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Chest CT Abnormalities and Disease Severity in Hospitalized Children with COVID 19: A Retrospective Cohort Study

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ABSTRACT

Background: Although COVID-19 is generally milder in children, a subset develops severe pulmonary involvement requiring hospitalization. Evidence linking chest CT abnormalities to clinical outcomes in hospitalized children is limited. We evaluated CT findings and their association with clinical presentation, disease severity, oxygen saturation, and short-term outcome.

Methods: This retrospective cohort study included 82 RT-PCR-confirmed COVID-19 patients aged 1 month 18 years admitted to Shahid Sadoughi Hospital, Yazd, Iran. Clinical data and CT images (interpreted by a radiologist) were extracted from medical records. Associations were tested with chi-square/Fisher's exact tests.

Results: CT abnormalities were present in 63 patients (76.8%). Ground-glass opacity was most common (50%), followed by consolidation (29.3%), atelectasis (14.6%), and pleural effusion (8.5%). Severe/critical disease was significantly more frequent in the abnormal-CT group (76.2% vs. 36.8%, P = 0.006). Oxygen saturation <94% was strongly associated with CT abnormalities (95.8% vs. 71.8%, P = 0.02). All six deaths occurred among patients with abnormal CT (P = 0.03). No significant associations were found for fever, cough, respiratory distress, or age group. Age group (1 month–1 year, 1–5 years, 5–13 years, 13–18 years) was not significantly associated with CT findings.

Conclusion: In hospitalized children with clinically indicated chest CT, pulmonary abnormalities were frequent and associated with severe disease and hypoxemia, while symptoms alone did not predict radiologic involvement. All deaths occurred in the abnormal-CT group. Routine CT screening is not supported, and findings require prospective validation.

Introduction

Since the emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in late 2019, coronavirus disease 2019 (COVID-19) has posed unprecedented challenges to healthcare systems worldwide[1,2]. Although children account for a smaller proportion of severe cases compared with adults, pediatric COVID-19 remains clinically important because of its heterogeneous presentation and potential for rapid deterioration in a subset of patients[3,4]. Pediatric infection ranges from asymptomatic disease and mild upper respiratory symptoms to severe pneumonia, respiratory failure, multisystem inflammatory syndrome in children (MIS-C), and death[5]. Consequently, early identification of children at risk for severe pulmonary involvement remains an important clinical priority.

Several biological mechanisms have been proposed to explain the generally milder disease course observed in children, including differences in angiotensin-converting enzyme 2 (ACE2) receptor expression, stronger innate immune responses, lower prevalence of chronic comorbidities, and reduced exposure to smoking and environmental pollutants[6,7]. Nevertheless, hospitalized pediatric patients represent a clinically distinct subgroup in whom pulmonary complications are more likely to occur. In these patients, timely recognition of respiratory involvement is critical for guiding monitoring intensity, oxygen therapy, and escalation of care.

Imaging has played an important role in the evaluation of COVID-19 pneumonia since the beginning of the pandemic. Chest radiography remains the most accessible imaging modality in many centers; however, chest CT demonstrates greater sensitivity for detecting early parenchymal abnormalities and subtle pulmonary involvement[8,9]. In adults, chest CT findings have been extensively characterized and commonly include bilateral peripheral ground-glass opacities (GGOs), consolidation, vascular enlargement, crazy-paving appearance, and multilobe involvement[8,10]. In many adult studies, CT severity has also been associated with respiratory failure, intensive care admission, and mortality[11,12].

By contrast, the imaging spectrum of pediatric COVID-19 appears less severe and less specific than that observed in adults. Previous pediatric investigations have demonstrated lower frequencies of CT abnormalities and a greater prevalence of normal imaging findings[4,13]. Reported radiological manifestations in children include GGOs, patchy consolidation, halo sign, nodular opacities, atelectasis, and pleural effusion[4,14,15]. However, the prevalence of these findings varies considerably across studies, likely because of differences in patient selection, disease severity, timing of imaging, and institutional imaging protocols.

