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Original Research Article

Clinical and biochemical profile of thyroid disorders in pediatric patients: a cross-sectional study

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ABSTRACT

Background: Thyroid disorders in children can significantly impact growth, development, and metabolic functions. Early identification and appropriate management are essential to prevent long-term complications. This study aimed to assess the clinical presentations and biochemical profiles of thyroid dysfunction among pediatric patients in a tertiary care setting in Bangladesh.
Methods: A cross-sectional observational study was conducted at the Department of Biochemistry and Molecular Biology and at the Department of Pediatric Endocrinology and Metabolic Disorder, Bangladesh Shishu hospital and institute, Dhaka, from June 2024 to December 2024. A total of 103 children aged 0 to 18 years, presenting with suspected thyroid dysfunction, were enrolled. Clinical features and thyroid hormone levels free triiodothyronine (FT3) and free thyroxine (FT4)-and thyroid stimulating hormone (TSH) were recorded and analyzed using SPSS version 25.
Results: Among 103 patients, 67 (65%) were male. Normal thyroid function was observed in 64 (62.1%) cases. Hypothyroidism was the most common thyroid disorder (n=21; 20.4%), comprising 7.8% with primary and 12.6% with subclinical hypothyroidism. Hyperthyroidism affected 14.5%, while 2.9% had central hypothyroidism. Primary hypothyroidism showed low FT3 (1.9±0.4 ng/dl), FT4 (0.7±0.2 pg/ml), and high TSH (13.8±4.1 µIU/mL), whereas hyperthyroidism showed elevated FT3 and FT4 with suppressed TSH. Central hypothyroidism presented with low FT4 and TSH. Common clinical features included neonatal jaundice (28.2%), constipation (21.4%), developmental delay (17.5%), and failure to thrive (15.5%).
Conclusions: Thyroid disorders in pediatric patients present with diverse clinical symptoms and hormone profiles. Routine screening in symptomatic children is essential for timely diagnosis and intervention, especially in resource-limited settings.

Keywords: Pediatric thyroid disorders, Hypothyroidism, Hyperthyroidism, FT3, FT4, TSH, Clinical profile, Endocrinology

INTRODUCTION

Thyroid disorders are among the most common endocrine abnormalities encountered in pediatric populations worldwide.[1] The thyroid gland plays a crucial role in growth, development, metabolism, and neurocognitive function, especially in children where adequate thyroid hormone levels are essential for normal physical and

mental development.[2] Any dysfunction, whether hypothyroidism or hyperthyroidism, can lead to significant morbidity if not diagnosed and treated early.[3]

Hypothyroidism, characterized by insufficient thyroid hormone production, is more common in children than hyperthyroidism.[4] Congenital hypothyroidism is a major cause of preventable intellectual disability globally and highlights the importance of early detection through newborn screening programs. In addition to congenital forms, acquired hypothyroidism may arise due to autoimmune thyroiditis (Hashimoto's thyroiditis), iodine deficiency, or thyroid surgery.[5] Clinical features in children often include growth retardation, delayed puberty, constipation, fatigue, and cognitive impairment. However, these symptoms are frequently subtle and nonspecific, which may delay diagnosis.[6]

Hyperthyroidism, although less common in the pediatric population, presents unique challenges. The most frequent cause is Graves' disease, an autoimmune disorder leading to excessive thyroid hormone secretion.[7] Symptoms may include weight loss despite increased appetite, hyperactivity, heat intolerance, palpitations, and accelerated growth.[8] Untreated hyperthyroidism can impair bone maturation and cause serious cardiovascular complications. Early recognition is vital to prevent long-term sequelae.[9]

The biochemical assessment of thyroid function involves measurement of serum thyroid hormones.[4] The interpretation of these values is age-specific, as thyroid hormone levels vary throughout childhood. Additionally, autoimmune markers such as anti-thyroid peroxidase (Anti-TPO) antibodies may help identify autoimmune thyroiditis, the most common etiology of acquired hypothyroidism in children.[10]

In developing countries like Bangladesh, thyroid disorders remain a significant health concern due to factors such as iodine deficiency, lack of awareness, limited screening programs, and delayed healthcare access.[11] Despite this, there is a scarcity of comprehensive data regarding the clinical and biochemical profiles of pediatric thyroid disorders in the region.[12] Understanding these profiles is essential for timely diagnosis, appropriate treatment, and prevention of complications.[13]

Moreover, thyroid dysfunction in children often coexists with other systemic conditions or developmental abnormalities, further complicating diagnosis and management.[11] Neonatal jaundice, developmental delay, growth failure, and congenital anomalies are among the associated clinical features frequently reported in children with thyroid dysfunction.[14] Awareness of these associations can prompt earlier investigation and intervention.

