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## Characteristic of COVID-19 pediatric patients: evidence from systematic review

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### Keywords

COVID-19, SARS-CoV-2, characteristic, symptoms, children, pandemic

### Conflict of interest

#### Konflikt interesów

None

Brak konfliktu interesów

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### Summary

**Introduction.** The SARS-CoV-2 infection pandemic has affected virtually the whole world. Since the outbreak in China, countries on all continents have been progressively infected, and COVID-19 represents a major challenge to healthcare systems even in highly developed countries. Children are a very special group, largely due to close family contacts, and may be susceptible to cross-infection. Children, generally, have low immunity and some exhibit a long incubation period after SARS-CoV-2 infection. Therefore, children should try to avoid contact with complex populations to avoid being infected by potential spreaders.

**Aim.** The aim of the study was to identify the most frequently observed symptoms in pediatric patients with confirmed COVID-19.

**Material and methods.** We performed a comprehensive systematic literature search of online databases, including PubMed, EMBASE, Web of Science, CENTRAL, from December 2019 to April 10, 2020 to identify all case studies. All the search results were evaluated according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The inclusion criteria for the articles were as follows: study population: pediatric patients with diagnosed COVID-19 (excluding newborn patient); study design: case studies; outcomes measure: at least one outcome reported among clinical symptoms.

**Results.** The analysis of 10 papers reporting 466 pediatric patients with confirmed COVID-19 revealed that the most frequently observed symptoms are fever (56.0%), cough (49.8%), headache (22.9%), sore throat (22.7%) and fatigue/myalgia (20.3%). The remaining symptoms are much less frequent. In 13.6% of cases, the disease was asymptomatic, and in 40.8% it was mild in clinical classification and in 40.2% moderate type. Relatively rarely children with severe and critical presentation of COVID-19 are observed (3.0 and 1.0%, respectively).

**Conclusions.** The five most frequent symptoms in pediatric patients with confirmed COVID-19 are: fever, cough, headache, sore throat and fatigue/myalgia. In the pediatric population, 81% of patients infected with SARS-CoV-2 have mild or moderate symptoms, and only 4% have severe and critical presentation.

### INTRODUCTION

The SARS-CoV-2 infection pandemic has affected virtually the whole world. Since the outbreak in China, countries on all continents have been progressively infected, and COVID-19 represents a major challenge to healthcare systems even in highly developed countries. Social isolation, the use of face masks, the use of personal protective equipment by medical personnel and rapid diagnosis are essential to control the epidemic. It is extremely important to determine the prevalence of

individual symptoms of SARS-CoV-2 infection, which may suggest performing appropriate tests to confirm or exclude the infection both in adults and in the pediatric population (1).

It has been observed that COVID-19 is much more severe and with significantly higher mortality in the population of older patients and with coexisting diseases. In the pediatric population a mild course of infection is observed much more often than in adults, although there are also fatalities. From a health safety

point of view, it is important that asymptomatic persons, which often occur in the pediatric population, may infect other people who have a severe or even fatal course of infection.

On January 30, 2020 World Health Organization (WHO) said a disease called COVID-19 is a 'public health emergency of an international range' (2). The number of infections has increased rapidly in many countries on all continents and resulted on 20/03/2020 announcement by WHO pandemic status. As of April 16, 2020, the reported number of confirmed infection cases equaled 2,167,955. Children are a very special group, largely due to close family contacts, and may be susceptible to cross-infection. Children, generally, have low immunity and some exhibit a long incubation period after SARS-CoV-2 infection. Therefore, children should try to avoid contact with complex populations to avoid being infected by potential spreaders. COVID-19 is an acute, self-limiting disease; nevertheless, patients can die, with a mortality rate over 6.7%, and have also been reported in critically ill children (3).

### AIM

The aim of the study was to identify the most frequently observed symptoms in pediatric patients with confirmed COVID-19.

### MATERIAL AND METHODS

We conducted a comprehensive systematic literature search of online databases, including PubMed, EMBASE, Web of Science, CENTRAL, from December 2019 to April 10, 2020 to identify all case studies. The search terms and relative variants were as follows: COVID-19; 2019-nCoV; clinical characteristics; pediatric; child. We also reviewed the references of included articles to guarantee the comprehensiveness and accuracy of our research. All the search results were evaluated according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The inclusion criterions for the articles were as follows: study population: pediatric patients with diagnosed COVID-19 (excluding newborn patient); study design: case studies; outcomes measure: at least one outcome reported among clinical symptoms.

