Epidemiological and Clinical Characteristics of COVID-19 in Adolescents and Young Adults

Jiaqiang Liao, Shibing Fan, Jing Chen, ..., Jinglong Lv, Lixin Xu, Chunhui Lang

Graphical Abstract

Public Summary

- Adolescents and young adults are more involved in frequent social activity, overseas studying, and international working or tourism which make them to be susceptible to the worldwide spread of Coronavirus Disease 2019 (COVID-19).

- Adolescent and younger patients with COVID-19 had a median incubation period of 8 days, and 50% of their family contacts developed illness within 1.4 days after exposure.

- Three asymptomatic patients with COVID-19 infected their family contacts.

- Few adolescent and young adult patients showed severe clinical signs and symptoms such as bacterial pneumonia changes by Chest CT findings, fever, and shortness of breath.

- Most adolescent and young adult patients had better prognosis outcomes after treatment.

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Epidemiological and Clinical Characteristics of COVID-19 in Adolescents and Young Adults

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BACKGROUND
Adolescents and young adults might play a key role in the worldwide spread of Coronavirus Disease 2019 (COVID-19) because they are more likely to be involved in overseas study, business, work, and travel. However, the epidemiological and clinical characteristics remain unknown.

METHODS
We collected demographic, epidemiological, and clinical data from 46 confirmed COVID-19 patients aged 10 to 35 years from the Chongqing Three Gorges Central Hospital. Several key epidemiological parameters, asymptomatic cases, transmission to family members, and clinical characteristics at admission and during treatment were summarized.

RESULTS
Of 46 confirmed patients, 14 patients (30.4%) were aged between 10 and 24 years, and 24 (52.2%) patients were male. The estimated mean incubation period was 6.6 days (95% confidence interval [CI] 4.4–9.6). The median serial interval was 1.9 days (95% CI 0.4–6.2). Three of the asymptomatic cases showed transmission to their family members. Only one patient was identified as a severe case at admission. The common symptoms at admission were dry cough (34, 81.0%) and fever (29, 69.1%). Nearly 60% of the patients showed ground-glass opacity on chest computed tomography. Three patients developed acute kidney injury during treatment.

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treatment. Most of the patients (78.3%) recovered and were discharged by the end of the follow-up.

CONCLUSIONS
This single-center study with a relatively small sample size showed that adolescent and young adult patients with COVID-19 had a long incubation period and a short serial interval. The transmission occurred from asymptomatic cases to family members. Fewer patients developed complications during treatment.

Introduction
The coronavirus disease COVID-19, a newly emerging infectious pneumonia with unknown causes, was firstly reported in Wuhan, Hubei Province, China in December 2019. The incidences of COVID-19 were rapidly reported across China because it occurred around the time of the Chinese spring festival. Early epidemiological and clinical studies reported that the majority of patients were middle-aged or elderly individuals, a mean incubation period of 5.2 days (range 0–14 days), and a serial interval of 7.5 days (95% confidence interval [CI] 2–17 days). The most common symptoms were fever, cough, and fatigue. Most of the patients presented the abnormal chest computed tomography (CT) findings such as ground-glass opacity and bilateral patchy shadowing. Patients older than 65 years were more likely to be severe cases and developed severe acute complications such as pneumonia, acute respiratory distress syndrome (ARDS), shock, and acute cardiac injury during treatment. These studies provided essential evidence to guide the early medical screen, diagnosis of COVID-19 cases, isolation of suspected cases, and clinical treatments. However, with the rapid progress of COVID-19 many new characteristics have emerged, which need to augment the evidence. One new feature is that increasing numbers of younger patients were confirmed across China. One study from the Chinese Center for Disease Control and Prevention indicated that 4,168
of the patients through February 11, 2020 were younger than 30 years. In addition, outbreaks of COVID-19 were reported worldwide. Several countries, such as South Korea, Japan, and Italy, are experiencing a sharp increase in confirmed cases of COVID-19. Younger individuals were more likely to be carriers of COVID-19 across countries, since they were more likely to be involved in overseas study, business, work, and travel. For example, in South Korea, 178 out of 431 confirmed cases, which were publicly announced on the website of the Ministry of Health and Welfare, were aged %\text{35 years} through March 1, 2020. However, as far as we know no study has been specifically conducted to explore the epidemiological and clinical characteristics in younger patients with COVID-19.

