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Demographic and Clinical Characteristics of COVID-19 in Children and the Effect of Household Tobacco Smoke Exposure on COVID-19

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What is already known on this topic?

- *Environmental tobacco smoke exposure is associated with many diseases, including lower respiratory tract infections, in pediatric age groups*
- *Active cigarette smoking has been found to be associated with the severity and the mortality of COVID-19.*

What this study adds on this topic?

- *Cough was found to be more common in pediatric COVID-19 patients with household environmental tobacco smoke exposure.*
- *Among pediatric patients with mild COVID-19, cough and fever were found to be more common in patients with household environmental tobacco smoke exposure.*
- *No relationship was found between clinical severity of COVID-19 and household environmental tobacco smoke exposure in pediatric patients*

ABSTRACT

Objective: Environmental tobacco smoke (ETS) exposure is associated with many diseases, including lower respiratory tract infections, in pediatric age groups. In this study, we aimed to assess the effect of household ETS exposure on symptom frequency and clinical severity in children and adolescents with COVID-19.

Materials and Methods: This retrospective study included pediatric cases (<18 years old) with a positive SARS-CoV-2 test, who were admitted to our hospital between 20.03.2020 and 01.05.2020. Patients with respiratory diseases and active smokers were excluded. Demographic characteristics, symptoms, and clinical severity of COVID-19 were obtained from parents and children using a questionnaire and from patients' files. Household ETS exposure was assessed by questionnaire.

Results: A total of 167 patients (median age 145 months, 50.7 % male) were included in the study. The frequency of household ETS exposure was 50.9%, and the frequency of cough was significantly higher in exposed children than non-exposed children (71.4% vs 50.8% respectively, p=0.02). The frequency of both fever and cough was significantly higher ETS-exposed in the subgroup of cases with a mild clinical course (69.5% vs 48.1% respectively, p= 0.02 for fever and 67.8% vs 44.4% respectively, p=0.01 for cough). There was no relationship between clinical severity and household ETS exposure.

Conclusion: Household ETS exposure may impact COVID-19 pediatric cases as demonstrated by the increased frequency of cough and fever in ETS-exposed children. As new lockdown measures are implemented, increasing public awareness about the effect of household ETS exposure on COVID-19as well as encouraging a decrease in ETS exposure are essential.

Keywords: Environmental tobacco smoke exposure, children, coronavirus disease 2019, COVID-19

INTRODUCTION

It has been known for many years that tobacco consumption causes millions of deaths, as well as new cases of cancer and, heart and lung disease, each year.[1] Secondhand smoke exposure, which is also called involuntary or passive smoking, is the exposure of non-smoking children or adults to tobacco smoke.[2] Children are exposed to environmental tobacco smoke (ETS) in social areas like the house, school, and public transportation.[3-5] ETS exposure has been found to be associated with many diseases including respiratory tract diseases, cancers, otitis media, as well as neurodevelopmental and behavioral problems, decreased cognitive and intellectual abilities, and sudden infant death in pediatric age groups.[6-12] Furthermore, ETS exposure causes the increased length of hospital stay, disease severity, and mortality due to lower respiratory tract infections.[13] Protection from ETS is strongly recommended due adverse effects on children.[14]

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The epidemic that started in Wuhan, China, in December 2019 and has now affected the entire world is called coronavirus disease-2019 (COVID-19) and is caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2).[15] As of December 27, 2020, it has affected 79 million people and resulted in approximately 1.7 million deaths.[16] Approximately 8%–10% of those infected were children.[17] In our country, a total of 2 million cases were counted by December 2020.[18] Although COVID-19 pediatric patients compared to adults, some pediatric cases require hospitalization and intensive care monitoring.

A person becomes more susceptible to SARS-CoV-2 with active smoking.[19] In studies, including meta-analyses, it has been shown that there is an association between active smoking and both COVID-19 severity and mortality.[20-24] The relationship between COVID-19 and ETS exposure has not been investigated. The frequency of active smoking is low among children; however, they are the population most vulnerable on ETS exposure, which is commonly ignored. Furthermore, the lockdowns have caused increased household ETS exposure in children and adolescents. This study aimed to evaluate the effect of household ETS exposure on symptom frequency and clinical severity in children and adolescents with COVID-19.

