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Original Research Article

A RETROSPECTIVE STUDY ON EVALUATION OF COMPUTED TOMOGRAPHY SEVERITY INDEX IN HRCT CHEST OF COVID PATIENTS AND IT'S CORELATION WITH OXYGEN SATURATION (SPO2) VALUES

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ABSTRACT

Objective: The study aimed to evaluate CT severity index and its correlation with oxygen saturation (SPO_2) value.

Methodology: In this retrospective study, a total of 200 COVID-19 RTPCR positive patients were enrolled as per inclusion-exclusion criteria. Along with demographical data, SPO_2 levels recorded on the day of the HRCT examination were taken from case records and correlated with CT severity index scoring.

Results: The mean age of patients was 41.42±16.13 years, with a male dominancy (67.50%). The mean SPO_2 level was 91.71±9.62. The mean CT severity index was 8.060±7.09. The majority of the patients had a mild CT severity index [97(48.50%)], followed by Moderate [82(41.00%)] and Severe [21(10.50%)].Most patients were observed under 20-34, followed by 50-64 years. Among all the patients, those with mild, moderate and severe CT severity index, 69.07%, 63.41% and 76.19%, respectively, were males. The mean value of SPO_2 was found to significantly decrease as severity increased. A non-significantly positive and negative correlation was noted in age and gender, respectively. Alternatively, a significantly negative correlation was observed between CT severity index and SPO_2.

Conclusion: According to results of present study, CT severity index can be used to estimate Covid-19 progression and consequently, disease management based on SPO_2 level.

Advances in knowledge: Covid-19 is an emerging disease having scant data on correlation of CT severity index with oxygen saturation (SPO_2) values. With help of present study, we

can suggest that CT severity index helps extrapolate the SPO2 level in Covid -19 patients and thus the management protocol.

KEYWORDS: Computed Tomography, Oxygen Saturation, COVID-19,Computed Tomography Severity Index.

1. INTRODUCTION

Coronavirus disease 2019 (COVID-19), a new form of pneumonia, was first reported in December 2019 and rapidly spread around the world. The novel coronavirus outbreak was first reported in Wuhan, Hubei province, China. [1,2] The virus was first referred to as the 2019 novel coronavirus (2019-nCoV), but the International Committee of Taxonomy of Viruses renamed it SARS-CoV-2.[3] It was hypothesised [4] that the source of the initial infection was the Huanan seafood market, but that human-to-human transmission subsequently occurred. The SARS-CoV-2 virus is responsible for coronavirus disease 2019, now known as COVID-19, which the WHO has classified as a pandemic public health emergency.Like other coronaviruses, the primary mechanism of transmission of SARS-CoV-2 is via infected respiratory droplets, with viral infection occurring by direct or indirect contact with the nasal, conjunctival, or oral mucosa when respiratory particles are inhaled or deposited on these mucous membranes.[6] The estimated mortality rate was 3.54 percent, which was significantly lower than the initial epicentre in Wuhan, China (approximately 6 percent) and the subsequent epicentre in Italy, Europe (approximately 12 percent) (about 13 percent). The United States has the highest number of COVID-19 cases to date (as of August 19, 2020, the cumulative number of cases was 5,393,138). Still, the mortality rate (about 3.14 percent) remains slightly below the global average.[7] Hypoxemic respiratory failure caused by viral pneumonia is a frequent reason for hospitalisation and intensive care unit admission. Further elaboration of the clinical spectrum of SARS-CoV-2 involves the concept of happy hypoxemia, which has been considered a clinical condition with no or minimal respiratory distress, despite a low room-air oxygen saturation as indicated by a pulse oximeter [typically, peripheral oxygen saturation (SpO_2) <90 percent].[8] As a result of the systemic inflammatory response to SARS-CoV-2 infection, the phenotypic presentation of patients, such as low elastance (and consequently high compliance), low ventilation-perfusion, and low lung recruitment, has been hypothesised to be the pathophysiological mechanism underlying this.[9,10]The quantification of peripheral oxygen saturation as measured by a pulse oximeter (SpO2) has been reported as a surrogate for oxygen partial pressure (PaO2) for the diagnosis and management of acute respiratory distress syndrome (ARDS).[11] Oxygen saturation measured by pulse oximeter (SpO2) is consistently lower than arterial oxygen saturation (SaO2) measured directly by blood gas analysis.[12] The literature on the relationship between SpO2, SaO2, and PaO2 in viral pneumonia caused by SARS-CoV-2 is, however, scant. Hence, we aimed to evaluate the CT severity index and its correlation with oxygen saturation (SPO_2) value.