In this study, based on retrospective case series data, we aimed to estimate the key epidemiological characteristics and describe the clinical symptoms, treatments, and hospital outcomes for adolescents and young adults with COVID-19.

### Results

Of 248 patients registered at the study hospital during the study period, 51 (20.6%) patients were aged from 10 to 35 years. Five patients who did not provide sufficient data at the epidemiological outbreak interview were further excluded. The social-economic demographics and symptoms of the study patients are summarized in Table 1. The majority were young adults (n = 32) and the rest were adolescents (n = 14). The main types of exposure were

Table 1. Baseline Characteristics of Study Patients Infected with COVID-19

| Characteristics                        | Total (n = 46) | Adolescents (n = 14) | Young Adults (n = 32) | p Value |
|----------------------------------------|---------------|----------------------|----------------------|---------|
| **Exposure types**                     |               |                      |                      |         |
| Resid in Wuhan                          | 19 (41.3)     | 7 (50.0)             | 12 (37.5)            |         |
| Travel to Wuhan                        | 3 (6.5)       | 2 (14.3)             | 1 (3.1)              |         |
| Contact with confirmed cases           | 22 (47.8)     | 5 (35.7)             | 17 (53.1)            |         |
| None                                   | 2 (4.4)       | 0 (0.0)              | 2 (6.3)              |         |
| **Gender**                             |               |                      |                      |         |
| Male                                   | 24 (52.2)     | 7 (50.0)             | 17 (53.1)            |         |
| Female                                 | 22 (47.8)     | 7 (50.0)             | 15 (46.9)            |         |
| **Education, years**                   |               |                      |                      |         |
| 1–9                                    | 18 (39.1)     | 6 (42.9)             | 12 (37.5)            | 0.94    |
| 10–12                                  | 10 (21.7)     | 3 (21.4)             | 7 (21.9)             |         |
| ≥13                                    | 18 (39.1)     | 5 (35.7)             | 13 (40.6)            |         |
| **BMI, kg/m²**                         |               |                      |                      | 0.51    |
| Underweight                            | 4 (8.7)       | 1 (7.1)              | 3 (9.4)              |         |
| Normal                                 | 24 (52.2)     | 8 (57.1)             | 16 (50.0)            |         |
| Overweight/obesity                     | 17 (37.0)     | 4 (28.6)             | 13 (40.6)            |         |
| **Smoking status**                     |               |                      |                      | 0.99    |
| Never                                  | 41 (89.1)     | 13 (92.9)            | 28 (87.5)            |         |
| Ever or now                            | 5 (10.9)      | 1 (7.1)              | 4 (12.5)             |         |
| **Physical activity**                  |               |                      |                      | 0.23    |
| Never                                  | 23 (50.0)     | 6 (42.9)             | 17 (53.1)            |         |
| Rare                                   | 14 (30.4)     | 3 (21.4)             | 11 (34.4)            |         |
| Often                                  | 9 (19.6)      | 5 (35.7)             | 4 (12.5)             |         |
| **Alcohol consumption**                |               |                      |                      | 0.72    |
| Never                                  | 32 (71.1)     | 11 (78.6)            | 21 (67.7)            |         |
| Rare or often                          | 13 (28.9)     | 3 (21.4)             | 10 (32.3)            |         |
| **Chronic disease history**            |               |                      |                      | 0.65    |
| None                                   | 40 (87.0)     | 13 (92.9)            | 27 (84.4)            |         |
| At least one**                         | 6 (13.0)      | 1 (7.1)              | 5 (15.6)             |         |
| **Severity**                           |               |                      |                      | 0.40    |
| Asymptomatic                           | 4 (8.7)       | 2 (14.3)             | 2 (6.3)              |         |
| Mild                                   | 41 (89.1)     | 12 (85.7)            | 29 (90.6)            |         |
| Severe                                 | 1 (2.2)       | 0 (0.0)              | 1 (3.1)              |         |

