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Original Paper

Evaluation of Epidemiological, Demographic, Clinical Characteristics and Laboratory Findings of COVID-19 in the Pediatric Emergency Department

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ABSTRACT

Background: The aim of this study was to evaluate the epidemiological, demographic, clinical characteristics and laboratory findings of pediatric COVID-19 patients.
Methods: Patients with a positive COVID-19 nasopharyngeal polymerase chain reaction (PCR) test between 11 March 2020 and 31 December 2020 were evaluated.
Results: During the study period, 3118 patients underwent PCR tests, and 621 of them (19.9%) were positive. Of the patients with a positive test result, 335 were male (53.9%), the median age was 11 years. There were 308 (49.6%) patients that had a history of household exposure. The mean time between the onset of the patients complaints and the diagnosis was 1.88 ± 1.16 days. The most common symptoms were: fever ($n = 424$), cough ($n = 419$) and nasal symptoms ($n = 157$); loss of smell (3.5%) and taste (4.3%) were other symptoms observed in only patients aged 10 years or older. The most common abnormal laboratory finding was lymphopenia ($n = 29$, 36.7%). Of the 621 patients, the vast majority ($n = 546$, 87.9%) were classified as mild COVID-19 disease. There was a significant relationship between disease severity and age and comorbidity ($p = 0.01$ and $p < 0.001$, respectively). Only 34 patients (5.5%) were admitted to hospital, and two patients were followed-up with a diagnosis of multisystem inflammatory syndrome in children. The mortality rate was 0.32%.

Conclusion: COVID-19 can cause different symptoms in children. Although the disease generally causes a mild clinic presentation, it should be kept in mind that it may be more severe especially in children with comorbidities.

KEYWORDS: COVID-19, child, emergency medicine, pandemic

INTRODUCTION

The novel coronavirus disease (COVID-19) first appeared in the Republic of China at the end of 2019 and spread rapidly, affecting the whole world. After the cases increased in all countries of the world, the World Health Organization declared COVID-19 a pandemic on 11 March 2020 [1, 2]. Studies reported that the disease can be seen in a wide spectrum from asymptomatic carriage to severe respiratory failure. It can cause life-threatening situations, such as acute respiratory distress syndrome (ARDS), acute kidney injury (AKI), acute coronary injury, and one or more organ failure, especially in the adult age group with comorbidity [3]. While most children are asymptomatic or have signs and symptoms of upper respiratory tract infection (RTI), life-threatening clinical conditions have been reported to develop especially in the infant age group and children with chronic diseases [4–8]. It is known that the virus spreads very quickly and easily. The presence of household exposure is known in the vast majority of cases reported in children [9, 10]. Especially in cases where the exposure history is not clear, it may be difficult to diagnose because of the variability of clinical and laboratory findings. The aim of this study was to evaluate the epidemiological, demographic, clinical characteristics and laboratory findings and the outcomes of confirmed COVID-19 patients by nasopharyngeal polymerase chain reaction (PCR) in the pediatric emergency department (PED).

MATERIALS AND METHODS

Study design

Our hospital is a tertiary pediatric hospital in Ankara, Turkey. The patients who underwent nasopharyngeal COVID-19 PCR test in the PED between 11 March 2020, the date of the first confirmed case in Turkey, and 31 December 2020 were retrospectively identified through the file registry system. In our hospital, we test suspected cases according to our national COVID-19 guidelines [11]. Suspected cases were defined as patients who had contact with a known COVID-19 patient and having at least one of the symptoms (fever, cough, tachypnea, RTI symptoms), or who had at least two of them: fever, cough, RTI symptoms, tachypnea, saturation O2 < 92, or who had respiratory failure requiring hospitalization. Patients with a positive PCR test result were included in the study. Management algorithm for suspected COVID-19 cases was shown in Fig. 1.

