



Clinical characteristics of COVID-19 in children compared with adults in Shandong Province, China

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Abstract

Aims and background The COVID-19 outbreak spread in China and is a threat to the world. We reported on the epidemiological, clinical, laboratory, and radiological characteristics of children cases to help health workers better understand and provide timely diagnosis and treatment.

Methods Retrospectively, two research centers' case series of 67 consecutive hospitalized cases including 53 adult and 14 children cases with COVID-19 between 23 Jan 2020 and 15 Feb 2020 from Jinan and Rizhao were enrolled in this study. Epidemiological, clinical, laboratory, and radiological characteristics of children and adults were analyzed and compared.

Results Most cases in children were mild (21.4%) and conventional cases (78.6%), with mild clinical signs and symptoms, and all cases were of family clusters. Fever (35.7%) and dry cough (21.4%) were described as clinical manifestations in children cases. Dry cough and phlegm were not the most common symptoms in children compared with adults ($p=0.03$). In the early stages of the disease, lymphocyte counts did not significantly decline but neutrophils count did in children compared with adults ($p=0.02$). There was a lower level of CRP ($p=0.00$) in children compared with adults. There were 8 (57.1%) asymptomatic cases and 6 (42.9%) symptomatic cases among the 14 children cases. The age of asymptomatic patients was younger than that of symptomatic patients ($p=0.03$). Even among asymptomatic patients, 5 (62.5%) cases had lung injuries including 3 (60%) cases with bilateral involvement, which was not different compared with that of symptomatic cases ($p=0.58$, $p=0.74$).

Conclusions The clinical symptoms of children are mild, there is substantial lung injury even among children, but that there is less clinical disease, perhaps because of a less pronounced inflammatory response, and that the occurrence of this pattern appears to inversely correlate with age.

Keywords Severe acute respiratory syndrome coronavirus-2 · Coronavirus disease 2019 · Children · Clinical characteristics

Abbreviations

SARS-CoV-2 Acute respiratory syndrome coronavirus-2
COVID-19 Coronavirus disease 2019
CT Computed tomographic scans
WBC White blood cell

N Neutrophil
L Lymphocyte
M Monocyte
PLT Blood platelet
CRP C-reactive protein
PCT Procalcitonin
LDH Lactic dehydrogenase
CK Creatine kinase
Myo Myohemoglobin
Ctn Cardiac troponin
BUN Urea nitrogen
Cr Creatinine
PT Prothrombin time
ALT Glutamic-pyruvic transaminase
AST Glutamic oxaloacetic transaminase
IL-6 Interleukin-6
ACE2 Angiotensin-converting enzyme 2

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Introduction

Since the first atypical pneumonia case was reported in Wuhan, China on December 31, 2019 [1], the pathogen was soon identified [2] and tentatively named 2019-nCoV by the World Health Organization (WHO) [3]. On 11 Feb 2020, the World Health Organization officially named it SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2) and the SARS-CoV-2 infection was named as the COVID-19 (Coronavirus Disease 2019) [4]. The infection quickly spread in China, and internationally [5, 6] and is still on-going.

Previous studies reported the main clinical characteristics of COVID-19. Fever, cough, shortness of breath, muscle ache, confusion, and headache were described as clinical manifestations. Laboratory tests and chest computed tomographic (CT) scans were also evaluated and the results suggested that decreased lymphocyte counts and bilateral pneumonia were common clinical features, especially in severe cases [7, 8].

At present, there is no effective anti-virus drug and vaccine for COVID-19, so early detection and isolation treatment are important to control the progression and spread of the disease. However, the current data mainly come from Hubei Province, especially from Wuhan city. Clinical features, especially in children, have not been reported outside Hubei Province.

In this study, we analyzed and compared the epidemic characteristics and clinical features in children and adults in Shandong Province, China. The aims were to help health workers better understanding the clinical features of COVID-19 in children and provide timely diagnosis and treatment.