2. MATERIAL AND METHODS

The present retrospective study was conducted at the Department of Radio diagnosis G. R. Medical College and J.A. Group of Hospitals, Gwalior, from September 2020 to October 2020. After obtaining ethical clearance and informed consent, 200 covid-19 RTPCR positive patients aged 18-79 years who underwent HRCT Chest in the Radiodiagnosis Department of

J.A. Group of Hospitals from September 2020 to October 2020 were taken for analysis as the samples in this study. However, pregnant females and patients with known interstitial lung disease cases were excluded. The demographic data and the SPO2 level recorded on the very same day of HRCT examination of all the patients were noted from case records.

Statistical Analysis:

The presentation of the Categorical variables was done in the form of numbers and percentages (%) and analysed with Chi-square test. On the other hand, the presentation of the continuous variables was done as mean ± SD and were analysed by ANOVA test. The data entry was done in the Microsoft EXCEL spreadsheet, and the final analysis was done using Statistical Package for Social Sciences (SPSS) software version 21.0. For statistical significance, a p-value of less than 0.05 was considered significant.

3. RESULTS

In the present study, the maximum number of patients (48.00%) were aged between 20-34 years, followed by 50-64 years (23.00%). The overall mean age was noted as 41.42±16.13 years. The majority of the patients were male [135(67.50%)], followed by the female [65(32.50%)].[TABLE-1] The mean SPO2 level of the enrolled patients was 91.71±9.62.The mean CT Severity index of the enrolled patients was 8.060±7.09.[FIGURE-1and 2] The majority of the patients had mild CT severity index [97(48.50%)], followed by Moderate [82(41.00%)] and Severe [21(10.50%)].[TABLE-2] The mean age of the enrolled patients in Mild, Moderate and Severe were 38.81±15.43, 44.30±16.88, and 42.19±14.22, respectively. Among the mild, moderate and severe CT severity index, most patients were observed under 20-34 years, followed by 50-64 years. Most patients with mild, moderate and severe CT severity index were males [69.07%, 63.41% and 76.19%, respectively], and the rest were females. The mean SPO2 level was higher [97.03±1.71] in patients with mild CT severity index. On the contrary, the mean SPO2 level was lower [72.38±15.14] in patients with severe CT severity index.[TABLE-3] While analysing the correlation analysis of CT severity index with Age, Gender and SPO2. The SPO2 [$p<0.0001$*] significantly correlated with the CT severity index. [TABLE-4] However, age [p=0.0812] and gender [p=0.8274] showed a non-significant correlation with the CT severity index.

TABLES AND FIGURES

TABLE 1: Demographic parameters of enrolled patients (n=200).

		NUMBER	PERCENTAGE
AGE	MEAN±SD	41.42±16.13	
	20-34	96	48.00%
	35-49	35	17.50%
	50-64	46	23.00%
	65-79	23	11.50%

GENDER	FEMALE	65	32.50%
	MALE	135	67.50%
	GRAND TOTAL	**200**	**100.00%**

TABLE-2: CT severity index of enrolled patients

CT SEVERITY INDEX	**NUMBER**	**PERCENTAGE**
MILD (<7)	97	48.50%
MODERATE (8-17)	82	41.00%
SEVERE (>18)	21	10.50%
GRAND TOTAL	**200**	**100.00%**

TABLE-3: Association of CT severity index with the age, gender and SPO2 level of enrolled patients