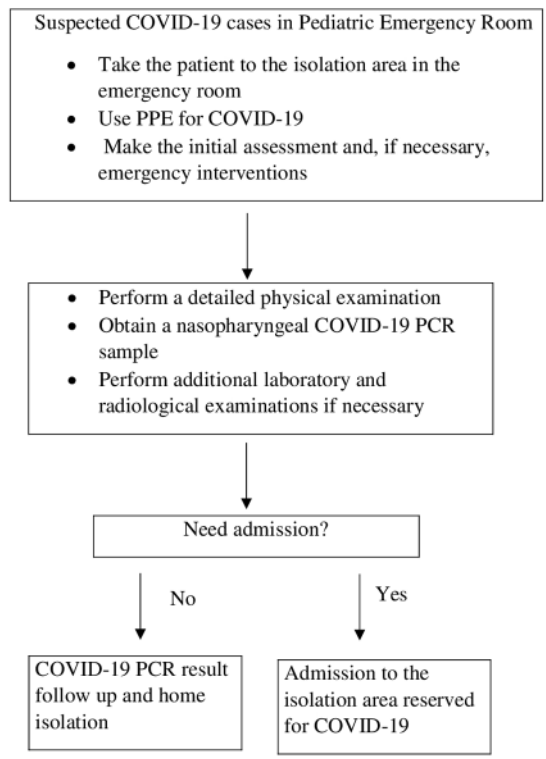

Fig. 1. Management algorithm for suspected COVID-19 cases. PPE: Personal protective equipment, PCR: polymerase chain reaction.

Data collection of the patients and epidemiological, demographic, clinical and laboratory features

Patients' age, gender, comorbidities and whether they had contact with COVID-19 patients were recorded. Patients were divided into four groups by age categories: 0–1-year old as 'infant', 2–5-year old as 'preschool', 6–11-year old as 'school age' and over 12-year old as 'adolescent'. In patients with a history of contact with COVID-19, the type of contact (household exposure or other members) and the time between contact and diagnosis were recorded. Since the time of household exposure cannot be clearly discerned, it was not recorded. Whether or not the patients had any complaints at the time of their admission to PED, if any, and the time between the onset of symptoms and diagnosis were recorded. Cough, runny nose, nasal congestion, sore throat, dyspnea, tachypnea, wheezing and sneezing were determined as 'respiratory system complaints'. Diarrhea, abdominal pain, nausea-vomiting and gastrointestinal (GI) bleeding were determined as 'GI symptoms'. Any other complaints of the patients were also recorded.

The physical examination findings of the patients in the PED were recorded. Whether chest X-ray or computed tomography (CT) was taken in the emergency department and the results (interpreted by the pediatric emergency specialist) were recorded. The decision regarding which laboratory tests to be performed on which patients was made by the physician concerned. The results of the patients were recorded. Hemoglobin and leukocyte counts were evaluated separately according to the age of the patients [12]. The limit for thrombocytopenia was accepted as 150 000/mm^3 [13]. The severity of the COVID-19 disease was classified by Dong *et al.* [14]: (i) Asymptomatic infection included cases with a positive diagnoses but without any clinical or radiological findings; (ii) mild disease included cases with acute upper RTI but without clinical and radiological pneumonia; (iii) moderate disease included cases with pneumonia and symptoms of lower RTI; (iv) severe disease included cases with progressive respiratory disease, dyspnea, and central cyanosis; and (v) critically ill cases presented with ARDS or respiratory failure, shock, and organ dysfunction, including encephalopathy, myocardial injury, coagulation abnormalities, and acute kidney injury. The relationship between COVID-19 disease severity and age, comorbidity, and gender were evaluated.

Hospital admission status and the reason and length of hospital stay were recorded. Finally, PED visits within two months of admission and whether the children were diagnosed with multisystem inflammatory syndrome in children (MIS-C) during these visits were evaluated.

The protocol for this study was approved by the local ethics committee (Number: E-21/02-100).

Statistical analysis

Statistical analysis was conducted with SPSS 19.0 (IBM Corp., Armonk, NY, USA). For descriptive statistics, normally distributed measurement data were expressed as mean ± SD, and non-normally distributed measurement data were expressed as median interquartile range (IQR). The relationship between COVID-19 disease severity and age, gender, and comorbidities were evaluated using χ^2 tests. A value of $p < 0.05$ was accepted as statistically significant.

RESULTS

During the study period, nasopharyngeal PCR test was applied to 3118 patients, 621 (19.9%) of them were positive. Of the patients with a positive test result, 335 were male (53.9%) and the median age was 11 years (IQR: 3–15). There were 92 (14.8%) patients that were between 0 and 1 year old, 60 (9.7%) patients had comorbidities and 387 (62.3%) had been in close contact with a COVID-19 positive patient. The mean time from contact to PCR was 6.16 ± 2.87 days. The mean time between the onset of the symptoms and the diagnosis was 1.88 ± 1.16 days. The demographic characteristics of the patients were shown in Table 1.