Methods

Patients

The present study is a retrospective descriptive clinical study. A total of 67 cases including 53 adult and 14 children cases of confirmed COVID-19 from the Jinan infectious diseases hospital and Rizhao people's hospital, which were the designated hospitals in Jinan and Rizhao city, between 23 Jan 2020 and 15 Feb 2020 were enrolled in this study. The project was approved by the ethics board of Jinan infectious hospital (No. 20200203). Informed consent was obtained from each patient or their guardian. All patients enrolled in this study were diagnosed according to the pneumonia diagnosis and treatment plan for the new coronavirus infection formulated by the National Health

Commission (trial version 5) [9]. Diagnostic criteria for asymptomatic cases: individuals infected by SARS-CoV-2 who remain asymptomatic throughout the course of the infection with or without abnormal chest CT imaging findings. Diagnostic criteria for mild cases: mild clinical symptoms, no radiographic findings of pneumonia. Diagnostic criteria for common cases: fever, respiratory symptoms, and radiographic manifestations of pneumonia. Diagnostic criteria for severe cases: (1) respiratory distress, respiratory frequency ≥ 30 times/min; (2) hypoxemia, with resting oxygen saturation $\leq 93\%$; and (3) arterial partial oxygen pressure (PaO_2)/oxygen absorption concentration (FiO_2) ≤ 300 mmHg (1 mmHg = 0.133 kPa). The diagnostic criteria for critical cases: (1) respiratory failure and mechanical ventilation is required; (2) shock; and (3) complicated with other organ failure requiring ICU care. There are four types of infection: (1) imported cases defined as a history of a sojourn in Hubei Province within 14 days of onset of the illness. (2) Family cluster defined as 3 or more than 3 people with confirmed cases in one family. (3) Close contact defined as close contact with cases from Hubei Province. (4) Unclear; the method of infection is unknown. A child is defined as less than 18 years of age.

Data collection

The medical records of patients were analyzed. Information recorded included demographic data, exposure history, symptoms, signs, laboratory findings and chest computed tomographic (CT) scans. Epidemiological, clinical, laboratory, and radiological characteristics data were obtained with data collection forms from electronic medical records. The date of disease onset was defined as the day when the symptom was noticed.

RT-PCR assay for COVID-19

Throat swab specimens were collected from patients with suspected COVID-19. COVID-19 was confirmed by RT-PCR using the same protocol. The dual-target detection kits were provided by the Shanghai Jienuo Company. Results: the cut-off value was 40, a Ct value < 37 was positive, a Ct value > 40 was negative, and 37–40 was a gray area (the diagnosis needs to be repeated).

The biochemical indicators and cytokine measurement

To characterize the effect of SARS-CoV-2 on the biochemical indicators and production of cytokines in the acute phase of the illness, plasma cytokines (PCT, CRP, and IL-6) and biochemical indicators were measured using the Human

Cytokine Standard 27-Plex Assays panel and the Bio-Plex 200 system (Bio-Rad, Hercules, CA, USA) for all patients according to the manufacturer's instructions. The normal range for each indicator is shown in Table 2.

Statistical analysis

Retrieved data were recorded into Microsoft® Excel for Mac (version 16.30) and analyzed. The Statistical Package for Social Sciences version 16.0 (SPSS 16.0; SPSS Inc., Chicago, IL, USA) and the Prism statistical software package (Version 5.0; Graphpad Software Inc. La Jolla, CA, USA) were used. Measurement data were described as mean \pm standard deviation. Background factors were compared using Student's *t*-test (numerical data) or the χ^2 test (categorical data). Differences were regarded as significant if the *p* value was less than 0.05 on either side.

Results and findings

A retrospective analysis was performed on patients in Jinan and Rizhao, Shandong Province from 23 Jan to 15 Feb 2020. There were 53 adult cases among the 67 cases, with a median age of 41.47 years (range 21–65 years), and 26 cases (49.1%) were males. Most of cases were mild (8 cases, 15.1%) and conventional (44 cases, 83%), with only 1 severe case (1.9%). The most common symptoms at onset of the illness were fever (60.4%), dry cough (54.7%), phlegm (37.7%), pharyngalgia (35.8%) and fatigue (32.1%). Less common symptoms were, headache (20.8%), anorexia (15.1%), myalgia (13.2%), chest distress (11.3%), nausea (5.7%), diarrhea (3.8%), dizziness (3.8%), and vomiting (1.9%) (Table 1).

