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Parental Concerns and Attitudes Regarding Influenza Vaccination of Children with Asthma During the COVID-19 Pandemic

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ABSTRACT

Objective: Guidelines recommend annual influenza vaccination for patients with moderate-to-severe asthma. This study aimed to investigate parental opinions and attitudes about influenza vaccination of their children with asthma before and during the COVID-19 pandemic.

Materials and Methods: The parents of children (<18 years of age) diagnosed with asthma before September 2019 were interviewed using a standard questionnaire to collect data regarding their children's demographic characteristics, asthma treatment, asthma control status within the last 2 years, and influenza vaccination status during and one year before the COVID-19 pandemic.

Results: The patient group included 288 children (60.1% [n=173] males) with a median age of 11 years (interquartile range [IQR]: 8-14). The median duration of asthma follow-up was 6 years (IQR 4-8). Over half of the children (n=166, 57.6%) had at least one influenza vaccination at any time (before/after the pandemic). After COVID-19, the immunization rate increased from 35.7% to 47.2% compared to the previous year, with 63 (21.9%) children not previously vaccinated receiving the influenza vaccine during the pandemic. Those with a history of multiple asthma attacks in the previous year, those at a higher step of asthma treatment, and those with a monthly household income above the minimum wage were more likely to be vaccinated. For children never vaccinated against influenza, the most common reason cited by their parents was that their children were apparently well (40.1%). For children who were not vaccinated during the pandemic despite previous vaccination, lockdown was reported as the main reason (61.5%).

Conclusion: COVID-19 affected parental attitudes toward influenza vaccination of their children with asthma. The immunization rate of children increased after COVID-19 compared to the previous year. While the apparent wellness of their child was the most common reason for parental hesitancy toward influenza vaccination before the COVID-19 pandemic, lockdown measures became the most common reason for not vaccinating during the pandemic.

Keywords: Asthma, COVID-19, influenza, influenza vaccination, vaccine hesitancy

INTRODUCTION

Asthma exacerbations are triggered by various factors such as allergens, irritants, exercise, weather changes, or respiratory tract infections (1). Recently, viral infections have been considered the most common trigger for acute asthma exacerbations (2,3). In a review of studies evaluating asthma attacks triggered by viral infections, rhinovirus (61.3%) was the most common etiology, followed by respiratory syncytial virus (12.6%) and influenza virus (10.3%) (4).

Influenza virus types A, B, and C are common causes of respiratory tract infections and seasonal epidemics, especially during the winter months. The influenza virus is also responsible for pandemics due to its high mutation rates

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(5). Every year, 20-30% of children and 5-10% of adults experience symptoms of influenza (6). Moreover, 2-3 million people suffer from severe illness and approximately 250,000-500,000 people die from influenza annually, with higher mortality rates observed in low-income countries (7).

The need for vaccination emerged due to the significant morbidity and mortality associated with the influenza A and B viruses in particular. Vaccination against influenza reduces the risk of infection from 30% to 11% in healthy children (8). Many studies have also demonstrated the effectiveness and benefits of influenza vaccination in diseases such as asthma in which influenza is associated with increased morbidity and mortality (9-11). In several large-scale studies, it has been shown that influenza vaccination is the most effective and most important preventive method both for reducing the frequency of influenza infection and reducing asthma attacks in patients with asthma (10,11).

Health authorities recommend that children with asthma be vaccinated before the influenza season (10). In our country, the Guidance on Pandemic Influenza Preparedness recommends that patients with asthma receive the influenza vaccine every year (12). Additionally, the World Health Organization's Seasonal Influenza Vaccination Recommendations during the COVID-19 Pandemic recommended influenza vaccination to people living with asthma and children younger than 6 years old (13).

Experts expressed concern that the possible twin-demic (dual) effect of influenza may increase morbidity and mortality during the COVID-19 pandemic (14). Pediatric influenza vaccination was suggested to be an important factor in reducing the likelihood of dual COVID-19/influenza epidemics (12,15).

However, some factors may change parents' vaccination intention. Studies have reported that the COVID-19 pandemic may affect parental influenza vaccination preferences (15-24). Homeschooling, lockdown, high education level, high income, and knowing their children are in a priority group for vaccinations are some factors previously reported to affect parental influenza vaccination intention during the COVID-19 pandemic (24-27).