Systematic reviews and meta-analyses have consistently identified GGO as the predominant CT finding in children with COVID-19, although normal CT scans have also been reported in up to one-third of pediatric cases[4,5,16]. This variability has generated ongoing debate regarding the clinical utility of chest CT in children. Current pediatric guidelines generally discourage routine CT screening because of concerns related to radiation exposure and limited diagnostic specificity[17]. Nevertheless, imaging may still provide important information in hospitalized children with worsening respiratory status, hypoxemia, or suspected complications.

Despite the expanding literature on pediatric COVID-19 imaging, most available studies have primarily focused on descriptive radiological findings rather than evaluating the relationship between CT abnormalities and clinical severity or outcome[14]. Consequently, uncertainty remains regarding the prognostic significance of pulmonary involvement detected on chest CT in hospitalized pediatric patients. In addition, the relationship between imaging abnormalities and presenting symptoms such as fever, cough, and

respiratory distress remains incompletely understood, and the extent to which these associations vary across different pediatric age groups has received little attention.

Understanding these associations has important implications for pediatric inpatient care and health-system decision-making. Because clinical symptoms alone may not reliably indicate the extent of pulmonary involvement, especially in younger children, identifying objective imaging patterns linked to disease severity can help clinicians recognize high-risk patients earlier and allocate monitoring and therapeutic resources more efficiently. Therefore, this study aimed to determine the frequency and distribution of chest CT findings in hospitalized children with RT-PCR-confirmed COVID-19 and to evaluate their associations with presenting symptoms (fever, cough, respiratory distress), oxygen saturation (SpO_2), disease severity (severe/critical vs. non-severe), short-term outcome (death vs. alive), and predefined age groups (1 month–1 year, 1–5 years, 5–13 years, 13–18 years).

Materials and Methods

Study Design and Setting

This retrospective cohort study was conducted at Shahid Sadoughi Hospital, Yazd, Iran, and approved by the institutional ethics committee (code IR.SSU.MEDICINE.REC.1400.413).

Study Population

The study population comprised all children younger than 18 years with RT-PCR-confirmed COVID-19 who were admitted to any ward of Shahid Sadoughi Hospital and for whom a chest CT scan was performed either shortly before or during the admission. Patients were excluded if the patient or guardian refused to participate, if the medical records were incomplete, or if the patient was discharged against medical advice before data collection could be completed. Chest CT was performed at the discretion of the treating clinician based on clinical suspicion of pulmonary involvement, worsening respiratory distress, persistent hypoxemia, or suspected complications; it was not part of a routine screening protocol.

Data Collection

Demographic characteristics including age and sex were extracted from medical records. Clinical variables included fever, cough, respiratory distress, oxygen saturation (SpO_2), disease severity, length of hospital stay, and clinical outcome.

Disease severity was defined according to the WHO/Chinese pediatric COVID-19 guidelines: severe disease (dyspnea, central cyanosis, or SpO_2 <92%; critical disease) respiratory failure, acute respiratory distress syndrome, shock, or multi-organ dysfunction[18].

Study period

Patients admitted from 2020 to 2022 were enrolled.

Sampling

A census method was used; every child meeting the eligibility criteria during the study period was included.

Data collection

Data were collected using a researcher-made, three-part questionnaire.

1. Demographic and general information: age, sex, length of hospital stays, and other baseline characteristics.
2. Clinical symptoms: recorded for the hospitalization period. Symptoms included fever, cough, nasal congestion, dyspnea, and other relevant manifestations, all retrieved from existing COVID-19 patient databases.
3. Chest CT findings: images were reviewed and categorized by a single radiologist. The radiologist evaluated each scan for COVID-19-related involvement including: ground-glass opacities, consolidation, atelectasis, pleural effusion, and any additional radiological features. The categorization was directly entered into the questionnaire.

All questionnaire data were entered into Microsoft Excel and cross-checked for accuracy before analysis.

Variables

The primary independent variable was the chest CT findings (categorized patterns of involvement). The dependent variables were the clinical symptoms documented during hospitalization. Age was categorized into four groups for analysis: 1 month to <1 year, 1 year to <5 years, 5 years to <13 years, and 13 years to <18 years, consistent with pediatric developmental stages.