There were 14 children cases among the 67 cases, with a median age of 6.2 years (range 0–16 years), and 6 cases (42.9%) were males. All the cases in children were familial clusters ($p=0.00$), with 3 cases (21.4%) of the mild type and 11 cases (78.6%) of the conventional type and no severe or critical case. Clinical symptoms in children were mild or even absent, only 5 (35.7%) cases showed signs of fever, 3 cases (21.4%) had dry cough, and 1 case had phlegm, other clinical signs of headache, fatigue, pharyngalgia, and myalgia were rare in children. None of the children developed anorexia, chest distress, dyspnea, nausea, vomiting, diarrhea, dizziness, or abdominal pain. However, dry cough and phlegm were not the most common symptoms in children compared with adults ($p=0.03$) (Table 1).

Laboratory tests of children and adults were analyzed. The results showed that the white blood cell counts of children were all normal, with decreased neutrophil counts ($p=0.00$) and increased lymphocyte counts ($p=0.00$) compared with adults (Table 2). Considering the physical characteristics of

the children with lymphocytes making up 60% of the white blood cells before 6 years and the proportions of lymphocytes and neutrophils in white blood cells being close to that of adults after 6 years, we further analyzed the difference in blood cell counts between children over 6 years and adults. There are 5 cases over 6 years (35.7%) among 14 children cases, the neutrophil counts ($1.62 \pm 0.34 \times 10^9/L$) were more decreased in children over 6 years than in adults ($p=0.02$). However, lymphocyte counts ($1.91 \pm 0.93 \times 10^9/L$) showed no difference ($p=0.41$) between the two groups. COVID-19 caused liver function damage, cardiac muscle damage, and coagulation function changes. The abnormal rate of ALT, AST, LDH, CK, Myo, PT, and D-dimer was 17%, 7.5%, 18.9%, 15.1%, 3.8%, 13.2%, and 35.8% in adults and 7.7%, 7.7%, 50%, 28.6%, 0%, 7.1%, and 35.7% in children, respectively (Table 2). The value and positive rate of LDH in children were more significantly increased than in adults ($p=0.01$; $p=0.02$) (Table 2). According to evaluation of infection indicators, the value of PCT showed no difference between children and adults. However, the value and positive rate of CRP were more significantly increased in adults than in children ($p=0.00$, $p=0.02$) (Table 2). Of the 67 cases, 56 cases had complications of lung injuries (83.6%) including 11 children and 45 adults. A total of 6 children (64.5%) and 30 adults (66.7%) had lung injuries with bilateral involvement, with no difference between the two groups ($p=0.45$). However, lung injuries in adults were more severe compared with that in children (Table 2, Fig. 1).

There were 8 (57.1%) asymptomatic cases and 6 (42.9%) symptomatic cases among the 14 children cases, with a median age of 3.98 years, and 5 cases (62.5%) were males in the asymptomatic cases and with a median age of 9.17 years, and 1 case (16.7%) was male in the symptomatic cases. The age of asymptomatic patients was younger than that of symptomatic patients ($p=0.03$) (Table 3). The white blood cell and lymphocyte counts were more decreased in symptomatic children cases than that in asymptomatic children cases ($p=0.04$, $p=0.04$). Although there were statistically significant differences in levels of Cr and AST between asymptomatic and symptomatic children cases, these differences were within the normal range and had no practical clinical significance. Even among asymptomatic patients, 5 (62.5%) cases had lung injuries including 3 (60%) cases with bilateral involvement, with no difference compared with that of symptomatic cases ($p=0.58$, $p=0.74$) (Table 3).