METHODS

This retrospective study was conducted in Istanbul Haseki Training and Research Hospital between 20.03.2020 and 01.05.2020. The ethics committee of Istanbul Haseki Training and Research Hospital approved the study (09.09.2020; protocol number 2020/87). Children and adolescents under 18 years of age and with a positive oro-or nasopharyngeal real-time reverse transcriptase-polymerase chain reaction (PCR) test for SARS-CoV-2 (Bioksen ArGe Teknik Co. Ltd, Turkey; Biospeedy®) were consecutively included in the study (n=188). Children with underlying respiratory diseases and/or active smoking were excluded from the study (n=21).

Demographic characteristics; presence of household SARS-CoV-2 contact; underlying diseases; and symptoms, duration of symptoms, and course of COVID-19 (duration and severity) were obtained from parents and children both via a questionnaire and retrospectively from patients' files. The number of active smokers in the household, the amount of cigarette consumption by active smokers (packs per day) and whether the active smoker(s) smokes inside the house were determined using a questionnaire to assess the household ETS exposure of the children.

The patients were divided into three groups based on clinical findings[1]: asymptomatic group, consisting of patients who underwent PCR test due to only a contact history and did not exhibit any complaints[2]; mild group, patients with nonspecific symptoms such as cough, fever, malaise and myalgia; and[3] moderate-to-severe group, patients whose pneumonia was confirmed by physical examination and imaging (chest X-ray and/or computed tomography) with or without requiring supplemental oxygen. The latter group consisted of hospitalized patients. Asymptomatic and mild cases were followed up by telephone or outpatient clinic visits and none of them had a clinical deterioration. Patients who were exposed to household environmental tobacco smoke were defined as the ETS (+) group, and those who were not exposed were defined as the ETS (-) group.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) version 22.0 (IBM SPSS Corp.; Armonk, NY, USA) was used for statistical analysis. Descriptive statistics were performed. Categorical variables were given as numbers (percentages) and analyzed with a Chi-square test or Fisher's exact test. Continuous variables were presented as median (minimum-maximum) and analyzed using the Mann-Whitney U test. Results were considered statistically significant if the p value obtained in a two-tailed was < 0.05.

RESULTS

A total of 167 patients were evaluated. The median age was 145 months (range 0.9–214 months) and the male: female ratio was 1:1 (84 males, 50.7%). The demographic and the clinical characteristics of the cases were presented in Table–1. The majority of the cases were above 5 years (81.4%) and had a mild disease course (67.7%). A total of 148 patients (88.6%) had contact with COVID-19 positive relative living in the same house. The median number of COVID-19 positive relative living at the same house was 3 people (minimum 1, maximum 11 people) Seventeen patients (10.1%) had no COVID-19 positive relatives at home. Data were not available for the remaining two children.

The median number of siblings was three and the median number of people living in the same house was five. The characteristics of household ETS exposure are presented in Table–2. Half of the children (n=85) were exposed to household ETS. In the majority of the ETS (+) cases, the number of active smoker in the household was one (85.9%), who was most often the father (61.2%). Approximately half of the household active smokers consumed 20 cigarettes per day or more.

The symptom frequency and the duration of symptoms among symptomatic patients (mild and moderate-to-severe clinical course) were given in Table-3. The most common symptoms were cough (61.7%) and fever (59.4%). The median duration of the symptoms was two days.

The comparison of the demographic and clinical characteristics of the patients according to household ETS exposure were presented in Tables 1 and 3. There was no significant difference between groups in age, gender or clinical severity. Among symptomatic patients, the prevalence of cough was significantly higher in the ETS (+) than in the ETS (-) group. Fever and cough were significantly more prevalent in the ETS (+) group ($p=0.02$ and $p=0.01$, respectively) among patients with a mild clinical course. Interestingly, fever was more prevalent in the ETS (-) group than in the ETS (+) group among patients with a moderate-to-severe clinical course ($p=0.03$).

