



Comorbidity of asthma in patients with attention-deficit/hyperactivity disorder (ADHD) aged 4–12 years in Iran: a cross-sectional study

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Introduction: Attention-deficit/hyperactivity disorder (ADHD) is defined as a stable pattern of attention deficits or impulsive hyperactivity that can interfere with the functioning, growth, and development of individuals. It is believed that both the type of asthma and the medications used to treat it exacerbate the symptoms of ADHD.

Methods and Materials: The present study was a cross-sectional analytical study conducted to investigate the incidence of asthma in ADHD patients aged 4–12 years who were referred to Urmia University of Medical Sciences clinics and hospitals. In this study, ADHD patients were diagnosed through a psychiatric interview and based on a paediatric asthma questionnaire (approved by asthma and allergy organizations and scientific institutions), and individuals with suspected asthma were selected. All 101 ADHD patients referred to these clinics during the specified period were examined. Five patients were excluded from the study because of lack of cooperation or incomplete information. Then, the selected subjects were divided into two age groups of less than 5 years and between 5 and 12 years. The final diagnosis of asthma was made by clinical findings and demographic questionnaire in subjects younger than 5 years, while it was made by spirometry in subjects between 5 and 12 years. Data analysis was conducted using SPSS software.

Results: The mean age of the 96 samples included in the study was 7.67 years with a standard deviation of 7.214. Sixteen of them (16.7%) were under 5 years of age and eighty of them (83.3%) were between 5 and 12 years of age. Asthma was diagnosed in 7 children under 5 years of age (7.3%) and in 14 children (14.6%) between 5 and 12 years of age. A total of 21 (21.9%) were diagnosed as having asthma after screening. On the basis of these results, the frequency of asthma according to classified age was significant ($P = 0.020$). The frequency of asthma based on sex and birth rank was also examined, and none of these factors showed a significant association with asthma. Medications taken by the ADHD patients were also examined in this study. The most commonly used medications in both groups of patients with asthma and no asthmatic patients were a combination of risperidone and atomoxetine or risperidone alone. The prevalence of asthma in the target population was also assessed in terms of parental smoking.

Conclusions: According to the results of this study, the incidence of asthma in ADHD patients aged 4–12 years is high, and this case is more frequent in subjects younger than 5 years than in subjects aged 5–12 years. It should be noted that according to the results of the present study, there was no significant association between birth rank, parental smoking, ADHD medication, and the frequency of asthma.

Keywords: Asthma, attention deficit and disruptive behaviour disorders, child, comorbidity, epidemiology

Introduction

Attention-deficit hyperactivity disorder (ADHD) and Asthma are two common health concerns that impact the lives of children worldwide^[1]. In recent years, researchers have become increasingly interested in exploring the relationship

between these two conditions^[2]. Specifically, studies have suggested that children with Asthma are more likely to be ADHD than those without the condition^[3]. This is particularly concerning when it comes to primary school-aged children, who are still developing their habits and behaviours around eating and exercise^[4].

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Annals of Medicine & Surgery (2023) 85:2568–2572

Received 2 April 2023; Accepted 30 April 2023

Published online 10 May 2023

<http://dx.doi.org/10.1097/MS9.0000000000000801>

ADHD is a neurodevelopmental disorder that impacts around 5–10% of children globally^[5]. The condition is characterized by symptoms such as hyperactivity, inattention, and impulsivity. These symptoms can negatively impact a child’s academic performance and social interactions, and can persist into adulthood if not diagnosed and managed appropriately^[6].

Children with asthma and allergies may have attention problems that are exacerbated by hypoxia and measures to maintain breathing. In addition, reduced breathing at night can lead to sleep disturbances^[7]. In addition to exacerbating ADHD and attention deficits, impulsive behaviour in children with asthma and allergies may be a secondary side effect of the allergic condition and its treatment^[8]. Based on reports from parents in some studies, children with asthma and allergies are more likely to suffer from academic and behavioural problems than people without allergic problems^[7]. Among the many emotional and behavioural problems, attention deficit has particular effects on children’s psychosocial adaptations, including their communication skills, interpersonal relationships, anxiety, and mood control^[9]. Medications used for asthma and allergic diseases have been found to cause side effects such as restlessness, sleep disturbances, headaches, or emotional and mood changes^[10]. Serotonin plays an important role in the pathophysiology of asthma and that asthma medications decrease serotonin levels in the brain, causing ADHD-like symptoms^[11].