While 597 of 621 patients with positive COVID-19 PCR test had one or more symptoms at presentation, 24 (3.9%) patients were asymptomatic. Asymptomatic patients were determined in routine PCR examinations before invasive procedures. At admission, patients complained of 25 different symptoms. Of 621 patients, 482 (77.6%) had respiratory and 129 (20.8%) had GI symptoms. There were 78

Table 1. The demographic characteristics of the patients

	n (%)
Age (years)	
0–1	92 (14.8)
2–5	109 (17.6)
6–11	148 (23.8)
12–18	272 (43.8)
Gender	
Male	335 (53.9)
Female	286 (46.1)
Nationality	
Refugees	15 (2.4)
Comorbidity	60 (9.7)
Chronic lung diseases	25 (41.7)
Hematologic–oncologic–immunological diseases	9 (15)
Congenital heart disease	8 (13.3)
Endocrine disorders	5 (8.3)
Rheumatic disorders	4 (6.7)
Renal diseases	4 (6.7)
Others[a]	5 (8.3)
Contact history	
Yes	387 (62.3)
Household exposure	308 (79.6)
Other types of contact	79 (20.4)
No	167 (26.9)
Sick member in the household (Unapproved COVID-19)	67 (10.8)

[a]Pyschiatric disorders, neurological disorders, gastrointestinal system disorders.

patients (12.6%) that had one symptom, while 519 patients (83.5%) had two or more symptoms. The most common symptoms were fever ($n = 424$), cough ($n = 419$), nasal symptoms ($n = 157$), diarrhea ($n = 83$) and sore throat ($n = 80$). Loss of smell and taste were the symptoms observed in patients only aged 10 years or older. Loss of smell was present in 22 (3.5%) patients, mean age 15.67 ± 2.09 years [minimum (min) 10–maximum (max) 17.7 years] and loss of taste was present in 27 (4.3%) patients, mean age 15.58 ± 1.82 years (min 12.5–max 17.8 years). The symptoms of the patients were shown in Fig. 2.

Of the patients, 206 (33.2%) had normal physical examination, while 377 (60.7%) and 38 (6.1%) patients had upper and lower RTI findings, respectively. A posterior–anterior chest X-ray was obtained in 175 (28.2%) of 621 patients upon admission. Of the 175 graphics, 125 (71.4%) were normal, 23 (13.1%) had peri hilar-bronchial wall thickening, 26 (14.9%) had infiltration and 1 (0.6%) had ground-glass opacities. None of the patients had thorax CT imaging.

Complete blood counts were conducted for 79 patients, including lymphopenia in 29 (36.7%), leukopenia in 11 (13.9%) and neutropenia in 7 (8.9%) patients. Mean values of the laboratory markers were: aspartate aminotransferase 40.91 ± 21.88 U/L, blood urea nitrogen 9.70 ± 4.38 mg/dl, serum creatinine 0.59 ± 0.22 mg/dl and D-dimer 1600.8 ± 885.8 ng/mL fibrinogen-equivalent units. The median values of laboratory markers were: erythrocyte sedimentation rate (ESR) 13 (7–33) mm/h, C-reactive protein 3.11 (2–11.8)

