# Chest x-ray findings in children with COVID-19: lesson learned from referral hospitals in Medan, North Sumatera, Indonesia

#### To the editor

Coronavirus disease 2019 (COVID-19) is a global pandemic that may elicit severe respiratory illnesses. 13% of the cases in Indonesia were paediatric cases, and only 32.7% of the children were symptomatic.<sup>1,2)</sup> Of those, 68% of patients had either radiological or clinical evidence of pneumonia, but the result was with a limited number of chest x-ray (CXR).<sup>2)</sup> World Health Organization in June 2020 advised CXR use as part of the diagnostic work-up for symptomatic COVID-19 when reverse transcription polymerase chain reaction (RT-PCR) results may not be as prompt.<sup>3)</sup> Radiology complements history taking and physical examination-the cornerstones of COVID-19 diagnosis -in paediatric populations during the pandemic; nevertheless, it is frequently overlooked, and little is known of its diagnostic value in children. This study aims to evaluate CXR findings in COVID-19-positive children and assess their association with clinical findings.

Medical records of hospitalised children with COVID-19 in 3 main COVID-19 referral hospitals in Medan City, North Sumatera, were reviewed. The inclusion criteria were children aged less than 18 years with COVID-19 infection confirmed by RT-PCR from April 1, 2020, to March 31, 2021. Patients without CXR were excluded. In total, 135 of 231 children were included in this analysis. Anteroposterior or posteroanterior positions of the paediatric CXR examination were performed at radiation doses suitable for children. A board-certified radiologist in each hospital analysed CXR readings, and the parameters evaluated were: (a) whether it is normal or abnormal, (b) the affected lung side (unilateral or bilateral), and (c) the radiological findings. Patient data such as age, sex, presenting symptoms, comorbidity, and outcome were also extracted. The COVID-19 severity classification was as per national guidelines.<sup>4)</sup> Comorbidity was defined as any additional condition that has existed or may occur during the clinical course under study and might affect the disease course or outcome.<sup>5)</sup> Numeric variables are presented as arithmetic means and categoric variables as frequencies and percentages. The strength of association between a predictor variable and an outcome variable (CXR findings) is measured using prevalence ratio (PR), that is, the ratio between the prevalence of outcome (abnormal CXR) among those with the factors divided by the prevalence rate among those without the factor. The crosstab option in SPSS was used to calculate the PR estimate and confidence intervals. Chi-square or Fisher exact test analysis was used to compare categorical data, and a *P* value of <0.05 was considered statistically significant. This study was approved by the Health Research Ethical Committee of Universitas Sumatera Utara (No.162/KEP/USU/2020).

The mean age of our study sample was 96.7 months old. Boys were 75 cases (55.6%), and 39.3% of subjects were above ten years old. Most cases were mild, and the most frequent symptoms were fever (80.7%), cough (63%), corvza (35.6%), and diarrhoea (16.3%). Of the 135 RT-PCR-confirmed COVID-19 paediatric patients, 52 had abnormal CXR findings suggestive of COVID-19. Given RT-PCR as the gold standard for COVID-19 diagnosis, the CXR sensitivity in our study is 38.5% (95%) confidence interval, 30.3%-47.3%). Bronchopneumonia was the most common parenchymal lesion found in 49 patients (94.2%). This finding was more common bilaterally (33 of 49, 67.3%) but in cases of unilaterality, the right lung was more common (14 of 49, 28.6%). Additionally, the consolidation in the CXR was primarily distributed in the perihilar and paracardial regions (63.3%), followed by diffuse (12.2%). Pleural effusion was detected in 2 patients (8.7%), but only 1 had this sign as an isolated finding. The chest imaging of children with severe and critical COVID-19 severity in our study demonstrates bilateral and diffuse consolidation.

As shown in Table 1, compared with preschool children, the PR (risk of having abnormal CXR) was significantly lower in the teenagers group (>10 years) by 0.38 times. Infants have a relatively similar risk of abnormal chest radiographs. Boys had a 1.18 higher risk of abnormal CXR; however, the risk estimate was not statistically significant. Only dyspnoea and rash were associated with a statistically significant increase in the risk of abnormal CXR findings. Dyspnoea increased the risk by 2.36 times, whereas rash increased the risk by 2.63 times. Having moderate, severe and critical COVID-19 were associated with a significantly increased risk of having abnormal radiographs (2.19 times, 2.92 times and 2.19 times, respectively). Children with comorbidities had a 64% higher risk of abnormal CXR. Seven of the 135 children with COVID-19 infection were deceased, all with multiple comorbidities of either malignancy, malnutrition, or sepsis. This includes one patient with a critical condition with