		CT SEVERITY INDEX						**P-VALUE**
		MILD		**MODERATE**		**SEVERE**		
		N/MEAN	**%/SD**	**N/MEAN**	**%/SD**	**N/MEAN**	**%/SD**	
AGE (years)	MEAN± SD	38.81	15.43	44.30	16.88	42.19	14.22	F=2.667 p=0.0720
	20-34	56	57.73 %	32	39.02 %	8	38.10 %	X=10.69 p=0.0983
	35-49	14	14.43 %	15	18.29 %	6	28.57 %	
	50-64	19	19.59 %	21	25.61 %	6	28.57 %	
	65-79	8	8.25%	14	17.07 %	1	4.76%	
GENDER	FEMALE	30	30.93 %	30	36.59 %	5	23.81 %	X=1.456 p=0.4828
	MALE	67	69.07 %	52	63.41 %	16	76.19 %	

SPO2	97.03	1.71	90.37	5.61	72.38	15.14	F=142.7 **p<0.0001 ***
Grand Total	**97**	**100.00 %**	**82**	**100.00 %**	**21**	**100.0 0%**	

TABLE-4: Spearman correlation analysis of the CT severity index of the enrolled patients with Age, Gender and SPO2 level.

SPEARMAN CORRELATION ANALYSIS	**CT SEVERITY INDEX Vs. AGE**	**CT SEVERITY INDEX Vs. GENDER**	**CT SEVERITY INDEX Vs. SPO2**
Spearman r	0.1236	-0.01552	-0.7645
95% confidence interval	-0.01954 to 0.2618	-0.1580 to 0.1276	-0.8180 to -0.6980
P value	0.0812	0.8274	**<0.0001***

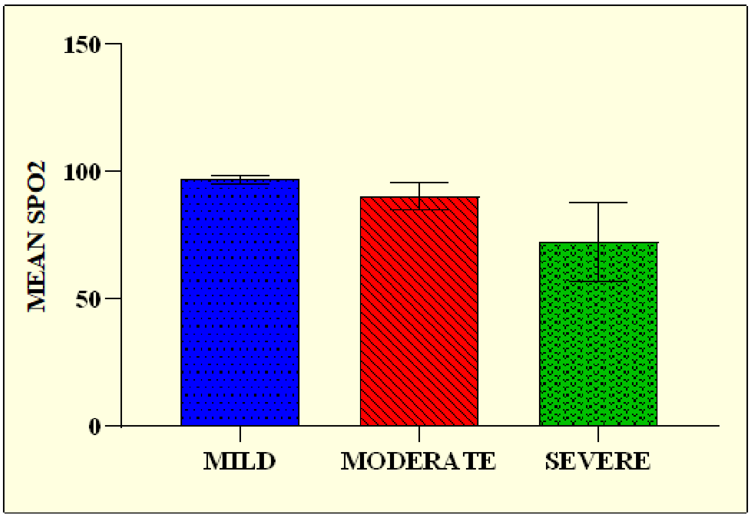

FIGURE-1: Graphical representation of the mean SPO2 level of the enrolled patients according to the CT severity index.

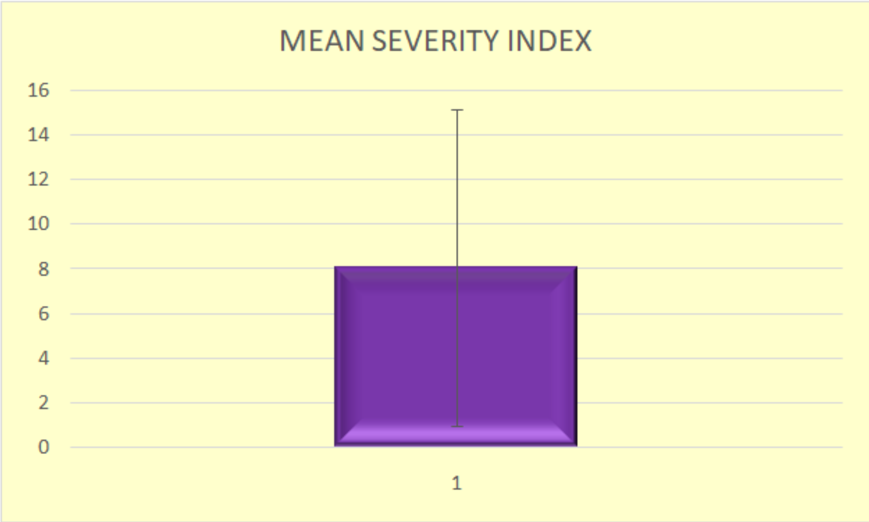

FIGURE-2: Graphical representation of the mean CT severity index of the enrolled patients.