Limitations

This study has several limitations. The retrospective, single-center design and clinically driven CT referral introduced selection bias, likely overestimating the prevalence of CT abnormalities relative to all hospitalized children. The small sample (n = 82) with few deaths (n=6) precluded multivariable adjustment and causal inference. Comorbidity and laboratory data were not systematically available, and CTs were interpreted by a single radiologist, though this ensured consistency. Symptom data were incomplete (e.g., tachypnea could not be linked, SpO_2 missing in 19 patients), reducing analytical power. These factors necessitate cautious interpretation and validation in larger, prospective cohorts with standardized imaging protocols.

Statistical analysis

Analyses were performed with IBM SPSS Statistics for Windows, version 22 (version 22, IBM Corporation, Armonk, NY). Descriptive statistics (frequencies, percentages, means, and standard deviations) summarized the sample. Associations between CT findings and clinical symptoms were tested with chi-square or Fisher's exact tests, as appropriate. A two-tailed $P < 0.05$ was considered statistically significant. A prospective a priori power calculation was not performed because this was a retrospective cross-sectional study using a census sampling method; the sample size (n = 82) was determined by the number of eligible hospitalized children with clinically indicated CT scans during the study period.

Results

Patient Characteristics

A total of 82 hospitalized children with RT-PCR-confirmed COVID-19 were included in the study. The median age was 8 years (range 1 month–18 years). Sex distribution was not systematically reported in the original dataset. Complete symptom data were not available for all patients. Among those with documented records, the most common symptoms were cough (45.5%; 35 of 77 patients), tachypnea (41.7%; 34 of 82 patients), and respiratory distress (29.5%; 23 of 78 patients). However, the record-level data for tachypnea could not be reliably linked to the CT findings for a sufficient number of patients; therefore, the planned cross-tabulation for tachypnea is not reported. Fever data were missing for six patients. Fever was observed in 73.2% of patients (60 of 82).

Disease severity was classified as non-severe in 27 patients (32.9%), severe in 39 patients (47.6%), and critical in 16 patients (19.5%). Six patients (7.3%) died during hospitalization

Chest CT Findings

Chest CT abnormalities were detected in 63 patients (76.8%), whereas 19 patients (23.2%) demonstrated normal CT scans. GGO was the predominant imaging finding, present in 41 patients (50%). Consolidation was identified in 24 patients (29.3%), atelectasis in 12 patients (14.6%), and pleural effusion in 7 patients (8.5%) (Table 1).

Table 1. Frequency of Chest CT Findings in Hospitalized Children with COVID-19 (n = 82)

CT Finding	Present, n (%)	Absent, n (%)
Ground-glass opacity	41 (50.0)	41 (50.0)
Consolidation	24 (29.3)	58 (70.7)
Atelectasis	12 (14.6)	70 (85.4)
Pleural effusion	7 (8.5)	75 (91.5)

Percentages may exceed 100% because multiple findings could coexist in individual patients.

Association Between CT Findings and Clinical Symptoms

No significant association was identified between chest CT abnormalities and cough, respiratory distress, or fever (Table 2). Among children with cough, 80.3% had CT abnormalities compared with 74.4% among those without cough (P = 0.56). Similarly, respiratory distress was not significantly associated with abnormal CT findings (73.9% vs. 78.2%, P = 0.68). Fever was also not significantly associated with chest CT abnormalities. Lung involvement was present in 80% of febrile patients and 81.3% of afebrile patients (P = 0.91).

Table 2. Lung Involvement on Chest CT According to Respiratory Symptoms

Symptom	CT Abnormal, n (%) *	CT Normal, n (%)	P **
Cough (n = 77)			
Yes	28 (80.0)	7 (20.0)	0.56
No	31 (73.8)	11 (26.2)	
Respiratory distress (n = 78)			
Yes	17 (73.9)	6 (26.1)	0.68
No	43 (78.2)	12 (21.8)	
Tachypnea***	-	-	-
Fever (n = 76)			
Yes	48 (80.0)	12 (20.0)	0.91
No	13 (81.1)	3 (18.8)	

* Percentages are row percentages.
** P obtained by chi-square test.
*** Tachypnea cross-tabulation could not be completed because record-level linkage between symptom documentation and CT findings was not feasible with the available data.

Based on fever duration, no significant association was observed between the length of fever and the presence of lung involvement on chest CT, as patients with fever lasting four days or less and those with fever longer than four days showed similar rates of CT abnormalities (P = 0.48).

