

## ORIGINAL ARTICLE

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# Health Status and Inconveniences of Asthmatic Children During the First Year of the COVID-19 Pandemic

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## ABSTRACT

The Coronavirus Disease 2019 (COVID-19) pandemic has been the most significant health concern in recent years, with respiratory symptoms being the most prominent. In children, asthma is the most prevalent chronic disease. Due to the similarities between the symptoms of these two conditions, we sought to assess the general health status of pediatric patients with asthma and their COVID-19-related difficulties during the first year of the pandemic in Iran.

We collected data for this study by administering a questionnaire to the parents of 200 children with asthma who were registered in the database of the Asthma Clinic at a tertiary medical center in Tehran, Iran.

Forty-five (22.5%) of 200 patients were suspected of having COVID-19, 11 (24.4%) underwent polymerase chain reaction (PCR) testing, and 10 (90.9%) assays were positive. During the first year of the pandemic, 41 patients (20.5%) were referred to a medical center at least once, with 31.7% due to an asthma attack. One hundred eighty-nine patients (94.5%) reported an improved disease status than the previous year, and only 31 patients (15.5%) were using asthma-related medications such as Salbutamol. The estimated mean Asthma Control Test (ACT) scores for two age categories, 4-11 years and 12-18 years, were  $25.55 \pm 2.27$  and  $23.28 \pm 3.31$ , respectively, indicating satisfactory disease control.

In the majority of our study population, asthma control was acceptable. However, the pandemic caused a significant increase in the anxiety levels of patients and their parents.

**Keywords:** Asthma; Child; COVID-19; Pandemics; SARS-CoV-2

## INTRODUCTION

Asthma is one of the most common chronic diseases in the world, with an estimated population of over 300 million patients. Globally, asthma was the 25th main

source of disability adjusted life years (DALYs) in 2001,<sup>1</sup> and the prevalence of asthma among Iranian children between 5 to 14 years old was estimated at 10.9% in 2015.<sup>2</sup> Respiratory viral infections, including common coronaviruses, cause more than 80% of asthma

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attacks.<sup>3</sup> Also, asthmatic patients have a higher risk of lower respiratory tract infections and severe symptoms due to viral respiratory agents.<sup>4</sup> In late December 2019, there were several reports about a new respiratory virus called SARS-CoV-2 in Wuhan, China, with expeditious transmission among the population. After a couple of weeks, on March 11, 2020, the quick spread of disease across the world urged World Health Organization (WHO) to announce it as a global pandemic.<sup>5</sup> The most common symptoms in pediatric Coronavirus Disease 2019 (COVID-19) patients are fever and cough,<sup>6</sup> and as stated by Centers for Disease Control and Prevention (CDC) report, the most common co-existing ailment for pediatric COVID-19 patients are chronic lung disease, cardiovascular disease and immunosuppression.<sup>7</sup> The association between pediatric asthma and contracting COVID-19, hospitalization and its severity is controversial in published literature. Some studies have concluded that asthma is one of the reasons for intensive care unit (ICU) hospitalization in children with COVID-19,<sup>8</sup> and there is a link between asthma and COVID-19 severity score and lower respiratory tract involvement.<sup>9</sup> However, several articles deduced that there was no connection between these conditions.<sup>10-12</sup> The hypothesis is that asthma may be a protective factor against COVID-19 for atopic patients due to the under-expression of the angiotensin-converting enzyme 2 (ACE2) receptor in their lungs. This receptor is essential for coronavirus recognition and infection.<sup>13,14</sup> Diagnosing pediatric asthma during the pandemic is challenging for healthcare workers. Similar initial symptoms like dry cough and shortness of breath and strict recommendations against using spirometry due to the high risk of aerosol spread are some of the reasons.<sup>15,16</sup> Studies have shown that constant usage of inhaled corticosteroids (ICS) does not increase the risk of hospitalization among COVID-19 patients,<sup>17</sup> and asthmatic patients admitted to hospital due to COVID-19 have a lesser amount of ICS usage in comparison to non-hospitalized patients.<sup>18</sup> The divergence of healthcare access among asthmatic patients with COVID-19 during the pandemic is a public health concern. The socioeconomic status, being an ethnic minority and different sources of health-related information are some of the significant components of this obstacle.<sup>19</sup> The trend of medical outpatient appointments for children with asthma has shifted from physical consultations to virtual sessions.<sup>20</sup> Also, there have been reports of diminished emergency visits related