(Continued on next column)
contact with other confirmed cases (22, 47.8%) or residing in Wuhan (19, 41.3%). Half of the patients were men (24, 52.2%), had a normal body mass index (BMI) (24, 52.2%), and never conducted physical activity (23, 50.0%). Fewer patients had histories of one or more medical disease (6, 13.0%), including obesity (n = 1), diabetes (n = 1), chronic obstructive pulmonary disease (n = 1), hyperthyroidism (n = 1), kidney stones (n = 1), and arthroli-thiasis (n = 1). Only one (2.2%) patient was identified as a severe case. The individual characteristics of this case are summarized in Table S1. Four patients were identified as asymptomatic on admission. The most common symptoms at admission were dry cough (34, 81.0%), fever (29, 69.1%), and expectoration (16, 38.1%). Less common symptoms included headache, fatigue, pharyngalgia, chest pain, anorexia, myalgia, dizziness, diarrhea, nausea, and shortness of breath. The common pathological changes seen on chest CT were ground-glass opacity (29, 63.0%) and bilateral patchy shadowing (12, 26.1%). No severe cases were identified among adolescent patients. Compared with young adults, adolescent patients had a lower probability to be asymptomatic (6.3% versus 14.3%). Fewer adolescent patients reported fever, headache, and fatigue. Only 7 (50.0%) adolescent patients showed ground-glass opacity on chest CT compared with 22 (68.8%) in young adults. However, none of these differences reached levels of statistical significance. The typical patterns of chest CT for adolescents and young adults are shown in Figure 1.

We recorded family-clustered events from six symptomatic index patients on admission (Figure 2). According to the definition of the serial interval, we only included 12 secondary cases out of these family-cluster data to estimate the distribution of serial interval (Figure 3A). The estimated median serial interval was
1.9 days (95% CI 0.4–6.2). The estimated 95th percentile of serial interval could reach as long as 28.6 days (95% CI 10.6–76.9). Among 14 patients who provided the exact date of traveling to Wuhan or contacting other confirmed cases, the estimated median incubation period was 8.3 days (95% CI 5.0–13.4) (Figure 3B). The estimated 95th percentile of the incubation period could reach as long as 24.8 days (95% CI 14.9–47.6). After excluding three asymptomatic cases, the estimated median incubation period decreased to 6.6 days (95% CI 4.4–9.6) (Figure 3C), and the estimated 95th percentile of the incubation period decreased to 14.8 days (95% CI 10.4–22.0). Based on 42 symptomatic cases, we estimated the median interval from symptom onset to the first medical visit to be 1.4 days (95% CI 0.8–2.4) (Figure 3D). The estimated 95th percentile of the period from symptom onset to the first medical visit was 13.2 days (95% CI 8.3–20.9).

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**Figure 2** Information on Exposures and Dates of Illness Onset in Six Symptomatic Cases and Their Family Close Contacts

Numbers in boxes are calendar dates. Data from the 12 secondary cases (close contacts were defined as those who had clear exposure to only one index case and had no other potential source of infection) were used to estimate the distribution of serial interval.
On admission, 10 (21.7%) patients had leukopenia (white blood cell count <4 × 10^9/L) and 29 (63.0%) had lymphopenia (Table 2). Ten patients (21.7%) had decreased levels of platelets (<150 × 10^9/L). The other elevated laboratory indicators in study patients were lactate dehydrogenase (9, 19.6%), C-reactive protein (9, 19.6%), D-dimer (7, 15.2%), alanine aminotransferase (7, 15.2%), and total bilirubin (7, 15.2%). Several differences were observed in laboratory findings between adolescent and young adult patients. For example, 8 (25.0%) young adult patients presented elevated levels of C-reactive protein while only one adolescent patient showed a similar pattern.

