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Thyroid Profile Abnormalities in Pediatric Population and their Correlation with Age: A Cross-Sectional Study at a Tertiary Care Hospital of South Punjab

Mehvish Sana, Zille Rubab, Ayesha Fayyaz, Waqas Imran

Abstract

Objective: To determine prevalence and pattern of thyroid profile abnormalities (hypothyroidism, hyperthyroidism, subclinical hypothyroidism, and subclinical hyperthyroidism) in pediatric population and to correlate these abnormalities with age in children presenting to a tertiary care hospital of South Punjab.

Study design and setting: This cross-sectional study was conducted for two months from 5-Dec-2024 to 5-Feb-2025 in Pathology department of Children Hospital and Institute of Child Health (CH & ICH) Multan.

Methodology: All the patients of 1-14 years whose thyroid profile was requested for any clinical indication were included in the study using consecutive sampling technique. Participants were divided into 3 age groups of 1-5 years, 6-10 years and 11-14 years. Data was entered and analyzed using SPSS 22. P-value of <0.05 was considered statistically significant.

Results: Among 200 children included in the study 60(30%) were found to have thyroid disorders. Subclinical hypothyroidism was seen in 36(60%) children and was most common thyroid disorder. Thyroid disorders were slightly more common in females. Difference of Mean T3, T4 and TSH in various thyroid disorders was statistically significant with p value of 0.000. Majority of the children (44%) were in 1-5 years age group. No correlation was found between age of the patients and thyroid disorders (r=0.004, sig. 2 tailed=0.966).

Conclusion: Subclinical hypothyroidism is the most common thyroid disorder among children and thyroid profile abnormalities are not related to age.

Keywords: Autoimmune thyroiditis, Hyperthyroidism, Hypothyroidism, Thyroid function tests

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INTRODUCTION:

Normal thyroid function is vital for proper neurocognitive growth, as well as for development and maturation during childhood and adolescence. Thyroid function tests are commonly available and are routinely requested in pediatric healthcare setup.[1] The impact of thyroid hormones on tissue growth is regulated by age and is tissue or organ specific, therefore medical consequences of any thyroid function abnormality differ depending on the child's age. In infancy and childhood, thyroid dysfunction leads to metabolic disruptions and affects growth and development. Therefore in pediatric setting, thorough assessment and management of thyroid function are crucial, as thyroid disorders can significantly affect neurodevelopment, physical growth, and overall health in children. Thyroid disorders make up a substantial portion of pediatric endocrine conditions, second only to diabetes in children worldwide.[2] In Pakistan, where iodine deficiency is prevalent, high rates of thyroid diseases are observed, likely due to inadequate dietary iodine intake, or autoimmune diseases affecting thyroid function, leading to either hypothyroidism or hyperthyroidism.[3] However, due to underdiagnosis, lack of awareness, and inconsistent availability of diagnostic services, timely detection and effective management are frequently compromised.

Thyroid disorders represent a range of conditions, from hypothyroidism to hyperthyroidism, indicated by the levels of Thyroid Stimulating Hormone (TSH), Triiodothyronine (T3), and Thyroxine (T4). Hypothyroidism is more prevalent than hyperthyroidism, both globally and in countries like Pakistan. It occurs when the thyroid gland fails to produce sufficient amounts of thyroid hormones, leading to a slowing down of metabolic processes. This condition is more

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commonly seen in women and increases with age. In contrast, hyperthyroidism, which involves the overproduction of thyroid hormones, is relatively less common.[4] Thyroid dysfunction can be subclinical and asymptomatic, characterized by irregular thyroid hormone levels where T3 and T4 levels remain normal while TSH levels are abnormal. In contrast, clinically symptomatic thyroid dysfunction involves abnormal levels of both T3 and T4 along with TSH.[5] Autoimmune thyroid diseases (AITDs), such as Hashimoto thyroiditis and Grave's disease, are the most common thyroid conditions with two different extremes in children. These disorders may occur as isolated autoimmune conditions or alongside other autoimmune diseases like Type 1 diabetes, celiac disease, pernicious anemia, and others.[6,7] Autoimmune thyroiditis (AIT) is one of the main causes of acquired hypothyroidism in pediatric population, leading to inflammation, gradual glandular destruction, and reduced hormone production and many cases are detected incidentally before overt symptoms emerge.[8] Timely diagnosis and appropriate treatment are crucial to support normal growth, developmental progress, and academic performance in children.