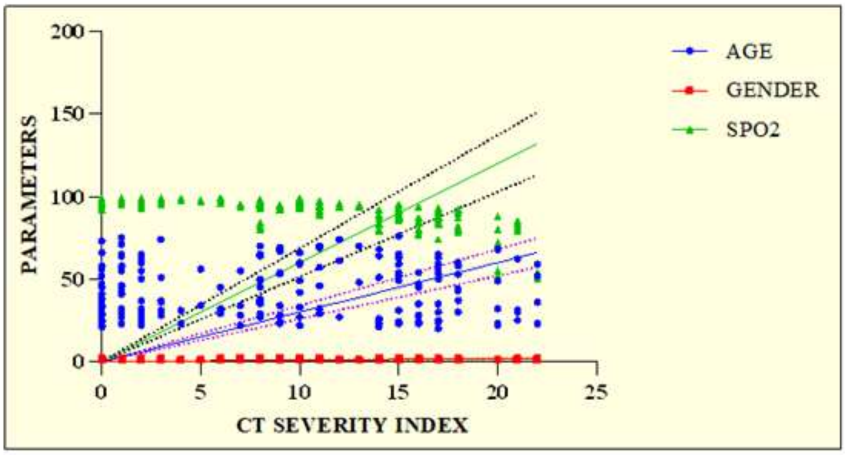

FIGURE-3: Graphical representation of the correlation analysis of the CT severity index of the enrolled patients with age, gender and SPO2 level.

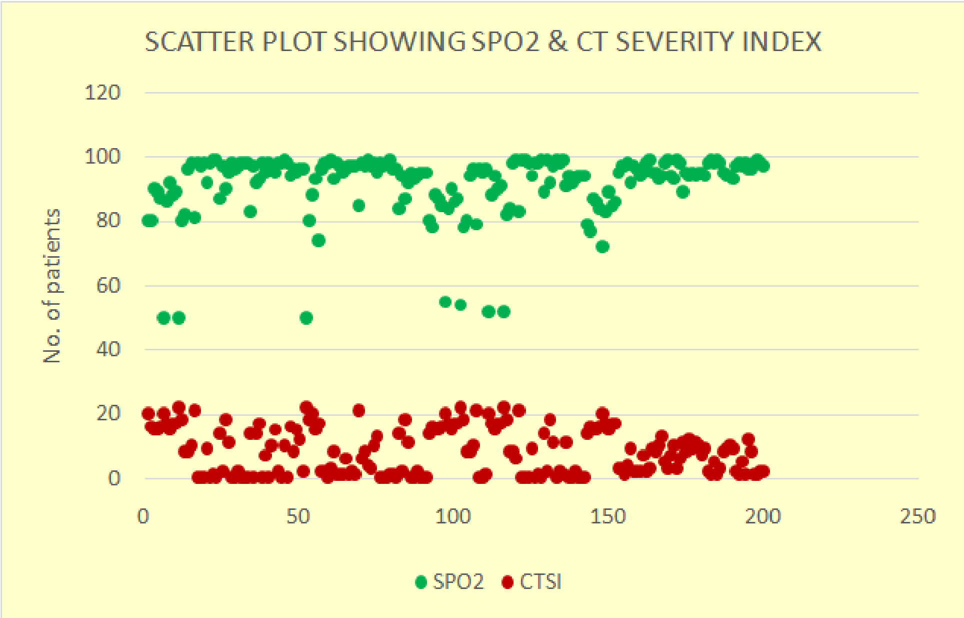

FIGURE-4: Scatter plot showing SPO2 & CT Severity index of the enrolled patients.

