipids), and metabolic disorders.

There are four main categories of thyroid disease (hypothyroidism, hyperthyroidism, structural

abnormalities and tumors). Symptoms of thyroid disease vary by type (Hall and Guyton, 2011). Hypothyroidism results from a reduced effect of thyroid hormone on tissues. It is more common in females, with a combined prevalence of 1% to 2% that increases with age (Canaris *et al.*, 2000). Hyperthyroidism occurs when the thyroid gland excessively produces thyroid hormones. The main states of hyperthyroidism are Graves' disease, toxic thyroid nodule, thyroid storm, toxic nodular stroma and hashitoxicosis. Approximately 1.2% of the population in the United States is affected by hyperthyroidism (Bahn *et al.*, 2011). The structural abnormality is an abnormal increase in size of the thyroid, including goiter, lingual thyroid, and thyroglossal duct cyst (Perros, 2007). Thyroid tumors, the clinical manifestation of thyroid cancer typically manifests as an expanding goiter or a single thyroid nodule. Despite the prevalence of thyroid nodules, thyroid cancer is uncommon (Perros, 2007).

MATERIALS AND METHODS

The study was conducted at Bacha Khan Medical Complex in Swabi Pakistan with a sample size of 104 individuals, randomly selected from the population under study. The data were collected through a survey questionnaire and by quantitatively estimating the levels of TSH, T3, and T4 hormones in the patients using a chemiluminescence immunoassay test. The study involved 40 male and 64 female subjects who underwent thyroid function tests to determine their thyroid status, which was classified as clinical, subclinical, or mixed hypothyroidism or hyperthyroidism. 5 cc of blood was taken from each subject, and the serum was used for further analysis to study the subjects' thyroid status.

Procedure adopted

The study involved blood samples being taken to the laboratory for analysis, where the levels of TSH, T3, and T4 hormones were measured using the chemiluminescence immunoassay (CLIA) method with AccuLite CLIA Micro Wells and TSH, T4, and T3 kits. The reference ranges for TSH, T3, and T4 were also established. Thyroid dysfunction was categorized into hyperthyroidism, subclinical hyperthyroidism, hypothyroidism, and subclinical hypothyroidism, each with its own specific hormone level changes. The TSH, T3, and T4 tests were conducted based on the principles of sandwich and competitive immunoassays, with each test having a total duration of about 18 min. The TSH test is used to measure the levels of TSH in a blood sample, while the T3 and T4 tests measure the levels of T3 and T4, respectively.

Data analysis

The analysis of the data was completed using two software prog: SPSS version 20 and Microsoft Excel version 2016. The appropriate statistical test used to analyze the results was the Chi-squared test. To determine the significance of the results, the p-value was calculated and considered significant if it was less than 0.05. The data obtained from the analysis were presented in various forms, including charts, tables, and statistical measures. The data was represented using different statistical measures such as percentages, frequencies, means, and standard deviations. These measures helped provide a better understanding of the data and insights into the results obtained from the analysis.

RESULTS

Table I shows the gender-wise distribution of clinical and subclinical forms of hypothyroidism and hyperthyroidism. Out of a total of 104 samples, 40 (38.5%) were males and 64 (61.5%) were females. The overall number of affected individuals was 24 (23.04%), with 7 (17.5%) being males and 17 (26.5%) being females. The ratio of clinical hypothyroidism was 3 (2.9%) in the total sample (Fig. 1), with 1 (2.5%) being male and 2 (3.1%) being female. The ratio of clinical hyperthyroidism was 4 (3.84%) in the total sample (Fig. 1), with 1 (2.5%) being male and 3 (4.7%) being female. On the other hand, the ratio of the subclinical form of both hypothyroidism and

hyperthyroidism was higher. The ratio of subclinical hypothyroidism was 10 (9.6%) in the total sample, with 3 (7.5%) being male and 7 (10.9%) being female. The ratio of subclinical hyperthyroidism was 7 (6.7%) in the total sample (Fig. 1), with 2 (5%) being male and 5 (7.8%) being female. The p-value was found to be 0.87, which is not statistically significant.

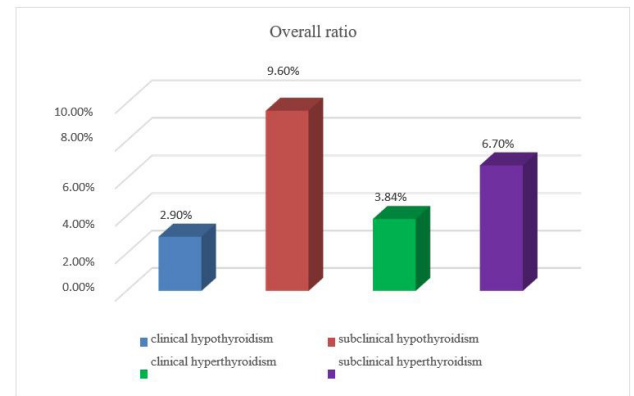


Fig. 1. Overall ratio.