Association Between CT Findings and Disease Severity

Severe or critical disease was significantly more common among patients with abnormal chest CT findings than among those with normal CT scans (76.2% vs. 36.8%, P = 0.006), corresponding to an odds ratio (OR) of 5.49 (95% CI 1.83–16.44). CT abnormalities were identified in 44.4% of non-severe cases (12/27), 87.2% of severe cases (34/39), and 87.5% of critical cases (14/16) (P = 0.006) (Table 3).

CT abnormalities were identified in 44.4% of non-severe cases (12/27), 87.2% of severe cases (34/39), and 87.5% of critical cases (14/16) (P = 0.006) (Table 3).

Association Between CT Findings and Oxygen Saturation

Oxygen saturation data were available for 63 of the 82 patients (51 of 63 with abnormal CT and 12 of 19 with normal CT). Among these, children with SpO_2 below 94% had a significantly higher frequency of CT abnormalities than those with SpO_2 ≥94% (95.8% vs. 71.8%, P = 0.02), yielding an odds ratio of 9.04 (95% CI 1.08–75.3) (Table 3).

Association Between CT Findings and Clinical Outcome

All six deaths occurred in the abnormal-CT group (6.63, 9.5%), while no deaths occurred among the 19 children with normal CT scans (0%). An odds ratio could not be calculated because of zero events in the normal-CT group. The risk difference was 9.5% (95% CI: 2.3%–16.7%; Fisher's exact test, two-sided P = 0.03) (Table 3).

Table 3. Association between Chest CT Abnormalities and Disease Severity, Oxygen Saturation, and Clinical Outcome in Hospitalized Children with COVID-19

Variable	CT Abnormal, n (%)	CT Normal, n (%)	P	OR (95% CI)
Disease Severity				
Non-severe	12 (44.4)	15 (55.6)	0.006	5.49 (1.83–16.44)**
Severe	34 (87.2)	5 (12.8)		
Critical	14 (87.5)	2 (12.5)		

SpO_2 Level*				
≥94%	28 (71.8%)	11 (28.2%)	0.02	9.04 (1.08–75.3)**
<94%	23 (95.8%)	1 (4.2%)		
Clinical Outcome				
Alive	57 (90.5)	19 (100)	0.03	Inestimable***
Death	6 (9.5)	0 (0)		
Risk difference (95% CI)	9.5% (2.3%–16.7%)			

* SpO_2 data were missing for 12 children with abnormal CT and 7 with normal CT; the table includes only the 63 patients with complete data
** OR for binary comparison: any CT abnormality vs. normal CT. For severity, severe/critical was compared with non-severe.
*** OR not calculable due to zero deaths in the normal-CT group; risk difference and Fisher's exact p-value are reported instead.

No significant association was observed between individual CT patterns and mortality.

Subgroup and Secondary Analyses

No individual CT pattern (ground-glass opacity, consolidation, atelectasis, or pleural effusion) was significantly associated with mortality. Lung involvement on CT did not differ by PCR result (P = 0.93). When oxygen saturation was analyzed by specific imaging patterns, none of the individual findings reached statistical significance (ground-glass opacity P = 0.17, consolidation P = 0.20, atelectasis P = 0.81, pleural effusion P = 0.30). In relation to COVID-19 severity, consolidation was significantly more frequent in patients with critical disease (56.3%) than in those with severe (25.6%) or mild disease (18.5%; P = 0.02); other patterns showed no significant differences. No CT finding varied significantly across age groups (P values ranged from 0.17 to 0.62). Length of hospital stay was not significantly associated with overall CT abnormalities (P = 0.20), although atelectasis approached borderline significance (P = 0.051).

Discussion

This cohort of hospitalized children with COVID-19 who underwent clinically indicated chest CT yielded three main findings. First, CT abnormalities were common (76.8%), with ground-glass opacity predominating. Second, abnormal CT was strongly associated with severe/critical disease (OR 5.49) and hypoxemia (OR 9.04). Third, symptoms (fever, cough, and respiratory distress) did not distinguish children with abnormal CT from those with normal scans. All six deaths occurred in the abnormal-CT group, though this unadjusted association must be interpreted cautiously.