This study aims to evaluate the clinical presentations and biochemical profiles of thyroid disorders in pediatric patients attending Bangladesh Shishu hospital and institute, Dhaka. By analyzing the patterns of thyroid hormone alterations and correlating them with clinical findings, the study seeks to enhance early detection strategies and optimize management approaches for pediatric thyroid disorders in Bangladesh.

METHODS

This cross-sectional observational study was conducted at the Department of Biochemistry and Molecular Biology and at the Department of Pediatric Endocrinology and Metabolic Disorder, Bangladesh Shishu hospital and institute, Dhaka, Bangladesh, from June 2024 to December 2024. A total of 103 pediatric patients aged 0 to 18 years, presenting with clinical suspicion of thyroid disorders, were enrolled consecutively during this period. The study aimed to evaluate the clinical and biochemical profile of thyroid dysfunction in the pediatric population.

Patients presenting with symptoms such as developmental delay, growth failure, constipation, goiter, or other features suggestive of thyroid abnormalities were included. Written informed consent was obtained from parents or guardians before participation. The exclusion criteria were children with incomplete biochemical data, patients with known syndromic disorders affecting thyroid function (such as Down syndrome or Turner syndrome) unless thyroid dysfunction was independently present, and those who had received prior thyroid treatment before enrollment.

All participants underwent thorough clinical assessment, including detailed history-taking and physical examination, along with anthropometric measurements. Clinical features such as neonatal jaundice, developmental delay, failure to thrive, congenital anomalies, and history of ICU admission were recorded. Blood samples were collected to measure serum FT3, FT4, and TSH levels using chemiluminescent immunoassay methods. Additional investigations, including anti-thyroid peroxidase (anti-TPO) antibody tests and imaging studies, were reviewed where applicable.

Based on clinical and biochemical findings, patients were categorized into groups: normal thyroid function, primary hypothyroidism, subclinical hypothyroidism, primary hyperthyroidism, subclinical hyperthyroidism, and central hypothyroidism. Data were entered and analyzed using SPSS version 25. Descriptive statistics, including means, standard deviation, frequencies and percentages, were calculated to summarize clinical and biochemical profiles.

RESULTS

Table 1 presents the distribution of various thyroid disorders among the 103 pediatric patients enrolled in the

study, categorized by gender. The majority of participants (62.1%) had normal thyroid function, with a higher number of males (n=42) compared to females (n=22). Hypothyroidism was observed in 20.4% of patients, with 7.8% diagnosed as primary hypothyroidism and 12.6% as subclinical hypothyroidism. Hyperthyroidism accounted for 14.5% of the cases, including 5.8% with primary and 8.7% with subclinical forms, again with a male predominance. Central hypothyroidism were found in 2.9% of the cases. Overall, thyroid disorders were more frequently observed in male patients (67 out of 103; 65%) than in females (36 out of 103; 35%).

Table 2 presents the biochemical profiles of pediatric patients based on thyroid diagnosis. In the normal group, mean FT3, FT4, and TSH levels were 3.1±0.6 ng/dl, 1.3±0.4 pg/ml, and 2.7±1.2 µIU/ml, respectively. Primary hypothyroidism showed low FT3 (1.9±0.4), low FT4 (0.7±0.2), and high TSH (13.8±4.1), while subclinical hypothyroidism had FT3 of 2.2±0.5, FT4 of 0.9±0.3, and TSH of 9.2±3.5. In primary hyperthyroidism, FT3 and FT4 were elevated (5.1±0.7 and 1.8±0.4), with suppressed TSH (0.03±0.01); similar values were seen in subclinical hyperthyroidism (FT3 4.9±0.9, FT4 1.6±0.5, TSH 0.05±0.02). Near-normal FT3 (2.4±0.6), low FT4 (0.8±0.3), and low TSH (0.5±0.2), consistent with central hypothyroidism.

