

## Characteristics of pneumonia in children with suspected/confirmed COVID-19

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### Abstract

**Background** The most common COVID-19 infection clinical features in pediatric patients are similar to those of other pulmonary diseases, i.e., fever, cough, and shortness of breath. Information about the characteristics of coinfection and superinfection in COVID-19 cases can reduce misdiagnosis and differentiate COVID-19 from other pulmonary infections.

**Objective** To observe the characteristics of pneumonia in children with suspected/confirmed COVID-19.

**Methods** This descriptive study used medical record data of children hospitalized from 1 January 2020 - 31 January 2021 to describe the characteristics of pneumonia in suspected and confirmed COVID-19 cases in Haji Adam Malik Hospital, Medan, North Sumatera. Pneumonia-related findings, such as clinical symptoms, chest X-ray, and blood test results, were collected.

**Results** There were 27 confirmed and 34 suspected COVID-19 children. Most of them were aged 6-8 years. Pneumonia was significantly associated with COVID-19. In confirmed COVID-19 cases, fever persisted after 3 days, with cough and shortness of breath. Patients did not have flu symptoms, but had below normal SpO<sub>2</sub> (81-90%). The occurrence of lung rhonchi was significant in confirmed COVID-19 group. Chest X-ray results showed lung opacity in all confirmed COVID-19 patients. Mean white blood cell (WBC) count was significantly lower in COVID-19 confirmed (3.49x10<sup>3</sup>/μL) vs. suspected group (17.9 x10<sup>3</sup>/μL) (P=0.011). Mean CRP was significantly higher in COVID-19 confirmed (26.5 mg/L) vs. suspected group (4 mg/L).

**Conclusion** Pneumonia with confirmed COVID-19 cases present with longer fever and lower SpO<sub>2</sub>. Patients are presented with lung ronchi, had lower WBCcount, and higher CRP. Chest X-ray shows opacity and consolidation. [Paediatr Indones. 2023;63:57-64; DOI: <https://doi.org/10.14238/pi63.2.2023.57-64> ].

**Keywords:** : COVID-19; pediatric pneumonia; characteristics of pneumonia

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the novel coronavirus first detected at the end of 2019 in Wuhan (Hubei Province), China.<sup>1-3</sup> In reports released from countries severely impacted in the early course of the pandemic in 2020, children below 18 years (median age 11-year-old) contributed to 1.8% of total infections (216,305 cases), with the main route of transmission was through household contact (82%). Around ten percent of the cases were asymptomatic, while the most common symptom reported was fever (44-50%).<sup>4-6</sup>

A literature review reported the characteristics of respiratory clinical symptoms in COVID-19 from 5 earlier studies in Wuhan, China. Common symptoms of pulmonary infection in COVID-19 cases were constitutional symptoms, such as fever (77-94%), myalgia (12-15%), and headache (6-34%). Upper respiratory tract infection symptoms were rhinorrhea (4.8-24%) and sore throat (13.9%), whereas lower respiratory tract infection symptoms were dyspnea

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(18.7-64%), shortness of breath (24%), cough (67.8-81%), sputum (23-56%), and hemoptysis (0.9-3%).<sup>7</sup>

The most common clinical symptoms reported in pediatric patients with confirmed COVID-19 were fever, cough, and shortness of breath.<sup>2,7,8</sup> However, these symptoms are also the most common in other pulmonary diseases. Cough usually occurs in patients with upper and lower respiratory tract infections.<sup>8</sup> COVID-19 infection symptoms are similar to symptoms of flu and other common cold viruses. Therefore, when screening for suspected COVID-19 infection, other criteria that meet the additional risk factors may be added, including travel history to pandemic areas or exposure to individuals with COVID-19 infections. Nasopharyngeal swab can help to detect the presence of the virus in the respiratory tract. Multiplex nucleic acid PCR testing in suspected COVID-19 cases revealed other infectious agents, including influenza A (2.8%), influenza B (4.4%), adenovirus (2.8%), *Chlamydia pneumoniae* (2.8%), and *Mycoplasma pneumoniae* (10.3%).<sup>9</sup> Pneumonia is the most common respiratory disease in children, with symptoms similar to COVID-19 infection symptoms.<sup>10</sup> In a study of 416 children (<10 years of age) with COVID-19 infection in China, 70.4% of the patients showed chest imaging of pneumonia viral infections.<sup>11</sup>

COVID-19 patients often suffer from complications of bacterial infections.<sup>12</sup> Children with suspected COVID-19 should undergo comprehensive clinical examinations, including epidemiological history, clinical characteristics, hematologic examinations, and imaging to reduce the risk of misdiagnosis and differentiate COVID-19 infection from other respiratory infections and coinfections.<sup>13</sup> However, information about coinfections and superinfections of lung patients with COVID-19 is still limited. As such, we aimed to assess the characteristics of pneumonia in children with suspected or confirmed COVID-19.

