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Original Article

Internet addiction and anxiety in asthmatic children after the first year of the COVID-19 pandemic*

Pınar Gökmirza Özdemir[1], Velat Çelik[2], Burçin Beken[3], Özge Türkyılmaz Uçar[1], Sibel Kaplan[1], Mehtap Yazıcıoğlu[1]

[1]Trakya University, Faculty of Medicine, Department of Pediatric Allergy and Immunology, Edirne, Türkiye
[2]Necip Fazıl City Hospital, Department of Pediatric Allergy and Immunology, Kahramanmaraş, Türkiye
[3]Kanuni Sultan Süleyman Training and Research Hospital, Department of Pediatric Allergy and Immunology, İstanbul, Türkiye

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ABSTRACT

Objective: Studies have revealed that people with asthma have a higher risk of anxiety during the COVID-19 pandemic. The relationship between internet addiction and anxiety has long been known, but to our knowledge, no studies have combined anxiety in asthmatic children and adolescents with internet use. This study investigated the relationship between anxiety levels and internet use in asthmatic children and adolescents during the late stage of the COVID-19 pandemic.

Method: A multicenter survey was conducted in February-March 2021, enrolling 78 asthmatic patients and 44 healthy controls. Anxiety was assessed with the State-Trait Anxiety Inventory for Children (STAI-C) for children aged 9-12 and with the State-Trait Anxiety Inventory (STAI) for adolescents aged 13-18. Internet use was assessed with the Internet Addiction Scale for Adolescents (IASA).

Results: Anxiety scores did not differ between patients and controls. The average time spent on the internet increased markedly (over three-fold) during the pandemic period compared to the pre-pandemic period (from 2.1±1.5 [0-6] hours per day to 6.9±3.5 [0-18] hours per day ($p<0.001$ in all participants). There was no difference in the IASA scores between the patients and controls. There was a correlation between the IASA and STAI state and trait (STAI [S] and STAI [T]) scores in the 13-18 year group ($r=0.28$, $p=0.03$, and $r=0.34$ $p=0.01$, respectively).

Conclusion: Problematic internet use has more impact on anxiety in adolescents than asthma during the late stage of the COVID-19 pandemic. We suggest that internet addiction should be kept in mind when evaluating anxiety in asthmatic adolescents during their follow-up.

Keywords: Anxiety, asthma, children, COVID-19 pandemic, internet addiction

INTRODUCTION

As of April 2022, SARS-CoV-2 (COVID-19) had been reported to have caused 504,600,544 infections and 6,198,747 deaths worldwide[1] and to have severely affected both psychological and physical health. A global systematic review of psychological outcomes conducted among the public during the COVID-19 pandemic found relatively high rates of anxiety (6.33-50.9%), depression (14.6-48.3%), posttraumatic stress disorder (7-53.8%), psychological distress (34.43-38%), and stress (8.1-81.9%).[2]

Children have constituted only 1-5% of diagnosed COVID-19 cases so far; symptoms have been milder than adults, and deaths

Correspondence: Pınar Gökmirza Özdemir **E-mail:** drpinar1975@hotmail.com
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have been extremely rare.[3] At the beginning of the pandemic, some health authorities suggested that asthma and allergic diseases might be risk factors for COVID-19. It later became clear that only uncontrolled asthma is a risk factor for severe COVID-19 and that patients with common allergic diseases do not develop distinct symptoms or severe outcomes.[4,5] Nevertheless, this potential relationship still had a potentially detrimental impact on patients' perceptions of their COVID-19 risk and mental health status.

Various interactions between allergy-related inflammatory and psychiatric disorders, such as depression, anxiety, and affective disorders, have been documented.[6-8] As allergic diseases themselves are associated with a negative effect on anxiety and depression, the COVID-19 pandemic could have resulted in an additional increase in the anxiety and depression levels of these patients. Many studies have dealt with the psychological impacts of COVID-19 on people with allergic diseases, especially those with asthma in specific age groups.[9-15] A recently published comprehensive review revealed that people with asthma, allergic rhinitis, and other chronic respiratory diseases are at higher risk for negative psychological outcomes, with risk factors including asthma severity, female sex, and previous history of anxiety and depression, likely owing to the perceived risk of severe disease from COVID-19.[16]

On the other hand, previous studies revealed the association between pathological internet use and psychological problems in adolescents, such as depression[17,18] and anxiety.[19,20] Although there have been many studies on the psychological impact of COVID-19 on asthmatic patients, to our knowledge, no previous study has investigated both anxiety and Internet use in asthmatic children and adolescents.