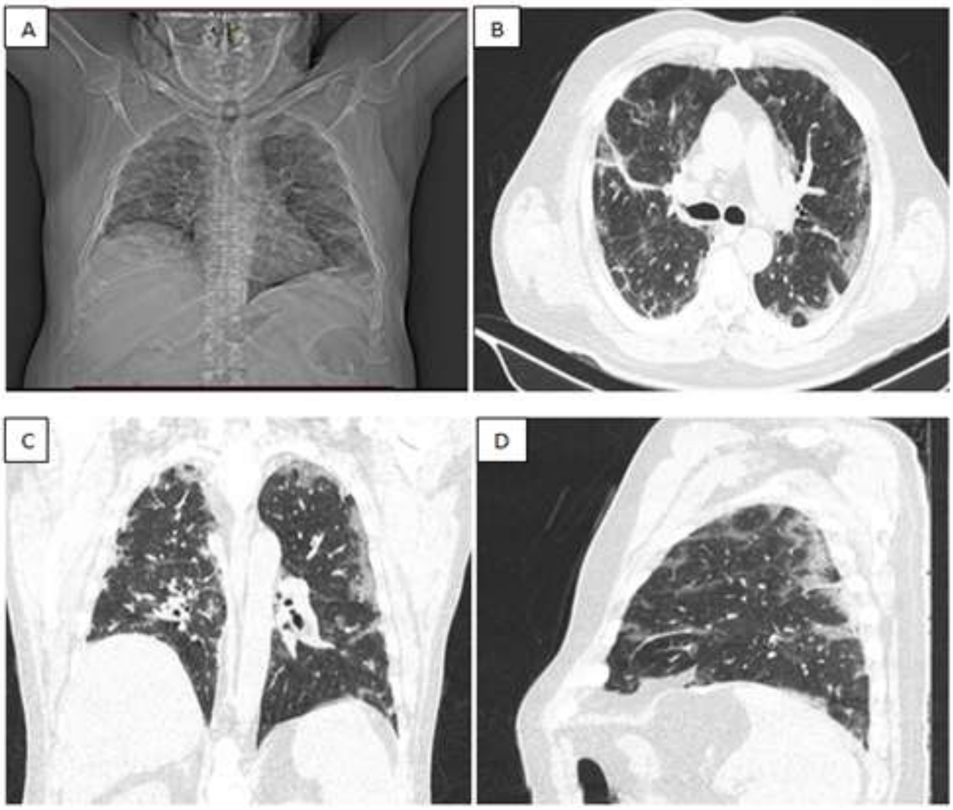

FIGURE-5: Radiograph (A), and CT axial (B), coronal (C) and sagittal (D) images of a 66 year old male patient showing predominantly peripheral patchy ground glass opacities. The CTSI score of patient was 7/25 (Mild) and SPO2 of patient was 97%.