## Methods

This descriptive study was done with medical record data from children with suspected or confirmed COVID-19 admitted in Haji Adam Malik Hospital, Medan, North Sumatera, from January 1, 2020 to January 31, 2021.

Subjects were pneumonia patients with clinically suspected COVID-19 or confirmed COVID-19 infection based on RT-PCR results. Sample size was estimated based on a formula for a cross-sectional study; the population proportion formula, to be a minimum of 57 subjects. Subjects were selected by consecutive sampling. Exclusion criteria were patients with suspected or confirmed COVID-19 who had underlying conditions other than lung diseases, patients who conducted self-quarantine, and patients with suspected or confirmed COVID-19 who only underwent an antigen test for SARS-CoV-2.

The variables analyzed were age, gender, physical examination results (pulse and respiratory rate, chest retraction, rhonchi, wheezing, and body temperature), chest X-ray, and blood test results, such as arterial blood gas analysis, CRP, procalcitonin (PCT), white blood cell count, neutrophils, and lymphocytes. Complaints presented in patients, such as fever (body temperature above 38°C), cough (wet or dry cough), flu symptoms (sniffles or allergy), and shortness of breath (abnormal breath frequency unrelated to the weather or physical activities), were recorded based on the duration when the condition occurred.

Data were processed and analyzed by *Statistical Package for the Social Sciences (SPSS) version 22* software. Univariate analysis (descriptive analysis) was used to describe the characteristics of all study variables to get distribution frequencies. Categorical variables were presented as frequency (n) and percentage (%), while numeric variables were presented as mean and standard deviation (SD) for normally distributed data, otherwise, median values were presented. This study was approved by Health Research Ethics Committee, Medical Faculty of Universitas Sumatera Utara.

## Results

There was a total of 61 patients reviewed in this study, where 27 (44.3%) was confirmed and 34 (55.7%) was suspected COVID-19 cases with pneumonia. **Table 1** shows the basic demographics of subjects. Of 26 male patients, 11/26 were confirmed with COVID-19 infection, while of 35 female subjects, 16/35 were confirmed with COVID-19. Over half subjects, such as 19/37, with confirmed COVID-19 were in the school age group (6-18 years), while only

a small proportion of neonates and pre-schoolers were COVID-19 positive, such as 2/10 were infants between 1 month and 1 year old, 4/10 were between 1 and 3-year-old, and 2/4 were between 3 and 6-year-old.

Among 17 patients with severe degree of pneumonia, 12/17 had confirmed COVID-19, whereas among 35 patients with mild degree of pneumonia, 23/35 subjects were suspected with COVID-19. Chi-square test revealed that a severe degree of pneumonia was significantly associated with COVID-19 infection ( $P=0.036$ ). In both confirmed and suspected COVID-19 groups, most subjects, 37/61 (60.7%), had good nutritional status. Nutritional status had no significant relationship with COVID-19 infection ( $P=0.216$ ).

Among the 27 confirmed COVID-19 patients, 2 (2/27) died. Of the 34 patients with suspected COVID-19, 10/34 died. Disease outcome, such as the

proportion of death, was significantly associated with COVID-19 infections in patients with pneumonia ( $P=0.032$ ). Respiratory support was needed by 23/27 of patients with confirmed COVID-19 and 23/34 of patients with suspected COVID-19 ( $P=0.114$ ). There were 18 subjects who had prior contacts with COVID-19-infected individuals, where 15/18 subjects were noted in confirmed COVID-19 cases, and only 3/18 subjects in suspected COVID-19 group. There was a correlation between having a contact history and COVID-19 diagnosis ( $P<0.001$ ) (Table 1).

Table 2 shows the characteristics of patients' subjective complaints. There was a significant difference between days of fever in the two groups ( $P<0.001$ ), where the confirmed COVID-19 group had significantly more subjects with persistent fever after 7 days than the suspected COVID-19 group. In both groups, over half of subjects had a cough for  $\leq 3$  days and no significant difference was found ( $P=0.95$ ).