In this study, we aimed to evaluate state and trait anxiety levels in asthmatic children and adolescents during the late stage of the COVID-19 pandemic and to evaluate their relationship with internet use. We also aimed to compare the results with those of age-matched healthy children.

MATERIALS AND METHODS

Study design and population

A multicenter survey was conducted at three pediatric allergy and immunology departments located in different cities of Türkiye: 1) Trakya University Medical Faculty/Edirne, 2) Kanuni Sultan Süleyman Training and Research Hospital/İstanbul and 3) Necip Fazıl City Hospital/Kahramanmaraş. The study was conducted between February and March 2021. The patients aged 9-18 years who had been followed up for asthma for at least one year at each study center were enrolled in the study.

The patients had been diagnosed with asthma according to the clinical diagnostic criteria of the Global Initiative for Asthma (GINA)[21], based on a history of variable respiratory symptoms, such as wheezing, shortness of breath, chest tightness, and cough, as well as evidence of variable expiratory airflow limitation using spirometry. Age- and sex-matched healthy children were enrolled as a control group. Children in the control group were recruited through snowball sampling from friends and relatives of the patients because healthy children did not go to hospitals during the study period, except in emergency situations, because of the risk of COVID-19 transmission. Except for the items regarding asthma, the survey questions were almost identical for the control group. Written informed consent was obtained from all participants before being included in the study.

Data collection instruments

Data were collected from respondents in three forms: an ad hoc, study-related questionnaire and two (types of) standardized and validated self-report questionnaires, one on anxiety (with different versions) and the other on internet use.

Study-related questionnaire: The questionnaire was designed by the authors and contained questions related to demographic data, type of education received during the pandemic, and a visual analog score on a scale of 1-10 to assess the fear of infection with COVID-19 for all respondents. It also included questions about treatment adherence, follow-up, and management/course of the disease for those diagnosed with asthma.

Anxiety questionnaire: The State-Trait Anxiety Inventory was employed to assess state (STAI [S]) and trait (STAI [T]) anxiety in patients and controls aged 13-18 years. For the younger age group (9-12 years), the State-Trait Anxiety Inventory for Children was used for state (STAI-C [S]) and trait (STAI-C [T]) anxiety, respectively.

The STAI-C contains two separate scales, one to measure state anxiety and the other to measure trait anxiety. The former consists of 20 items asking children how they feel at the present time, the latter of 20 items asking children how they feel in general.

This measures relatively stable individual differences in anxiety trends. Items are scored on a three-point Likert scale ("hardly ever," "sometimes," and "often"). Each scale yields a score between 20 and 60, with higher scores indicating higher levels of anxiety. A validation and reliability study of the Turkish version made by Özusta yielded 0.82 and 0.81 for STAI-C (S) and (T), respectively.[22]

The STAI (here applied to the older group) is similar. The 20 state questions ask how participants feel "right now" using items that measure subjective anxiety, tension, nervousness, anxiety, and activation/arousal to evaluate the present intensity of current emotions, here on a four-point Likert scale ("not at all," "somewhat, "moderately so," and "very much so"). The 20 trait questions assess relatively stable aspects of "anxiety tendency" in situations of general calmness, trust, and security to evaluate the "in general" frequency of emotions, again on a four-point Likert scale ("almost never," "sometimes," "often," and "almost always"). Both scales yield a score of between 20 and 80, with higher scores indicating higher anxiety. A validation and reliability study of the Turkish version made by Öner and Le Compte found the internal reliability of the STAI (S) and STAI (T) to be 0.94-0.96 and 0.83-0.87, respectively.[23]

Internet use questionnaire: Internet use was assessed with the Internet Addiction Scale for Adolescents (IASA). Developed by Taş[24], this scale comprises nine items and one factor (it has no reverse-coded items). The responses of the scale evaluate the "general" frequency of emotions related to internet use, with a five-point Likert scale ("never," "rarely," "sometimes," "often" and "always"). Each scale yields a score of 9-45, with higher scores indicating higher levels of internet addiction. The correlation coefficient of the test-retest performed at a one-month interval is 0.72; Cronbach's alpha internal consistency coefficient is 0.81.