It has been suggested that both the type of asthma and the medications used to treat it exacerbate the symptoms of ADHD^[12]. However, studies that have investigated the possible association between ADHD and asthma have not yielded consistent results. The study of 140 boys with ADHD and 140 girls with ADHD found no positive association between ADHD and asthma^[13]. Asthma severity and medication (treatment) are strongly associated, and medication (treatment) may explain the association with ADHD rather than asthma. Treatment with β_2 agonists and inhaled corticosteroids has been reported to cause behavioural side effects in children^[14]. However, no significant difference was found between asthma children taking asthma medications and asthma children not taking these medications in terms of hyperactivity and impulsive behaviour^[15]. The aim of this study is to determine the comorbidity of asthma in patients with ADHD aged 4–12 years in Iran in 2022.

Methods and materials

This study is a descriptive-analytical work. The statistical population in this study consists of ADHD patients referred to child and adolescent psychiatric clinics. A convenience sampling was used in the present study. Our work was performed in accordance with STROCCS criteria^[16].

Data collection instrument

Connor’s Parent Questionnaire (CPQ) is a tool used by psychologists and educators to assess a child’s behaviour in the classroom and at home. The questionnaire is designed to identify symptoms of ADHD and other behaviour-related issues that may impact a child’s learning or social interactions^[17].

The CPQ consists of 48 questions, and parents are asked to rate their child’s behaviour on a 4-point scale (never, occasionally, often, very often). The questions are divided into several categories,

HIGHLIGHTS

- Attention-deficit/hyperactivity disorder (ADHD) and Asthma are two common health concerns that impact the lives of children.
- ADHD is a neurodevelopmental disorder that impacts around 5–10% of children.
- Asthma and its medications can exacerbate the symptoms of ADHD.

including inattention, hyperactivity/impulsivity, oppositional behaviour, anxiety, and depression.

A valid and scientific questionnaire on asthma in children was used to diagnose suspected cases of asthma. It has been used in previous research projects and approved by scientific organizations and institutions and under the supervision of asthma and allergy specialists for children (the questionnaire includes questions on personal information, clinical history, aggravating factors, history of the disease, and family history). ADHD was also diagnosed by a psychiatric interview by a child psychiatrist.

Procedure

The Code of Ethics (IR. UMSU. REC.1398.060) from the Ethics Commission was received. The prepared questionnaire was administered to all ADHD patients aged 4–12 years (and their parents) over the course of a year (each patient answered it once), and finally, the final diagnosis of the disease was made on the basis of clinical findings and information from the questionnaire in subjects younger than 5 years and on the basis of spirometry in subjects aged 5–12 years. Qualitative variables are reported in the form of corresponding tables and graphs, and quantitative variables are reported as mean±standard deviation. The χ^2 test (Fisher’s test, where appropriate) was used for frequency comparison. Data were analyzed using SPSS22 software and the significance level was considered lower than 0.05. This study was registered at <https://www.researchregistry.com> (registration number: researchregistry8281).

Results

In this descriptive cross-sectional study, conducted to evaluate the incidence of asthma in ADHD patients aged 4–12 years referred

Table 1
Frequency and percentage of asthma based on classified age.

Variables	Classified age		Total	Results
	Below 5 years	Between 5 and 12 years		
No asthma				
N	9	66	75	$P=0.002$
Classified age (%)	56.3	82.5	78.1	$df=1$
Total (%)	9.4	68.8	78.1	$\chi^2=5.376$
Asthma				
N	7	14	21	
Classified age (%)	43.8	17.5	21.9	
Total (%)	7.3	14.6	21.9	

Table 2
Frequency and percentage of asthma based on sex.

	gender		Total	Results
	Female	Male		
No asthma				
<i>N</i>	16	59	75	$P=0.474$
Sex (%)	84.2	76.6	78.1	df = 1
Total (%)	16.7	61.5	78.1	$\chi^2 = 0.513$
Asthma				
<i>N</i>	3	18	21	
Sex (%)	15.8	23.4	21.9	
Total (%)	3.1	18.8	21.9	

to Urmia University of Medical Sciences hospitals and clinics, all 101 ADHD patients referred to these clinics during the specified period were studied. Five patients were excluded from the study due to lack of cooperation or incomplete information. The mean age of the 96 patients included in the study was 7.67 years with a SD of 7.214 years. Sixteen of them (16.7%) were under 5 years of age and 80 of them (83.3%) were between 5 and 12 years of age. Asthma was diagnosed in 7 children aged 5 years (7.3%) and in 14 children aged 5–12 years, and it was diagnosed in a total of 21 children (21.9) after screening.

