



# Clinical characteristics of a case series of children with coronavirus disease 2019

Li Zhu MD<sup>1</sup> | Jian Wang MD<sup>2</sup> | Rui Huang MD, PhD<sup>2</sup> | Longgen Liu MD<sup>3</sup> | Haiyan Zhao MD<sup>4</sup> | Chao Wu MD, PhD<sup>2</sup> | Chuanwu Zhu MD, PhD<sup>1</sup>

<sup>1</sup>Department of Infectious Diseases, The Affiliated Infectious Diseases Hospital of Soochow University, Suzhou, China

<sup>2</sup>Department of Infectious Diseases, Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School, Nanjing, China

<sup>3</sup>Department of Infectious Diseases, The Third People's Hospital of Changzhou, Changzhou, China

<sup>4</sup>Department of Infectious Diseases, The People's Hospital of Suqian, Suqian, China

## Correspondence

Chao Wu, MD, PhD, Department of Infectious Diseases, Nanjing Drum Tower Hospital, The Affiliated Hospital of Nanjing University Medical School, No. 321 Zhongshan Road, 210008 Nanjing, China.  
Email: [dr.wu@nju.edu.cn](mailto:dr.wu@nju.edu.cn)

Chuanwu Zhu, MD, PhD, Department of Infectious Diseases, The Affiliated Infectious Diseases Hospital of Soochow University, No. 10 Guangqian Road, 215100 Suzhou, China.  
Email: [zhuchw@126.com](mailto:zhuchw@126.com)

## Funding information

Fundamental Research Funds for the Central Universities, Grant/Award Number: 14380459

## Abstract

We reported the clinical characteristics of a case series of 10 patients with coronavirus disease 2019 (COVID-19) aged from 1 year to 18 years. Seven patients had contact with confirmed COVID-19 family members before onset. Fever (4 [40.0%]) and cough (3 [30.0%]) were the most common symptoms. No patient showed leucopenia and lymphopenia on admission. Pneumonia was observed in chest CT images in 5 (50.0%) patients. Five (50.0%) patients received antiviral treatment. No patient had severe complications or developed a severe illness in our study. Our study indicated that COVID-19 children present less severe symptoms and have better outcomes.

## KEYWORDS

children, coronavirus disease 2019, prognosis

## 1 | INTRODUCTION

In December 2019, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection spread rapidly among humans worldwide.<sup>1</sup> The epidemiological, radiological, and clinical characteristics of COVID-19 have been reported in the general population.<sup>2</sup> Elderly patients with comorbidities may be more likely infected by SARS-CoV-2 according to previous reports.<sup>3</sup> In addition, the characteristics of COVID-19 in special populations were also reported. Wei et al<sup>4</sup> reported nine confirmed infants in Wuhan under 1 year of age with a good prognosis. However, to the best of our knowledge, few studies have reported the clinical characteristics of COVID-19 in children outside of Wuhan. We describe the epidemiological and clinical characteristics of COVID-19 in a case series of 10 children aged from 1 year to 18 years in Jiangsu province, China.

## 2 | METHODS

Children aged from 1 year to 18 years with confirmed COVID-19 were retrospectively recruited from 3 designated hospitals in three cities of Jiangsu province, China. All children were confirmed with COVID-19 between January 24, 2020 and February 22, 2020 based on the criterion of the World Health Organization (WHO) interim guidance.<sup>5</sup>

Demographic, epidemiological and clinical data were collected from medical records. All patients were confirmed by quantitative real-time reverse transcriptase polymerase chain reaction (RT-PCR) method on throat swab sample or anal swab sample. The protocol of RT-PCR was consistent with the recommendation of World Health Organization.<sup>5</sup> RT-PCR was tested in both hospitals and local centers for disease control and prevention.

Li Zhu, Jian Wang, and Rui Huang contributed equally to this study.

This study was approved by the ethics committees of these hospitals, with a waiver of informed consent.

### 3 | RESULTS

A total of 10 children with COVID-19 were included in the study (Table 1). Five (50%) patients were male. The oldest patient is 17 years and the youngest patient is 1 year and 7 months old. Seven patients had contact with confirmed COVID-19 family members, none of

whom visited or lived in Wuhan. The other three children had been living in Wuhan and arrived in Jiangsu within 2 weeks before the diagnosis. No family member had a history of exposure to the Huanan seafood market.

