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The Association between Asthma Severity and Thyroid Function Tests in Children

M. Mohammadpour Tahamtan (MD)[1], M. Alijanpour (MD)[2], M. Nikpour (PhD)[2], I. Mohammadzadeh (MD)[2], M. Pornasrollah (PhD)[3], P. Payandeh (MD)[3], M. Kiani (MD)[*2]

1.Student Research Committee, Babol University of Medical Sciences, Babol, I.R.Iran.
2.Non-Communicable Pediatric Diseases Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, I.R.Iran.
3.Clinical Research Development Unit of Amirkola Children's Hospital, Babol University of Medical Sciences, Babol, I.R.Iran.

*Corresponding Author: M. Kiani (MD)
Address: Non-Communicable Pediatric Diseases Research Center, Amirkola Children's Hospital, Babol, I.R.Iran.
Tel: +98 (11) 32346963. **E-mail:** kianimasood@yahoo.com

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ABSTRACT

Background and Objective: The association between asthma and thyroid hormone fluctuations has been examined across multiple studies, with contradictory outcomes reported. Given the notable lack of evidence in this area, especially when it comes to the pediatric Iranian population, the present study was conducted to evaluate the association between asthma severity and thyroid function tests.

Methods: This cross-sectional study was conducted on 60 children with persistent asthma referred to Amirkola Children's Hospital, Babol, Iran, in 2022. The diagnosis of asthma was established based on the Global Initiative for Asthma (GINA) guidelines and confirmed by a pediatric pulmonology subspecialist. Asthma severity was determined according to the Guidelines for the Diagnosis and Management of Asthma Expert Panel Report 3, and patients were classified into three groups: mild (n=20), moderate (n=23), and severe (n=17). Thyroid function tests were assessed by measuring T3, T4, and TSH levels.

Findings: The mean age of the study population was 7.0±2.6 years, with 31 subjects (51.66%) being male. Mean serum levels were as follows: TSH 2.67±1.39 µIU/ml, T4 8.94±2.26 µg/dl, and T3 1.93±0.43 ng/ml. Analysis revealed no statistically significant differences in TSH, T4, or T3 levels among the mild, moderate, and severe asthma subgroups. Moreover, there was no significant relationship between asthma severity and the presence of at least one abnormal thyroid function test (p=0.30, r=-0.13).

Conclusion: Our results indicated that serum levels and mean concentrations of TSH, T4, and T3 did not show a statistically significant association with asthma severity among children.

Keywords: *Asthma, Thyroid Gland, Thyroid Function Tests, Child.*

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Introduction

Asthma is a prevalent chronic inflammatory disorder of the airways, clinically manifested by respiratory symptoms including shortness of breath, wheezing, coughing, and chest pressure (1). It remains the primary reason for emergency department consultations, inpatient admissions, and school absence among children (2). Despite the therapeutic advancements in asthma control and pharmacotherapy, its incidence continues to escalate globally (3).

The underlying cause of pediatric asthma remains elusive, yet accumulating evidence suggests that both environmental triggers and hereditary–genetic predispositions contribute to its pathogenesis. Supporting diagnostic features include the presence of risk factors such as comorbid allergic conditions (allergic rhinitis, atopic dermatitis, and food allergies), parental history of asthma, or asthma-like manifestations occurring independently of upper respiratory infections. Notably, while familial aggregation is frequently reported, a positive family history is neither essential nor solely determinative for asthma onset (3-5).

The thyroid gland plays a fundamental role in the endocrine system, being chiefly responsible for the biosynthesis, intracellular storage, and regulated secretion of the thyroid hormones. Of the total hormonal output, the vast majority—approximately 80 to 90 percent—is secreted in the form of thyroxine, or T4, which serves as a prohormone, while the remaining 10 to 20 percent is released as the more biologically active triiodothyronine (T3) (6, 7). These hormones are widely regarded as master regulators of systemic physiology, exerting profound and direct influences on a diverse array of target organs and tissues, including the cardiovascular system, pulmonary parenchyma and airways, skeletal muscle contractility, metabolism and the immune system (8, 9). Thyroid functional disorders most commonly present as hypothyroidism, resulting either from intrinsic glandular failure (primary hypothyroidism) or from defective TSH stimulation (central hypothyroidism). Hyperthyroidism, characterized by excessive thyroid hormone production, is relatively rare in the pediatric age group when compared with hypothyroidism (2).

Extensive research has been conducted on the pathophysiological mechanisms between non-pulmonary comorbidities and asthma, as well as their influence on asthma-related outcomes. These comorbidities include type 2 diabetes mellitus, hypertension, atherosclerotic cardiovascular disease, adrenal and thyroid gland disorders, pregnancy, osteoporosis, medication-related adverse effects, and psychiatric conditions (10). The inflammatory pathogenesis of asthma involves Th1, Th2, and Th17 immune pathways. Given that certain of these pathways—particularly Th17—show overlap with autoimmune-mediated hypothyroidism, a potential coexistence between the two diseases may be hypothesized (11). Conversely, some investigators have reported that hyperthyroidism is associated with increased asthma severity (12).

To date, several studies have investigated changes in thyroid function tests in patients with asthma. In some of these investigations, changes in thyroid function parameters (predominantly deficient thyroid hormone levels) have been shown to influence both the frequency and severity of asthmatic attacks as well as their therapeutic response. Given the limited number of such studies, and considering that research conducted in Iran—particularly in pediatric populations—remains scarce, the present study was conducted with the aim of determining the association between asthma severity and thyroid function tests in children aged 3 to 18 years referred to Amirkola Children's Hospital, Babol.