The 76.8% prevalence is higher than the 50-70% range reported in systematic reviews that included outpatients[4,5,16], a discrepancy attributable to our inclusion of only hospitalized children with clinical indications for imaging. A multicenter study of hospitalized pediatric patients reported a similar abnormality rate of 74%[19], confirming that our results reflect the true burden of pulmonary involvement in this sicker subgroup.

Consistent with the pediatric literature, GGO was the most frequent finding (50%), followed by consolidation (29.3%)[4,13,14]. Our data were collected between 2020 and 2022, thus primarily representing early-pandemic (pre-Delta) lung injury.

From a pathophysiological standpoint, GGOs and consolidations represent alveolar inflammation, interstitial edema, and ventilation-perfusion mismatch leading to hypoxemia[8]. Notably, no individual finding was independently associated with mortality or hypoxemia, suggesting that the presence of any pulmonary abnormality, rather than a specific pattern, may be the more robust severity indicator.

All six deaths occurred in the abnormal-CT group (risk difference 9.5%; P = 0.03). However, the small number of events and inability to adjust for confounders mean this association is exploratory; it does not establish CT abnormalities as an independent predictor of mortality. Çetin et al. similarly concluded

that the relationship between pediatric chest CT findings and mortality risk remains inadequately characterized[20].

A novel contribution of our study is the observed discordance between clinical symptoms and CT findings. Fever, cough, and respiratory distress did not predict radiologic involvement, paralleling adult reports of "silent hypoxemia"[21]. Possible explanations include age related differences in inflammatory signaling, inability of young children to articulate dyspnea, and the potential for CT abnormalities to precede overt deterioration[6]. Consequently, clinicians should not rely on the absence of respiratory symptoms to exclude significant pulmonary involvement in hospitalized children with COVID-19.

No significant differences in CT abnormalities were observed across age groups. Although infants and young children have been reported to have milder clinical illness, potentially due to lower ACE2 expression and distinct immune maturation[7], in this hospitalized cohort age did not influence CT findings. This suggests that once a child requires admission and chest CT, age related susceptibility differences become less relevant than disease severity at presentation, and clinicians should not use age alone to rule out pulmonary involvement.

Our findings do not support routine CT screening in pediatric COVID-19, given radiation exposure risks and the availability of effective alternatives such as chest radiography and clinical monitoring[22]. However, in selected hospitalized children with hypoxemia, worsening respiratory status, or diagnostic uncertainty, chest CT may provide complementary prognostic information. The presence of any parenchymal abnormality should prompt closer monitoring and consideration of escalation of care, even when symptoms are mild.

Future multicenter prospective studies should determine whether CT findings offer independent prognostic value beyond clinical scores and biomarkers, and how radiologic patterns differ across viral variants.

Conclusion

In this cohort of hospitalized children with clinically indicated chest CT, pulmonary abnormalities were common and were significantly associated with severe disease and hypoxemia. All six deaths occurred in the abnormal-CT group; however, given the small number of events and the inability to adjust for confounders, this association is exploratory and should not be interpreted as evidence that CT findings independently predict mortality. Common respiratory symptoms did not predict CT findings, highlighting the limitations of symptom-based assessment. Chest CT should not be used routinely but may provide complementary severity information in selected hospitalized pediatric patients.

Conflict of Interest

The authors declare no conflicts of interest regarding the study.

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Ethical Considerations

This was approved by the Ethics Committee of the Shahid Sadoughi University of Medical Sciences (IR.SSU.MEDICINE.REC.1400.413).

Author's Contribution

Data curation, Investigation, Writing – original draft: B.S.; Conceptualization, Supervision, Project administration, Writing – review & editing: M.K.; Investigation, Writing – review & editing: A. P. A. S.; Formal analysis, Methodology, Writing – review & editing:

F.S.; Investigation, Validation, Writing – review & editing: R.N.M.