No effect of the intensity of household ETS (the number of cigarettes consumed per day) or whether the active smoker was

Table 1. Demographic Characteristics of the Cases with and without Household Environmental Tobacco Smoke Exposure

	Total (n = 167)	Household ETS (+) (n = 85)	Household ETS (-) (n = 82)	*P* Value*
Age, months	145 (0.9 - 214)	143 (4.0 - 214)	145.5 (0.9 - 214)	0.94
Age distrubition				0.84
< 5 year	31 (18.6 %)	17 (20%)	14 (17.1%)	
5-15 year	78 (46.7 %)	38 (44.7%)	40 (40.8%)	
≥ 15 year	58 (34.7 %)	30 (35.3%)	28 (34.1%)	
Gender				0.36
Female	83 (49.3 %)	39 (45.8%)	44 (53.6%)	
Male	84 (50.7 %)	46 (54.2%)	38 (46.4%)	
Number of sibling	3 (0-10)	3 (0-8)	3 (0 - 10)	0.69
Number of people living at home	5 (2 - 11)	5 (3 - 11)	5 (2 - 9)	0.54
Clinical severity				0.66
Asymptomatic	34 (20.4%)	15 (17.6 %)	19 (23.2%)	
Mild	113 (67.7 %)	59 (69.4 %)	54 (65.9%)	
Moderate-to-severe	20 (12.0%)	11 (12.9 %)	9 (11.0 %)	

Data is given as median (minimum-maximum) or n(%).
*Mann-Whitney U test was performed to compare continuous data and Chi-Square test or Fisher's Exact test was used to compare categorical data
ETS, exposure to tobacco smoke.

COVID-19-positive, on clinical severity, symptom frequency and symptom duration (data not shown).

DISCUSSION

Our study population consisted of COVID-19-positive children and adolescents diagnosed in the early period of the pandemic when the quarantine measures were intensive. Therefore, children were exposed to household tobacco smoke more than ever. The main results of this study were that the frequency of household ETS exposure among COVID-19 positive children and adolescents was 50.9% and the frequency of cough was significantly higher in ETS-exposed children than in non-exposed children. In addition, the frequency of both fever and cough was significantly higher in ETS (+) cases with a mild clinical course.

Table 2. The Characteristics of the Household Active Smoker Relatives of the Cases

	n (%) or median (minimum-maximum)
Household active smoker (n:85)	
Mother	14 (16.5%)
Father	52 (61.2%)
Both parents	7 (8.2%)
Siblings	12 (14.1%)
Others	3 (3.5%)
Number of household active smoker (n:85)	1 (1-3)
1 person	73 (85.9%)
2 people	10 (11.8%)
≥ 2 people	2 (2.3%)
Total number of cigarettes consumed by active smokers during the day (n:84)	17.5 (3-60)
<10	16 (19.0%)
10-20	26 (31.0%)
≥ 20	42 (50.0%)

Many diseases develop in children due to ETS exposure, and the number of affected children is rapidly increasing each year. ETS exposure has been found to be associated with respiratory tract diseases, cancers, otitis media, neurodevelopmental and behavioral problems, decreased cognitive and intellectual abilities, and sudden infant death in pediatric age groups.[6-12] In children under one year old, in particular, if the parents smoke, the predisposition to lower respiratory tract diseases and the frequency of lower respiratory tract infections such as pneumonia and bronchiolitis are increased.[14,25,26] A study from Turkey conducted by Arvas et al.,[27] also reported an increased frequency of lower respiratory tract infection in children who were exposed to household ETS. If the smoker is the mother or the primary caregiver, the predisposition to and frequency of disease are further increased.[28] Furthermore, ETS exposure causes increased of hospital stay, disease severity, and mortality due to lower respiratory tract infections.[13] The proposed mechanisms are ETS-induced damage to flora and, oro- and nasophareyngeal epithelial cells and mucociliary activity, rather than direct damage to the lungs.[28-32]

The studies conducted in Turkey have reported frequencies of household ETS exposure among children, between 53% and 85%[3-5], and that the main active smoker was the father.[4,33-35] In line with the literature, in the current study the frequency of household ETS exposure was 50.9% and the main household active smoker was the father.

