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Characteristics of pediatric COVID-19 patients admitted to the emergency department and factors associated with pneumonia

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Abstract:

OBJECTIVES: Coronavirus disease 2019 (COVID-19) that causes a respiratory illness, continues to be a global pandemic. In this study, we purpose to identify the features of children with COVID-19 and the factors affecting disease severity.

METHODS: This is a retrospective, observational study was conducted on patients who presented with suspicion of COVID-19 from April 1, 2020, to March 31, 2021, at a tertiary care medical center in Turkey. The characteristics of 640 children who were confirmed to have COVID-19 by real-time reverse transcription-polymerase chain reaction were retrieved from medical records.

RESULTS: The mean age of the cases was 10 ± 6 years, and 56% of them were male. Seasonal difference did not affect the number of cases. The majority of the cases ($n = 501$, 78%) were infected by family members. Fever (67%) and cough (38%) were common complaints. The mean duration of fever was 1.9 ± 1.1 days. One-fourth of the cases were asymptomatic, 462 (72%) had mild upper respiratory tract infections, and 18 (3%) had pneumonia. Patients with pneumonia were more likely to have comorbidities and had a longer fever duration (both $P < 0.001$). Fever, cough, and respiratory distress were more common in patients with pneumonia ($P = 0.010$, $P = 0.023$, and $P < 0.001$, respectively). The mean C-reactive protein (CRP) value of the patients with pneumonia was significantly higher than that of the others ($P < 0.001$). A total of 70 (11%) complicated patients were hospitalized, 5 of them requiring intensive care admission. All hospitalized patients were discharged with recovery.

CONCLUSIONS: Although pediatric COVID-19 patients tended to have a mild disease, some children with comorbidities can still develop a severe illness. CRP value is a useful indicator in the diagnosis of COVID-19 pneumonia. Furthermore, the prevalence rate of COVID-19 did not decrease with hot seasons.

Keywords:

Children, clinical characteristics, coronavirus disease 2019, emergency department, pneumonia

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Introduction

Coronavirus disease 2019 (COVID-19) is a contagious infection that was first identified in China in December 2019, and it can lead to severe disease and death.[1-3] In the 1st day of February 2020, COVID-19 has rapidly spread worldwide, especially European countries, leading to an ongoing pandemic.[3-8] The first COVID-19 case in Turkey was diagnosed on March 11, 2020.

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Box-ED section

What is already known on the study topic?

- Children infected with coronavirus disease 2019 (COVID-19) mostly have mild clinical symptoms, but some of them suffer from severe illness
- There is a strong negative correlation with statistical significance between the monthly average environment temperature and total COVID-19 cases.

What is the conflict on the issue? Has it importance for readers?

- COVID-19 has spread throughout the world and many studies have been published, but some mechanisms related to the course of infection, especially in childhood, are unknown and need to be further investigated.

How is this study structured?

- This was a single-center, retrospective, observational study that includes data from 640 patients.

What does this study tell us?

- COVID-19 is a mild disease for most children, but the illness may be more severe, especially in patients with comorbidities. C-reactive protein value is a useful indicator in the diagnosis of COVID-19 pneumonia
- The spread of COVID-19 does not decrease with hot seasons.

As of January 1, 2022, more than 300 million people have been infected with COVID-19, resulting in more than 5 million deaths worldwide.[9] By January 1, 2022, Turkey with 9.5 million cases is one of the countries that have most COVID-19 patients in the world.[9]

The early studies about the disease have reported that most of the COVID-19-related severe diseases and deaths were observed in elderly patients.[6,10,11] In addition, almost all of those patients had underlying diseases, such as hypertension, diabetes, immune deficiency, malignancy, chronic lung disease, or cardiovascular disease which impaired their immune system and lung function.[10-12] Children infected with COVID-19 mostly had mild clinical symptoms or no symptoms and no deaths have been reported in the pediatric population for a long time.[13] However, deaths and severe illness, such as septic shock, multisystem inflammatory syndrome in children (MIS-C), multiorgan system dysfunction, and acute respiratory distress syndrome have recently been reported in children with COVID-19.[14,15]

Although the disease has spread throughout the world and many studies have been published, some mechanisms related to the course of infection, especially in childhood, are unknown and need to be further investigated.[13-16] The epidemiological and clinical patterns of COVID-19 vary widely between many countries.[13-16] In the present study, we aim to demonstrate the regional data on the characteristics and outcomes of Turkish children with COVID-19 disease and determine the factors that show severity.