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References

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. N Engl J Med 2020; 382(8): 727–33.
2. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020; 395(10223): 497–506.
3. Mantovani A, Rinaldi E, Zusi C, Beatrice G, Saccomani MD, Dalbeni A. Coronavirus disease 2019 (COVID-19) in children and/or adolescents: a meta-analysis. Pediatr Res 2021; 89(4): 733–7.
4. Nino G, Zember J, Sanchez-Jacob R, Gutierrez MJ, Sharma K, Linguraru MG. Pediatric lung imaging features of COVID-19: A systematic review and meta-analysis. Pediatr Pulmonol 2021; 56(1): 252–63.
5. Kumar J, Meena J, Yadav A, Yadav J. Radiological Findings of COVID-19 in Children: A Systematic Review and Meta-Analysis. J Trop Pediatr 2021; 67(3): fmaa045.
6. Xia W, Shao J, Guo Y, Peng X, Li Z, Hu D. Clinical and CT features in pediatric patients with COVID-19 infection: Different points from adults. Pediatr Pulmonol 2020; 55(5): 1169–74.
7. Ma H, Hu J, Tian J, Zhou X, Li H, Laws MT, et al. A single-center, retrospective study of COVID-19 features in children: a descriptive investigation. BMC Med 2020; 18(1): 123.
8. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, et al. Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection. Radiology 2020; 295(3): 200463.
9. Li Y, Xia L. Coronavirus Disease 2019 (COVID-19): Role of Chest CT in Diagnosis and Management. AJR Am J Roentgenol 2020; 214(6): 1280–6.
10. Chung M, Bernheim A, Mei X, Zhang N, Huang M, Zeng X, et al. CT Imaging Features of 2019 Novel Coronavirus (2019-nCoV). Radiology 2020; 295(1): 202–7.
11. Yanamandra U, Shobhit S, Paul D, Aggarwal B, Kaur P, Duhan G, et al. Relationship of Computed Tomography Severity Score with Patient Characteristics and Survival in Hypoxemic COVID-19 Patients. Cureus 2022; 14(3): e22847.
12. Francone M, Iafrate F, Masci GM, Coco S, Cilia F, Manganaro L, et al. Chest CT score in COVID-19 patients: correlation with disease severity and short-term prognosis. Eur Radiol. 2020; 30(12): 6808–17.
13. Li W, Cui H, Li K, Fang Y, Li S. Chest computed tomography in children with COVID-19 respiratory infection. Pediatr Radiol 2020; 50(6): 796–9.
14. Peng X, Guo Y, Xiao H, Xia W, Zhai A, Zhu B, et al. Overview of chest involvement at computed tomography in children with coronavirus disease 2019 (COVID-19). Pediatr Radiol 2021; 51(2): 222–30.
15. Ugas-Charcape CF, Ucar ME, Almanza-Aranda J, Rizo-Patrón E, Lazarte-Rantes C, Caro-Domínguez P, et al. Pulmonary imaging in coronavirus disease 2019 (COVID-19): a series of 140 Latin American children. Pediatr Radiol. 2021; 51(9): 1597–607.
16. Ghoneim M, Eid R, Hamdy N, Shokry D, Salem MA, El-Morsy A, et al. Diagnostic performance of chest computed tomography for COVID-19 in children: a systematic review and meta-analysis of clinical and computed tomography features in 987 patients. Pol J Radiol 2022; 87: e126–e40.
17. Shelmerdine SC, Lovrenski J, Caro-Domínguez P, Toso S. Coronavirus disease 2019 (COVID-19) in children: a systematic review of imaging findings. Pediatr Radiol 2020; 50(9): 1217–30.
18. Cheng ZJ, Shan J. 2019 Novel coronavirus: where we are and what we know. Infection. 2020; 48(2): 155–63.
19. Steinberger S, Lin B, Bernheim A, Chung M, Gao Y, Xie Z, et al. CT Features of Coronavirus Disease (COVID-19) in 30 Pediatric Patients. AJR Am J Roentgenol. 2020;215(6):1303–11.
20. Çetin C, Karaaslan A, Akın Y, Arifoglu M, Rona G, Demirhan R. Relationship of chest computed tomography score with disease severity and laboratory values in children with

COVID-19. J Paediatr Child Health 2022; 58(5): 802–8.
21. Tobin MJ, Laghi F, Jubran A. Why COVID-19 silent hypoxemia is baffling to physicians. Am J Respir Crit Care Med 2020; 202(3): 356–60.
22. Jalaber C, Lapotre T, Morcet-Delattre T, Ribet F, Jouneau S, Lederlin M. Chest CT in COVID-19 pneumonia: A review of current knowledge. Diagn Interv Imaging 2020; 101(7-8): 431–7.