All forms of the questionnaires were distributed as hard copies by the authors at each study center during regular visits (for the patients) and by e-mail (to the controls). In total, they took approximately 25-30 minutes to complete.

Statistical analysis

We performed statistical analysis using the IBM SPSS Statistics for Windows, V.25.0 (IBM, Armonk, New York, USA) software. Numerical variables were presented as mean ± standard deviation, while the median (Inter Quartile Range) and categorical variables were presented as numbers and percentages. The normality distribution of numerical variables was evaluated using the one-sample Shapiro-Wilk test. Categorical data of the patient and control groups were compared using the chi-square test ($\chi 2$).

The Mann-Whitney U test was used to compare anxiety and internet addiction scores between the groups. The Wilcoxon test was used for the comparison of pre-and post-pandemic values of disease control parameters in asthmatic patients. The Spearman correlation analysis was used to investigate the associations between anxiety and internet addiction scores. Multivariate logistic regression analysis was used to analyze whether the anxiety scores and internet addiction scale scores between the two groups were affected by variables found to differ between the two groups. All analyses were two-tailed, and $p<0.05$ was considered statistically significant.

RESULTS

Demographic characteristics and ad hoc survey

A total of 122 participants from three pediatric allergy and immunology departments were included in the study. There were 78 asthmatic patients and 44 sex- and age-matched healthy controls. The distribution of the respondents among the centers was 44.8%, 32%, and 23.2% from, respectively, the Trakya University School of Medicine, Kanuni Sultan Süleyman Training and Research Hospital, and the Necip Fazıl City Hospital.

The monthly income and education level of mothers and fathers were higher in the control group, whereas the number of people living at home was higher in the patient group. The demographic characteristics of the patients and controls are shown in Table 1.

Most of the respondents thought that they had adequate information about COVID-19 virus transmission, symptoms, and protective measures (95, 94.2, and 96.7%, respectively). All respondents were following distance education at home during the study because schools had been closed by the government.

The median follow-up time of the patients was 22.5 months. Most were using inhaled corticosteroids as maintenance therapy. There was a significant difference in the numbers of emergency service admissions and hospitalizations due to asthma exacerbation between the year before the pandemic and since the beginning of the pandemic. Only nine (11.5%) patients

Table 1. Demographic characteristics of respondents			
	Patients (n=78)	**Controls (n=44)**	**p***
Age, years median (IQR)	11.5 (10-15)	13 (10-14)	0.89
Gender (male) n (%)	48 (61.5)	26 (59)	0.79
Education level of mothers n (%)			
Primary, middle, and high school	72 (92.3)	25 (56.8)	p=0.000002
University	6 (7.7)	19 (43.2)	
Education level of fathers n (%)			
Elementary, middle and high school	67 (85.9)	22 (50)	p=0.000009
University	11 (14.1)	22 (50)	
Monthly income n (%)			
< 5000 TL	59 (75.6)	22 (50)	0.004
> 5000 TL	19 (24.4)	22 (50)	
The number of people living in the house: median (IQR)	4.00 (5-4)	4.00 (4-3)	p=0.0003
Existence of any person in the family with increased risk of severe Covid-19 risk	27 (34.6)	13 (29.5)	0.56
Existence of any person in the family diagnosed with Covid-19 infection during the pandemic	30 (38.4)	12 (27.2)	0.21
Any isolation occurring in the family due to Covid-19 infection (Yes)	29 (37.1)	12 (27.2)	0.26
Average time to reach the hospital in case of an emergency			
< 30 minutes	63 (80.8)	38 (86.4)	0.43
> 30 minutes	15 (19.2)	6 (13.6)	
Existence of death due to Covid-19 in the family	3 (3.8)	1 (2.2)	1

IQR: Inter Quartile Range, *Mann-Whitney U test, Chi-Square test, Fisher exact test

had reported difficulties in securing their maintenance therapy during the pandemic. Thirty-three (42.3%) had experienced problems in contacting their doctor during the pandemic and 32 (41.0%) had avoided admission to Emergency Services (ES) for the fear of being infected with COVID-19 (Table 2).