The treatments and prognosis outcomes are summarized in Table 3. During the treatment periods, all patients received antiviral therapy, 39 (84.8%) patients received oxygen inhalation, and 43 (93.5%) patients received interferon-a inhalation. Few patients (5, 10.9%) received antifungal treatment. Three (6.5%) patients developed acute kidney injury during the treatment. The median interval from the date of admission to the date of consecutively negative results for COVID-19 nucleic acid tests was 12.5 days (interquartile range [IQR] 8.0–16.0). The median duration of persistent fever during admission was 5 days (IQR 1–8). Until February 25, 2020, 36 patients had recovered and been discharged, 10 patients were still hospitalized, and no patients died. Compared with young adults, adolescent patients received less oxygen inhalation therapy.

We observed four asymptomatic cases at admission, all of whom were consistently confirmed as asymptomatic cases by our face-to-face or telephone interviews. The disease progress of the asymptomatic patients during the treatment period is shown in Figure 4. Two asymptomatic patients (cases 2 and 3) still did not show any symptoms until February 23, 2020. Asymptomatic case 1 developed symptoms of shortness of breath, difficulty breathing, and chest tightness in the 17 days after admission. Asymptomatic case 4 developed symptoms of dry cough, phlegm, and nausea in the 6 days after admission, and his COVID-19 nucleic acid transformed into negative in the 14 days after admission. We detected family-clustered events from three asymptomatic cases, which indicated that the transmission during their asymptomatic periods occurred between them and their family close contacts. For example, two relatives of asymptomatic case 1 who lived with him and did not report other potential infection sources developed the illness on January 17, 2020.
This study, to the best of our knowledge, is the first to assess the epidemiological and clinical characteristics of COVID-19 in adolescent and young adult patients. We added new knowledge to help understand the characteristics of COVID-19 in the younger population. We detected four asymptomatic cases out of 46 patients admitted. We reported a mean incubation period of 7.2 days in symptomatic cases, which could reach as long as 10 days allowing for the truncated time to event data for asymptomatic cases. We estimated a median serial interval of 1.9 days from the date of illness onset in index patients to the date of developing illness in their family close contacts. We found that the most common symptoms were dry cough, fever, and expectoration. Only 29 (63.0%) of the patients showed the ground-glass opacity on chest CT scan. The typical changes of laboratory indicators were decreased white blood cell count, decreased lymphocyte count, decreased platelet count, increased lactate dehydrogenase, and increased C-reactive protein. During the treatment three patients developed acute kidney injury, but no other medical complications were documented. Nearly 80% of the patients recovered and were discharged at the end of follow-up.

Our study suggests that the incubation period of COVID-19 in adolescents and young adults might be longer than that in older patients. A retrospective study reported a mean incubation period of 5.2 days (95% CI 4.1–7.0) and 95th percentile of the incubation period of 12.5 days based on early COVID-19 patients from...
A later study, which used the data of travelers from Wuhan, estimated the mean incubation period as 6.4 days (95% CI 5.6–7.7), ranging from 2.2 to 11.1 days. Similar studies reported a shorter incubation period (median 4 days) for patients outside Wuhan. However, most of these studies were based on patients older than 50 years, and knowledge gaps persisted for the incubation period in younger COVID-19 patients. In this study, we used patients who provided exact information about exposure time intervals and reported a mean incubation period of 7.2 days (95% CI 5.2–10.1) for patients younger than 35 years. The 95th percentile of the incubation period was 14.8 days (95% CI 10.4–22.00). Allowing for appropriately truncated periods for asymptomatic cases, the estimated mean incubation period was 10.0 days (95% CI 6.4–16.1) while the estimated 95th percentile could reach as long as 24.8 days (95% CI 14.9–47.6). Our findings highlight the importance of extending medical observation or quarantine periods for adolescent and young adult patients with COVID-19.

Our study suggests that person-to-person transmission of COVID-19 can occur rapidly from infected adolescent and young adults to their family contacts. We recorded six family-clustered events of COVID-19 in asymptomatic patients. We estimated the mean serial interval to be 6.5 days (95% CI 2.5–17.4), which is shorter than that (7.5 days, 95% CI 5.3–19.0) estimated from early patients in Wuhan. Most importantly, we estimated the median serial interval to be 1.9 days (95% CI 0.4–6.2), which was still lower than that (4.0 days, 95% CI 3.1–4.9) estimated in a recent modeling study.