This study aimed to investigate parental attitudes toward having their children with asthma vaccinated against influenza during the 2020-2021 COVID-19 pandemic and evaluate whether the pandemic had an impact on parental preferences. By assessing parental attitudes towards influenza vaccination, this study ultimately aims to provide relevant data for the development of national and international public health strategies for achieving herd immunity.

MATERIALS and METHODS

Study Population

Between 2019 and 2021, the parents of children 18 months to 18 years of age who were diagnosed with asthma before September 2019 and followed for at least 2 years at the pediatric allergy and immunology clinic of our hospital were included in the study. Patients who had previously experienced any reaction or complication with the influenza vaccine in 2018-2019 were excluded.

Questionnaire

The parents were informed about the nature and scope of the study. Their views on the general health, vaccination status, asthma symptoms, and treatment of their children were questioned in face-to-face interviews using a study-specific questionnaire created by a pediatric allergist. Consent to participate and for the use of their children's data in the study was obtained from each parent. The study was approved by the Institutional Review Board of Ankara City Hospital (no: E2-21-359).

Demographic and clinical data such as the patients' age, sex, perinatal, natal, and postnatal characteristics, atopy status, presence of concomitant atopic diseases, and family history were collected using the questionnaire. In addition, for the diagnosis of asthma, parents were asked about their child's follow-up duration, number of prior attacks that required hospitalization, need for intensive care, asthma control status, and medications, and the information provided was checked against hospital records. The parents were also questioned about whether their child received the influenza vaccine in the 2019-2020 season and whether influenza vaccination affected asthma control and exacerbations. Finally, parents were asked whether they intended to have their children vaccinated against influenza in the 2020-2021 season and the reason(s) for their preference.

Statistical Analysis

The study data were analyzed using SPSS version 22.0 (IBM Corp, Armonk, NY). Continuous data did not show a normal distribution and were presented as median and interquartile range (IQR, 25th-75th percentiles). A p-value of <0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

The patient group included a total of 288 children with a median age of 11 years (IQR: 8-14), 60.1% (n=173) of whom were male. The median duration of asthma follow-up was 6 years (range 4-8). The sociodemographic characteristics of the patients are summarized in Table I. Also characteristics of asthma in children are summarized in Table II. A history of COVID-19 infection was reported in 93 patients (32.3%).

Table I: Sociodemographic characteristics of patients and their parents (n=288).

Age (years), median	11 (8-14)
Sex (male), n (%)	173 (60.1)
Chronic illness, n (%)	55 (19)
Concomitant Allergic disease, n (%)	189 (65)
Atopic Dermatitis	22 (7.6)
Food Allergy	11 (3.8)
Allergic Rhinitis	177 (61.4)
Family history of allergic diseases	85
Maternal age (years), median/IQR	38 (33-41)
Paternal age (years), median/IQR	42 (38-45)
Maternal education level	
Primary school	82 (28.5)
Secondary school	41 (14.2)
High school	93 (32.3)
University	72 (25)
Paternal education level	
Primary school	63 (21.9)
Secondary school	45 (15.6)
High school	117 (40.6)
University	63 (21.9)
Monthly income	
Less than minimum wage	47 (16.3)
Minimum wage	110 (38.2)
Above minimum wage	131 (45.5)
Family members with a chronic illness (Asthma/HT*/DM*/Heart disease)	111
Number of siblings, median (IQR)	1 (0-2)

HT: Hypertension, **IQR:** Interquartile range, **DM:** Diabetes mellitus

Rates of Vaccination

A total of 166 (57.6%) patients received the influenza vaccine at least once at any time (before or after the pandemic). While 103 (35.7%) patients were vaccinated against influenza before the COVID-19 pandemic, 136 (47.2%) patients were vaccinated during the COVID-19 period.

Table II: Characteristics of asthma in children.