Table 3 shows the age distribution of pediatric patients by thyroid diagnosis. The mean age in the normal group was 5.9±3.0 years (range: 0.6-12 years). Patients with primary hypothyroidism were the youngest, with a mean age of 3.3±1.7 years (range: 1-6 years), followed by those with subclinical hypothyroidism at 4.5±2.3 years (range: 0.8-11 years). In contrast, children with primary hyperthyroidism had a higher mean age of 7.1±2.0 years (range: 4.5-11.5 years), and those with subclinical hyperthyroidism averaged 6.9±1.6 years (range: 5.5-10 years). Patients with Central hypothyroidism had a mean age of 6.2±2.5 years, ranging from 2.4 to 9.8 years.

Table 4 outlines the common clinical presentations and associated conditions among the 103 pediatric patients with thyroid disorders. The most frequent findings were neonatal jaundice (28.2%), constipation or worm infestation (21.4%), and developmental delay or low IQ (17.5%). Other notable conditions included failure to thrive, low weight, or stunting in 15.5% of cases, and congenital anomalies such as hernia or atrial septal defect (11.7%). A history of ICU admission was noted in 8.7%, while short stature or delayed growth affected 7.8% of patients. Less common but clinically significant associations included respiratory distress or pneumonia (5.8%), seizures or neurological deficits (4.9%), sepsis (3.9%), and cardiac abnormalities (3.9%). Recurrent infections and other conditions like goiter, anemia, or rickets were each reported in under 6% of cases.

Table 1: Distribution of thyroid disorders by gender, (n=103).

Diagnosis	Male	Female	Total	Percentage (%)
Normal	42	22	64	62.1
Primary hypothyroidism	5	3	8	7.8
Subclinical hypothyroidism	9	4	13	12.6
Primary hyperthyroidism	4	2	6	5.8
Subclinical hyperthyroidism	5	4	9	8.7
Central hypothyroidism	2	1	3	2.9
Total	67	36	103	100

Table 2: Biochemical profile according to thyroid diagnosis.

Diagnosis	FT3 (ng/dl), mean±SD	FT4 (pg/ml), mean±SD	TSH (µIU/ml), mean±SD
Normal	3.1±0.6	1.3±0.4	2.7±1.2
Primary hypothyroidism	1.9±0.4	0.7±0.2	13.8±4.1
Subclinical hypothyroidism	2.2±0.5	0.9±0.3	9.2±3.5
Primary hyperthyroidism	5.1±0.7	1.8±0.4	0.03±0.01
Subclinical hyperthyroidism	4.9±0.9	1.6±0.5	0.05±0.02
Central hypothyroidism	2.4±0.6	0.80.3	0.5±0.2

Table 3: Age distribution of patients by diagnosis.

Diagnosis	Mean age, (in years)	Minimum age (in years)	Maximum age (in years)
Normal	5.9±3.0	0.6	12
Primary hypothyroidism	3.3±1.7	1	6
Subclinical hypothyroidism	4.5±2.3	0.8	11
Primary hyperthyroidism	7.1±2.0	4.5	11.5
Subclinical hyperthyroidism	6.9±1.6	5.5	10
Central hypothyroidism	6.2±2.5	2.4	9.8

Table 4: Common clinical presentations and associated conditions among pediatric patients with thyroid disorders, (n=103).

Clinical history/associated condition	N	Percentage (%)
Neonatal jaundice	29	28.2
Constipation/worm infestation	22	21.4
Developmental delay/low IQ	18	17.5
Failure to thrive/low weight/stunting	16	15.5
Congenital anomalies (e.g., hernia, ASD)	12	11.7
ICU admission history	9	8.7
Short stature/delayed growth	8	7.8
Respiratory distress/pneumonia	6	5.8
Seizure/neurological deficits	5	4.9
Sepsis (neonatal or postnatal)	4	3.9
Cardiac abnormalities (e.g., cardiomegaly, CHD)	4	3.9
Recurrent or neonatal infections	3	2.9
Others (e.g., goiter, anemia, rickets)	6	5.8

DISCUSSION

This cross-sectional study evaluated the clinical and biochemical profile of thyroid disorders among 103 pediatric patients in a tertiary care hospital in Bangladesh. The findings reveal that thyroid dysfunction is not uncommon in the pediatric population and may present with a broad spectrum of clinical features, underscoring the importance of early recognition and appropriate management.