We provided evidence supporting the transmission of COVID-19 from adolescent and young adult asymptomatic patients to their family or close contacts. In this study, of the four out of 46 patients identified as asymptomatic cases, three were identified as the index patients in their families. The two asymptomatic primary cases had neither symptoms nor chest CT findings during the treatment. One asymptomatic primary case suffered from difficulty breathing, shortness of breath, and chest tightness in the 17 days during treatment. Most importantly, all of their family contacts developed symptoms before the admission date of the asymptomatic index patients. Our findings were consistent with the existing evidence. Rothe et al. first reported that an asymptomatic Chinese woman might be the transmission source for her two German business partners. Tong et al. reported a two-family cluster of COVID-19 patients in Zhejiang Province after each family’s primary case contacted an asymptomatic case of COVID-19 from Wuhan.

Recently, a similar study has identified a 20-year-old
Chinese woman as an asymptomatic carrier who has infected five individuals in her family.\(^{14}\)

Compared with the early evidence from Wuhan patients, the adolescent and young adult patients with COVID-19 presented different patterns of symptoms and fewer abnormalities of laboratory indicators on admission. The most common symptoms were fever (83%), cough (82%), and shortness of breath (31%) in early elderly patients from Wuhan.\(^{3}\) Later studies with more case series reported other common symptoms including fatigue, gastrointestinal symptoms, upper
airway congestion, myalgia, and headache.\textsuperscript{4,6,15} The results of chest CT indicated that nearly 80% of the early patients showed bilateral pneumonia and ground-glass opacity.\textsuperscript{3,4,15,16} Laboratory examinations indicated that over 70% of the patients had lymphocytopenia, elevated lactate dehydrogenase, and elevated C-reactive protein.\textsuperscript{3,4,17} In this study, the most common symptoms on admission were dry cough (81.0%), fever (69.1%), and expectoration (38.1%). Only one patient reported shortness of breath on admission. The proportion of those with reported fever at admission decreased to 58.3% in adolescent patients. Nearly 60% of the patients showed ground-glass opacity changes on chest CT, which decreased to 50% in adolescent patients. Only 26.09% and 13.04% of all patients showed bilateral patchy shadowing or consolidation on chest CT. In terms of laboratory examinations, 63.0% of the patients had lymphocytopenia, which agrees closely with the existing evidence. However, fewer patients had elevated levels of lactate dehydrogenase (19.6%) and C-reactive protein (19.6%). Both of these abnormalities of laboratory findings were less pronounced in adolescent patients.

Our study indicated that younger patients have a better prognosis during treatment. Early studies reported that nearly 40% of the patients have at least one medical chronic disease at admission, and common complications during treatment included ARDS, shock, acute cardiac injury, arrhythmia, kidney injury, and liver dysfunction.\textsuperscript{3,4,6,18} Most of the patients received antiviral therapy and oxygen inhalation while some received glucocorticoid therapy or antifungal treatment. Nearly 20% of the patients were identified as severe cases and received mechanical ventilation and extracorporeal membrane oxygenation. In our study, only one (2.2%) patient was identified as a severe case on admission. After undergoing treatment with antiviral therapy, interferon-\(\alpha\) inhalation, and oxygen inhalation, nearly 80% of the patients recovered and were discharged at the end of follow-up. Three patients developed severe kidney injury during treatment. Although a significant difference was observed in the treatment with oxygen inhalation for adolescent and young adult patients, this was largely due to clinician's personal preference. Therefore, this difference has no clinical significance.

This study provided initial evidence for the epidemiological and clinical characteristics of COVID-19 in adolescents and young adults. Compared with early evidence from middle-aged or elderly patients, the adolescent and young adult patients had a longer incubation period, indicating that a longer period for medical observation or isolation is needed for these patients. The shorter serial interval indicated that transmission could occur rapidly from younger patients to their close contacts. Compared with older patients, younger counterparts had fewer typical signs and symptoms and fewer abnormalities in laboratory findings, and fewer of them developed severe complications during treatment. Our results suggest that adolescents and young adults might be the key subpopulation at a later stage for preventing the worldwide spread of COVID-19.