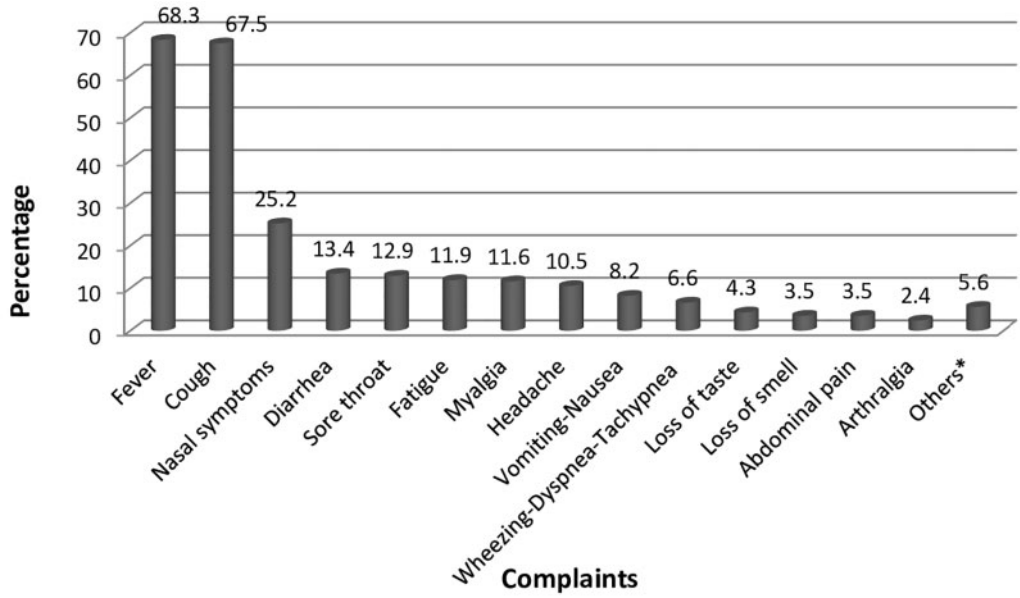

Fig. 2. The complaints of the patients. *Conjunctivitis (1.6%), chest pain (1.4%), dizziness (1%), earache (0.5%), skin rash (0.3%), febrile seizure (0.3%), epistaxis (0.3%), gastrointestinal bleeding (0.2) %.

Table 2. The distribution of laboratory results by severity of disease

	Asymptomatic *n*: 24 (%)	Mild *n*: 546 (%)	Moderate *n*: 42 (%)	Severe *n*: 5 (%)	Critical *n*: 4 (%)	Total 621 (%)
Chest X-ray	2	123	41	5	4	175 (28.2)
Abnormal	0	14 (11.4)	28 (68.3)	5 (100)	4 (100)	51 (29.1)
CBC	0	50	20	5	4	79
Leukopenia	0	8 (16)	3 (15)	0	0	11 (13.9)
Leukocytosis	0	1 (2)	2 (10)	0	1 (25)	4 (5.1)
Neutropenia	0	5 (10)	1 (5)	1 (20)	0	7 (8.9)
Neutrophilia	0	4 (8)	2 (10)	0	2 (50)	8 (10.1)
Lymphopenia	0	16 (32)	9 (45)	2 (40)	2 (50)	29 (36.7)
Lymphocytosis	0	1 (2)	0	0	0	1 (1.3)
Thrombocytopenia	0	1 (2)	0	0	0	1 (1.3)
Anemia	0	3 (6)	2 (10)	3 (60)	1 (25)	9 (11,4)

Note: CBC, Complete blood count.

mg/L, alanine aminotransferase 18 (12–27.75) U/L, lactate dehydrogenase 321.5 (283.5–404.5) IU/L and troponin I 0.000 (0.000–0.01) ng/mL. The distribution of the laboratory results by severity of disease were shown in Table 2.

Of the 621 patients, 24 (3.9%) were classified as asymptomatic, 546 (87.9%) were as mild, 42 (6.8%) were as moderate, 5 (0.8%) were as severe and 4 (0.6%) were as critical according to disease severity. Of the nine patients classified as 'severe or critical', six had comorbidities (three of them had chronic lung diseases and others had endocrinologic, immunologic and renal diseases). Total number of the 60 patients with comorbidity, six (10%) were in the

severe and critical COVID-19 group, while only 3 (0.53%) of 561 patients without comorbidity were in the severe and critical COVID-19 group. When the relationship between the severity of COVID-19 and age, comorbidity, and gender was examined, young age and the presence of comorbidity significantly increased the disease severity ($p = 0.01$ and $p < 0.001$, respectively). There was no significant difference between gender and disease severity ($p = 0.164$). The distribution of disease severity by age group was shown in Table 3.