Discussion

The severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) infection outbreak has spread in China and around the world [10, 11]. WHO defined it as a Public Health Emergency of International Concern (PHEIC).

Table 1 Epidemiological characteristics and clinical features of COVID-19 in children and adults

	Total (67)	N (%)		p
		Children (14)	Adults (53)	
Age, median, years	34.10	6.20	41.47	0.00
Gender	M (32) (47.8%) F (35) (52.2%)	M (6) (42.9%) F (8) (57.1%)	M (26) (49.1%) F (27) (50.9%)	0.68
Clinical type	67	14	53	0.50
Mild	11 (16.4%)	3 (21.4%)	8 (15.1%)	
Conventional	55 (82.1%)	11 (78.6%)	44 (83%)	
Severe	1 (1.5%)	0 (0%)	1 (1.9%)	
Critical	0 (0%)	0 (0%)	0 (0%)	
Infection method:	67	14	53	0.00
Imported	13 (19.4%)	0 (0%)	13 (24.5%)	
Family cluster	27 (40.3%)	14 (100%)	13 (24.5%)	
Close contact	22 (32.8%)	0 (0%)	22 (41.5%)	
Unclear	5 (7.5%)	0 (0%)	5 (9.4%)	
Time, day	7.11 ± 5.45	6.18 ± 6.41	7.36 ± 5.21	0.48
Signs and symptoms:				
Fever	37 (55.2%)	5 (35.7%)	32 (60.4%)	0.10
Fever (≥ 38.5 °C)	6 (16.2%)	1 (20%)	5 (15.6%)	0.81
Fever (< 38.5 °C)	31 (83.8%)	4 (80%)	27 (84.4%)	
Dry cough	32 (47.8%)	3 (21.4%)	29 (54.7%)	0.03
Phlegm	21 (31.3%)	1 (7.1%)	20 (37.7%)	0.03
Headache	12 (17.9%)	1 (7.1%)	11 (20.8%)	0.24
Fatigue	18 (26.9%)	1 (7.1%)	17 (32.1%)	0.06
Anorexia	8 (11.9%)	0 (0%)	8 (15.1%)	0.12
Chest distress	6 (9%)	0 (0%)	6 (11.3%)	0.19
Dyspnea	3 (4.5%)	0 (0%)	3 (5.7%)	0.36
Pharyngalgia	20 (29.9%)	1 (7.1%)	19 (35.8%)	0.04
Myalgia	8 (11.9%)	1 (7.1%)	7 (13.2%)	0.53
Nausea	3 (4.5%)	00 (0%)	3 (5.7%)	0.36
Vomiting	1 (1.5%)	00 (0%)	1 (1.9%)	0.61
Diarrhea	2 (3%)	00 (0%)	2 (3.8%)	0.46
Dizziness	1 (1.5%)	00 (0%)	1 (1.9%)	0.61
Abdominal pain	0 (0%)	00 (0%)	0 (0%)	
Heart rate	87.80 ± 12.67	93.00 ± 9.99	86.62 ± 13.00	0.12
Respiratory rate	20.22 ± 2.70	21.67 ± 1.61	19.89 ± 2.79	0.01

Time from onset to diagnosis

Coronaviridae (CoVs) are the largest known single stranded RNA viruses [12]. They have been categorized in three groups, alpha-CoVs, beta-CoVs, and gamma-CoVs according to phylogenetic analyses and antigenic criteria [11]. The human severe acute respiratory syndrome (SARS) virus, the Middle Eastern respiratory syndrome (MERS) virus, and the SARS-CoV-2 all belong to beta-CoVs [13]. The bat coronavirus (BCoV) and the SARS-CoV-2 share 96.2% sequence identity. Bats were once thought to be the source of SARS-CoV-2. However, sufficient evidence is lacking.