**Table 1.** Subjects' characteristics

Demographic characteristics	Confirmed COVID-19 (n=27)	Suspected COVID-19 (n=34)	P value
Gender, n			
Male	11	15	0.791 <sup>a</sup>
Female	16	19	
Age, n			
Infant (1 month - 1 year)	2	8	0.360 <sup>b</sup>
Early childhood (1-3 years)	4	6	
Pre-school (3-6 years)	2	2	
School age (6-18 years)	19	18	
Mean (SD), months	115.19 (71.13)	81.09 (69.33)	
Median (range), months	116.01 (2 - 215)	86.5 (1 - 196)	
Degree of pneumonia, n			
Mild	12	23	0.036 <sup>a</sup>
Severe	12	5	
ARDS/critical	3	6	
Nutritional status, n			
Malnutrition	2	7	0.216 <sup>b</sup>
Poor nutrition	4	4	
Good nutrition	18	19	
Overweight	1	4	
Obese	2	0	
Disease outcomes, n			
Died	2	10	0.032 <sup>a</sup>
Recovered	25	24	
Respiratory support, n			
Yes	23	23	0.114 <sup>a</sup>
No	4	11	
COVID-19 contact history, n			
Yes	15	3	<0.001 <sup>a</sup>
No	12	31	

<sup>a</sup>Chi-square, <sup>b</sup>Kruskal Wallis

On the other hand, flu symptoms were not a major complaint in either group, as 23/27 and 33/34 of the confirmed and suspected groups, respectively, did not have flu. Shortness of breath was experienced by the subjects in both groups but was found more in confirmed cases ( $P=0.019$ ).

**Table 3** shows the results of subjects' physical examinations. The majority of both confirmed and suspected COVID-19 groups had  $> 38.5^{\circ}\text{C}$  body temperature, but was more found in COVID-19 cases ( $P=0.029$ ). Heart and respiratory rates were not significantly different between groups ( $P=0.100$  and  $P=0.789$ , respectively). Lower oxygen saturation ( $\text{SpO}_2$ ) was significantly correlated to COVID-19 infection ( $P=0.03$ ). Chest retraction was not significantly different in between groups ( $P=0.381$ ). However, lung rhonchi was significantly found higher in the suspected group ( $P=0.017$ ).

**Table 4** shows the chest X-ray results according to age groups. All subjects had infiltrates, appearance on chest X-ray. In the COVID-19 confirmed group, consolidation and opacity were mostly observed in the school age group (6-18 years). There were significantly more school aged subjects with consolidation in the confirmed COVID-19 group than in the suspected COVID-19 group [15/27 vs. 6/34, respectively ( $P=0.005$ )]. In addition, there were significantly more school aged subjects with opacity in the confirmed COVID-19 group than in the suspected COVID-19

group [16/27 vs. 0/34, respectively ( $P<0.001$ )].

**Table 5** shows the blood test analysis results of all subjects. Mean WBC count was significantly lower in the confirmed group ( $3.49 \times 10^3/\mu\text{L}$ ) than in the suspected group ( $17.9 \times 10^3/\mu\text{L}$ ) ( $P=0.011$ ). In addition, mean CRP was significantly higher in the COVID-19 confirmed group (26.5 mg/L) than in the suspected group (4 mg/L) ( $P=0.019$ ). There was no significant relationship with regards to blood gas analysis between the two groups ( $P=0.125$ ). Similarly, there were no significant differences in hemoglobin, platelets count, neutrophil, lymphocyte, fibrinogen, or D-dimer results between the two groups ( $P>0.05$  for all).

## Discussion

From January 2020 to January 2021 in Haji Adam Malik Hospital, Medan, North Sumatra, 27/61 (44%) of pneumonia patients had confirmed COVID-19 infection. While children can become the carriers of SARS-CoV-2 virus, those with clinical symptoms of severe COVID-19, especially those suffering from pneumonia, should be treated in hospitals like adults. Those with mild symptoms require self-quarantine.<sup>11</sup> Pneumonia in children is often untreated or ignored, resulting in high morbidity and mortality rates. In most children, viral pneumonia tends to clear up

**Table 2.** Analysis of subjective complaints

Subjective complaint	Confirmed COVID-19 (n=27)	Suspected COVID-19 (n=34)	P value
Days of fever, n			
$\leq 3$ days	0	8	$<0.001^a$
4-6 days	5	18	
$\geq 7$ days	2	8	
Days of cough, n			
$\leq 3$ days	18	18	0.095 <sup>b</sup>
4-6 days	8	8	
$\geq 7$ days	1	8	
Flu, n			
Yes, $\leq 3$ days	4	1	0.161 <sup>c</sup>
No	23	33	
Shortness of breath, n			
No	7	5	0.019 <sup>a</sup>
$\leq 3$ days	20	22	
4-6 days	0	7	