to asthma in children since the early months of the pandemic,<sup>21,22</sup> which could be a consequence of better air quality during mandatory quarantine and lesser personal contact between children due to online education.<sup>21</sup> The strict lockdown conditions have significantly affected the mental health of patients with asthma,<sup>23</sup> and their parents have expressed concerns about the failure of outpatient care and the higher risk of contracting COVID-19 among their children.<sup>24</sup> This study aimed to evaluate the status of pediatric asthma control during the first year of the pandemic and the impact of the pandemic on the mental health and lifestyles of these patients and their families.

## MATERIALS AND METHODS

### Study Population and Setting

This cross-sectional study included randomly selected 200 patients under 18 years of age, who were diagnosed with asthma at least one year before the pandemic's beginning and registered in a data bank of Asthma and Allergy Clinic in Tehran, Iran.

### Data Collection and Variables

The data were collected mainly in the spring of 2021, almost a year after the pandemic began, by interviewing parents of these patients via telephone. We used a questionnaire to gather information about their disease history and contracting COVID-19, state of asthma control, medications they used, frequency of asthma attacks and emergency ward visits, hospitalization, mental health status, anxiety and stress levels and changes in their lifestyles during the first year of pandemic. The parents were asked about the changes in their physician's visits, their information sources for medical questions and changes in their socioeconomic and insurance coverage since the beginning of the pandemic. To assess the mental health status of parents, we asked them about their concerns about their child's illness and related stress levels in the first year of the pandemic.

### Data Analysis

We used SPSS Statistics 26 for statistical analysis. The data for normally distributed variables were reported as the mean and standard deviation. Categorical variables were described as frequencies and percentages.

## RESULTS

We have studied 200 pediatric patients with asthma, of whom 129 patients (64.5%) were male and 71 patients (35.5%) were female. Mean age among this population was  $9.01 \pm 3.06$  years. The estimated mean age of asthma diagnosis for these patients was  $4.57 \pm 2.66$  years. There was not any allergic-related condition reported for 37.5% of patients. The most common allergic comorbidities for the rest of the population were allergic rhinitis (57.5%) and eczema (4.5%). One hundred fifty-nine patients (79.5%) had no emergency ward or outpatient clinic visits. As for the other 41 patients (20.5%), 13 of them (6.5% of the total population and 31.4% of this subgroup) have had at least one asthma-related visit to receive medical care, and only one of these patients was hospitalized due to asthma. None of these patients was smoker, but 46 patients (23%) were passive smokers. During the last two years, regarding influenza vaccine, 141 patients (70.5%) did not get any vaccine, 40 patients (20%) got only one shot, and only 19 patients (9.5%) were fully vaccinated (Table 1). There were 45 (22.5%) suspected cases of COVID-19 among this population, and 11 of them have undergone diagnostic PCR tests. The test results of 10 patients (5% of total population) were positive. Although 101 patients (50.5%) had one of their parents contracting COVID-19, only two patients (4.4%) were referred to designated COVID-19 centers since the beginning of the pandemic (Table 2).

According to interviews with parents, among the 45 suspicious cases of COVID-19, the most common symptoms were excessive cough (24.4%), shortness of breath (6.6%), and worsening of wheeze (2.2%). During the first year of the pandemic, 189 patients (94.5%) have stated a better disease status, four patients (2%) have had a worsened condition, and seven patients (3.5%) had not reported any changes related to their disease severity compared to last year. At the time of this study, 169 patients (84.5%) were not using any asthma-related drugs and only 31 patients (15.5%) reported taking the medications mentioned above. The type of drugs and percentage of consumption among these 31 patients are illustrated in Table 1.