In studies, including meta-analyses, it has been shown that there is an association between active smoking and both COVID-19 severity and mortality.[28-32] To our knowledge, is no study has evaluated COVID-19 and ETS exposure. Although active smoking among children is rare, they are the most

Table 3. Comparison of the Symptom Frequency and Duration of the Symptomatic Patients According to Household Environmental Tobacco Smoke Exposure

	Symptoms	Total	Household ETS (+) (n:70)	Household ETS (-) (n = 63)	*P* Value*
All symptomatic patients (n=133)	Cough	82 (61.7 %)	50 (71.4 %)	32 (50.8%)	**0.02**
	Duration of cough	2 (1-10)	1 (1-10)	2 (1-7)	0.91
	Fever	79 (59.4 %)	45 (64.3 %)	34 (54.0 %)	0.23
	Duration of fever	1 (1-5)	1 (1-4)	1 (1-5)	0.71
	Shortness of breath	26 (19.5 %)	14 (20.0 %)	12 (19.0%)	1
	Duration of shortness of breath	2 (1-7)	2 (1-7)	3 (1-7)	0.31
	Sore throat	25 (18.8 %)	9 (12.9 %)	16 (25.4 %)	0.10
	Duration of sore throat	2 (1-7)	7 (2-7)	2 (1-3)	0.28
	Myalgia	21 (15.8%)	6 (8.6 %)	15 (23.8 %)	0.30
	Duration of myalgia	3 (1-7)	3 (2-3)	2 (1-7)	0.44
	Rhinorrhea	15 (11.3 %)	7 (10.0 %)	8 (12.7 %)	0.83
	Duration of rhinorrhea	3 (1-7)	7 (2-7)	3 (1-3)	**0.04**
	Diarrhae	13 (9.6 %)	8 (11.4 %)	5 (7.9 %)	0.70
	Duration of diarrhea	3 (1-10)	3 (1-10)	4 (1-5)	0.77
	Abdominal pain	8 (6 %)	3 (4.3 %)	5 (7.9 %)	0.30
	Duration of abdominal pain	3 (1-7)	3 (2-7)	3 (1-7)	0.76
	Duration of the disease	2 (1-10)	2 (1-10)	2 (1-7)	0.76
Mild (n= 113)	Fever	67 (59.2%)	41 (69.5 %)	26 (48.1 %)	**0.03**
	Duration of fever	1 (1-5)	1 (1-4)	1 (1-5)	0.82
	Cough	64 (56.6%)	40 (67.8 %)	24 (44.4 %)	**0.02**
	Duration of cough	2 (2-7)	2 (1-7)	2 (1-7)	0.45
	Sore throat	25 (22.1%)	9 (15.3 %)	16 (29.6 %)	0.07
	Duration of sore throat	2 (1-7)	3 (1-7)	2 (1-7)	0.28
	Myalgia	18 (15.9%)	6 (10.2 %)	12 (22.2 %)	0.12
	Duration of myalgia	3 (1-7)	3 (2-3)	3 (1-7)	0.91
	Shortness of breath	16 (14.1%)	8 (13.6 %)	8 (14.3 %)	1
	Duration of shortness of breath	3 (1-7)	2 (1-7)	3 (1-7)	0.31
	Rhinorrhea	15 (13.2%)	7 (11.9 %)	8 (14.8 %)	0.85
	Duration of rhinorrhea	3 (1-7)	4 (2-7)	3 (1-3)	0.04
	Diarrhae	10 (8.8%)	6 (10.2 %)	4 (7.4 %)	0.75
	Duration of diarrhea	5 (1-10)	4,5 (1-10)	5 (3-5)	1
	Abdominal pain	8 (7.0%)	3 (5.1 %)	5 (9.3 %)	0.48
	Duration of abdominal pain	3 (1-7)	3 (2-7)	3 (1-7)	0.76
	Duration of the disease	2 (1-10)	2 (1-10)	2 (1-7)	0.83
Modarete-to-severe (n=20)	Cough	18 (90.0%)	10 (90.9 %)	8 (88.9 %)	1
	Duration of cough	2 (1-10)	4 (1-10)	2 (1-4)	0.15
	Fever	12 (60.0%)	4 (36.4%)	8 (88.9%)	**0.03**
	Duration of fever	1 (1-3)	2.5 (1-3)	1 (1-3)	0.10
	Shortness of breath	10 (50.0%)	6 (54.5 %)	4 (44.5 %)	1
	Duration of shortness of breath	1 (1-3)	1 (1-3)	1.5 (1-2)	1
	Myalgia	3 (15.0%)	0	3 (33.3 %)	0.07
	Duration of myalgia	1 (1-1)		1 (1-1)	
	Diarrhae	3 (15.0%)	2 (18.2 %)	1 (11.1 %)	1
	Duration of diarrhea	2 (1-3)	3 (3-3)	1 (1-1)	0.31
	Duration of the disease	2 (1-10)	3 (1-10)	2(1-4)	0.21