Based on the results of the analysis of Table 1, there is a significant relationship between the frequency of asthma and the classified age of the subjects ($P=0.020$).

The frequency of asthma was calculated based on sex, and the results are shown in Table 2. nineteen of the subjects were female (16.7%) and 77 were male (83.3%). Sixteen of the females (84.2%) and 59 of the males (6.6.) 76%) do not have asthma. In contrast, 3 females (15.8%) and 18 males (23.4%) have a proven case of asthma. Based on the results of the analysis of Table 2, there is not a significant relationship between the frequency of asthma and the sex of the subjects ($P=0.474$).

Based on Table 3, the most commonly used medications in both groups of asthma patients and non-asthma subjects are the combination of risperidone and atomoxetine and risperidone alone, respectively. Based on the results of the analysis of Table 3, there is not a significant relationship between the frequency of asthma and the medications used for ADHD ($P=0.178$). Based on the above results, 37 fathers in the target population are smokers and 59 are nonsmokers, of whom 8 (37.3% of the total

population) have asthma and 29 (30.2% of the total population) do not have asthma. Of the 59 individuals, 13 (13.5%) have asthma and 46 (47.9%) did not have asthma. It should be noted that none of the mothers in the study population were smokers. According to the χ^2 test, there is no significant association between the frequency of asthma and parental smoking ($P=0.962$) (Table 4).

Discussion

The present study was a cross-sectional analytical study conducted to investigate the incidence of asthma in ADHD patients aged 4–12 years who were referred to Urmia.

The present study investigated the incidence of asthma in ADHD patients aged 4–12 years admitted to Urmia University of Medical Sciences hospitals and clinics in 2022. Of 101 samples, 5 samples were excluded from the study due to the aforementioned conditions. For the remaining 96 samples, the mean age was 7.67 years with a standard deviation of 7.214 years. Sixteen children (16.7%) were under 5 years of age and eighty children (83.3%) were between 5 and 12 years of age. Seven children aged 5 years (7.3%) and fourteen children (14.6%) aged between 5 and 12 years, and a total of twenty-one children (21.9%) were diagnosed as asthma patients after screening.

In a study conducted by Tsai and colleagues, the incidence of asthma in ADHD patients was investigated. The results of the study showed that the frequency of asthma in the ADHD group was 4.3 times higher than that in the control group in the age group of 12–17 years, and it was 1.5 times higher in male children and 1.6 times higher in children living in urban areas. It was concluded that ADHD children are positively associated with asthma, but the underlying mechanisms need further explanation^[18]. In our study, 7 of 16 children aged less than 5 years were diagnosed with asthma, representing 43.8% of this group, and 14 of 80 children aged 5–12 years were diagnosed with no asthma, representing 17.5% of this group. The incidence of asthma in individuals younger than 5 years was much higher than in individuals aged 5–12 years. The results of the statistical analysis of the data show a significant association between the frequency of asthma and the classified age of the subjects ($P=0.020$) and are consistent with the results of a previous study.

In addition, in our study, 19 of the subjects were female (16.7%) and 77 were male (83.3%), and 16 of the female subjects (84.2%) and 59 of the male subjects (76.6%) did not have

Table 3
Frequency and percentage of asthma based on medications used for ADHD.

	Medications used for ADHD					Total	Results
	Ritalin	Risperidone	Atomoxetine	Risperidone and Ritalin	Risperidone and Atomoxetine		
No asthma							
<i>N</i>	5	18	5	14	30	75	$P=0.178$
Medications used for ADHD (%)	83.3	62.1	83.3	93.3	81.1	78.1	df = 5
Total (%)	5.2	18.8	5.2	14.6	31.3	78.1	$\chi^2 = 7.624$
Asthma							
<i>N</i>	1	11	1	1	7	21	
Medications used for ADHD (%)	16.7	37.9	16.7	6.7	18.9	21.9	
Total (%)	1	11.5	1	1	7.3	21.9	

ADHD, attention-deficit/hyperactivity disorder.

Table 4
Frequency and percentage of asthma based on parental smoking.