We have used Asthma Control Test (ACT) for two age groups of 4-11 years old and 12-18 years old. The estimated mean scores were  $25.55 \pm 2.27$  and  $23.28 \pm 3.31$ , respectively. Since the beginning of the pandemic, 44 patients (22%) have experienced at least one episode of

difficulty in obtaining their asthma medications due to national drug shortage or increases in their prices (Table 1). Sixty-three patients (31.5%) have started to use home remedies and herbal medicines to strengthen their immune systems and improve their asthma status during the pandemic, and 42 patients (21%) have taken up using vitamin C and multivitamins. Considering the surge in using alcohol-based disinfectants to avoid contracting COVID-19, 65 patients (32.5%) had worsened respiratory symptoms concerning this trend. Parents of these patients stated that they had used social media (73.5%), TV broadcasts (61%) and medical staff (35%) to gain the best amount of information they could get concerning to the pandemic in the past year.

Eighty-five parents (42.5%) have not expressed any concerns related to the COVID-19 pandemic. Sixty-eight parents (34%) were concerned about their children contracting COVID-19, and 20 parents (10%) were worried about exacerbation of their children's asthma. Seventeen parents (8.5%) have had miscellaneous apprehensions like the effect of probable offline school education on the state of their children's health (Table 3). To assess the state of stress among concerned parents, we asked them to rate their anxiety level from 0 to 10 according to their severity. The calculated mean stress level was  $5.93 \pm 2.82$ , with the highest frequency in level 5 (34 parents-17%). The most frequent causes of excessive stress levels among these parents were: adverse effect of the pandemic-related anxiety on exacerbation of asthma symptoms (86.5%), the rapid and uncontrollable increase of stress levels among parents since the beginning of the pandemic (77%), worry about the higher risk of hospitalization of their children due to COVID-19 related asthma symptoms (73%) and concern about the mental health and anxiety state of their children about the COVID-19 pandemic (70.5%).

During the first year of the pandemic, 67 patients (33.5%) have had at least one episode of specialist consultation due to asthma, 49 visits (73.1% of total visits) were face to face, 11 visits (16.4%) were conducted online, and the remaining seven patients (10.4%) have had both forms of appointments. After interviewing the parents, we have evaluated the changes in their lifestyles in accordance with quarantine protocols. More than half of the families (59%) were committed entirely to national safety guidelines against COVID-19, and only nine families (4.5%) did not adhere to any protection rules.

**Table 1. Patients' demographic characteristic**

Characteristic	
<b>Age (Year), mean</b>	
Male	8.93
Female	9.15
	<b>Number (%)</b>
<b>Gender</b>	
Male	129 (64.5)
Female	71 (35.5)
<b>Allergic co-morbidities</b>	
Allergic rhinitis	115 (57.5)
Food allergy	4 (2)
Urticaria	4 (2)
Eczema	9 (4.5)
None	75 (37.5)
<b>Parents smoking status</b>	
Smoker	46 (23)
Non-smoker	154 (77)
<b>Influenza vaccination in recent year</b>	
Yes	20 (10)
No	180 (90)
<b>Asthma status compared to last year</b>	
Better	189 (94.5)
Worse	4 (2)
Unchanged	7 (3.5)
<b>Asthma ED in recent year</b>	
Yes	13 (6.5)
No	187 (93.5)
<b>Asthma medication use status in recent year</b>	
Yes	31 (15.5)
No	169 (84.5)
<b>Current asthma and allergy medications (Among users, n=31)</b>	
Salbutamol	30 (96.8)
Montelukast	20 (64.5)
ICS	17 (54.8)
ICS w/LABA	12 (38.7)
Oral steroids	6 (19.4)
INS	7 (22.6)
Antihistamines	6 (19.4)
<b>Patients' difficulties in obtaining asthma medication</b>	
Yes	44 (22)
No	156 (78)
<b>ACT score, mean±SD</b>	
4-11 y/o	25.55 ± 2.27
12-18 y/o	23.28 ± 3.31

ACT: Asthma control test; ED: Emergency department; ICS: Inhaled corticosteroid; LABA: Long-acting beta-agonist; INS: Intra nasal steroid

## COVID-19 and Asthmatic Children

**Table 2. Status of COVID-19 tests among patients and their families**

	Number (%)	Total (%)
<b>A family member with COVID-19</b>		
Yes	101 (50.5%)	200 (100%)
No	99 (49.5%)	
<b>Patients suspected to have COVID-19</b>		
Yes	45 (22.5%)	
No	155 (77.5%)	200 (100%)
<b>PCR tests done for patients</b>		
Yes	11 (5.5%)	200 (100%)
No	189 (94.5%)	