A total of 67 cases including 53 adult and 14 children cases, of which only 1 case was the severe type and no one was in critical condition, is far lower than reported in

Wuhan [14, 15]. There were no deaths reported because of few cases of the severe or critical type. The reason for this is considered as follows: (1) There is no major epidemic in the regions except Hubei Province for strong prevention and control and (2) the virulence and pathogenicity of the virus decrease in the 2nd and 3rd generation of transmission [16]. All cases of children belong to the mild or conventional type of COVID-19, and all children are part of family clusters. Previous studies found no cases in children, who were once thought to be less susceptible [17]. According to the current trend, all people including children are susceptible to SARS-CoV-2, and person-to-person transmission develops familial clusters [18]. The reason why all children are in family

Table 2 Comparison of lab tests and CT scan of COVID-19 in children and adults

	Normal range	Median (IQR)			<i>p</i>
		Total (<i>N</i> =67)	Children (<i>n</i> =14)	Adults (<i>n</i> =53)	
WBC ($\times 10^9/L$)	4–10	5.33 \pm 1.84	5.93 \pm 2.52	5.17 \pm 1.60	0.30
Decreased			4 (28.6%)	10 (18.9%)	0.61
N ($\times 10^9/L$)	2–7	2.88 \pm 1.45	1.76 \pm 0.53	3.18 \pm 1.45	0.00
Decreased			9 (0%)	6 (11.3%)	0.00
L ($\times 10^9/L$)	0.8–4	2.02 \pm 1.36	3.68 \pm 2.04	1.57 \pm 0.59	0.00
Decreased			1 (7.1%)	5 (9.4%)	0.79
M ($\times 10^9/L$)	0.12–0.8	0.36 \pm 0.15	0.36 \pm 0.11	0.36 \pm 0.16	0.95
Increased			0 (0%)	(0%)	
HBG (g/L)	110–150	137.3 \pm 20.02	131.64 \pm 12.92	138.83 \pm 21.38	0.12
Increased			1 (7.1%)	2(2.8%)	0.08
PLT ($\times 10^9/L$)	100–300	213.4 \pm 64.62	243.79 \pm 76.16	205.29 \pm 59.36	0.047
Increased			2 (14.3%)	2 (2.8%)	0.14
CRP (mg/L)	0.068–8.2	9.05 \pm 15.81	1.26 \pm 2.82	11.19 \pm 17.21	0.00
Increased			1 (7.1%)	18 (34%)	0.048
PCT ($\mu g/L$)	0–0.05	0.05 \pm 0.05	0.05 \pm 0.02	0.05 \pm 0.06	0.83
Increased			5 (35.7%)	13 (24.5%)	0.40
LDH (U/L)	109–245	222.6 \pm 71.68	298.63 \pm 92.95	205.57 \pm 53.80	0.01
Increased			7 (50%)	10 (18.9%)	0.02
CK (U/L)	26–140	94.38 \pm 57.11	107.54 \pm 44.70	91.08 \pm 59.73	0.36
Increased			4 (28.6%)	8 (15.1%)	0.24
Myo ($\mu g/L$)	10–46	18.84 \pm 11.61	15.33 \pm 7.92	19.50 \pm 12.13	0.33
Increased			0 (0%)	2 (3.8%)	0.46
Ctn ($\mu g/L$)	0–0.01	0.01 \pm 0.00	0.01 \pm 0.00	0.01 \pm 0.00	0.68
Increased			0 (0%)	0 (0%)	
BUN (mmol/L)	2.9–8.2	4.07 \pm 1.21	4.23 \pm 1.12	4.03 \pm 1.24	0.58
Increased			0 (0%)	1 (1.9%)	0.61
Cr ($\mu mol/L$)	50.4–98.1	59.80 \pm 14.29	43.08 \pm 11.20	64.30 \pm 11.44	0.00
Increased			0 (0%)	0 (0%)	
PT (s)	8.8–13.8	12.61 \pm 0.99	12.53 \pm 0.89	12.63 \pm 1.01	0.75
Increased			1 (7.1%)	7 (13.2%)	0.53
D-dimer ($\mu g/ml$)	0–0.5	0.49 \pm 0.37	0.47 \pm 0.26	0.50 \pm 0.40	0.82
Increased			5 (35.7%)	19 (35.8%)	0.99
ALT (U/L)	– 0–40	28.42 \pm 28.31	21.29 \pm 29.18	30.35 \pm 28.05	0.29
Increased			1 (7.1%)	9 (17%)	0.36
AST (U/L)	0–40	25.47 \pm 12.77	29.00 \pm 8.84	24.52 \pm 13.54	0.25
Increased			1 (7.1%)	7 (13.2%)	0.96
IL-6 (pg/ml)	0–7	7.94 \pm 12.98	2.50 \pm 2.83	9.16 \pm 14.04	0.01
Increased			1 (7.1%)	4 (7.5%)	0.24
Lung injury		56	11 (78.6%)	45 (84.9%)	0.57
CT (bilateral)		36	6 (54.5%)	30 (66.7%)	0.45
CT (unilateral)		20	5 (45.5%)	15 (33.3%)	