In patients with severe hypothyroidism, key signs include growth failure and weight gain, though some children may show normal growth parameters for the population at first presentation. Enlargement of pituitary gland should be considered in every child with severe hypothyroidism.[8] In subclinical hypothyroidism, growth limitations or cognitive impairments are generally not noted, but subtle cardiac problems have been reported.[9] Most children with subclinical hyperthyroidism are usually asymptomatic, especially when the suppression of TSH is mild and short-lived. This is commonly seen in the early stages or recovery phase of thyroid dysfunction, or in cases where thyroid hormone is administered externally also called iatrogenic subclinical hyperthyroidism. Due to the subtle nature of symptoms, routine laboratory screening can be valuable particularly in children with known risk factors such as autoimmune conditions or a family history of thyroid disease. When subclinical hyperthyroidism is persistent or shows signs of progression, it requires close monitoring or intervention to prevent potential long-term complications affecting the heart, bone development, and neurological function.[10] Hyperthyroidism is rare but can have serious effects on a child's growth and development. Clinicians should be aware of subtle clinical manifestations of this condition. Early recognition and referral to a pediatric endocrinologist can help prevent complications associated with this condition.[11] In pediatric patients, thyroid function tests (TFTs) abnormalities can impart diagnostic challenges due to the wide range of clinical signs that may accompany them. Possible causes of abnormal TFTs include Grave's disease, Hashimoto thyroiditis, congenital hypothyroidism, resistance to thyroid hormone, iodine deficiency, sick euthyroid syndrome, medications and interference with thyroid function assays.[12]

This study aims to determine the prevalence and pattern of thyroid profile abnormalities in children and to correlate these abnormalities with age. In countries like Pakistan, where iodine deficiency remains a concern, there is a higher incidence of thyroid disorders, particularly in children. Thyroid disorders in children can significantly impact growth, neurodevelopment, and overall health. Among these, subclinical thyroid disorders are often overlooked due to the absence of obvious clinical symptoms. However, emerging evidence suggests that these subclinical disorders if left undiagnosed or untreated also contribute to subtle changes in growth patterns, cognitive function and cardiovascular risk over time. There is insufficient local data on the prevalence and pattern of thyroid dysfunctions in children. Identifying these patterns is crucial for early diagnosis, timely intervention, and long-term health monitoring. This study aims to address this gap by evaluating thyroid profile abnormalities, with a special focus on subclinical forms, and exploring their correlation with age in children attending a tertiary care hospital in South Punjab.

METHODOLOGY:

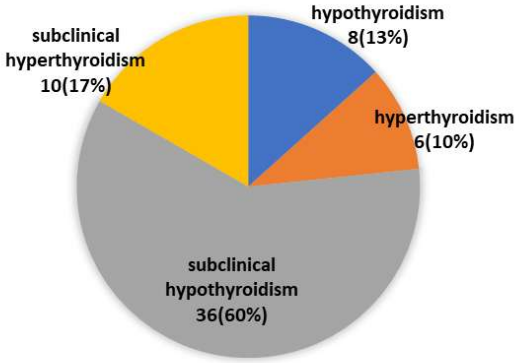
This cross-sectional study was conducted for two months from 5-Dec-2024 to 5-Feb-2025 in Pathology department of Children Hospital and Institute of Child Health (CH & ICH) Multan. Ethical approval was taken from Ethical Review Committee of institute before commencing the study (2364 DATED 5-12-24). All the Children of 1-14 years of both genders whose thyroid profile was requested for any clinical indication including but not limited to growth abnormalities, physical findings or constitutional symptoms indicating thyroid disorders, neurodevelopmental concerns, high risk individuals with family history of thyroid or autoimmune disorders were included in the study using consecutive sampling technique. Informed consent was taken from parents of the patients. Children with critical or chronic systemic illness, undergoing treatment for any thyroid disorder, receiving medications that could interfere with thyroid hormone levels, and individuals for whom informed consent was not obtained were excluded. Sample size of 130 was calculated using prevalence 13% margin of error 5% and confidence interval 95%.[13] However to overcome issue of missing data we enrolled 200 patients. Participants were divided into 3 age groups of 1-5 years, 6-10 years and 11-14 years. 2 ml blood for thyroid profile (TSH, free T4, free T3) was obtained in gel tube under aseptic conditions. Sample was allowed to clot, serum was separated after centrifugation and thyroid profile was performed on VITROS ECiQ immunodiagnostic system, chemiluminescence based homogeneous immunoassay analyzer. Demographic variables and thyroid profile results were recorded on a predesigned proforma. Reference ranges used for fT3, fT4 and TSH are 2.3-5.0pg/ml, 0.8-2.0ng/ml, 0.5-4.7uIU/ml. Thyroid profile

abnormalities (hypothyroidism or hyperthyroidism, subclinical hypothyroidism and subclinical hyperthyroidism) were defined as per the standard cut offs of fT3, fT4 and TSH. The data was entered and analyzed on SPSS version 22. Shapiro Wilk test was applied to check normality of data. Mean and SD was given for quantitative variables with normal distribution while Median and range was given for variables with skewed distribution. Independent *t*-test and analysis of variance (ANOVA) were used to test for statistically significant differences of T3, T4, TSH in males, females and different thyroid disorders respectively. Pearson correlation was used to see correlation between thyroid profile abnormalities and age. P-value of <0.05 was considered to be statistically significant.

RESULTS:

200 children were included in this study among which 94(47%) were male and 106(53%) were female. Participants were divided into 3 age groups. 88(44%) were included in 1-5 years age group, 80(40%) in 6-10 years age group and 32(16%) in 11-14 years age group. Mean age of the study participants was 6.3±3.7 years. Mean T3 and T4 were 3.7±1.03 pg/ml and 1.45±0.5 ng/dl respectively. Median TSH was 2.82(1.50-4.78) uIU/ml. 60(30%) patients were found to have thyroid disorders. Among all these thyroid disorders subclinical hypothyroidism was most prevalent as shown in figure 1. Thyroid disorders were found to be slightly more prevalent in females than in males as shown in figure 2 with a ratio of 1.4:1. Mean T3, T4 and TSH difference was statistically insignificant in males and females with p value of 0.59, 0.93 and 0.34 respectively. Difference of mean T3, T4 and TSH values were statistically significant (p=0.000) among euthyroid, hypothyroid, hyperthyroid, subclinical hypothyroid and subclinical hyperthyroid patients as shown in table 1. No correlation was found between thyroid disorders and age of the patients (r=0.004, sig. 2 tailed=0.966) (table 2).

Figure 1: Frequency of thyroid disorders(n=60)



DISCUSSION:

In our study, thyroid disorders were identified in 30% of patients. The most common thyroid disorder was subclinical hypothyroidism, accounting for 60% of cases, followed by subclinical hyperthyroidism (17%), overt hypothyroidism (13%), and hyperthyroidism (10%). The overall prevalence of thyroid disorders in the study group was as follows: subclinical hypothyroidism 36(18%), subclinical hyperthyroidism 10(5%), overt hypothyroidism 8(4%), and hyperthyroidism 6(3%). A study in India involving 498 children discovered thyroid abnormalities in 65 (13%) children, 6(93.8%) were diagnosed with hypothyroidism