Years since asthma diagnosis, median (IQR)	6 (4-8)
Number of attacks during COVID-19 pandemic, median (IQR)	1 (0-2)
Treatment received in 2019 (pre-COVID)	
None	17
SABA* (if necessary)	50
ICS*	120
LTRA*	9
ICS+LTRA	71
ICS+ LABA*	12
ICS+LABA+LTRA	9
Treatment received in 2020-2021 (COVID-19 period)	
None	5
SABA (if necessary)	56
ICS	128
LTRA	11
ICS+LTRA	51
ICS+ LABA	24
ICS+LABA+LTRA	13
Treatment change after COVID-19	
No	187
Yes	101
Step-down	49
Step-up	52
Atopy (e.g., pollens/house dust), (n=165 tested)	
No	59
Yes	106
Monosensitized	68
Pollens	44
House dust	17
Mold	5
Cat dander	2
Polysensitized	38
Pollens	27
House dust	20
Mold	8
Cat/dog dander	18
Cockroach	5

ICS: Inhaled corticosteroid, **LTRA:** Leukotriene receptor antagonist, **LABA:** Long-acting beta agonist, **SABA:** Short- acting beta agonist

During the pandemic, there were 195 (67.7%) patients whose vaccination status was unchanged compared to previous years. Of these, 122 (42.3%) patients were not vaccinated in either period and 73 (25.3%) patients were vaccinated in both periods.

The influenza vaccination status of 93 (32.3%) children changed during the pandemic period. Of these, 30 patients (32.3%, n=30/93) were vaccinated before but not during the COVID-19 pandemic (10.4% of all patients, n=30/288). The remaining 63 children (67.7%, n=63/93) were vaccinated during the COVID-19 pandemic but not previously (21.9% of all patients, n=63/288). There was no significant difference between the parents of children who were vaccinated (n=103) and not vaccinated (n=185) before the COVID-19 pandemic in terms of intention to vaccinate their children during the pandemic (29%, n=30/103 vs. 34%, n=63/185, p=0.432).

Comparison of Vaccinated and Non-Vaccinated Patients

The children who had never been vaccinated against influenza and those who were vaccinated at least once did not differ statistically in age, sex, change in asthma treatment step in the post-COVID period, or maternal/paternal education levels. However, those with a history of multiple asthma attacks in the previous year, those at a higher step of asthma treatment (above step 2), and those with a monthly household income above the minimum wage were more likely to be vaccinated at any time (p<0.005, p=0.039, and p<0.01, respectively) (Table III).

The comparison between children who were and were not vaccinated in 2020 (during the COVID-19 pandemic) showed that boys (p=0.030), those at a higher step of asthma treatment (p=0.002), and those with a monthly household income above the minimum wage (p<0.001) were more likely to be vaccinated (Table III).

Causes of Vaccine Hesitancy

The parents of children who had never been vaccinated against influenza reported that the primary reason for opting out of vaccination was that their children were well (40.1%). The second reason was doubt about the efficacy of the vaccine or being against vaccination altogether (20.5%) (Table IV). COVID-19 lockdown (61.5%) was the most common cause of vaccine hesitancy among parents who had not vaccinated their children during the pandemic despite doing so before the pandemic (Table IV).

Table III: Comparison of vaccinated versus non-vaccinated patients.

	Never vaccinated n=122	Vaccinated at least once n=166	p	Vaccinated during COVID-19 n=136	Not vaccinated during COVID-19 n=152	p
Age, years	10 (8-14.5)	11 (8-14)	0.725	11 (8-15)	11 (8-14)	0.626
Sex, male	68 (55.7%)	105 (63.2%)	0.198	91 (66.9%)	82 (53.9%)	0.030
Maternal education level (high school or higher)	72 (59%)	93 (56%)	0.612	73 (53.6%)	92 (60.5%)	0.283
Paternal education level (high school or higher)	76 (62.2%)	104 (62.6%)	0.951	83 (61%)	97 (63.8%)	0.628
Monthly household income Above minimum wage	33 (27%)	98 (59%)	0.00	80 (58.8%)	51 (33.5%)	0.000
Infected with COVID-19 virus	44 (36%)	51 (30.7%)	0.341	42 (30.8%)	53 (34.8%)	0.531
Asthma treatment steps changed	43 (35.3%)	58 (34.9%)	0.957	50 (36.7%)	51 (33.5%)	0.621
Asthma duration	6 (4-8)	6 (4-8)	0.793	6 (4-8)	6 (4-8)	0.971
Family member with a chronic illness	46 (37.7%)	65 (39.1%)	0.845	52 (38%)	60 (39%)	0.904
Number of asthma attacks in the previous year	0 (0-2)	1 (0-3)	0.10	1 (0-2)	0 (0-2)	0.021
Asthma treatment step >2	30 (24.5)	58 (34.9)	0.039	54 (39.7)	34 (22.3)	0.002
Paternal age, years	42 (38-45)	42 (38-45)	0.786	42 (37-46)	41 (38-45)	0.942
Maternal age, years	38 (33-41)	38 (37.7-41.25)	0.932	38 (32-41)	38 (33-41)	0.645