**Table 3. Status of parents of asthmatic children in one year after the onset of the pandemic**

	No. (%)
Haven't expressed any concerns related to COVID-19 pandemic	85 (42.5)
Were concerned about their children contracting COVID-19	68 (34)
Concern of exacerbation of child asthma	20 (10)
Concern of being infected with COVID-19 and exacerbation the child's asthma	10 (5)
Other concerns	17 (8.5)
Lost their job	27 (13.5)
Lost their insurance	10 (5)

Parents of 27 patients (13.5%) lost their jobs, and ten patients (5%) lost their insurance coverage since the pandemic's beginning.

### DISCUSSION

After the announcement of a global pandemic of SARS-CoV 19 in March 2020, there was a special attentiveness toward chronic underlying conditions such as cardiopulmonary diseases among physicians. Although there were multiple reports about diabetes and hypertension as underlying risk factors for contracting COVID-19 disease and its severity,<sup>25,26</sup> a similar correlation between asthma and COVID-19 was not detected.<sup>10-12</sup> In our study, 64.5% of patients were male, and 35.5% were female, akin to previously reported elevation in the prevalence of asthma in prepubertal boys.<sup>27</sup> Incidence of COVID-19 was estimated at 5%, which is higher than the previously reported 2.1% in this age group.<sup>28</sup> These patients did not manifest aggressive

symptoms of COVID-19 infection, similar to findings of other studies.<sup>11,29</sup> The prevalence of allergic rhinitis was 57.5% among this population, following previously reported 19 to 94%.<sup>30</sup> The under expression of ACE-2 receptor in the lungs of atopic patients could be a protective factor against developing COVID-19,<sup>14</sup> and thus, there is a lower frequency of this allergic comorbidity among COVID-19 patients with asthma.<sup>18</sup> During the first year of the pandemic, only 20.5% of patients have had an asthma-related medical visit to receive treatment. This low rate in emergency visits was reported in different studies.<sup>21,22,31,32</sup> The possible reasons could be the better adherence to treatment guidelines during the pandemic, managing the acute symptoms of asthma at home during extended periods of national quarantines, the decline of exposure to viral agents throughout the online education,<sup>22</sup> fear of exposing children to COVID-19 during hospital visits,<sup>32</sup> and better state of air pollutants in the course of lockdowns.<sup>22,31</sup> About 33% of patients were passive

smokers and considering the effect of smoking on the augmentation of ACE2 receptors in the lungs of these patients, and it can cause a significant increase in susceptibility to contracting COVID-19 and manifesting severe symptoms.<sup>33</sup> Only 19 patients (9.5%) were fully vaccinated against influenza in the last two years. Regarding the recommendation of annual immunization against influenza for all the children six months and older with high-risk conditions such as asthma.<sup>34</sup> These minimal rates can cause a higher risk of hospitalization during the pandemic. This study was conducted before the emergence of Delta and Omicron variants of SARS-Cov-2, and according to primarily published reports, children were usually infected by a close family member<sup>6</sup> and although 50.5% of parents in this study have contracted COVID-19, only 45 patients (22.5%) were suspected of having COVID-19 based on their symptoms and family history. Only 11 of these patients (24.4% of suspected cases) have undergone PCR testing, and 10 of these tests (90.9% of total test done) were positive. These lower transmission rates between family members and hospitalization of pediatric patients could be due to appropriate commitment to self-isolation protocols and milder symptoms of COVID-19 among children.<sup>6,35</sup> As reported by interviews with their parents, the most common respiratory symptoms of these 45 patients were excessive cough (24.4%), shortness of breath (6.6%) and severe wheezing (2.2%), which are difficult to differentiate from asthma exacerbation.<sup>15</sup> In our survey, 94.5% of patients have had a better asthma control in comparison to the last year, and only 2% have stated a worsened disease severity which is comparable to other studies.<sup>36</sup> Due to strict recommendations against using spirometry to monitor disease status,<sup>16</sup> we have used the ACT (Asthma Control Test) score to surveil disease control during the pandemic. ACT is a patient-completed asthma control questionnaire, used as a screening tool for clinical evaluation. It consists of 5 questions, scored 1(worst) to 5(best) individually with the highest total score of 25. A score  $\geq 20$  is considered well-controlled asthma. In our study, the ACT score for both age groups was more than 20, resembling the reported  $22.76 \pm 3.06$  in previous works.<sup>36</sup> We can explain this enhancement in asthma control amid our patients with lower physical activity of children and the lesser exposure to outdoor triggers and air pollutants during national lockdowns.<sup>37</sup> Only 15.5% of patients in our study were on maintenance therapy for their asthma which is another indicator of good disease control.