<sup>a</sup>Kruskal Wallis, <sup>b</sup>Chi-square, <sup>c</sup>Fisher's exact

**Table 3.** Analysis of physical examination characteristics

Clinical physical examination	Confirmed COVID-19 (n=27)	Suspected COVID-19 (n=34)	P value
Body temperature, n			
37.5-38.5°C	2	12	0.029 <sup>a</sup>
38.6-39.4°C	11	14	
39.5-40.5°C	10	7	
>40.5°C	4	1	
Heart rate, n			
81-120 bpm	22	19	0.100 <sup>a</sup>
121-149 bpm	3	7	
≥150 bpm	2	8	
Respiratory rate, n			0.789 <sup>a</sup>
19-30 x/minute	9	12	
31-39 x/minute	3	4	
40-60 x/minute	13	13	
≥60 x/minute	2	5	
O <sub>2</sub> saturation (SpO <sub>2</sub> ), n			
71-80%	1	6	0.003 <sup>a</sup>
81-90%	15	4	
91-94%	3	6	
≥95%	8	18	
Retraction,			
Yes	6	11	0.381 <sup>b</sup>
No	21	23	
Ronchi, n			
Yes	10	23	0.017 <sup>b</sup>
No	17	11	

<sup>a</sup>Kruskal Wallis, <sup>b</sup>Chi-square**Table 4.** Analysis of chest x-ray results by age group

Chest X-ray	Confirmed COVID-19 (n=27)	Suspected COVID-19 (n=34)	P value
Infiltrates, n			
Infant (1 month - 1 year)	2	8	-
Early childhood (1-3 years)	4	6	-
Pre-school (3-6 years)	2	2	-
School age (6-18 years)	19	18	-
Consolidation, n			
Infant (1 month - 1 year)	1	3	1.000 <sup>a</sup>
Early childhood (1-3 years)	3	3	0.571 <sup>a</sup>
Pre-school (3-6 years)	2	2	-
School age (6-18 years)	15	6	0.005 <sup>b</sup>
Opacity, n			
Infant (1 month - 1 year)	1	0	0.200 <sup>a</sup>
Early childhood (1-3 years)	1	0	0.400 <sup>a</sup>
Pre-school (3-6 years)	2	0	0.333 <sup>a</sup>
School age (6-18 years)	16	0	<0.001 <sup>b</sup>

<sup>a</sup>Fisher's exact, <sup>b</sup>Chi-square

**Table 5.** Blood test result analysis

Blood tests	Confirmed COVID-19 (n=27)	Suspected COVID-19 (n=34)	P value
Arterial blood gas, n			
Metabolic acidosis	10	21	0.125 <sup>a</sup>
Metabolic alkalosis	17	13	
Respiratory rate, n			
Normal	7	7	
Hemoglobin			
Mean (SD), g/dL	9.16 (2.11)	11.39 (1.41)	0.283 <sup>b</sup>
Median (range), g/dL	9.2 (3.9-13.6)	11.5 (7.8-14.1)	
Thrombocyte			
Mean (SD), x10 <sup>3</sup> /μL	143.7 (782.73)	317.69 (186.79)	0.928 <sup>c</sup>
Median (range), x10 <sup>3</sup> /μL	138 (8-385)	326.5 (24-686)	
Leukocyte			
Mean (SD), x10 <sup>3</sup> /μL	3.49 (3.81)	17.9 (18.94)	0.011 <sup>c</sup>
Median (range), x10 <sup>3</sup> /μL	2.8 (2-183)	12 (2-69.81)	
Neutrophil			
Mean (SD), %	69.81 (17.61)	61.68 (18.91)	0.964 <sup>c</sup>
Median (range), %	75.2 (18.9-93.9)	64.8 (22.3-90.4)	
Lymphocyte			
Mean (SD), %	22.02 (15.33)	28.87 (17.61)	0.502 <sup>c</sup>
Median (range), %	18 (2.6-68.6)	26.7 (3-67.8)	
CRP			
Mean (SD), mg/L	26.5 (36.15)	4.0 (5.84)	0.019 <sup>c</sup>
Median (range), mg/L	14.5 (0.7-158.2)	1.1 (0.7-25.6)	
Fibrinogen			
Mean (SD), mg/dL	251.52 (96.23)	98.21 (61.04)	0.086 <sup>c</sup>
Median (range), mg/L	237 (129-610)	79 (30-275)	
D-dimer			
Mean (SD), μg/mL	1427.48 (857.89)	475.85 (282.47)	0.114 <sup>c</sup>
Median (range), μg/mL	1120 (550-4000)	401 (130-1410)	