### RESULTS

The analysis of 10 papers reporting 466 pediatric patients with confirmed COVID-19 revealed that the most frequently observed symptoms are fever (56.0%), cough (49.8%), headache (22.9%), sore throat (22.7%) and fatigue/myalgia (20.3%) (1, 3-11). The remaining symptoms are much less frequent. Detailed characteristics of pediatric patients with COVID-19 are presented in table 1.

In 13.6% of cases, the disease was asymptomatic, and in 40.8% it was mild in clinical classification (supplementary table 1) and in 40.2% moderate type. Relatively rarely children with severe and critical presentation of COVID-19 are observed (3.0 vs. 1.0%, re-

spectively). Classification of clinical types of COVID-19 in pediatric patients is presented in table 2.

**Tab. 1.** Summary of pediatric patient characteristics

Characteristic	Number (%)	Reference
Sex		
Boy	518/897 (56.9%)	(1, 3-2)
Girl	379/897 (43.1%)	
Age	5.1 ± 3.6	(1, 4, 7-11)
Symptom		
Fever	261/466 (56.0%)	(1, 3-11)
Nasal congestion	45/399 (11.3%)	(3-6, 9-11)
Cough	232/466 (49.8%)	(1, 3-11)
Sore throat	82/362 (22.7%)	(3-6, 10)
Dyspnea	44/382 (11.5%)	(3-5, 8, 10)
Abdominal pain	19/316 (6.0%)	(5, 11)
Vomiting	8/59 (13.6%)	(4, 6, 7)
Diarrhea	51/380 (13.4%)	(3-7, 10, 11)
Vomiting or diarrhea	33/327 (10.1%)	(1)
Pharyngeal congestion	1/36 (2.8%)	(1)
Headache	88/383 (22.9%)	(1, 5, 6)
Fatigue/myalgia	71/350 (20.3%)	(3, 5, 6, 8)
Clinical classification		
Asymptomatic	108/797 (13.6%)	(7-9, 12)
Mild	353/866 (40.8%)	(1, 6, 7, 9, 11, 12)
Moderate	348/866 (40.2%)	(1, 6, 8, 11, 12)
Severe	23/770 (3.0%)	(6, 8, 12)
Critical	8/797 (1.0%)	(6, 8, 11, 12)

**Tab. 2.** Definitions of clinical types of COVID-19 among pediatric patients (1)

<p>Mild disease</p> <p>Upper respiratory symptoms (e.g., fever, sore throat or pharyngeal congestion) for a short duration</p> <p>Positive RT-PCR test for SARS-CoV-2</p>
<p>Moderate disease</p> <p>Mild pneumonia</p> <p>Fever, cough, fatigue, myalgia and headache</p> <p>No complications and manifestations related to severe conditions</p>
<p>Severe disease</p> <p>Mild or Moderate clinical features, plus any manifestations that suggest disease progression such as:</p> <p>Hypoxia</p> <p>Rapid breath (≥ 70 breaths per minute for infants; ≥ 50 breath per minute for children ages &gt; 1 year)</p> <p>Lack of consciousness, coma, depression, convulsions</p> <p>Myocardial injury</p> <p>Dehydration, difficulty feeding, gastrointestinal dysfunction</p> <p>Elevated liver enzymes</p> <p>Coagulation dysfunction, rhabdomyolysis, and any other manifestation suggesting injuries to vital signs</p>
<p>Clinical illness</p> <p>Rapid disease progression, plus any other conditions, including:</p> <p>Septic shock</p> <p>Organ failure that needs monitoring in the ICU</p> <p>Respiratory failure with need for mechanical ventilation</p>

### DISCUSSION

Determining the prevalence of symptoms in pediatric patients infected with SARS-CoV-2 is important from a practical point of view. Our meta-analysis allowed to determine the prevalence of particular symptoms as well as the severity of pediatric patient's clinical manifestations and the percentage of asymptomatic cases. The obtained data enable better clinical assessment of pediatric patients with regard to the risk of SARS-CoV-2 infection.

The symptoms of COVID-19 occurring in children are similar to those of the adult population, but there are differences in their prevalence. In adults taste and smell disturbances have been frequently reported, such reports are less frequent in pediatric patients. Some of the symptoms of COVID-19 occurring in children are accompanied by other diseases typical for this group of patients. It should be remembered that the severe course of COVID-19 in children is not uncommon, pediatric patients may also require treatment in intensive care units due to severe respiratory failure and the need for invasive ventilation. The clinical manifestation of SARS-CoV-2 infection in children can be unusual and less aggressive than in teenage and adult patients (1, 10).