Figure 2: Gender distribution of thyroid disorders. (n=60)

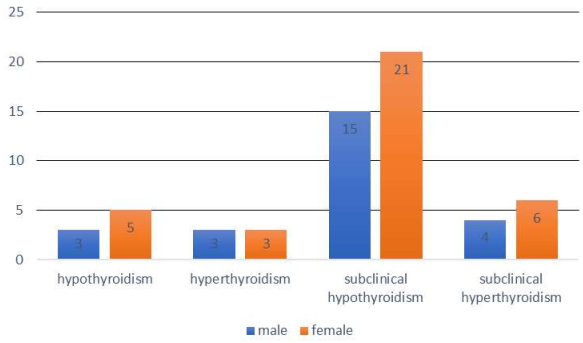


Table 1: Difference of mean T3, T4 and TSH values among different thyroid disorders

Thyroid profile	Thyroid disorders					*p* value
	Euthyroid	Hypothyroidism	Hyperthyroidism	Subclinical hypothyroidism	Subclinical hyperthyroidism	
T3	3.7±0.6	1.7±0.3	6.8±1.5	3.6±0.7	4.1±0.3	0.000
T4	1.4±0.3	0.24±0.16	0.24±0.16	1.5±0.3	1.5±0.4	0.000
TSH	2.6±1.1	2.4±0.8	2.4±0.8	8.8±5.2	0.3±0.19	0.000

Table 2: Correlation of age group and thyroid disorders

		Age group	Thyroid disorder
Age group	Pearson Correlation	1	.004
	Sig. (2-tailed)		.966
	N	200	200

and 4(6.2%) with hyperthyroidism, and a male-to-female ratio of 1:1.2 was noticed.[13] In Pakistan, the incidence of subclinical hyperthyroidism, subclinical hypothyroidism overt hyperthyroidism and overt hypothyroidism is reported to be 5.8%, 5.4%, 5.1% and 4.1% respectively.[14] Moreover, it is evident that both hyperthyroidism and hypothyroidism (subclinical or overt) are more widespread in females than in males.[14] Our research also showed that subclinical thyroid disorders are more frequent than overt thyroid disorders with female predominance. A smaller study in India reported 37% of children with thyroid dysfunction had hypothyroidism.[15] A Saudi Arabian study revealed that hypothyroidism is more frequent in pediatric population than hyperthyroidism, with 50.34% of cases being Hashimoto thyroiditis, and 64.2% of those affected were females.[16] A study conducted in Pakistan showed that thyroid disorders are five times more frequent in females than males.[17] Our findings align with these studies, indicating that hypothyroidism, particularly subclinical hypothyroidism, is more prevalent than hyperthyroidism, with thyroid disorders being more common in females. In our study, the male-to-female ratio was 1:1.4, which further supports prior studies.[13, 14, 16, 17]

Clinical evidence suggest that acquired thyroid disease with obvious clinical findings is rare. Most cases tend to have a subtle or asymptomatic onset, often going undetected until routine screening or evaluation for unrelated issues reveals abnormalities in thyroid function. As a result, many children with acquired thyroid dysfunction may not be diagnosed until the disease has progressed, emphasizing the importance of high clinical suspicion and timely screening especially in at-risk populations.[18]