clusters is that it is the traditional Chinese New Year holiday, children have less chance to have contact with the outside world, and Chinese families always attach great importance to the protection of children.

A retrospective analysis on clinical features of children of COVID-19 compared with that of adults from two research centers was made. The findings showed that clinical

symptoms were mild in children with fever and dry cough being the most common symptoms, and other symptoms were rare. However, dry cough and phlegm are not the most common symptoms in children compared with adults. This is because a lower inflammatory response to lung injuries causes milder clinical symptoms in children compared with adults.

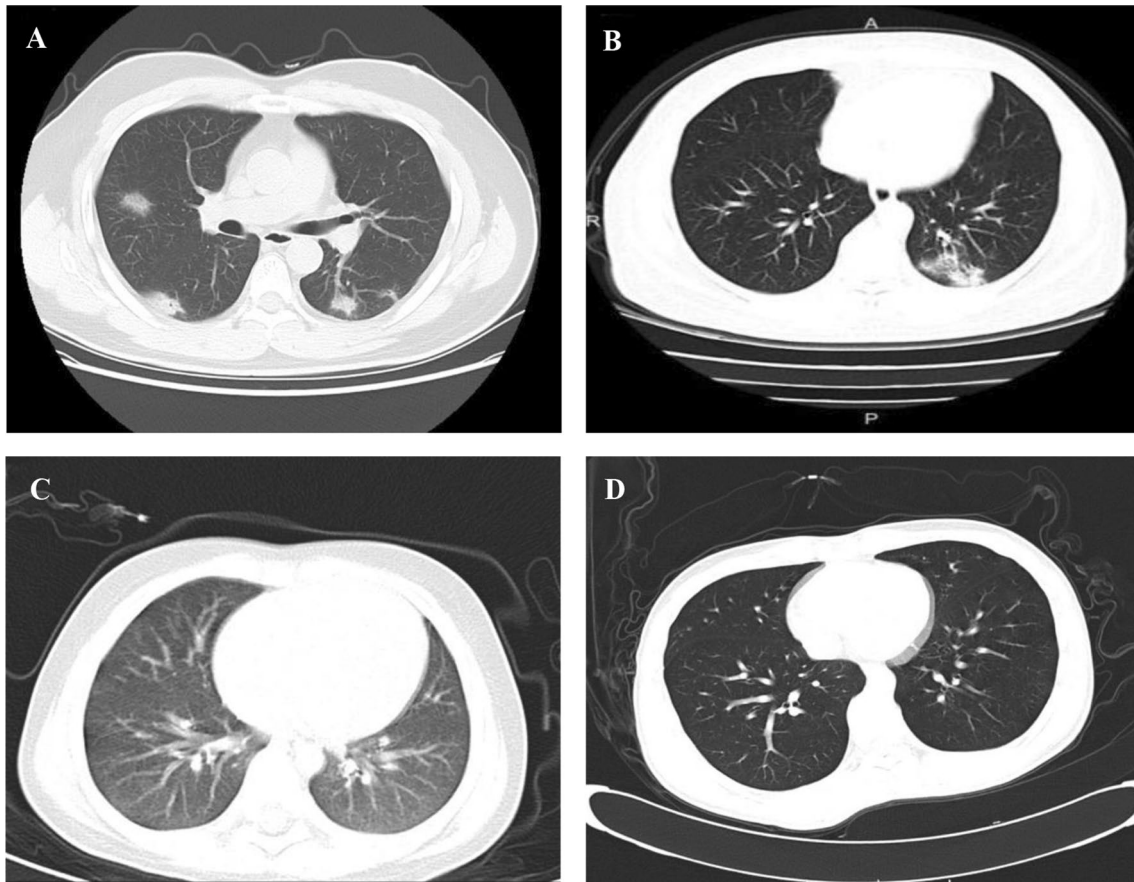


Fig. 1 **a** Transverse chest CT images from a 42-year-old man showing bilateral multiple lobular and subsegmental areas in the lung on day 7 after symptom onset. **b** Transverse chest CT images from a 35-year-old woman showing unilateral lobular and subsegmental areas in the lung on day 5 after symptom onset. **c** Transverse chest

CT images from a 5-year-old male child showing mild bilateral bronchiolitis in the lung on day 5 after symptom onset. **d** Transverse chest CT images from a 16-year-old male child showing no obvious lesion in the lung on day 8 after symptom onset

Previous reports indicated that decreased lymphocytes counts were common clinical features, especially in severe cases [7, 8]. As a result of viral infection, white blood cell and lymphocyte counts can be reduced by consumption. However, similar results did not appear in our study, with only a total of 6 cases including 1 case of a child with decreased lymphocytes counts, and the value of lymphocytes counts showed no significant differences in children over 6 years