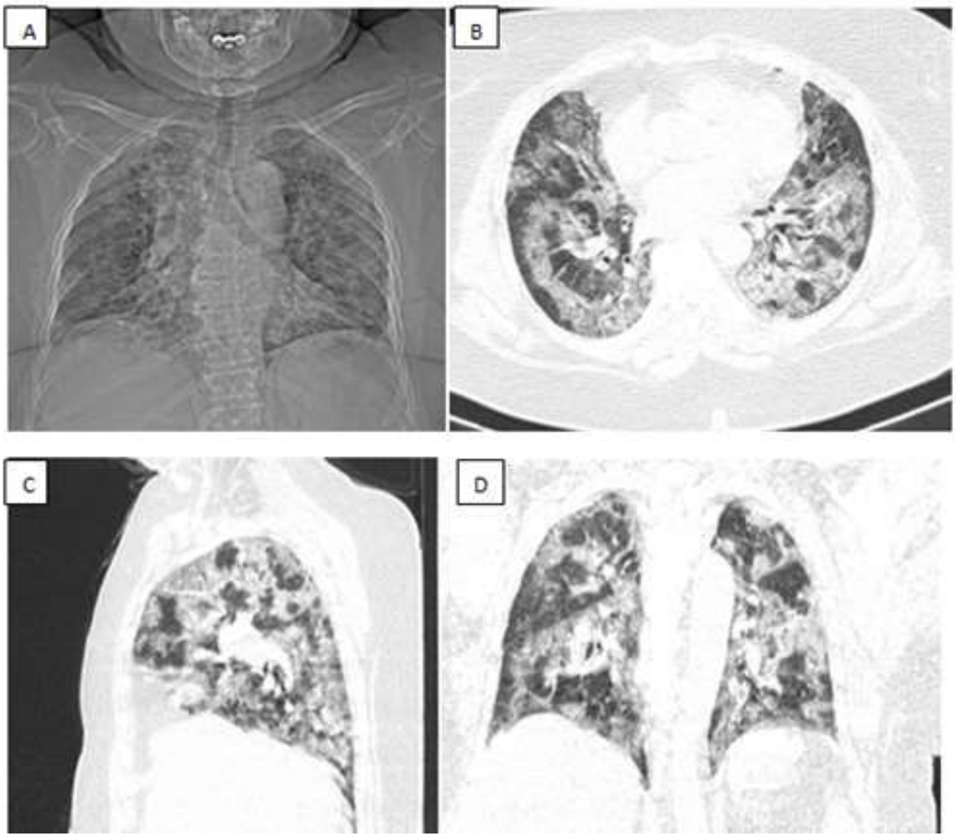

FIGURE-6: Radiograph (A), and CT axial (B), coronal (C) and sagittal (D) images of a 60 year old female patient showing extensive ground glass opacities. The CTSI score of patient was 18/25 (Severe) and SPO2 of patient was 72%.

4. DISCUSSION

The present study included two hundred covid RTPCR positive patients aged 18-79 years with a mean age of 41.42±16.13 years. There were more males (67.50%) and fewer females (32.50%). Quantitative and semi-quantitative chest CT scan markers were studied by Yang et al. [85]in China to determine how they related to patients' clinical states. They looked into 102 patients' CT scan results who had COVID-19 infections and reported that individuals with severe COVID-19 infections had significantly higher total CT severity scores than those with milder illnesses. Additionally, it was recommended that the degree of pulmonary involvement might be assessed using a CT severity score. [13] It should be noted that clinical severity criteria for respiratory distress included a respiratory rate of less than 30 beats per minute, a resting blood oxygen saturation of less than 93%, or a partial pressure of arterial blood oxygen (PaO2)/oxygen concentration (FiO2) of less than 300 mm Hg. These data, which demonstrate greater CT severity scores in hypoxic individuals, are consistent with our findings. In order to look into potential connections between chest CT results and patient clinical circumstances, Zhao et al. conducted another investigation on 101 COVID-19 infection cases. They noted that ground-glass opacities or mixed ground-glass opacities, consolidation, and vascular enlargement were the most frequent clinical conditions in patients. Still, they also emphasised the use of quantitative and semi-quantitative indicators for further assessment or even prediction of the clinical condition of patients. To assess the