In our study, hypothyroidism emerged as the most common thyroid disorder, affecting 20.4% of children, which is consistent with findings reported by Singh et al who also documented a high prevalence of pediatric hypothyroidism in tertiary care settings in India.[15] Primary hypothyroidism accounted for 7.8% and was more common in younger children, with a mean age of 3.3 years. These findings align with previous literature suggesting that primary hypothyroidism tends to present earlier in life and is often associated with developmental delays, constipation, and failure to thrive.[16]

Biochemical evaluation in our study showed low FT3 and FT4 levels with elevated TSH in primary hypothyroidism, while hyperthyroid patients exhibited the opposite pattern-high FT3 and FT4 with suppressed TSH. Similar hormonal profiles have been well documented in international studies, validating the utility of these biomarkers in pediatric thyroid evaluation.[17.,18] Additionally, our identification of central hypothyroidism in a small subset of patients highlights the need for clinicians to consider hypothalamic-pituitary axis dysfunction, particularly in children with low FT4 and inappropriately low or normal TSH.[19]

The mean age of hyperthyroid children in our cohort was notably higher (7.1 years), consistent with global trends showing that autoimmune hyperthyroidism such as Graves' disease typically presents in later childhood or adolescence.[20] Although hyperthyroidism was less frequent (14.5%), its clinical implications—including accelerated growth and cardiovascular symptoms-warrant vigilance.

One of the noteworthy findings in our study was the high rate of neonatal jaundice (28.2%) and developmental delay or low IQ (17.5%) among children with thyroid dysfunction. These findings are in agreement with prior studies highlighting the association between congenital hypothyroidism and early neurodevelopmental impairment when diagnosis is delayed.[21] Additionally, short stature, anemia, and stunting were frequently observed, suggesting the systemic impact of thyroid dysfunction during critical growth periods.

Several studies, including those by Islam et al and Gamal et al have reported a significant association between iron deficiency anemia and thyroid disorders, especially in resource-limited settings.[18,22] This relationship may be bidirectional, as thyroid hormones influence erythropoiesis and iron metabolism, while iron deficiency can impair thyroid peroxidase activity, leading to reduced hormone synthesis.

Notably, 11.7% of children in our study had congenital anomalies such as hernia and congenital heart disease (CHD). Talwar et al previously demonstrated altered thyroid hormone levels in children with CHD undergoing cardiopulmonary bypass, indicating a potential interaction between thyroid function and cardiovascular development.[23] These findings underscore the need for routine thyroid screening in children with congenital anomalies, especially in the neonatal period.

Despite the systemic implications of thyroid dysfunction, some recent studies have found that thyroid autoimmunity may not significantly affect mental health or quality of life in children when appropriately managed.[24] However, in settings like Bangladesh, delayed diagnosis and limited access to endocrinological services may exacerbate the neurodevelopmental burden.

This study also highlights the importance of evaluating thyroid function in children with non-specific clinical complaints. Xie et al demonstrated in their cross-sectional study that screening children with unexplained abdominal symptoms uncovered a substantial number of undiagnosed thyroid dysfunction cases, supporting a broader clinical suspicion.[25]

Limitations

The study's limitations include its single-center design and relatively small sample size, which may limit generalizability. Moreover, autoimmune markers such as anti-TPO antibodies were not evaluated in all patients, which could have provided more clarity regarding etiology, especially in cases of subclinical or atypical presentations.

CONCLUSION

In conclusion, thyroid disorders in the pediatric population present with a diverse range of biochemical patterns and clinical features, often overlapping with other developmental or systemic conditions. Early screening, especially in children presenting with developmental delay, growth retardation, or congenital anomalies, is essential. Public health initiatives should focus on awareness, timely testing, and access to pediatric endocrine care in low-resource settings like Bangladesh.

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