Thirty-four (5.5%) patients were admitted to hospital, 19 (55.9%) had pneumonia, 6 (17.6%) had fever without focus, 3 had (8.8%) septicemia, 2 had chronic disease exacerbations, 2 had MIS-C, 1 had GI bleeding and 1 had febrile seizures. Only two patients needed intensive care and mechanical ventilation. Supplemental oxygen therapy, intravenous hydration, antipyretic drugs, antibiotherapy, inhaler bronchodilator and anticonvulsant treatments were administered to 34 hospitalized patients according to their needs in PED. Specific COVID-19 treatments were administered during service follow-up. The median length of hospital stay was 4 days (range 1–40). One of the patients followed-up with the diagnosis of MIS-C was an 8-year-old boy who presented with complaints of fever, rash and conjunctivitis lasting for 6 days and developed coagulopathy and cardiac dysfunction during the follow-up; the other patient, a 3.5-year-old boy presented with fever and vomiting for 3 days, and cardiac and hepatic dysfunction developed during follow-up. Both patients had been in close contact with a COVID-19-positive patient and they were discharged without sequelae after appropriate treatment. Two (0.32%) patients died. One of them had underlying autoimmune polyendocrinopathy with aspleni and developed COVID-19 pneumonia and fungal septicemia. The other one had a history of cardiac arrest, long QT syndrome, and epilepsy, and developed acute renal failure, encephalopathy, and septicemia in the follow-up. All other patients were discharged after their treatment was completed.

Ninety-three (15%) of all patients visited our hospital for another reason within 2 months, and MIS-C was not considered in any of these patients.

DISCUSSION

This was a comprehensive study evaluating the epidemiological, demographic, clinical characteristics and laboratory findings of pediatric patients diagnosed with COVID-19 in the PED in the first nine months of the pandemic. It was determined that COVID-19 caused a wide spectrum of symptoms in pediatric patients. The disease generally causes a mild clinical presentation; however, it may be more severe especially in children with young age and comorbidity.

The rate of test positivity in pediatric patients varies. In a study conducted in Texas, the test positivity rate was 7.3%, while it was found to be 4% in the first peak period of the pandemic in England [15, 16]. In this study, the test positivity rate was 19.9%. The higher test positivity rates may have been due to the existence of guidelines that enable better diagnosis of the disease and more selective testing of this process already existed.

The time from the onset of symptoms to diagnosis varies from a mean of 3–8 days in different studies [14, 17, 18]. The mean time of diagnosis was 1.88 ± 1.16 days in our study. These differences may be due to differences in the testing criteria and test capacity of the countries, and the pandemic intensity at the time of the studies.

Table 3. The distribution of disease severity by age groups

Age (years)	Asymptomatic *n* (%)	Mild *n* (%)	Moderate *n* (%)	Severe *n* (%)	Critical *n* (%)	Total
0–1	3 (3.3)	73 (79.3)	14 (15.2)	2 (2.2)	0	92
2–5	2 (1.8)	93 (85.3)	11 (10.1)	2 (1.8)	1 (0.9)	109
6–11	5 (3.4)	137 (92.6)	5 (3.4)	0	1 (0.7)	148
12–18	14 (5.1)	243 (89.3)	12 (4.4)	1 (0.4)	2 (0.7)	272
Total	24 (3.9)	546 (87.9)	42 (6.8)	5 (0.8)	4 (0.6)	621

The majority of pediatric patients infected with COVID-19 were part of a family cluster outbreak. The rate of household exposure of COVID-19 was reported as 41%, 74% and 76.6% depending on the study [19–21]. In the present study, 308 (49.6%) patients had a confirmed history of household exposure, while 67 (10.8%) patients had contact with an individual who had flu-like symptoms at home but was not a confirmed case. The differences in household exposure rates may be due to studies being conducted at different times of the pandemic, differences in testing criteria between countries, and the measures taken by governments and families. Questioning individuals with 'flu-like symptoms' at home, along with a history of contact with a confirmed COVID-19 patient, can help identify patients to be tested.

COVID-19 usually presents with symptoms of the upper RTI. Cough, fever, nasal symptoms and sore throat were reported as the most common complaints in children [15, 22]. GI symptoms, such as abdominal pain, diarrhea and vomiting, may also be seen in pediatric patients. In a study conducted in Mexico, GI symptoms were determined in 24% of children [23]. It has been reported that loss of smell and taste were less common in pediatric patients compared to adults; thus, the loss of smell and taste were generally not queried in most pediatric COVID-19 studies. In the few studies that reported loss of smell and taste, they were observed in 6.4% of cases in a study from Turkey and as 4–8% in a Mexican study [2, 23, 24]. In our study, the most common symptoms manifested by patients were fever (68.3%), cough (67.5%) and nasal symptoms (25.2%). GI symptoms were determined in 129 (20.8%) of the patients. Loss of smell was present in 22 (3.5%) and loss of taste was present in 27 (4.3%) patients; all of these patients were 10 years or older. The findings in our study were generally compatible with the literature. The fact that the loss of smell and taste is seen in older children may be due to the inability of young children to describe these complaints. We think that GI symptoms, and the loss of smell and taste should also be queried in addition to fever and respiratory symptoms in children with suspected COVID-19.