<sup>a</sup>Chi-square, <sup>b</sup>T-independent, <sup>c</sup>Mann-Whitney

without any treatment and rarely with any long-term sequelae.<sup>14</sup>

How children contribute to SARS-CoV-2 community transmission is still difficult to be determined, especially with the high asymptomatic infection rate in the younger age group.<sup>5</sup> COVID-19 clinical characteristics in children usually appear as mild (37%) or moderate (45%) respiratory infection, such as common respiratory problems, like common cold, pharyngitis, or allergies.<sup>15</sup> COVID-19 symptoms, such as fever, cough, and shortness of breath, were common in our subjects. Among 27 pediatric patients with confirmed COVID-19, 22 (81.5%) subjects experienced fever that persisted after 7 days, while 5 (18.5%) experienced fever shorter than 7 days. In contrast to the suspected group, 22/34 of patients had fever, which mostly persisted for 4-6 days in

18/34 subjects. All of the patients in confirmed COVID-19 group had cough, where 18/27 patients suffered from cough for up to 3 days. Moreover, only 4/27 of the confirmed group had flu symptoms. But, 20/27 patients experienced shortness of breath with low oxygen saturation rate. Cough duration was not significantly different between groups (P=0.95). Patients with confirmed COVID-19 had much lower O<sub>2</sub> saturation than those in suspected COVID-19 group. A previous study reported that 80% of pediatric COVID-19 patients had a mean body temperature of >37.3°C, while 60% had cough, 40% had pharyngitis, and 20% had rhinorrhea and sniffles.<sup>2</sup> Pneumonia was the most common respiratory problem in children with suspected COVID-19.<sup>10</sup> Viral and bacterial pneumonia are often preceded by a few days of upper respiratory tract infections, usually



accompanied by rhinitis and cough. Severe infection may be accompanied by cyanosis and respiratory fatigue, especially in babies.<sup>16</sup> A study reported that two neonates with COVID-19 (<3 months old) developed bronchiolitis after a 2-to-10-day delay of SARS-CoV-2 infection diagnosis without RSV coinfection.<sup>10</sup> Another study explained that almost 5% frequency of OC43 and 229E coronaviruses was found in infants with acute bronchiolitis. Physical examination revealed rales (5%), retraction (5%), and cyanosis (5%) in children with COVID-19.<sup>2</sup> In our study, no chest wall retractions were observed in 77.8% of the confirmed group and in 67.6% of the suspected COVID-19 group.

Chest X-ray images revealed infiltrates in all subjects. In the confirmed COVID-19 group, consolidation and opacity were mostly observed in school age children (6 to 18 years). No opacity was observed in the suspected COVID-19 group. A study analyzed the chest images of the lungs of children with COVID-19 infection and reported that there could be a slight increase of ground-glass opacification or even severe pneumonia.<sup>11</sup>

Blood test results showed metabolic acidosis in 10/27 of patients with confirmed COVID-19 and of 21/34 of the suspected group, but the difference was not statistically significant. In confirmed COVID-19 subjects, hemoglobin, WBC, and platelets count decreased, while CRP and D-dimer increased. The mean WBC count in the confirmed COVID-19 group ( $3.49 \times 10^3/\mu\text{L}$ ) was significantly lower than that in the suspected COVID-19 group ( $17.9 \times 10^3/\mu\text{L}$ ) ( $P=0.011$ ). Furthermore, the mean CRP was significantly higher in the COVID-19 confirmed group (26.5 mg/L) than that of the suspected COVID-19 group (4.0 mg/L) ( $P=0.019$ ). Yasuhara *et al.*<sup>17</sup> stated that patients with multisystem inflammatory syndrome in children (MIS-C) experienced an increase in CRP by 39.5% with a median value of (166.5 [30.2-302.5] mg/L and procalcitonin by 3.2% with a median value of (16.3 [15.1-47.5] ng/mL. High procalcitonin (PCT) values is a marker for inflammatory.<sup>18</sup>

Inflammation markers in the form of increased procalcitonin (PCT) > 0.5 ng/ml were found in patients infected by either virus or bacteria,<sup>19</sup> and normal procalcitonin (PCT) values can be found in the majority of infection cases.<sup>20</sup> Comprehensive tests on blood count, heart function, kidney function,

coagulation parameter (if needed), and other relevant tests need to be considered and performed according to subjects' clinical conditions. The increase in liver enzymes, muscle enzymes, and myoglobin in conjunction with d-dimer levels were reported in severe cases, alongside normal or increasing CRP values.<sup>20</sup>

In conclusion, the characteristics of pneumonia associated with COVID-19 are significant prolonged and higher fever, less shortness of breath, less lung rhonchi, greater opacity on chest x-ray, lower WBC count, and higher CRP compared to pneumonia in non-COVID-19 patients.

## Conflict of interest

None declared.

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