Internet use

There was no statistical difference in the IASA scores between the patients and controls (Table 3). Asked about their average time spent on the internet before and during the pandemic, 90.1% of respondents reported an increase. A mean of 2.1±1.5 (0-6) hours was reported as spent on the internet in the pre-pandemic period and 6.9±3.5 (0-18) hours during the pandemic (p<0.001). There was no statistical difference between the patient and control groups (2.2±1.7 [0-6]) pre-pandemic and 6.7±3.7 [0-18] during the pandemic vs. 1.9±1.1 [0-5] pre-pandemic and 7.2±3.0 [1-14] during the pandemic; p=0.87 and 0.44, respectively).

State/trait anxiety and relationship with internet addiction

There were no significant differences between patients and controls when comparing the state and trait anxiety scores according to the age groups. We hypothesized that this might be related to the demographic characteristics that were found to be significantly different between the two groups. We created a model in multivariate logistic regression analysis to analyze whether the anxiety scores and internet addiction scale scores between the two groups were affected by these variables, which we found to be different between the two groups. We included the education level of mothers, the education level of fathers, monthly income, and the number of people living in the house in this model. We then performed a multivariate logistic regression analysis by putting all the anxiety scores and internet scores into this model one by one. As a result of this analysis, we again did not find a significant difference between the two groups (Table 3).

Table 2. Treatment properties and clinical courses of the asthmatic patients (n=78)

	n (%)	In the last year before the pandemic, mean±SD	Since the beginning of the pandemic, mean±SD	p*
Use of any maintenance therapy				
ICS	63 (80.7)			
AIT	16 (20.5)			
Any problem experienced in the providing of the maintenance therapy during Covid-19 pandemic	9 (11.5)			
The number of days/week requiring bronchodilator therapy*		1.1±1.98	0.5±1.48	p=0.00009
The number of days/week missing maintenance therapy*		0.45±0.95	0.38±1.09	0.46
The number ES admissions due to asth-ma exacerbation*		0.98±2.72	0.46±1.08	0.004
The number hospitalization due to asth-ma exacerbation*		0.22±0.92	0.01±0.11	0.04
Any problems contacting a doctor dur-ing the Covid-19 pandemic	33 (42.3)			
Avoidance of admission to ES due to fear of being infected with Covid-19	32 (41.0)			

*Wilcoxon test, ICS: Inhaler Cortico Steroid, AIT: Allergen Immunotherapy, ES: Emergency Service

Table 3. Anxiety and internet addiction scale scores of the patient and control groups and multivariate logistic regression analysis to model the possible variables related to the anxiety scores and the internet addiction scale scores

Age group	Scores	Patients (n=78) Median (IQR)	Controls (n=44) Median (IQR)	Crude p*	Adjusted p **	Adjusted OR (95% CI)**
9-12	STAI-C (S)	45.0 (48.0-43.0)	49.0 (50.0-41.5)	0.28	0.881	0.99 (0.87-1.13)
9-12	STAI-C (T)	35.0 (40.0-31.0)	38.5 (44.0-33.5)	0.11	0.175	0.94 (0.85-1.03)
13-18	STAI-(S)	36.0 (41.0-29.0)	40.0 (44.2-31.0)	0.20	0.392	0.97 (0.89-1.05)
13-18	STAI-(T)	35.0 (45.0-31.0)	39.0 (45.7-32.0)	0.33	0.184	0.95 (0.89-1.02)
10-18	IASA	16.0 (21.0-13.0)	17.0 (22.0-14.0)	0.17	0.172	0.95 (0.89-1.02)