	Parental smoking		Total	Results
	Father	None of them		
No asthma				
<i>N</i>	29	46	75	$P=0.962$
Parental smoking (%)	78.4	78	78.1	$df=1$
Total (%)	30.2	47.9	78.1	$\chi^2=0.002$
Asthma				
<i>N</i>	8	13	21	
Parental smoking (%)	21.6	22	21.9	
Total (%)	8.3	13.5	21.9	

asthma, but 3 female (15.8%) and 18 male (23.4%) subjects had asthma. Based on the above results, there was no significant association between the frequency of asthma and sex and was not consistent with the results of previous studies ($P=0.474$). Previous studies have shown that asthma and ADHD may be indirectly associated with common genetic or environmental risk factors. A number of environmental risk factors, such as parental socioeconomic status and parental smoking, have been associated with both asthma and ADHD^[19]. In our study, the frequency of asthma in ADHD patients was calculated in relation to ADHD medications. The results show that the most frequently taken medications in both groups of patients with asthma and non-asthmatics were a combination of risperidone and atomoxetine or risperidone alone, with no significant association between the two according to the χ^2 test ($P=0.178$). It should be noted that no association between ADHD medications and asthma was found in previous studies. A study conducted by Bahrami *et al.*^[20] investigated the prevalence of ADHD and associated factors among primary school students in Kamyaran in 2014–2015. Their results showed an association between birth rank and the presence of ADHD. In the present study, we also investigated the frequency of asthma in ADHD patients according to birth rank. On the basis of statistical data analysis and χ^2 test, no significant association was found between birth rank and asthma frequency, and our study results are in agreement with the results of the aforementioned study ($P=0.418$). The frequency of asthma based on being an only child was also evaluated, and no significant difference was found between asthma and non-asthma patients ($P=0.485$). The association between children with ADHD and asthma can have several implications for clinical practice. First, healthcare providers need to be aware of the increased likelihood of asthma in children with ADHD and actively screen for asthma symptoms in these patients during routine assessments. This means asking questions about wheezing, coughing, and shortness of breath as well as monitoring lung function through spirometry testing^[16]. Second, healthcare providers need to consider how medication treatments for ADHD may impact asthma symptoms. Stimulant medications used to treat ADHD such as methylphenidate and amphetamines can exacerbate asthma symptoms in some patients. Providers should closely monitor asthma symptoms in children with ADHD who are taking these medications and consider alternative treatments for ADHD if necessary^[18]. Third, healthcare providers need to develop individualized treatment plans for children with both ADHD and asthma. This may involve collaborating with specialists such as pulmonologists,

allergists, and behavioural therapists to ensure that all aspects of a child's health are addressed in the treatment plan^[17].

This study only provides a snapshot of a population, and the sample selected may not be representative of the entire population, especially in Iran where there are cultural, ethnic, and regional differences. Moreover, this study had smaller sample sizes compared with other study designs. In Iran, a lack of resources or funding for research may limit the sample size and hence the generalizability of the results.

Conclusion

The results of the study show that the incidence of asthma in ADHD patients aged 4–12 years is high and that this case is more common in individuals younger than 5 years than in individuals aged 5–12 years. Thus, by using a valid paediatric asthma questionnaire in ADHD patients and a simple examination and spirometry, if necessary, this disease can be easily diagnosed and accordingly = the disease and its progression and aggravation in the future and its harmful physical and economic effects on people can be prevented. It should be noted that based on the results of the present study, there is no significant association between birth rank, parental smoking, parental social and economic status, sex, ADHD medication, and frequency of asthma. Due to the lack of time in our study, it is recommended that further studies with a larger sample size be conducted to more accurately determine the frequency of asthma in the target population. It is also recommended that a study be conducted to determine the frequency of ADHD among asthma patients in the age range of 4–12 years to examine the relationship between these two diseases with more confidence.

Ethical approval

The Ethics Committee of Urmia University of Medical sciences approved this study (Ethics No. IR. UMSU. REC.1398.060).

Consent

Written informed consent was obtained from the patient for publication of this study. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Source of funding

NA.

Author contribution

Y.M.: study concept, data collection, writing the paper and making the revision of the manuscript following the reviewer's instructions. A.K. and G.H.: study concept, reviewing and validating the manuscript's credibility. H.H.: reviewing and validating the manuscript's credibility.

Conflicts of interest disclosure

NA.

Research registration unique identifying number (UIN)

NA.

Guarantor

Arezou Kiani.

Provenance and peer review

Not commissioned, externally peer-reviewed.

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