compared with adults. On the other hand, neutrophil counts decreased in children compared with adults ($p=0.02$). So, lymphocyte decline is not an important indicator for the diagnosis of childhood cases and the neutrophil count decline should be focused on. These may be due to a lower inflammatory response in children. SARS-CoV-2 infection may induced lung injuries, liver function damage, cardiac muscle damage, kidney damage, and coagulation function changes [7, 8]. Among these laboratory tests, elevated LDH is more common in children than in adults ($p=0.02$). An elevated LDH is commonly seen in

cardiopulmonary disease and inflammation. The elevated LDH suggests that the SARS-CoV-2 infection appears to be more likely to cause cardiopulmonary injury and inflammation in children, although lung inflammation in children is less severe than in adults. Of course, since the level of LDH is not high in children, it may not have practical clinical significance. Both CRP and IL-6 are major indicators of inflammation. An elevated level of CRP and IL-6 was shown in adults, but not in children, which suggests that inflammation caused by viral infection, especially in the lungs, is less severe in children than in adults. In addition, lung injuries are not uncommon in children and are characterized by bilateral involvement, which is similar to that of adults. However, lung injuries in adults were more severe compared with children (Fig. 1). Of the 14 children cases, 8 cases were asymptomatic cases. The age of asymptomatic patients was younger than that of symptomatic patients. The white blood cell and lymphocyte counts were more decreased in symptomatic children cases than that in asymptomatic children

Table 3 Lab tests and CT scan of COVID-19 in asymptomatic children cases and symptomatic children cases