Table II demonstrates the age-wise proportion of both clinical and subclinical forms of hypothyroidism and hyperthyroidism. The highest ratio of thyroid dysfunction was found in the age group 31-40 (6.73%), followed by the age groups 41-50 (5.8%). The occurrence of clinical

Table I. Distributions of thyroid dysfunctions in males and females.

Prevalence of thyroid dysfunction	Male =40	Female =64	Total =104	P- value
Clinical hypothyroidism	1 (2.5%)	2 (3.12%)	3 (2.9%)	0.87
Subclinical hypothyroidism	3 (7.5%)	7 (10.93%)	10 (9.6%)	
Clinical hyperthyroidism	1 (2.5%)	3 (4.7%)	4 (3.84%)	
Subclinical hyperthyroidism	2 (5%)	5 (7.8%)	7 (6.7%)	
Total	7 (17.5%)	17 (26.5%)	24 (23.04%)	

Table II. Distribution of thyroid dysfunctions in different age groups.

Age	Clinical hypothyroidism	Subclinical hypothyroidism	Clinical hyperthyroidism	Subclinical hyperthyroidism	Total
21-30	0 (0%)	1 (0.97%)	1 (0.97%)	2 (1.9%)	4 (3.84%)
31-40	1 (0.97%)	4 (3.8%)	1 (0.97%)	1 (0.97%)	7 (6.73%)
41-50	1 (0.97%)	3 (2.9%)	0 (0%)	2 (1.92%)	6 (5.8%)
51-60	0 (0%)	0 (0%)	1 (0.97%)	1 (0.97%)	2 (1.92%)
>-60	1 (0.97%)	2 (1.92%)	1 (0.97%)	1 (0.97%)	5 (4.80%)
P. value	0.93				

hypothyroidism was the same in the 31-50 and >60 age groups (0.97%), and it was not found in the 21-30 and 50-60 age groups. On the other hand, the occurrence of subclinical hypothyroidism was high in the 31-40 age group (3.8%), followed by the 41-50 age group (2.9%), and it was not found in the 51-60 age group. The prevalence of clinical hyperthyroidism was the same in all age groups (0.97%), except in the 41-50 age group where no cases were found. Conversely, the prevalence of subclinical hyperthyroidism was high in the 21-30 and 41-50 age groups (1.92%), followed by other age groups. The p-value was 0.93, which is statistically non-significant.

Table III. Mean, standard deviation, minimum and maximum values of thyroid hormones.

Thyroid hormones	Mean	SD	Minimum	Maximum
T3 (ng/ml)	1.05	0.41	0.04	3.27
T4 (µg/dl)	8.60	4.93	1.20	50.65
TSH (µIU/ml)	5.52	16.64	0.001	>100.00

Table III shows the mean, SD (standard deviation), maximum, and minimum values of the thyroid hormones T3, T4, and TSH. The mean of the T3 was 1.05, the SD was 0.41, the maximum value was 3.27, and the minimum value was 0.04. The mean of the T4 was 8.6, the SD was 4.93, the maximum value was 50.65, and the minimum value was 1.2. The mean of the TSH was 5.52, the SD was 16.64, the maximum value was greater than 100, and the minimum value was 0.001.

Table IV shows the standard deviation and mean of thyroid dysfunction levels by comparing thyroid hormone levels. The SD and mean of T3, T4, and TSH in normal individuals were 1.02 ± 0.25 , 8.06 ± 1.62 , and 1.66 ± 1.24 . In clinical hypothyroidism, the mean and SD of T3, T4, and TSH were 0.50 ± 0.52 , 5.18 ± 3.85 , and 35.13 ± 56.22 , respectively, while in subclinical hypothyroidism, they were 10.64 ± 1.39 , 5.52 ± 1.64 , and 33.82 ± 33.20 , respectively. Similarly, in hyperthyroidism, the mean and SD were 2.11 ± 0.96 , 25.03 ± 17.39 , and 0.23 ± 0.44 for T3, T4, and TSH, respectively, while in subclinical hyperthyroidism, they were 1.29 ± 0.23 , 10.65 ± 3.10 , and 0.72 ± 0.23 , respectively.

Table IV. Representation of dysfunction levels by comparing thyroid hormones levels.