Methods

After approval by the Ethics Committee of Babol University of Medical Sciences (code: IR.MUBABOL.REC.1401.042), this cross-sectional study was conducted on all children with asthma referred to Amirkola Children's Hospital, Babol, in 2022. Participants were selected via census sampling

according to inclusion criteria. Children aged 3-18 years with a confirmed diagnosis of asthma were enrolled. Exclusion criteria included a history of hereditary thyroid disease, prior use of thyroid hormones, liver disease, and asthma in the acute exacerbation phase.

Asthma diagnosis was established by a pediatric pulmonologist according to the GINA guidelines, based on a history of respiratory symptoms and, when feasible (in children over 5 years of age), spirometry testing. Disease severity was classified according to the Guidelines for the Diagnosis and Management of Asthma Expert Panel Report 3. Based on this protocol, children with stable asthma were categorized into mild, moderate, and severe groups based on clinical symptom scores and pulmonary function test results.

For the evaluation of thyroid function tests (TSH, T4, T3), 2 cc of blood was drawn from all children. These tests were performed using the ELISA method with kits from Ideal Tashkhis Atieh Company (Iran) at the laboratory of Amirkola Children's Hospital. Additionally, demographic data including age, sex, and weight were collected for all participants.

Data were analyzed using SPSS software (version 25). Statistical methods included ANOVA (one-way analysis of variance), Chi-square tests, and Pearson correlation coefficient. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 60 children with asthma were enrolled in the study, comprising 31 males and 29 females. The mean age and weight were 7.0±2.6 years and 26.3±10.8 kg, respectively.

According to asthma severity, 20 children (33.3%) were classified as mild, 23 (38.3%) as moderate, and 17 (28.3%) as severe. The mean TSH level was 2.67±1.39 µIU/mL, while mean T4 and T3 levels were 8.94±2.26 µg/dL and 1.93±0.43 ng/mL, respectively. One-way ANOVA results demonstrated no significant differences in mean TSH, T4, or T3 levels across mild (p=0.20), moderate (p=0.24), and severe (p=0.69) asthma severity groups (Table 1).

Table 1. Comparison of mean TSH, T4, and T3 levels according to asthma severity groups

Thyroid Test	N	Mean±SD	p-value
TSH			
Mild	20	2.934±1.406	
Moderate	23	2.725±1.447	0.20
Severe	17	2.135±1.232	
T4			
Mild	20	8.477±1.746	
Moderate	23	8.818±2.711	0.26
Severe	17	9.682±2.087	
T3			
Mild	16	1.853±0.385	
Moderate	22	1.951±1.642	0.69
Severe	17	1.974±0.569	

Of the 60 children, 53 (88.3%) had normal TSH levels and 7 (11.7%) had abnormal TSH. Regarding T4, 55 (91.7%) had normal values and 5 (8.3%) had abnormal values. For T3, 51 (85%) had normal levels and 9 (15%) had abnormal levels. Overall, 42 children (70%) had all three thyroid function tests (TSH, T4, T3) within normal limits, while 18 (30%) had at least one abnormal result among the three tests. No significant

association was found between asthma severity and having at least one abnormal thyroid test (r=-0.13, p=0.30). The study also found no significant association between asthma severity and abnormal TSH (r=-0.23, p=0.15), abnormal T4 (r=-0.096, p=0.46), or abnormal T3 (r=-0.086, p=0.51).

Discussion

The findings of this study demonstrated no significant relationship between asthma severity and mean TSH, T4, or T3 levels. No significant associations were observed between asthma severity and thyroid hormone levels, which aligns with the study by Lindberg et al., who reported no significant differences in TSH, T3, or T4 between asthmatic and healthy children (14). Similarly, the study by Ismaeil et al. in Egypt found no statistically significant differences in thyroid hormone levels across different asthma severity grades, nor between asthmatic and healthy children (15).

In the present study, no significant relationship was found between asthma severity and T3 levels. This contrasts with the findings of Bingyan et al., who reported a significant deficiency in free T3 levels in men with respiratory failure compared to healthy men (16). This discrepancy may be attributable to differences in the age groups of the study populations. Furthermore, in a clinical trial by Khalek et al., administration of T3 hormone for 30 days led to improvement in asthmatic symptoms (17). Similarly, Ismail et al., in a study of 12 euthyroid asthmatic children, found that oral T3 hormone administration reduced disease symptoms (18).

The results of the present study demonstrated that the mean levels of TSH, T4, and T3 did not differ significantly among the three asthma severity groups. However, these findings diverge from those of Hu Fang et al., who reported significantly higher serum TSH levels in children with severe asthma, alongside lower T4 and T3 levels compared to the control group. Notably, their comparisons between the mild-to-moderate asthma group and the control group were not statistically significant, suggesting that thyroid dysfunction was absent in children with mild-to-moderate asthma but present in those with severe disease (19). Additionally, the evaluation of thyroid function tests by Eliseeva et al. showed that in children with controlled asthma, TSH levels and subclinical hypothyroidism were higher compared to those with poorly controlled asthma, although the difference was not statistically significant (20).

In this study, no significant relationship was found between asthma severity and abnormal thyroid function tests. Similar findings were reported by Samareh Fekri et al., who showed no significant difference in thyroid hormone levels between asthmatic and non-asthmatic groups (21).

A limitation of the present study is the absence of a control group (non-asthmatic children), which restricts the generalizability (external validity) of the findings. However, the rigor applied to asthma severity classification enhanced internal validity. Multicenter studies with larger sample sizes and inclusion of a control group are recommended. The results indicate that serum levels and mean values of TSH, T4, and T3 are not significantly associated with asthma severity in children.

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