The most common initial symptoms at the onset of illness were fever (4 [40.0%]), followed by cough (3 [30.0%]) and headache (2 [20.0%]). Other symptoms, including fatigue, sore throat, muscle ache, shortness of breath, or diarrhea were not presented in these patients. Three of 10 (30%) patients had no clinical symptoms before admission, who received COVID-19 screening due to the contact with confirmed COVID-19 family members.

**TABLE 1** Epidemiologic and clinical characteristics of 10 children with coronavirus disease 2019

| Characteristics                       | Patient 1 | Patient 2 | Patient 3 | Patient 4 | Patient 5 | Patient 6 | Patient 7 | Patient 8 | Patient 9 | Patient 10 |
|---------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| Age, y                                | 1 y 7 mo  | 9         | 11        | 6         | 10        | 4         | 7         | 14        | 12        | 17         |
| Sex                                   | Male      | Female    | Female    | Male      | Male      | Male      | Female    | Male      | Female    | Female     |
| Exposure history                      |           |           |           |           |           |           |           |           |           |            |
| Contact with confirmed family members | Yes       | Yes       | Yes       | Yes       | Yes       | Yes       | No        | Yes       | No        | No         |
| Lived in Wuhan                        | No        | No        | No        | No        | No        | No        | Yes       | No        | Yes       | Yes        |
| Onset symptoms and signs              |           |           |           |           |           |           |           |           |           |            |
| Fever                                 | No        | No        | No        | No        | Yes       | No        | Yes       | Yes       | No        | Yes        |
| Cough                                 | No        | Yes       | Yes       | No        | Yes       | No        | No        | No        | No        | No         |
| Sore throat                           | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| Headache                              | No        | No        | No        | No        | No        | No        | No        | Yes       | No        | Yes        |
| Shortness of breath                   | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| Vomiting                              | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| Diarrhea                              | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| Laboratory tests                      |           |           |           |           |           |           |           |           |           |            |
| WBC, $\times 10^9/L$                  | 12.94     | 8.04      | 9.1       | 7.57      | 6.96      | 8.14      | 4.65      | 5.96      | 3.85      | 7.45       |
| Decreased                             | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| Lymphocyte, $\times 10^9/L$           | 11.46     | 2.18      | 3.22      | 4.08      | 3.64      | 3.68      | 2.72      | 1.88      | 1.71      | 2.59       |
| Decreased                             | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| ALT, U/L                              | 24        | 69        | 41        | 31        | 24        | 31        | 10.4      | 12.3      | 26        | 13         |
| Increased                             | No        | Yes       | Yes       | No        | No        | No        | No        | No        | No        | No         |
| CRP, mg/L                             | <0.5      | <0.5      | <0.5      | <0.5      | <0.5      | <0.5      | 1.47      | 1.22      | 0.65      | 0.67       |
| Increased                             | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| PCT, ng/mL                            | 0.034     | 0.028     | 0.026     | 0.023     | <0.02     | 0.099     | 0.025     | 0.024     | NA        | NA         |
| Increased                             | No        | No        | No        | No        | No        | No        | No        | No        | NA        | NA         |
| Chest CT findings                     |           |           |           |           |           |           |           |           |           |            |
| Unilateral pneumonia                  | Yes       | No        | Yes       | No        | No        | No        | No        | No        | Yes       | No         |
| Bilateral pneumonia                   | No        | No        | No        | No        | No        | No        | No        | Yes       | No        | Yes        |
| Treatment                             |           |           |           |           |           |           |           |           |           |            |
| Oxygen therapy                        | No        | Yes       | No        | No        | No        | No        | No        | No        | No        | No         |
| Antiviral therapy                     | No        | Yes       | No        | No        | No        | No        | Yes       | Yes       | Yes       | Yes        |
| Antibiotic therapy                    | No        | No        | Yes       | No        | No        | No        | No        | No        | No        | No         |
| Corticosteroid                        | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| $\gamma$ -Globulin                    | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| Outcomes                              |           |           |           |           |           |           |           |           |           |            |
| Hospital discharge                    | Yes       | No        | Yes       | Yes       | No        | No        | Yes       | Yes       | Yes       | Yes        |
| Severe complication                   | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |
| ICU admission                         | No        | No        | No        | No        | No        | No        | No        | No        | No        | No         |

Abbreviations: ALT, alanine aminotransferase; CRP, C-reactive protein; ICU, intensive care unit; NA, not available; PCT, procalcitonin; WBC, white blood cells.