Thyroid hormones	Normal (Mean±SD)	Hypothyroidism (Mean±SD)	Subclinical hypothyroidism (Mean±SD)	Hyperthyroidism (Mean±SD)	Subclinical hyperthyroidism (Mean±SD)
T3 (ng/ml)	1.02 ± 0.25	0.50 ± 0.52	10.64 ± 1.39	2.11 ± 0.96	1.29 ± 0.23
T4 (µg/dl)	8.06 ± 1.62	5.18 ± 3.85	5.52 ± 1.64	25.03 ± 17.39	10.65 ± 3.10
TSH (µIU/ml)	1.66 ± 1.24	35.13 ± 56.22	33.82 ± 33.20	0.23 ± 0.44	0.72

DISCUSSION

This study at Bacha Khan Medical Complex, Swabi Pakistan, aimed to determine the occurrence of clinical and subclinical hypothyroidism and hyperthyroidism. It involved 104 patients of different ages and genders, randomly selected from the outpatient department. Blood samples were taken and analyzed for TSH, T3, and T4 levels to diagnose thyroid dysfunction. Hypothyroidism is diagnosed with high TSH and low T3, T4 levels, while hyperthyroidism is identified with low TSH and high T3, T4 levels. The study aimed to identify risk factors for thyroid dysfunction in the local population. It was found that the overall prevalence of thyroid dysfunction in the population was 23.04%, with 2.9% having clinical hypothyroidism and 9.6% having subclinical hypothyroidism. Clinical hyperthyroidism was found in 3.84% of the population, while subclinical hyperthyroidism was found in 6.7%. The results indicate a significant number of undiagnosed cases and emphasize the importance of routine screening for early detection and treatment of thyroid dysfunction.

In previous studies conducted in Pakistan, Akhter *et al.* (2001) found a higher prevalence of clinical hypothyroidism (4.1%) and hyperthyroidism (5.1%), while subclinical hypothyroidism (5.4%) and hyperthyroidism (5.8%) were lower compared to the present study. Similarly, Alam *et al.* (2019) reported lower rates of clinical and subclinical hypothyroidism and hyperthyroidism in the District Mardan compared to the District Swabi. These studies also attributed thyroid dysfunction to iodine deficiency. In a study conducted in Libya by Nouh *et al.* (2008), the prevalence of clinical and subclinical hyperthyroidism was 0.84%, while clinical and subclinical hypothyroidism was 1.12% and 6.18%, respectively. These rates were lower than those found in the present study. In a study by Alanazi *et al.* (2018), involving 160 participants, 22.5% had thyroid disease. Among the cases, 30.5% had hyperthyroidism and 69.5% had hypothyroidism. The overall occurrence of thyroid dysfunction (22.5%) was similar to the present study (23.04%). According to Velayutham *et al.* (2015), the prevalence of hypothyroidism and hyperthyroidism was 7.3% and 0.3%, respectively. Strieder *et al.* (2003) found that 3.6% had hypothyroidism and 1.9%

had hyperthyroidism due to the presence of thyroid peroxidase autoantibodies. These results align with the current study, where hypothyroidism (2.9%) was higher than hyperthyroidism (3.84%). In contrast, [Moussa *et al.* \(2016\)](#) reported higher rates of hypothyroidism (56%) and hyperthyroidism (32.6%) in the Hail region of Saudi Arabia. According to [Vanderpump \(2019\)](#), hyperthyroidism occurs in women at a rate of 0.5-2%, while hypothyroidism occurs at a rate of 1-2%. Women are affected by these conditions ten times more frequently than men, which can be attributed to factors such as increasing age and iodine deficiency. In a study conducted by [Alam *et al.* \(2019\)](#) in the Mardan region, the occurrence of thyroid disorders was higher in females (22.06%) compared to males (17.18%). The rates of clinical and subclinical hyperthyroidism were 5.26% and 5.66% in females, respectively, and 3.12% and 4.16% in males. The rates of clinical and subclinical hypothyroidism were 5.06% and 6.07% in females, respectively, and 4.68% and 5.20% in males. Menstrual abnormalities, lactation, and pregnancy were identified as common causes of thyroid problems in females. A comparative study revealed slightly higher prevalence rate of both clinical and subclinical hypothyroidism in the Swabi region than in Mardan.

The current study, like others, found a higher prevalence of subclinical hypothyroidism compared to other forms of thyroid dysfunction. The overall prevalence of thyroid dysfunction was 23.04%, with subclinical hypothyroidism being the most common (9.6%). Different countries, such as Libya and Saudi Arabia, have also reported varying prevalence rates of thyroid dysfunction, with some showing a higher occurrence of hypothyroidism than hyperthyroidism. These variations may be attributed to factors like population differences, geographic location, methodologies, environmental factors, and various risk factors such as iodine deficiency and the presence of thyroid peroxidase (TPO) autoantibodies.

