CORRESPONDENCE

SARS-CoV-2 Infection in Children

TO THE EDITOR: As of March 10, 2020, the 2019 novel coronavirus (SARS-CoV-2) has been responsible for more than 110,000 infections and 4000 deaths worldwide, but data regarding the epidemiologic characteristics and clinical features of infected children are limited.[1-3] A recent review of 72,314 cases by the Chinese Center for Disease Control and Prevention showed that less than 1% of the cases were in children younger than 10 years of age.[2] In order to determine the spectrum of disease in children, we evaluated children infected with SARS-CoV-2 and treated at the Wuhan Children's Hospital, the only center assigned by the central government for treating infected children under 16 years of age in Wuhan. Both symptomatic and asymptomatic children with known contact with persons having confirmed or suspected SARS-CoV-2 infection were evaluated. Nasopharyngeal or throat swabs were obtained for detection of SARS-CoV-2 RNA by established methods.[4] The clinical outcomes were monitored up to March 8, 2020.

Of the 1391 children assessed and tested from January 28 through February 26, 2020, a total of 171 (12.3%) were confirmed to have SARS-CoV-2 infection. Demographic data and clinical features are summarized in Table 1. (Details of the laboratory and radiologic findings are provided in the Supplementary Appendix, available with the full text of this letter at NEJM.org.) The median age of the infected children was 6.7 years. Fever was present in 41.5% of the children at any time during the illness. Other common signs and symptoms included cough and pharyngeal erythema. A total of 27 patients (15.8%) did not have any symptoms of infection or radiologic features of pneumonia. A total of 12 patients had radiologic features of pneumonia but did not have any symptoms of infection. During the course of hospitalization, 3 patients required intensive care support and invasive mechanical ventilation; all had coexisting conditions (hydronephrosis, leukemia [for which the patient was receiving maintenance chemotherapy], and intussusception). Lymphopenia (lymphocyte count, $<1.2\times10^9$ per liter) was present in 6 patients (3.5%). The most

Table 1. Epidemiologic Characteristics, Clinical Features, and Radiologic Findings of 171 Children with SARS-CoV-2 Infection.*

Characteristic	Value
Age	
Median (range)	6.7 yr (1 day–15 yr)
Distribution — no. (%)	
<1 yr	31 (18.1)
1–5 yr	40 (23.4)
6–10 yr	58 (33.9)
11–15 yr	42 (24.6)
Sex — no. (%)	
Male	104 (60.8)
Female	67 (39.2)
Diagnosis — no. (%)	
Asymptomatic infection	27 (15.8)
Upper respiratory tract infection	33 (19.3)
Pneumonia	111 (64.9)

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Table 1. (Continued)

Characteristic	Value
Exposure or contact information — no. (%)	
Family cluster	154 (90.1)
Confirmed family members	131 (76.6)
Suspected family members	23 (13.5)
Unidentified source of infection	15 (8.8)
Contact with other suspected case	2 (1.2)
Signs and symptoms	
Cough — no. (%)	83 (48.5)
Pharyngeal erythema — no. (%)	79 (46.2)
Fever — no. (%)	71 (41.5)
Median duration of fever (range) — days	3 (1–16)
Highest temperature during hospitalization — no. (%)	
<37.5°C	100 (58.5)
37.5–38.0°C	16 (9.4)
38.1–39.0°C	39 (22.8)
>39.0°C	16 (9.4)
Diarrhea — no. (%)	15 (8.8)
Fatigue — no. (%)	13 (7.6)
Rhinorrhea — no. (%)	13 (7.6)
Vomiting — no. (%)	11 (6.4)
Nasal congestion — no. (%)	9 (5.3)
Tachypnea on admission — no. (%)†	49 (28.7)
Tachycardia on admission — no. (%)‡	72 (42.1)
Oxygen saturation <92% during period of hospitalization — no. (%)	4 (2.3)
Abnormalities on computed tomography of the chest — no. (%)	
Ground-glass opacity	56 (32.7)
Local patchy shadowing	32 (18.7)
Bilateral patchy shadowing	21 (12.3)
Interstitial abnormalities	2 (1.2)

* Percentages may not total 100 because of rounding.
† The normal ranges of respiratory rate (in breaths per minute) were as follows: 40 to 60 for newborns, 30 to 40 for children younger than 1 year of age, 25 to 30 for those 1 to 3 years of age, 20 to 25 for those 4 to 7 years of age, 18 to 20 for those 8 to 14 years of age, and 12 to 20 for those older than 14 years of age. Tachypnea refers to a respiratory rate higher than the upper limit of the normal range according to age.
‡ The normal ranges of pulse rate (in beats per minute) were as follows: 120 to 140 for newborns, 110 to 130 for children younger than 1 year of age, 100 to 120 for those 1 to 3 years of age, 80 to 100 for those 4 to 7 years of age, 70 to 90 for those 8 to 14 years of age, and 60 to 70 for those older than 14 years of age. Tachycardia refers to a pulse rate higher than the upper limit of the normal range according to age.

common radiologic finding was bilateral ground-glass opacity (32.7%). As of March 8, 2020, there was one death. A 10-month-old child with intussusception had multiorgan failure and died 4 weeks after admission. A total of 21 patients were in stable condition in the general wards, and 149 have been discharged from the hospital.

This report describes a spectrum of illness from SARS-CoV-2 infection in children. In contrast with infected adults, most infected children appear to have a milder clinical course. Asymptomatic infections were not uncommon.[2] Determination of the transmission potential of these asymptomatic patients is important for guiding

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the development of measures to control the ongoing pandemic.

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1. World Health Organization. Coronavirus disease 2019 (COVID-19): situation report — 50 (https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200310-sitrep-50-covid-19.pdf?sfvrsn=55e904fb_2).
2. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA 2020 February 24 (Epub ahead of print).
3. Guan W, Ni Z, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med. DOI: 10.1056/NEJMoa2002032.
4. World Health Organization. Country & technical guidance — coronavirus disease (COVID-19) (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance).

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