Table IV: Causes of vaccine hesitancy among parents.

		Never vaccinated n=122	Not vaccinated during COVID-19 n=131	Patients vaccinated before COVID-19 but not during COVID-19 n=30
Patient-related	Not frequently sick	49	37	1
	Scared of getting a vaccine Unwilling to get vaccinated	8	9	2
	Had flu already	5	9	4
	Current illness/treatment (Glycogen storage disease/immunotherapy)	2	2	-
Parent-related	Anti-vaccine	14	5	-
	Fear of side effects of vaccine	7	3	-
	Disbelief in vaccine effectiveness	11	13	2
	Believes that vaccination reduces immunity	3	2	-
	No particular reason	5	6	-
	unsure	2	2	-
	Financial reasons	2	2	-
	Vaccination was not recommended by a healthcare provider	14	18	1
Pandemic-related	The child did not go to school because of lockdown	-	21	19
	Fear of going to the hospital during the pandemic	-	2	1

DISCUSSION

In this study comparing the attitudes of the parents of 288 children with asthma towards influenza vaccination during and before the COVID-19 pandemic, we determined that 57.6% of the children were vaccinated at least once. During the pandemic, parental attitudes towards vaccination changed in 32% of the parents, with approximately two-thirds of these parents having their children vaccinated during the COVID-19 pandemic despite not having done so before. In contrast, parents who did not have their children vaccinated during the pandemic despite doing so previously cited pandemic lockdowns as the most common reason (61.5%) for their influenza vaccination hesitancy.

Many studies have investigated the potential impact of the COVID-19 pandemic on influenza vaccination preferences (15-19). Studies among adults, especially health workers, reported both decreasing and increasing rates of influenza vaccinations during the pandemic (16,18-20). In a study from China, there was a decreased rate of influenza vaccination throughout the pandemic (20). In contrast, a study involving nurses reported a 50% increase in influenza vaccination associated with COVID-19 (16). In another study of healthcare providers, Grochowska et al. reported a 2-fold increase in the influenza vaccination rate during the COVID-19 pandemic compared to the previous year (18). An observational study from the United Kingdom also indicated that the rate of influenza vaccination among adults increased, especially among those who had not been previously vaccinated (19).

As with adults, many studies reported changes in influenza vaccination rates among children during the COVID-19 pandemic (15,21,22). In a study by Sokol and Grummon evaluating changes in parental intention to have their children vaccinated against influenza during the COVID-19 pandemic, 60% of the parents showed a change in their attitudes towards influenza vaccination (15). Parents whose children received the influenza vaccine previously reported that they were more likely to have their children vaccinated in the future due to the pandemic. However, the authors suggested that the COVID-19

pandemic alone was not sufficient to encourage parents to vaccinate their children against influenza (15). In a study by Goldman et al., parental willingness to vaccinate their children against influenza was reported to increase by 15.8% during the pandemic period compared to the previous year (22). Seiler et al. also reported a considerable increase in parental intention to have their children vaccinated against influenza during the pandemic period, and children with chronic conditions were found to be more frequently vaccinated than healthy children (23). Özer et al. reported that the rate of influenza vaccination in children with asthma increased during the COVID-19 pandemic (21). In the current study, the rate of influenza vaccination in children with asthma increased by 12% during the pandemic compared to the previous year. Parental intention to have their children receive the influenza vaccine changed in 32% (n=93) of the parents during the COVID-19 pandemic. However, this change in parental intention did not differ statistically between parents who did and did not have their children vaccinated before the pandemic. While 25.3% (n=73) of the parents had their children vaccinated both before and after the pandemic, 21.8% (n=63) of those who did not have their children vaccinated before the pandemic chose to vaccinate after the pandemic.