Data is given as median (minimum-maximum) or n(%).
*Mann-Whitney U test was performed to compare continuous data and Chi-Square test or Fisher's Exact test was used to compare categorical data
ETS, exposure to tobacco smoke.

vulnerable population in terms of ETS exposure. Furthermore, the lockdowns have caused increased *household* ETS exposure in children and adolescents. As described above associations between ETS exposure and the frequency and the severity of lower respiratory tract infections have been reported. However, in the current study, there was no association between household ETS exposure and the clinical severity of COVID-19. It is known that COVID-19 tends to have a milder course in children. The majority of our cohort consisted of patients with a mild clinical course (67.7%). The patients with a moderate-to-severe clinical course comprised only 12% of all patients, which may impede the ability of our study to demonstrate the effect of household ETS on clinical severity. Therefore, it is necessary to evaluate this subject in future studies including more patients.

Fever and cough are among the most common symptoms in pediatric COVID-19 cases. The frequency of fever and cough has been found to be 35%-46% and 37%-41%, respectively.[36-38] In addition, the frequency of patients having at least one of the symptoms fever, cough, and shortness of breath was found to be approximately 60%.[36-38] In our study, fever (59.4%) and cough (61.7%) were the most common symptoms among all symptomatic patients. These percentages were higher than those reported in the literature. Cough was significantly more frequent in ETS (+) patients (71.4%) than in ETS (-) patients (50.8%). Both fever and cough were also more frequent in ETS (+) patients in the subgroup of children with a milder clinical course.

The major limitation of our study that household ETS exposure was assessed only by questionnaires; more objective markers such as urine cotinine levels were not performed. However, ETS exposure is mainly assessed by questionnaires in the literature. Furthermore, a study evaluating the effect of ETS exposure on the incidence of lower respiratory tract disease by using both questionnaire and urine cotinine level, reported that urine cotinine will not necessarily improve the validity of such studies.[39]

CONCLUSION

As a result, the COVID-19 pandemic is still ongoing and in the light of current information, the effect of active smoking on the severity and mortality of COVID-19 is known. Our study has demonstrated that household ETS exposure may impact COVID-19 pediatric cases, as demonstrated by the increased frequency of cough and fever among ETS-exposed children and adolescents. Furthermore, as new lockdown measures are implemented, household ETS exposure may continue to be increased. Increasing public awareness about the effect of household ETS on COVID-19, in addition to encouraging decrease ETS exposure, is essential, especially for vulnerable children and adolescents.

Ethical Committee Approval: Ethical comittee approval was received from the Ethics Committee of Istanbul Haseki Training and Research Hospital (Approval No: 2020/87).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

Peer Review: Externally peer-reviewed.

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