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Table 1	. Risk of	abnormal	COVID-1	9 CXR	findings in	n children
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Variable	CXR findings			
Valiable	Normal	Abnormal	PR (95% CI)	r value"
Age group (yr)				0.003
Infants (<1)	6 (42.9)	8 (57.1)	1.03 (0.61–1.77)	
Preschool children (1-4)	7 (44.7)	21 (55.3)	Ref	
School age children (5–10)	18 (60.0)	12 (40.0)	0.72 (0.42–1.22)	
Teenagers (>10)	42 (79.2)	11 (20.8)	0.38 (0.21-0.68)	
Sex				0.452
Boy	44 (58.7)	31 (41.3)	1.18 (0.76–1.83)	
Girl	39 (65.0)	21 (35.0)	Ref	
Symptoms <sup>b)</sup>				
Fever	66 (60.6)	43 (39.4)	1.14 (0.64–2.03)	0.649
Cough	51 (60.0)	34 (40.0)	1.11 (0.71–1.75)	0.645
Coryza	28 (58.3)	20 (41.7)	1.13 (0.73–1.75)	0.577
Diarrhoea	12 (54.5)	10 (45.5)	1.22 (0.73-2.05)	0.465
Anosmia	9 (100)	0 (0)	N/A	0.013
Nausea/vomiting	6 (46.2)	7 (53.8)	1.46 (0.84–2.54)	0.232
Headache	4 (66.7)	2 (33.3)	0.86 (0.27-2.72)	0.789
Dyspnoea	2 (18.2)	9 (81.8)	2.36 (1.63-3.41)	0.002
Rash	0 (0)	1 (100)	2.63 (2.12-3.26)	0.385
COVID-19 severity				0.037
Asymptomatic	6 (60.0)	4 (40.0)	1.17 (0.53-2.60)	
Mild	75 (65.8)	39 (34.2)	Ref	
Moderate	1 (25.0)	3 (75.0)	2.19 (1.18-4.08)	
Severe	0 (0)	3 (100)	2.92 (2.27-3.77)	
Critical	1 (25.0)	3 (75.0)	2.19 (1.18-4.08)	
Comorbidity				0.022
Yes	21 (47.7)	23 (52.3)	1.64 (1.09-2.48)	
No	62 (68.1)	29 (31.9)	Ref	
Outcome				0.008
Discharged	81 (64.1)	46 (35.9)	0.42 (0.29-0.61)	
Death	1 (14.3)	6 (85.7)	Ref	

COVID-19, coronavirus disease 2019; CXR, chest x-ray; PR, prevalence ratio; CI, confidence interval; N/A, not available.

<sup>a)</sup>Obtained using the chi-square or Fisher exact analysis. <sup>b)</sup>Reference: patients without that particular symptom.

a normal chest radiograph, of whom COVID-19 was found incidentally per the admission testing protocol. However, mortality was likely due to renal failure from the underlying poststreptococcal glomerulonephritis.

A systematic review of 1,325 studies by Viner et al.<sup>6)</sup> reported fever and cough as the most common presenting symptoms. Our study found that 80.7% of children presented with fever and 63% cough; however, it is not associated with an increased risk of CXR abnormalities despite being the commonest. Dyspnoea increased the risk of abnormal CXR by 2.36 times. In contrast, anosmia was statistically significantly more common in children with normal radiographs, possibly due to its occurrence in mild cases, as reported in Egypt.<sup>7)</sup> A wide range of CXR sensitivities in COVID-19 patients have been reported, from 11.4% to 90%,<sup>8,9)</sup> depending on the disease course (early vs. late admission) and pathology severity (low-grade vs. high-grade pathology). In their

study by Caro-Dominguez et al.,<sup>9)</sup> 90% of 91 children with COVID-19 had abnormal CXR, demonstrating perihilar bronchial thickening (58%) and airspace consolidation (35%). This study, however, was in the early pandemic phase and thus may have missed the coronavirus strain variation. Nonetheless, most findings are common of atypical pneumonia, making CXR alone not recommended and should be adjunct to anamnesis and other diagnostic work-ups.

Our findings suggested that COVID-19 severity and comorbidities are statistically significantly associated with an increased risk of abnormal CXR findings. The most common comorbidities in our study patients were malnutrition (34.1%) and malignancy (15.9%), comparable to the national report across Indonesia.<sup>10</sup> Anthropometric measurements were inconsistently available in the record; thus, the incidence of undetected malnutrition may be higher.

CXR, particularly in limited-resource settings, is more readily available and recommended by both the WHO and Indonesian COVID-19 guidelines and plays a paramount role in diagnosing COVID-19. The limitation of this study is its retrospective nature and the interpretation of CXR by different radiologists with varying experiences. Nevertheless, the current findings represent all-encompassing chest radiology data from all types of referral hospitals within one year study period.

Andrew Limavady, MD<sup>1</sup>, Eka Airlangga, MD<sup>2</sup>, Ririe Fachrina Malisie, MD, PhD<sup>3</sup>, Ayodhia Pitaloka Pasaribu, MD, PhD<sup>3</sup>

<sup>1</sup>Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia; <sup>2</sup>Department of Child Health, Universitas Muhammadiyah Sumatera Utara, Medan, Indonesia; <sup>3</sup>Department of Child Health, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia

Corresponding author: Ayodhia Pitaloka Pasaribu, MD, PhD Department of Child Health, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia 20155 Email: ayodhia@usu.ac.id https://orcid.org/0000-0002-3830-8073

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#### ORCID:

Andrew Limavady https://orcid.org/0000-0002-2537-4477 Eka Airlangga https://orcid.org/0000-0002-9330-4219 Ririe Fachrina Malisie https://orcid.org/0000-0002-5579-7999 Ayodhia Pitaloka Pasaribu https://orcid.org/0000-0002-38308073

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