There is no specific laboratory finding of COVID-19. An analysis of laboratory tests revealed different results in children. Decreased lymphocytes and leukocytes were more common than elevated counts of these markers [22, 25]. As the most common complete blood count abnormality, Qiu *et al.* [26] found lymphopenia (30.6%), Wang *et al.* [27] found leukocytosis (9.7%) and lymphopenia (6.5%), and Lu *et al.* [21] found leukopenia (26.3%). In our study, the most common abnormal laboratory findings were lymphopenia ($n = 29$, 36.7%), leukopenia ($n = 11$, 13.9%) and anemia ($n = 9$, 11.4%). Ma *et al.* [28] determined thrombocytopenia in 14% of patients; whereas in our study, thrombocytopenia was found in only one patient (1.3%). Differences in laboratory findings may be due to differences in disease severity distribution, laboratory testing criteria, the time between symptom onset, and the testing time.

The use of imaging methods in the diagnosis of pediatric COVID-19 is limited. There is no standard protocol for imaging. In our study, there was an abnormal chest X-ray in all severe and critically ill patients and in most of the moderate patients. However, none of these patients had thorax CT. In adult patients, CT is preferred, especially in cases in which there is clinical suspicion and the PCR test is negative, or in cases in which the test result will take a long time [19, 29]. However, its use is limited in pediatric patients due to the risk of radiation. Since our study included only confirmed COVID-19 patients and CT findings did not change the treatment protocols, no patients had undergone thorax CT imaging.

COVID-19 generally leads to a mild clinical situation in children. Various studies have reported that approximately 80–90% of pediatric COVID-19 cases are asymptomatic or mild. The infant age group and children with comorbidity were reported to develop more severe disease [2, 14, 30]. In a pediatric review reported that, severe COVID-19 was present in 5.1% of children with comorbidity, and in 0.2% without comorbidity [31]. In a study, it was suggested that it would be useful to screen the infants (60 days and younger) with sepsis-like syndrome for COVID-19 [32]. Hospital admission rates in children range from 8 to 43% [15, 18, 19]. Foster *et al.* [15]

reported the mortality rate as 0.16%, Dong *et al.* [14] as 0.05%, and Yayla *et al.* [24] as 1.3%. In our study, 24 (3.9%) of the patients were asymptomatic, 546 (87.9%) were mild, 42 (6.8%) were moderate, 5 (0.8%) were severe and 4 (0.6%) were classified as critical COVID-19. It is noteworthy that a young age and having a history of comorbidity significantly increased the disease severity. While 10% of patients with comorbidity had severe and critical COVID-19, 0.53% of patients without comorbidity had severe and critical illness. There were 34 patients (5.5%) admitted to hospital; two (0.32%) patients died because of comorbidity and septicemia during inpatient follow-up. Differences in mortality and hospitalization rates may be due to differences in age distribution and illness severity of the patients, the frequency of underlying comorbidities, and differences in hospital admission indications by physicians.

Our study had some limitations. This was a single-center, retrospectively designed study. Thus, evaluation could only be made based on the data available from medical records. Since laboratory and imaging tests were performed by decision from the physician and in a small number of patients, they may not reflect the results of all COVID-19-positive patients. Therefore, statistical studies could not be performed between clinical classification and laboratory-imaging examinations.

In conclusion, in addition to common symptoms such as fever, cough, nasal symptoms in pediatric COVID-19 patients, rare symptoms such as GI symptoms should also be reported. Further, in the adolescent age group, loss of smell and taste should also be questioned. In addition to a history of contact with a confirmed COVID-19 patient, the presence of an individual with flu-like symptoms at household should be warning for COVID-19. Although the disease generally causes a mild clinical presentation, it should be kept in mind that more severe forms may develop, especially in children with comorbidity and young age.

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DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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