The risk of vertical transmission in infants born to mothers with suspected or confirmed SARS-CoV-2 infection is unclear but transmission from family members/providers to neonates is also possible.

Concerns about the infection of SARS-CoV-2 patients, including children, as a result of contact with health services, including hospitals and clinics, may lead to delays or failures in the diagnosis of non-COVID-19 emergencies in children, which may increase morbidity and mortality.

Early diagnosis of SARS-CoV-2 infection is extremely important not only in adults, but especially in children because of the risk of infection of parents and grandparents as well as other caregivers at an older age or with coexisting diseases, as it is in this group that the incidence of COVID-19 and its severe course and risk of death are particularly high.

The presented symptoms of SARS-CoV-2 infection in children cannot be ignored, also for epidemiological reasons, because of the possibility of confusion of SARS-CoV-2 infection with other diseases typical for childhood.

Although guidelines for dealing with SARS-CoV-2 infections in children are already being developed, they are based on relatively limited data. Further studies on large groups of patients as well as screening tests are necessary in order to accurately assess the percentage of asymptomatic cases and the clinical course of COVID-19 in children.

Our analysis has several limitations. The first limitation is the type of research we analyze and the related limitations and difficulties in interpreting the data. The research was carried out in different countries with different healthcare systems and the extent of testing toward SARS-CoV-2. Data on asymptomatic patients may be subject to an error difficult to estimate. Another limitation is the fact that no distinction was made between individual age groups in the population of pediatric patients due to data deficits or differences in the analyzed publications.

## CONCLUSIONS

In summary, the five most frequent symptoms in pediatric patients with confirmed COVID-19 are: fever, cough, headache, sore throat and fatigue/myalgia. In the pediatric population, 81% of patients infected with SARS-CoV-2 have mild or moderate symptoms, and only 4% have severe and critical presentation.

## BIBLIOGRAPHY

1. Qiu H, Wu J, Hong L et al.: Clinical and epidemiological features of 36 children with coronavirus disease 2019 (COVID-19) in Zhejiang, China: an observational cohort study. *Lancet Infect Dis* 2020. doi: 10.1016/S1473-3099(20)30198-5.
2. World Health Organization: [https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-\(2005\)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-\(2019-ncov\)](https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)), 2020 (data dostępu: 13.04.2020).
3. Xia W, Shao J, Guo Y et al.: Clinical and CT features in pediatric patients with COVID-19 infection: Different points from adults. *Pediatr Pulmonol* 2020; 55(5): 1169-1174.
4. Cai J, Xu J, Lin D et al.: A Case Series of children with 2019 novel coronavirus infection: clinical and epidemiological features. *Clin Infect Dis* 2020. doi: 10.1093/cid/ciaa198.
5. CDC COVID-19 Response Team: Coronavirus Disease 2019 in Children – United States, February 12-April 2, 2020. *MMWR Morb Mortal Wkly Rep* 2020; 69(14): 422-426.
6. Sun D, Li H, Lu XX et al.: Clinical features of severe pediatric patients with coronavirus disease 2019 in Wuhan: a single center's observational study. *World J Pediatr* 2020. doi: 10.1007/s12519-020-00354-4.
7. Tang A, Xu W, Shen M et al.: A retrospective study of the clinical characteristics of COVID-19 infection in 26 children. *medRxiv* 2020. <https://doi.org/10.1101/2020.03.08.20029710>.
8. Wang S, Guo L, Chen L et al.: A case report of neonatal COVID-19 infection in China. *Clin Infect Dis* 2020. doi: 10.1093/cid/ciaa225.
9. Wei M, Yuan J, Liu Y et al.: Novel Coronavirus Infection in Hospitalized Infants Under 1 Year of Age in China. *JAMA* 2020. doi: 10.1001/jama.2020.2131.
10. Xu Y, Li X, Zhu B et al.: Characteristics of pediatric SARS-CoV-2 infection and potential evidence for persistent fecal viral shedding. *Nat Med* 2020; 26(4): 502-505.
11. Zheng F, Liao C, Fan QH et al.: Clinical Characteristics of Children with Coronavirus Disease 2019 in Hubei, China. *Curr Med Sci* 2020. doi: 10.1007/s11596-020-2172-6.
12. Dong Y, Mo X, Hu Y et al.: Epidemiological Characteristics of 2143 Pediatric Patients With 2019 Coronavirus Disease in China. *Pediatrics* 2020. doi: 10.1542/peds.2020-0702.