Methods

Study design and patients

Children with COVID-19 infection who presented to a tertiary pediatric emergency department (ED) between April 1 2020 and March 31 2021 were evaluated in this single center retrospective observational study. Our ED with approximately 90000 visits annually is one of the largest centers of southwestern Turkey, where more than 10 million people live.

Our study was reviewed and approved by the Ethics Review Committee of Ege University with the institutional review board approval number of 20-4.2T/20 and the date July 22, 2021.

Procedures

Nasopharyngeal swab (NPS) specimens were obtained from all suspected COVID-19 cases who had any findings of lower or upper respiratory tract infection (RTI) (respiratory distress, hypoxemia, fever, cough, muscle/joint pain, sore throat, and nasal congestion), history of traveling abroad in the last 14 days, or contact history with someone infected with COVID-19 in the last 2 weeks as well as those who are scheduled to be hospitalized for another illness. COVID-19 was identified from the assay of NPS specimens using real-time reverse transcription-polymerase chain reaction (RT-PCR). The blood test and X-ray results of the patients who had positive COVID-19 results were obtained. If the positive COVID-19 patients with respiratory distress findings had negative X-ray scan results, they were required to undergo chest computed tomography (CT). In addition, all patients with MIS-C features were tested for COVID-19, including both serology and reverse RT-PCR on a narrowly spaced primer.[17]

The demographic, clinical, and laboratory characteristics (age, sex, exposure history, history of traveling abroad, underlying disease, signs and symptoms, laboratory findings, X-ray or chest CT scan results, treatments, and clinical outcomes) of the patients with positive COVID-19 results were reviewed and included in the study.

Respiratory distress, preexisting comorbidities (chronic lung disease, heart disease, developmental delay, diabetes, immune compromise, malignancy, morbid obesity and tracheostomy), poor laboratory criterias

(blood lymphocyte count <800/µl, C-reactive protein (CRP) > 40 mg/L), pneumonia findings on X-ray or CT scan were assigned as poor prognostic criterias.18 Positive COVID-19 patients with any poor prognostic criteria were considered as complicated and hospitalized.[18]

Possible cases and clinical staging of the patients were established according to the "Health Ministry of Turkey's Guidelines for Diagnosis and Treatment of COVID-19" which was released by the COVID-19 National Health Commission of Turkey.[18]

All of the cases with COVID-19 were called by phone daily to obtain their data until their symptoms were completely resolved and/or the test results were negative.

Our health-care workers followed all the recommendations from the beginning of the COVID-19 process in Turkey.

Statistical analysis

We performed all analyses with SPSS for Windows (ver. 22.0 SPSS Inc., IL, USA). Descriptive statistical data were expressed as counts and percentage, median, and interquartile range. The potential factors that could influence the outcome, were compared using Pearson's Chi-squared test or Fisher's exact test, Student's *t*-test, or Mann–Whitney *U*-test. A two-tailed $P < 0.05$ was considered statistically significant.

Results

A total of 27419 patients under 18 years visited the ED during the study period. Overall, 5642 were tested for COVID-19, and 640 (11.3%) with positive test results were included in the study. The mean age of the positive cases was 10 ± 6 years, with ages ranging from 1 month to 18 years. The most common age group was adolescents (56%). The majority of the cases (n = 359, 56%) were male. Most cases (n = 501, 78%) had a history of contact with a family member who was confirmed to have COVID-19, whereas 83 (13%) had a history of exposure from outside. No patient went abroad prior to symptom onset. Moreover, 43 (7%) cases had comorbidities.

The lowest test positivity rate was detected in June 2020, whereas the highest rate was detected in November 2020. However, the cases did not have seasonal variability. Figure 1 shows the distribution of the total performed tests and positive cases by month.

The most common presenting symptoms were fever (67%), cough (38%), and weakness/myalgia (29%). The maximum measured body temperature of the COVID-19 cases was 39.3°C, whereas the mean duration

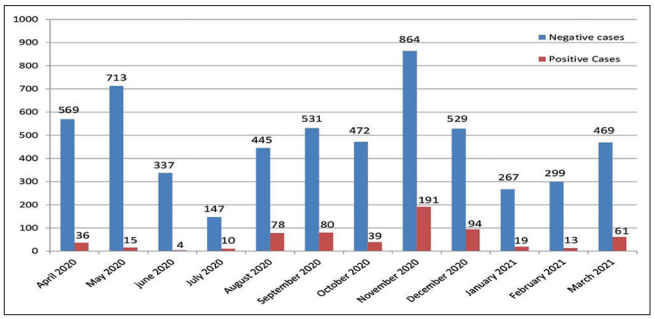

Figure 1: Distribution the of positive cases, and total performed tests by month

of fever was 1.9 ± 1.1 days (maximum: 6 days). A total of 160 (25%) cases were asymptomatic, whereas 462 (72%) had mild upper RTIs.