Studies examining factors affecting influenza vaccination intentions during the COVID-19 pandemic have indicated that previous vaccination is the most important factor (15,24). Salawati et al. identified the threat posed by the pandemic to human life, high education levels, and high monthly income as other factors associated with vaccination rates (24). In the study by Goldman et al., parents with higher education level were more likely to have their children vaccinated against influenza, including those who did not do so in the previous year (22). In a study by Lai et al., it was reported that for parents, knowing their children are in a priority group for vaccination affected their intention and they became less hesitant towards influenza vaccination (25). In our study, we observed that the influenza vaccination rate during the COVID-19 pandemic was higher among boys, those with higher income, children with a high frequency of asthma exacerbations, and those at a higher step of asthma treatment. Parental education level did not significantly affect influenza vaccination intention in our study. On the other hand, 11% of the parents whose children had never been vaccinated reported that lack of physician advice was the cause of their vaccine hesitancy. Similarly, previous studies have shown that educating parents about the importance of influenza vaccination and emphasizing it as a top priority for children with chronic illnesses is important for acceptance of influenza vaccination in children with asthma (25,26). Therefore, to improve vaccination rates among children with asthma, parents should be given detailed information about the importance of influenza vaccination for their children.

In contrast, other studies have reported that COVID-19 did not increase influenza vaccination rates among children and that homeschooling and lockdowns changed parental intention to have their children get the influenza vaccine (15,24,27). Fogel et al. have reported that the frequency of influenza vaccination among children decreased during the COVID-19 pandemic compared to previous years and suggested that this may be because the patients were reluctant to go to hospitals for fear of COVID-19 transmission or that the measures taken for COVID-19 (such as wearing masks) may also reduce influenza transmission (27). Similarly, we determined in this study that lockdown was the most common reason parents did not have their children vaccinated against influenza during the COVID-19 pandemic. It should be kept in mind that the strategies implemented during pandemics may affect vaccination for other diseases, and measures should be taken accordingly.

The major limitation of our study was that it was a cross-sectional survey study relying on parental self-report. Because of the retrospective nature of our study, the children's asthma control status before the COVID-19 pandemic was assessed according to parental reports, which are subjective. However, we checked parental reports against the documented asthma treatment steps of children and found a high degree of agreement. The main strength of our study is that the asthma patients were followed for a median of 6 years. Furthermore, the data from the current study reflects experience from a single center, and the economic burden of vaccination on families was not a confounding factor because influenza vaccination is provided free of charge to asthmatic patients provided that their condition is documented with a medical report.

In conclusion, COVID-19 affected parents' attitudes toward influenza vaccination of their children with asthma. The immunization rate of children after COVID-19 increased by 12% (from 35% to 42%) compared to the previous year. While 10.4% of patients were vaccinated before but not during the pandemic, 21.9% were not vaccinated

before but were vaccinated during the pandemic. Those with a history of multiple asthma attacks in the previous year, those at a higher step of asthma treatment (above step 2), and those with a monthly household income above the minimum wage were more likely to be vaccinated. While the apparent wellness of their child was the most common reason for parental unwillingness to vaccinate their children against influenza before the pandemic, lockdown was the most common reason for not being vaccinated during the COVID-19 pandemic. Thus, it should be kept in mind that strategies developed to fight pandemics may impact vaccination patterns and that measures should be taken accordingly.

Conflict of Interest

The author declares no conflict of interest.

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Authorship Contributions

Concept: **Sule Buyuk Yaytokgil, Emine Dibek Misirlioglu,** Design: **Sule Buyuk Yaytokgil, Emine Dibek Misirlioglu,** Data collection or processing: **Sule Buyuk Yaytokgil, Gulsah Sen, Azize Pinar Metbulut,** Analysis or Interpretation: **Sule Buyuk Yaytokgil, Candan Islamoglu,** Literature search: **Sule Buyuk Yaytokgil, Gulsah Sen, Emine Dibek Misirlioglu,** Writing: **Sule Buyuk Yaytokgil, Emine Dibek Misirlioglu,** Approval: **Sule Buyuk Yaytokgil, Emine Dibek Misirlioglu.**

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