In terms of gender distribution, the study included a total of 24 affected individuals, with 7 (17.5%) being males and 17 (26.5%) being females. Clinical hypothyroidism accounted for 3 (2.99%) cases, with 1 (2.5%) being male and 2 (3.12%) being female. Clinical hyperthyroidism accounted for 4 (3.84%) cases, with 1 (2.5%) being male and 3 (4.7%) being female. On the other hand, the subclinical forms of both hypothyroidism and hyperthyroidism were more prevalent. Subclinical hypothyroidism accounted for 10 (9.6%) cases, with 3 (7.5%) being male and 7 (10.93%) being female. Subclinical hyperthyroidism accounted for 7 (6.7%) cases, with 2 (5%) being male and 5 (7.8%) being female. The calculated p-value of 0.87 indicates non-significance.

While examining thyroid dysfunction across different

age group, the study found that the highest prevalence was observed in the 31-40 age group (6.73%), followed by the 41-50 age group (5.8%). The occurrence of clinical hypothyroidism was the same in the 31-40 and >60 age group (0.97%), while it was not found in the 21-30 and 51-60 age groups. Subclinical hypothyroidism was more common in the 31-40 age group (3.8%), followed by the 41-50 age group (2.9%), and it was not found in the 51-60 age group. Regarding clinical hyperthyroidism, it had a consistent occurrence across all age groups, except for the 41-50 age group where no cases were found. The incidence of clinical hyperthyroidism seemed relatively consistent across different age groups, except for this age range. Subclinical hyperthyroidism was most prevalent in the 21-30 and 41-50 age group (1.92%), and the statistical analysis showed a non-significant p-value of 0.93.

The current study, along with previous research, highlights that thyroid dysfunctions, particularly subclinical hypothyroidism and subclinical hyperthyroidism, are more common in women compared to men. Several factors contribute to this gender difference, including lactation, pregnancy, menstrual abnormalities, and iodine deficiency. Autoimmune conditions, which are more prevalent in women, can also contribute to higher rates of thyroid diseases. The interaction between thyroid hormones and the hormonal changes during the menstrual cycle is believed to play a role in the higher incidence among women. Additionally, menopause and its fluctuating hormone levels can increase the likelihood of thyroid diseases. Some women may mistake the symptoms of menopause for thyroid issues, leading to delayed treatment-seeking.

CONCLUSION

In conclusion, this study in Swabi, Pakistan found that thyroid dysfunction is common, with a higher prevalence in females. Among the 104 samples, 61.5% were females, and the overall prevalence was 23.04%. Clinical hypothyroidism was 2.99%, slightly higher in females (3.12%), while clinical hyperthyroidism was 3.84%, with a higher prevalence in females (4.7%). Subclinical forms had higher ratios: subclinical hypothyroidism at 9.6%, with 10.93% in females and 7.5% in males, and subclinical hyperthyroidism at 6.7%, with 7.8% in females and 5% in males. The study also showed thyroid dysfunction across age group, with the highest prevalence in the 31-40 age group (6.73%) and the 41-50 age group (5.8%). Clinical hypothyroidism affected the 31-50 and > 60 age group (0.97%), not the 21-30 and 50-60 age group. Subclinical hypothyroidism was highest in the 31-40 age groups (3.8%) and the 41-50 age group (2.9%), while it was not present

in the 51-60 age group. Clinical hyperthyroidism had the same prevalence in all age group (0.97%), except for no cases in the 41-50 age group. Subclinical hyperthyroidism was highly prevalent in the 21-30 and 41-50 age group (1.92%), as well as other age group.

DECLARATIONS

Acknowledgement

We feel highly privileged to take this opportunity to express our profound gratitude and sense of devotion to Dr. Mehreen Riaz for her encouragement, fruitful suggestions, and confidence in our abilities to do this work. We are also thankful to Dr. Ihsan Ullah (Assistant Professor and in charge of Clinical Pathology and Blood Bank), Irfan Khan, and Malik Waqas Khan (Lab technicians) of Bacha Khan Medical Complex (BKMC) for granting permission and providing facilities during this study.

Funding

This project was self-funded.

IRB approval

The research proposal was reviewed and approved by the Internal Research Project Committee of Women University Swabi.

Ethical statement

All the ethical issues was addressed according to the international standards.

Statement of conflict of interest

The authors have declared no conflict of interest.

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