A total of 70 (11%) complicated cases were hospitalized. Fifty-two of them who were clinically noncomplicated had at least one poor laboratory prognostic criterion and/or comorbidity. Pneumonia was detected in 18 patients. Five of them had severe respiratory distress and were admitted to pediatric intensive care unit (PICU). All severe patients had comorbidities. The youngest patient with pneumonia was 3 years old. The patients with pneumonia among the complicated ones were treated with favipiravir. All cases with pneumonia were diagnosed based on their X-ray results. Only three patients who had respiratory distress with negative X-ray scan results were required to undergo chest CT. However, all chest CTs were negative.

The rate of comorbidity was significantly higher, and the mean duration of fever was longer in patients with pneumonia when compared with others (both $P < 0.001$). Fever, cough, and respiratory distress were present at a higher rate in patients with pneumonia (P = 0.010, P = 0.023, and $P < 0.001$, respectively). Patients with pneumonia had a markedly higher mean CRP value than the others ($P < 0.001$). The patient demographic, clinical, and laboratory characteristics are summarized in Table 1.

During the follow-up period, no patient showed any significant clinical characteristics such as shock, encephalopathy, heart failure, coagulation dysfunction, or acute kidney injury. All of the patients, including those admitted to the PICU, were discharged with good health.

Noncomplicated positive COVID-19 patients were neither hospitalized nor given any treatment (except paracetamol). Five patients with positive COVID-19 serology were diagnosed with MIS-C. All of the patients with MIS-C were successfully treated and discharged.

Table 1: Demographic, clinical, and laboratory characteristics of the cases

Cases' characteristics	All cases, *n*=640	Pneumonia (–), *n*=622 (97%)	Pneumonia (+), *n*=18 (3%)	*P*
Age, years, median (IQR)	10 (3-15)	10 (3-15)	13 (3-16)	0.265
Age group (years)				
<1	56 (9)	56 (9)	0	0.270
1-6	140 (22)	137 (22)	3 (17)	
6-12	84 (13)	81 (13)	3 (17)	
12-18	360 (56)	348 (56)	12 (66)	
Sex (male), *n* (%)	357 (56)	348 (56)	9 (50)	0.634
Comorbidities (+), *n* (%)	43 (7)	32 (5)	11 (61)	<0.001
Having a confirmed family member, *n* (%)	501 (78)	485 (78)	16 (83)	0.141
Symptomatic cases, *n* (%)	480 (75)	462 (74)	18 (100)	0.010
Presenting symptoms (+), *n* (%)				
Fever	427 (67)	410 (66)	17 (94)	0.010
Cough	242 (38)	230 (37)	12 (67)	0.023
Weakness/myalgia	186 (29)	182 (29)	6 (33)	0.793
Dyspnea	17 (3)	8 (1)	9 (50)	<0.001
Loss of taste and/or smell	95 (15)	93 (15)	2 (11)	0.885
Total duration of fever, days, median (IQR)	2 (1.25–3)	2 (0–3)	4 (2–5)	<0.001
Laboratory results, median (IQR)				
White blood cell count, $\times 10^9$ per L	7.4 (5.3-9)	7.5 (5.1-9)	7.2 (5.7-12.4)	0.286
Neutrophil count, $\times 10^9$ per L	3.8 (2.3-5.7)	3.5 (2.1-5)	4.3 (3.3-7.5)	0.890
Lymphocyte count, $\times 10^9$ per L	2.2 (1.4-3)	2.2 (1.5-3)	2.2 (1-4.1)	0.130
Hemoglobin, g/dl	13.2 (11-14.8)	13.4 (11.2-14.4)	12.2 (10.8-14)	0.245
Platelet count, $\times 10^9$ per L	192 (174-246)	190 (172-248)	202 (182-276)	0.765
CRP, mg/L	10 (4-16)	8 (3-12)	28 (6-64)	<0.001