During the first months of the pandemic, there were some concerns about the effect of ICS on a higher risk of contracting COVID-19 and its severity. Later, with more studies done, it was recommended to strictly adhere to ICS therapy if it was necessary for treatment.<sup>16,38</sup> and there was not any higher risk of hospitalization due to COVID-19 in patients who were using ICS constantly.<sup>17</sup> Herbal medicines and vitamin complements were used by 31.5% of our patients during the pandemic. Although they are being marketed as a miraculous cure for common cold and flu generally, in different studies, it has been shown that herbal medicines affect viral infections to some extent.<sup>39,40</sup> The most important problem with these herbal plants is the inability to measure the remedial component, conforming to modern medicine. The trend of using social media (73.5%) as the main route of obtaining pandemic-related information in our study, compared to counsel with medical staff (35%), could conflate scientific data with rumors and result in significant harm to patients' health. One of the challenges during multiple lockdowns was the remarkable decline of outdoor physical activity among children. This problem could predispose children to weight gain and obesity, which is a known risk factor for more frequent asthma exacerbations and reduced response to related medications.<sup>41</sup> Another adverse effect of quarantine was on the mental health of children and their families.<sup>20,23</sup> More than half of the parents (65%) have revealed newfound COVID-related anxiety among their children. The mean score of self-reported stress level for parents was almost 6 (from 1 to 10). The most common concerns among the parents were the higher risk of contracting COVID-19 and hospitalization in asthmatic patients, exacerbation of respiratory symptoms with COVID-19 and shortage of medications and outpatient care during the pandemic.<sup>24</sup> Like a similar shortage of inhaled salbutamol in Canada,<sup>42</sup> 22% of our patients had a problem with obtaining asthma medications during the first year of the pandemic. We have observed that 33.5% of our patients kept close contact with their physicians during this time frame. Most of these patients (73.1%) had face-to-face appointments, and the remaining ones had virtual and online consultations following several guidelines.<sup>16,43</sup> Another repercussion of the pandemic was excessive usage of alcohol-based disinfectants. It has been previously established that extended exposure to disinfectants could cause an increase in asthma symptoms and exacerbations<sup>44,45</sup> which was reported by

32.5% of our patients. In our survey, 13.5% of parents lost their jobs, and 5% of patients lost their insurance coverage in the first year of the pandemic. One of the main concerns of public health since the beginning of the pandemic was the unfavorable effect of economic instability on the mental health of families and their children. These children of families who lost their jobs due to the pandemic are five times more prone to being maltreated and neglected in their homes and manifest depression and anxiety as a result which could influence the asthma status of these patients.<sup>46</sup>

According to our study, the incidence of PCR-positive COVID-19 among our patients was 5% which is notably lesser than infected family members. Furthermore, there was not any reported hospitalization due to COVID-19 among the patients. The status of asthma control among most of our study population was acceptable. However, there was a significant rise in the anxiety levels of patients and their parents due to the pandemic, which requires further investigation to address its burden on the mental health and well-being of patients.

### STATEMENT OF ETHICS

This study was approved by the ethics committee of the Tehran University of Medical Sciences (Approval ID: IR.TUMS.CHMC.REC.1399.159).

Since the present study was conducted through a telephone survey, a written consent was not prepared to obtain information, but after obtaining the code of ethics and the approval of the university's ethics committee, all the necessary information was given to the families and parents of asthmatic children. The participants in the study have answered the questions by phone only if they are satisfied, and the information related to them has been used in the study without registering and disclosing their names. Also, anyone who did not want to participate in the study during the telephone interview was excluded from the study.

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The authors did not receive any funding.

### CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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