Subclinical hypothyroidism (SCH) in children is generally considered a mild and often transient condition. Research shows that in approximately 68% to 88% of cases, SCH either remains stable or resolves spontaneously without advancing to overt hypothyroidism. Only a small proportion of patients experience progression to clinically significant hypothyroidism or develop autoimmune thyroid disorders, such as Hashimoto's thyroiditis. Despite its typically benign course, SCH often causes concern among parents and primary care providers, mainly due to the uncertainty of its long term outcomes. Even in asymptomatic cases, abnormal thyroid function test results can lead to anxiety and frequent referrals to pediatric endocrinologists for further assessment. This pattern highlights the importance of evidence based guidelines to help clinicians identify which children require active intervention versus those who can be safely observed over time. A better understanding of the natural course of SCH is key to avoid overtreatment while ensuring that children at risk of progression receive appropriate care.[19] Infants with subclinical hypothyroidism need careful follow-up, as elevated TSH level may be transitory in about half of the cases and resolve spontaneously or progress to overt hypothyroidism which may impair neurological development.[20] Iodine deficiency is one of the most common causes of subclinical hypothyroidism in children, though supporting evidence is lacking. Other causes include maternal thyroid dysfunction, autoimmune thyroid diseases (Hashimoto's thyroiditis), genetic syndromes (Down syndrome) and gene mutations in TSH receptor.[21]

Graves' disease (GD) accounts for 60-80% of hyperthyroidism cases in children, and some sources suggest it may be responsible for more than 95% hyperthyroid cases, making it nearly synonymous with hyperthyroidism particularly in school age children and adolescents..[22] Graves' disease is an autoimmune disorder characterized by the production of TSH receptor antibodies (TRAbs) stimulating the thyroid gland for overproduction thyroid hormones T3 and T4 and ultimately leading to clinical hyperthyroidism. Other causes of hyperthyroidism including Hashitoxicosis, toxic adenoma or multinodular goiter, thyroiditis and exogenous thyroid hormone ingestion are rare in children.

Thyroid disorders are influenced by different factors such as geographical dissemination, iodine utilization, nutritional habits and genetic susceptibility.[23] In geographical dissemination endemic goiter remains a health concern in parts of Asia, Africa, and Latin America, largely due to insufficient iodine intake. Although global initiatives have significantly lowered its prevalence but continued and targeted public health efforts are essential to reach the most vulnerable and isolated populations. Diet and nutrition stand out as modifiable factors that can improve thyroid function and reduce the frequency of thyroid conditions.[24] Unlike genetic or geographic factors, nutritional choices can be adjusted, offering both preventive and therapeutic benefits for various thyroid conditions. In developed economies, the prevalence of undetected thyroid disorder is declining due to widespread thyroid function assessments and lower treatment initiation thresholds.[21] Previously only overt thyroid disorders were treated but now proactive approach of treating subclinical thyroid disorders prevents progression to overt disease and reduces complications. While thyroid conditions are easily managed in advanced nations, low-income countries face a larger and often underestimated burden. Developing specialized healthcare centers for thyroid disorders which include comprehensive diagnostic services with tailored treatment options and postgraduate endocrinology education is crucial for meeting this need in developing nations.[25]

CONCLUSION:

This study concludes that subclinical thyroid disorders are more prevalent than overt thyroid dysfunction in the pediatric population, with subclinical hypothyroidism emerging as the most frequently observed abnormality. The findings underscore that thyroid profile abnormalities occur across all pediatric age groups without a significant correlation to age, suggesting that age alone should not be considered a

primary determinant in evaluating thyroid function in children.

LIMITATIONS:

This study was conducted in a tertiary care hospital therefore participants may not be representative of general pediatric population particularly those from underprivileged areas who may not have access to tertiary care hospital.

RECOMMENDATIONS:

It is recommended that children with symptoms suggestive of thyroid dysfunction and family history of thyroid or autoimmune disorder should undergo prompt thyroid evaluation. It is also recommended that TSH should be used for initial screening of thyroid disorders. Free T4 and free T3 should be advised when TSH is abnormal or if there is strong clinical indication. Availability of data: Authors confirm that data supporting the results of this study are available in the article.

Authors Contribution:
Mehvish Sana: Concept design, data collection, data analysis, manuscript writing
Zille Rubab: Proof reading and revision
Ayesha Fayyaz: Manuscript writing, proof reading
Waqas Imran: Proof reading and revision

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