CRP: C-reactive protein, IQR: Interquartile range

Discussion

In this study, we investigated the characteristics of 640 pediatric cases with laboratory-confirmed COVID-19 in Turkey. Most infected children had at least one family member with confirmed COVID-19 disease. The most probable reason for this is that due to the closure of schools in the relevant period and the presence of quarantine throughout the country, the children were only in contact with their family members. Unlike other viral infections, the COVID-19 cases did not show any seasonal changes. The most frequent complaints upon admission were fever and cough. Although most of them were clinically mild or asymptomatic, some patients had pneumonia, required hospitalization, and received medication. All of the patients were discharged with complete recovery. This study showed that COVID-19 is generally a mild illness for the pediatric population but can rarely be severe. These findings are consistent with those of previous studies.[19-21]

Many researchers have investigated the epidemiological features of the cases who were more often affected by COVID-19 and/or those with a more severe classification of the disease since the beginning of the outbreak.[13-17] Previous studies have stated that patients infected with COVID-19 were more likely to be older than 1 year.[16,17] Based on previously published data, males are more susceptible to COVID-19, and sex difference has no effect on the outcome. However, patients with comorbidity may be more severely affected by the disease.[14-17,21] Our results had similar features, fewer cases were under 1 year old, majority of them were male, and the difference of age and gender was not related to the outcome, but the presence of comorbidity increased the risk of pneumonia.

Although majority of the cases in this study presented with fever, cough, and weakness/myalgia, a significant number was asymptomatic. These findings are similar to those of previous reports.[17,21,22] Based on the comparison between the present COVID-19 results and the other viral upper RTIs such as influenza, a shorter duration of symptoms and less severe clinical manifestations can be observed in COVID-19-infected children. On the other hand, patients with pneumonia had a significantly longer duration of symptoms than noncomplicated cases. In line with our data, Lu *et al*. have reported that the median duration of fever in their study was 3 days, and only 9.4% of the cases had fever (>39°C).[21]

Laboratory findings, such as lymphocyte count and CRP value, are often used to predict the outcome of adult patients with COVID-19.[23] However, it is controversial to utilize these biomarkers in children. Absolute lymphocyte counts were mostly normal in the pediatric age group, whereas high CRP values have been observed

in a significant part of the hospitalized children.[24,25] Similarly, we found that while the proportion of patients with significant lymphopenia is very low in all cases, patients with pneumonia had significantly higher CRP values than the others.

It is known that viral RTIs have a seasonal character and become less prevalent in the summer owing to the high temperature and solar radiation.[26,27] Since the beginning of the outbreak, one of the most curious topics about COVID-19 was whether it would have a seasonal variability.[28] Mandal *et al*. have found strong negative correlations with statistical significance between the monthly average environment temperature and several COVID-19 cases, including total cases, active cases, and cases per million of a country.[29] Differently, we determined that the number of COVID-19 cases was not related to air temperature and seasons.

Limitations

Our study has some limitations. Firstly, since this is a retrospective study, an over- or underestimation of these findings could be observed. Secondly, since it reflects the experience of a single center, its results cannot be generalized to other settings. Thirdly, since we obtained some clinical features of the cases from their families during the follow-up, some information may not be reliable.

Conclusions

COVID-19 is a mild disease for most children, but the illness may be more severe, especially in patients with comorbidities. The disease is mostly transmitted from their families. Fever and cough are the most common symptoms. One-fourth of the cases were asymptomatic. While absolute lymphocyte count is not a useful indicator for predicting the outcome in these cases, CRP value may be valuable. Although a warmer weather alone cannot contain the epidemic in summer, it does help reduce the transmission rates. Furthermore, hot seasons do not decrease the spread of COVID-19.

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Author contribution statement

1. Study concept and design: A.Y. and E.U.S.
2. Acquisition of data: A.Y., G.G.O., and H.I.
3. Analysis and interpretation of data: A.Y., C.T., and Z.S.B.
4. Drafting of the manuscript: A.Y., G.O., and R.S.
5. Critical revision of the manuscript for important intellectual content: R.S. and E.U.S.
6. Statistical analysis: A.Y. and Z.S.B.
7. Administrative, technical, and material support: C.T., H.I., and G.G.O.
8. Study supervision: R.S. and E.U.S.

Conflicts of interest

None declared.

Ethical approval

Our study was reviewed and approved by the Ethics Review Committee of Ege University School of Medicine (Ethics approval number: 20-4.2T/20 and dated July 22, 2021).

Consent to participate

Subjects were included in the study after giving their informed consent.

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