IQR: Inter Quartile Range, CI: confidence interval; OR: odds ratio;
STAI-C (S): State-Trait Anxiety Inventory for Children, State, STAI-C (T): State-Trait Anxiety Inventory for Children, Trait, STAI-(S): State-Trait Anxiety Inventory, State, STAI-(T): State-Trait Anxiety Inventory, Trait, IASA: Internet Addiction Scale for Adolescents
*Mann-Whitney U test **Adjusted for education level of mothers, education level of fathers, monthly income, the number of people living in the house

Table 4. Correlation analysis between anxiety scores and the internet addiction scale score

	STAI-C (S)	STAI-C (T)	STAI-(S)	STAI-(T)
IASA	r: 0.09 p: 0.47	r: 0.17 p: 0.17	r: 0.28* p: 0.03	r: 0.34* p: 0.01

r: correlation coefficient,
STAI-C (S): State-Trait Anxiety Inventory for Children, State, STAI-C (T): State-Trait Anxiety Inventory for Children, Trait, STAI-(S): State-Trait Anxiety Inventory, State STAI-(T): State-Trait Anxiety Inventory, IASA: Internet Addiction Scale for Adolescents

Correlation analysis for anxiety and internet addiction in the 13-18 age group revealed a correlation between the IASA and the STAI (S) and (T) scores (r=0.28, p=0.03, and r=0.34, p=0.01, respectively) (Table 4).

Fear of COVID-19 Infection

There was no difference between the patients and controls in terms of their subjective visual analog scores for fear of COVID-19 infection (median [IQR] 5.5 (7.2-4.0) vs. 6 [7.0-4.0], p=0.98).

DISCUSSION

This case-control study focused on the assessment of asthmatic children and adolescents in the context of state-trait anxiety during the late stage of the COVID-19 pandemic. To the best of our knowledge, it is the first study to combine this with an evaluation of the impact of internet use on anxiety.

We found no difference between the anxiety scores of asthmatic patients and their healthy peers, but there was a correlation between state-trait anxiety scores and internet addiction scale scores in the 13-18 age group.

It is well known that there is a relationship between psychiatric comorbidities and symptom control, medication adherence, and exacerbations in asthma.[21] As allergic diseases themselves are associated with a negative effect on anxiety and depression, the COVID-19 pandemic could result in an additional increase in anxiety and depression levels in these patients.

Studies conducted in the immediate aftermath of the lockdown due to the COVID-19 pandemic showed that patients with asthma, allergic rhinitis, and other chronic respiratory diseases were at higher risk for negative psychological outcomes.[11-13,16] Among these studies, two conducted in asthmatic adults are noteworthy here because they included data comparing anxiety and depression scores between the pre-pandemic period and shortly after the lockdown. Both showed asthma to be associated with a decline in mental health status during lockdown.[11,12] These results were not surprising. The impact of the pandemic on mental health was very strong even in the general population[2], and the link between asthma and COVID-19 was still being debated at the time they were performed, when it was unclear whether asthma might be considered a risk factor for severe COVID-19 infection. In addition, lockdowns may result in social isolation, which is known to have a negative impact on anxiety and depression levels.[25]

It is likely that the psychological rather than physical effects of the pandemic and/or lockdown had a greater impact on the mental health of people with asthma in the early period of the pandemic. Indeed, a later study from Italy, after the lockdown, by Di Riso et al.[10] performed as an online survey, showed that asthmatic children presented no difference in psychological functioning evaluated as psychological adjustment (Strengths and Difficulties Questionnaire, SDQ) and separation anxiety (Separation Anxiety Factor of the Spence Children Anxiety Scale, SCAS-SAD). Our study was also performed during the later period of the pandemic, and our results are compatible with this study, despite the differences in methodology. The period of the study may be more important than whether participants have asthma or not. During the pandemic, it became clear that only uncontrolled asthma is a risk factor for severe COVID-19 and that patients with common allergic diseases do not develop distinct symptoms or severe outcomes.[4,5] Moreover, social isolation measures had been reduced by the later stages of the pandemic, so the anxiety levels of these patients might be expected to have diminished by then.