	Normal range	Median (IQR)			<i>p</i>
		Total (<i>N</i> = 14)	Asymptomatic <i>N</i> = 8 (57.1%)	Symptomatic <i>N</i> = 6 (42.9%)	
Age, median, years		6.20	3.98	9.17	0.03
Gender		M (6,42.9%) F (8,57.1%)	M (5,62.5%) F (3,37.5%)	M (1,16.7%) F (5,83.3%)	0.09
Clinical type		14	8	6	0.09
Mild		3 (21.4%)	3 (37.5%)	0	
Conventional		11 (78.6%)	5 (62.5%)	6 (100%)	
Time, day		6.18 ± 6.41	5.43 ± 6.33	7.17 ± 9.97	0.64
WBC (× 10 ⁹ /L)	4–10	5.94 ± 2.52	7.11 ± 2.38	4.38 ± 1.85	0.04
N (× 10 ⁹ /L)	2–7	1.76 ± 0.53	1.93 ± 0.60	1.53 ± 0.35	0.17
L (× 10 ⁹ /L)	0.8–4	3.68 ± 2.04	4.64 ± 1.77	2.40 ± 0.1.73	0.04
M (× 10 ⁹ /L)	0.12–0.8	0.36 ± 0.11	0.36 ± 0.09	0.36 ± 0.14	0.96
HBG (g/L)	110–150	131.64 ± 12.92	131.63 ± 9.26	131.67 ± 17.72	1.00
PLT (× 10 ⁹ /L)	100–300	243.79 ± 76.16	260.88 ± 93.38	221.00 ± 42.20	0.35
CRP (mg/L)	0.068–8.2	1.26 ± 2.82	0.65 ± 0.72	2.08 ± 4.31	0.46
PCT (μg/L)	0–0.05	0.05 ± 0.02	0.05 ± 0.02	0.05 ± 0.02	0.69
LDH (U/L)	109–245	298.64 ± 81.53	333.03 ± 92.32	252.77 ± 30.53	0.07
CK (U/L)	26–140	107.54 ± 42.95	116.85 ± 51.82	95.12 ± 26.70	0.37
Myo (μg/L)	10–46	15.33 ± 6.21	16.21 ± 7.15	14.17 ± 5.10	0.56
Ctn (μg/L)	0–0.01	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	
BUN (mmol/L)	2.9–8.2	4.23 ± 1.12	4.47 ± 1.30	3.92 ± 0.82	0.39
Cr (μmol/L)	50.4–98.1	43.08 ± 11.19	36.99 ± 7.04	51.20 ± 10.86	0.01
PT (s)	8.8–13.8	12.53 ± 0.78	12.63 ± 0.56	12.39 ± 1.06	0.58
D-dimer (μg/ml)	0–0.5	0.47 ± 0.23	0.49 ± 0.21	0.45 ± 0.27	0.74
ALT (U/L)	– 0–40	21.29 ± 29.18	28.13 ± 38.08	12.17 ± 3.06	0.33
AST (U/L)	0–40	29.00 ± 8.84	33.38 ± 7.17	23.17 ± 7.73	0.03
IL-6 (pg/ml)	0–7	2.50 ± 2.08	2.00 ± 0.53	3.17 ± 3.14	0.32
Lung injury		11 (78.6%)	5 (62.5%)	6 (100%)	0.58
CT (bilateral)		6 (54.5%)	3 (60%)	3 (50%)	0.74
CT (unilateral)		5 (45.5%)	2 (40%)	3 (50%)	

Time from onset to diagnosis

cases, which was due to a lower inflammatory response in asymptomatic children cases. Even among asymptomatic patients, 62.5% of cases had lung injuries. Therefore, lung injuries caused by SARS-CoV-2 is still relatively obvious. The CT findings may further provide the reason why elevated levels of CRP were shown in adults, but not in children and elevated levels of LDH are common in children. The spike-protein (S) of SARS-CoV that mediates entrance to human respiratory epithelial cells by interacting with cell surface receptor angiotensin-converting enzyme 2 (ACE2) is the most important means of pathogenesis [19, 20]. The number of ACE2 receptors are significantly lower in children than in adults and more in the lungs than in other organs [20], which may be the primary reason why children have fewer clinical symptoms and organ dysfunction than adults and lung injuries even among asymptomatic children cases. In addition, the weak immune response triggered by viral

infection because of children's weakened immune function maybe responsible for this state.

In summary, most cases in children were mild and conventional cases, with mild clinical signs and symptoms, our data suggest that there is substantial lung injuries even among children, but that there is less clinical disease, perhaps because of a lower pronounced inflammatory response, and that the occurrence of this pattern appears to inversely correlate with age.

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Compliance with ethical standards

Conflicts of interest The authors have no conflicts of interest to disclose.

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