This study has some limitations. First, we conducted this study based on only 46 patients. The relatively small sample size limited us in obtaining sound evidence concerning differences in most characteristics between subgroups, so the study findings should interpreted with caution. Second, at the end date of this study nearly 20% of the patients were still hospitalized, which limited us in fully illuminating the outcomes of the study patients. Finally, our conclusions should be extended to the general population with caution because the study patients are from a single hospital in Chongqing City.

**Conclusions**

This single-center study with a relatively small sample size suggested that adolescent and young adult COVID-19 patients had a longer incubation period, a shorter serial interval, and a higher probability of being asymptomatic in comparison with older patients reported thus far in the literature. Transmission to family contacts occurred in several asymptomatic cases. Fewer patients developed complications during treatment.
Material and Methods

Study Design and Participants

In this study, we defined the adolescents as 10–24 years of age and young adults as 25–35 years of age according to the World Health Organization’s definition. Chongqing, which is the China’s fourth municipality after Beijing, Shanghai, and Tianjin, is one of the areas adjacent to Hubei Province. Until March 20, 2020, the confirmed cases of COVID-19 have reached 576, which is the highest in four municipalities of China. According to the Chongqing government, the Chongqing Three Gorges Central Hospital, which is one of the major tertiary teaching hospitals of Chongqing University and located in Wanzhou district, Chongqing City, was responsible for treating the patients from ten districts or counties from Chongqing City. Until March 20, 2020, the study hospital treated 248 confirmed cases, which accounted for 43.1% of the patients confirmed in Chongqing. In this study, we retrospectively reviewed the medical records of confirmed COVID-19 cases aged from 10 to 35 years who were hospitalized in the study hospital from January 25, 2020 to February 18, 2020.

Data Collection

Epidemiological data were collected using a standardized questionnaire through face-to-face or telephone interviews with patients or their family members. We firstly collected demographic and social-economic information such as height and weight, educational level, and behavioral characteristics such as smoking, alcohol consumption, and physical activities. We then investigated the exposure date and types for each patient during 1 month before the date of symptom onset. For those who resided in Wuhan, we further collected the histories of exposure to the Huanan Seafood wholesale market or other similar markets. We collected the earliest date of symptom onset and the specific symptoms. For those who were the first of the family to develop symptoms (index patients), we further interviewed their family contacts with exposure histories regarding the index patient, date of symptom onset, date of the first medical visit, and date of confirmation. The clinical information for study patients was abstracted from medical records. We collected several key dates including date of onset of clinical symptoms, date of primary visit to health facilities, and date of confirmation. The typical clinical symptoms and data from the chest CT scan for each patient were collected on admission. The medical histories and treatments such as antiviral therapy, antimicrobial therapy, corticosteroid therapy, and respiratory support were simultaneously recorded. We further collected the data of complications for patients during treatment. Patients were diagnosed with ARDS if they satisfied the Berlin definition, and acute kidney injury was defined according to the Kidney Disease Improving Global Outcomes classification.19,20 The criteria for diagnosis of cardiac injury were based on the serum levels of cardiac biomarkers (>99th percentile upper reference limit) or presentation of new abnormalities in electrocardiography and echocardiography. We defined types of patients according to the examinations on admission. The mild type was defined as respiratory symptoms and positive CT findings of pneumonia. The severe type was defined satisfying one of the following criteria: (1) respiratory distress with respiratory frequency ≥30/min; (2) pulse oximeter oxygen saturation ≤93% at rest; and (3) oxygenation index (artery partial pressure of oxygen/inspired oxygen fraction, PaO2/FiO2) ≤300 mmHg. The clinical outcomes (recovered and discharged, continuing treatment, or death) were consistently observed until February 23, 2020. The epidemiological data were input by Epidata 3.0 (The EpiData Association, Odense, Denmark, 2003) with double-checking. To ensure the accuracy of the clinical data, two researchers also independently reviewed the electronic medical records.