In our study, most asthmatics were using inhaled corticosteroids as maintenance therapy. Although 42.3% experienced a problem in contacting their doctor, they never considered stopping their current medication. They also reported an improved clinical disease course when comparing the year before the pandemic with the period since its onset. However, this may be mitigated, since, in Turkey, the supply of maintenance drugs used in the treatment of chronic diseases was allowed by the government without a prescription during the pandemic, and only 11.5% of the patients reported that they had difficulties in the provision of their maintenance therapy. Previous studies have similarly found increased adherence to asthma medication and improved asthma control during the pandemic[26,27], which may be another important factor that played a role in controlling patients' anxiety levels.

In our study, patients' subjective visual analog scores for fear of being infected with COVID-19 were not higher than those of the healthy controls. However, 41% of the asthmatic patients had avoided admission to ES since the beginning of the pandemic due to the fear of infection. Compatible with our results, previous studies revealed that adult asthmatic patients were relatively afraid of acquiring the COVID-19 disease and likely to avoid using healthcare facilities as a result.[12,14] It was also reported that Italian asthmatic children were more concerned about contagion than non-asthmatics.[10] It is possible that improved adherence to asthma medication in all countries might have been related to the fear of being infected with COVID-19 and avoidance of healthcare facilities.

We found a sharp increase in the time spent on the internet during the pandemic among all respondents. There was no statistical difference between the patients and controls in terms of the time that they spent on the internet and their IASA scores. Correlation analysis between anxiety scores and internet addiction scale scores revealed a correlation between the IASA and state and trait STAI scores in the 13-18 age group. Ha et al.[17] reported a significant association between internet addiction and depressive symptoms in 452 Korean adolescents. In another cross-sectional study, conducted among 440 upper secondary schools/colleges students, the prevalence of internet addiction was found to be 80.7%, and there was a significant association between internet addiction and stress, depression, and anxiety.[20]

We think that the relationship between IASA scores and anxiety scores was the most important result of our study, because the STAI scores suggested a moderate level of anxiety in patients and even in controls. This result did not differ even after multivariate logistic regression analysis, performed to eliminate the effect of potential confounding factors, such as education or the socio-economic status of the families.

Thus, excessive internet use might have had a greater impact on anxiety than the presence of allergic diseases during the late period of the COVID-19 pandemic.

Our study has three main strengths. One is that the asthma was not only self-reported but diagnosed by pediatric allergists in each study center. This means our study population was well-characterized. Another is that this is the first study to simultaneously evaluate the impact of internet use on anxiety scores in patients with allergic diseases during the COVID-19 pandemic. The third strength is that the analyses of anxiety and internet addiction were performed using standardized and validated scales.

There are some limitations in this study. First, pre-pandemic data on anxiety were not available, and therefore we could not make comparisons to assess the independent impact of the COVID-19 pandemic on our results. Second, we did not evaluate the main purpose of internet use; thus, we have no data on the ratio of educational time to time spent on other activities, such as playing games or engaging in social media.

CONCLUSION

This study has revealed no difference in anxiety scores between asthmatic patients and their healthy peers during the late stage of the COVID-19 pandemic. However, there was a correlation between state and trait STAI scores and internet addiction scale scores in the older (13-18) age group. Considering the well-known relations in asthma between psychiatric comorbidities and symptom control and between medication adherence and exacerbation, it is important to be aware that internet addiction may be a relevant anxiety-related factor. Therefore, we suggest that the follow-up of these patients should include an evaluation for excessive internet use and referral to a psychiatrist when necessary, especially during adolescence.

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Ethical approval

This study has been approved by the Trakya University Faculty of Medicine Scientific Research Ethics Committee (approval date 18.01.2021, number 2020/366). Written informed consent was obtained from the participants.

Author contribution

Concept: PGÖ, VÇ, BB, ÖTU, SK, MY; Design: PGÖ, MY; Data Collection or Processing: PGÖ, VÇ, BB, ÖTU, SK; Analysis or Interpretation: PGÖ, VÇ; Literature Search: PGÖ; Writing: PGÖ, VÇ, BB, ÖTU, SK, MY. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest.

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