No patient showed leucopenia and lymphopenia on admission. Three of 10 patients (30%) had mildly increased levels of alanine aminotransferase (ALT). The peak level of ALT was 69 U/L. Inflammatory markers including C-reactive protein and procalcitonin were normal in all patients. All patients received a chest CT examination on admission. Typical findings of chest CT images were observed in five (50.0%) patients. Of the five patients, two (40.0%) had bilateral and one (20.0%) had unilateral ground-glass opacity.

Oxygen therapy was required in one (10.0%) patients. Five (50.0%) patients received antiviral treatment, including lopinavir/ritonavir ( $n = 4$ ; 40.0%), interferon  $\alpha$ -2b ( $n = 4$ ; 40.0%), and oseltamivir ( $n = 1$ ; 10.0%). One (10.0%) patient was given antibiotic treatment and no patient was treated with corticosteroid or gamma globulin. As of February 25, 2020, 5 (50.0%) of 10 patients have been discharged, and 5 (50.0%) patients remained hospitalized. No patient had severe complications and no patient developed a severe illness in our study. No patient was admitted to the ICU or deceased in our study.

## 4 | DISCUSSION

The current study reported the clinical characters of 10 children with confirmed COVID-19 from Jiangsu province, China. Most of the patients had contact with confirmed COVID-19 family members in our study, suggesting that family clustering infection is common in infected children and the protection for children who had a confirmed family member is important.

Consistent with adult patients, fever and cough were the most common symptoms at the onset of illness.<sup>2</sup> However, asymptomatic infection is common in children patients. The illness in all children was mild and no severe complication occurred. Previous studies in adult patients reported intensive care unit (ICU) admission ranged from 26.1% to 32% and the fatality rate ranged from 4.3% to 15%.<sup>3</sup> Our results suggested that the outcomes of children were better than adult patients. Similarly, Wei et al<sup>4</sup> reported nine infants and no patient was admitted to the ICU or had any severe complications. The children rarely combine comorbidities and may be less susceptible to developing severe illness than elderly patients.<sup>4</sup>

Although the antiviral effect was uncertain, 50.0% of patients received antiviral therapy in this study. However, the benefit of antiviral therapy for COVID-19 remains unclear. In addition, 10.0% of patients received empirical antibacterial therapy, and no patient received corticosteroids or gamma globulin due to the mild illness.

There were several limitations to this study. First, the sample size is small and only 10 childhood patients were enrolled. The results need to be confirmed by a larger sample study. In addition, as of February 25, 2020, five patients remained in hospital and the clinical outcomes were not available at the time

of analysis. Thus, the risk factors of poor prognosis for children patients remains unknown.

## 5 | SUMMARY

In conclusion, compared with adult patients, COVID-19 children present less severe symptoms and have better outcomes. Our results provide valuable information to understanding the epidemiological and clinical features of COVID-19 in children.

### ACKNOWLEDGMENT

This study was supported by the Fundamental Research Funds for the Central Universities (No. 14380459).

### CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

### AUTHOR CONTRIBUTIONS

Concept and design: CZ, CW. Acquisition, analysis, or interpretation of data: LZ, JW, RH, LL, HZ. Drafting of the manuscript: LZ, JW, RH. Critical revision of the manuscript for important intellectual content: CZ, CW. Statistical analysis: JW. Administrative, technical, or material support: LL, HZ. Supervision: CZ, CW.

### ORCID

Chao Wu  <http://orcid.org/0000-0002-1657-010X>

### REFERENCES

1. Paules CI, Marston HD, Fauci AS. Coronavirus infections-more than just the common cold. *JAMA*. 2020;323:707.
2. Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*. 2020;395:507-513.
3. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020;395:497-506.
4. Wei M, Yuan J, Liu Y, et al. Novel coronavirus infection in hospitalized infants under 1 year of age in China. *JAMA*. 2020. <https://doi.org/10.1001/jama.2020.2131>. [published online ahead of print February 14, 2020].
5. World Health Organization. Laboratory diagnostics for novel coronavirus. 2020. <https://www.who.int/health-topics/coronavirus/laboratory-diagnostics-for-novel-coronavirus>. Accessed February 6, 2020.

**How to cite this article:** Zhu L, Wang J, Huang R, et al. Clinical characteristics of a case series of children with coronavirus disease 2019. *Pediatric Pulmonology*. 2020;1-3. <https://doi.org/10.1002/ppul.24767>