Laboratory Confirmation and Tests

The criteria of diagnosis for COVID-19 cases were based on the national recommendation of the New Coronavirus Pneumonia Prevention and Control Program (sixth edition).21 In brief, the throat or lower respiratory tract swab samples were collected and processed at the Department of Clinical Laboratory in the study hospital. The 2019-nCoV RNA were then extracted from the patients who were suspected of having the 2019-nCoV infection. Finally, the throat swabs were placed into a collection tube with 150 μL of virus preservation solution and total RNA was extracted within 2 h using a respiratory sample RNA isolation kit (Suzhou Tianlong Biotechnology; Roche's COBASZ480). An RT-PCR assay with a cycle threshold value (Ct-value) of less than 37 was defined as positive. Asymptomatic cases were defined as those who presented positive results by conducting the nucleic acid test of COVID-19 and had no elevated measured temperature or self-reported fever, and no gastrointestinal or respiratory symptoms such as cough and sore throat reported by physicians on admission. To confirm the validity, we further conducted a face-to-face or telephone interview with each asymptomatic patient to collect information on symptoms before 2 weeks of admission. For each patient the laboratory tests, which included routine blood tests, serum biochemistry, and coagulation function, were performed on admission.

Statistical Analysis

We described the differences in demographic factors, symptoms at admission, comorbidities, and chest CT findings across age groups. We summarized the distribution of laboratory findings for cases using median and IQR among total cases, those aged 10–24 years, and those aged 25–35 years. We defined the incubation period as the time interval from the date of exposure to the date of symptom onset. We included two types of patients who could recall the exact date of traveling to Wuhan or contacting other confirmed cases. To ensure accuracy, those who reported more than one exposure source (n = 1) or contacting period over 3 days (n = 7) were excluded. For patients who reported exposure time on 1 day, the exposure day was defined as the exposure date.
The first day was defined as the exposure date for those who reported exposure time within 2 days. The middle day was defined as the exposure date for those who reported exposure time within 3 days. We used a parametric survival analysis model with Weibull distribution to estimate the distribution of the incubation period. Since the asymptomatic cases at the first medical visit could develop symptoms during the follow-up, we first treated the incubation period for asymptomatic cases as right-censored data (from the date of exposure to the date of the first medical visit) and performed the estimations. We then excluded the asymptomatic cases and repeated the estimations. We defined family-clustered events as patients who were the first to develop symptoms in their family (index patient) and whose family members (secondary cases) had a clear contact history with the index patient and had no other potential sources of infection. We used the date of symptom onset to measure the date of illness onset. We defined the serial interval as the time interval from the date of illness onset for the index patient to the date of illness onset for the secondary cases. We used a parametric survival analysis model with gamma distribution to estimate the distribution of serial interval. We further calculated the time interval from the date of symptom onset to the date of the first medical visit using a parametric survival model with Weibull distribution. We finally compared the differences of treatments, days of persistent fever during treatment, days of transformation to negative results by COVID-19 nucleic acid tests during treatment, and prognosis outcomes across different age groups. We compared proportions of categorical variables using the chi-square test and used Fisher’s exact test when the minimum expected values for the variables were less than 1. We used independent group t tests to compare means of continuous variables following a normal distribution; otherwise, Mann-Whitney rank tests were used. We performed summaries and significance tests using SAS 9.4, and parametric survival analyses were conducted by R 3.1.1. The statistical significance level was defined as 0.05 with a two-sided test.

**Ethical Approval**

Data collection and analyses of cases were approved by the institutional ethics board of Three Gorges Hospital affiliated with Chongqing University (No.2020-7(18)).

Since the epidemiological interview for the study case is part of a continuing public health outbreak investigation, individual consent was considered exempt.

**Declaration of Interests**

All authors declare no competing interests.

**Supplemental Information**

Supplemental Information can be found online at https://doi.org/10.1016/j.xinn.2020.04.001.

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