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severity and scope of the disease, they proposed using a CT severity score. [14] Our conclusions are supported by these facts. In 51 patients with COVID-19 disease, Fang et al. compared the outcomes of the reverse transcription-polymerase chain reaction (RT-PCR) to the outcomes of the CT severity score. They observed that patients with higher CT severity scores had more severe infections in the days that followed and that the sensitivity of chest CT was higher than that of RT-PCR (98% vs 71%, respectively; p <0.001). These findings suggest that more severe clinical problems in patients are associated with higher CT severity scores. We further believe that associations between higher CT severity scores and hypoxia may justify this concern. Out of the 270 patients who were evaluated, 27 had hypoxia by the time of admission, and these patients had significantly higher CT severity scores based on an independent t-test (p = 0.001), according to Aalinezhad M. et al.[15]. Patients with hypoxia had a mean CT severity score of 18.14±7.43, while those without hypoxia had a mean score of 12.64±7.25. These results are consistent with what we are currently investigating. We found a significant (p<0.0001) correlation between the SPO2 level and the CT severity index (95% confidence interval: -0.8180 to -0.6980). Further, Aalinezhad M. et al. (2021) [15]also evaluated blood oxygen saturation and CT severity score in patients based on gender and found that the mean CT severity score was significantly lower in male patients. On the contrary, age [p=0.0812] and gender [p=0.8274] had no significant correlation with CT severity index in our study. The clinical characteristics and prognosis of the disease varies among patients of different ages, according to Liu Y. et al. [16] description, and a thorough evaluation of age may enable doctors all around the world to construct risk stratification for all COVID-19 patients. When compared to patients who were younger than 60, those who were older displayed larger clinical symptoms, greater severity, and longer disease courses. For the elderly, more medical procedures may be required as well as closer monitoring. Statistics on the age breakdown of persons who died as a result of COVID-19 are available from a number of different nations. However, the average age of the patients enrolled in the current study was 41.42±16.13. The majority of the patients were between the ages of 20 and 34 [96(48.00%)], followed by 50 and 64 [46(23.00%)]. and no association [p=0.0983] was found between the CT severity index and age.These results showed that among COVID-19 patients, a higher CT severity score was related with more serious clinical issues. Researchers also propose that associations between higher CT severity scores and hypoxia may contribute to the justification of this concern. [15] Individuals with oxygen saturation levels less than 93% should have undergone imaging modalities, according to certain research in the literature. According to UK recommendations, pulse oximetry should be used for testing and monitoring people who are sick, breathless, or at high risk for COVID-19. [17] It is indicated that considering a chest CT scan is not solely dependent on the oxygen saturation level, nor is it a deciding factor. When deciding whether to offer a chest CT scan and other diagnostic procedures, it is important to thoroughly assess the patient's general clinical state as well as all of their symptoms.[18]But because it showed a substantial link, this study shows that oxygen saturation should be considered as an auxiliary component rather than as the exclusive means of diagnosis when considering a chest CT scan into account.It is crucial to determine whether there is a correlation between oxygen saturation and CT severity. According to Aalinezhad et al., the degree of CT was significantly correlated with oxygen saturation. [15] Higher CT scores were found to demand more oxygen throughout the course of the disease. Correspondingly, Komatlapalli et al., found that oxygen saturation values decrease as CT severity scores increases. [19] Similar to the previous studies, the study conducted by Qadir FI. et al. [20]identified a significant correlation between CT severity and oxygen saturation level, showing that oxygen saturation level declines as CT severity

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increased. This finding is similar to that of the earlier studies. Another study by Qaasemya et al.[18] revealed a connection between low oxygen saturation and the degree of lung involvement. However, people between the ages of 20 and 40 did not exhibit this association.[15] This finding is significant because it shows that young people with nearly normal oxygen saturation levels can yet have significant lung involvement.

5. CONCLUSION

According to the present study's results, individuals with hypoxia have significantly increased CT severity index. On the contrary, in terms of age and gender, no correlation was observed with CT severity index. Researchers found a considerable negative correlation between CT severity and oxygen saturation, which has crucial treatment implications. This finding was published in the journal Critical Care Medicine. This study had few drawbacks like a retrospective design that may have hindered its ability to uncover prognostic markers. It was a single centre study with limited sample size. Further, multicentric studies with larger populations and additional parameters are necessary to analyse the CT severity index and its correlation with the oxygen saturation (SPO2) value of covid-19 patients.

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CONFLICT OF INTEREST: There is no conflict of interest.

6. REFERENCES

1. 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. The lancet. 2020 Feb 15;395(10223):497-506.
2. Raeiszadeh M, Adeli B. A critical review on ultraviolet disinfection systems against COVID-19 outbreak: applicability, validation, and safety considerations. Acs Photonics. 2020 Oct 14;7(11):2941-51.
3. Gorbalenya AE, Baker SC, Baric RS, de Groot RJ, Drosten C, Gulyaeva AA, et al. Coronaviridae Study Group of the International Committee on Taxonomy of Viruses. The species severe acute respiratory syndrome-related coronavirus: classifying 2019-nCoV and naming it SARS-CoV-2. Nat. Microbiol. 2020 Mar 2;5(4):536-44.
4. Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. The lancet. 2020 Feb 15;395(10223):514-23.
5. Ghebreyesus TA. World Health Organization. WHO Director-General’s opening remarks at the media briefing on COVID-19-25 May 2020.
6. World Health Organization. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations: scientific brief, 29 March 2020. World Health Organization; 2020.
7. Sahu KK, Kumar R. Current perspective on pandemic of COVID-19 in the United States. Journal of family medicine and primary care. 2020 Apr;9(4):1784.
8. Dhont S, Derom E, Van Braeckel E, Depuydt P, Lambrecht BN. The pathophysiology of ‘happy’hypoxemia in COVID-19. Respiratory research. 2020 Dec;21(1):1-9.

9. González-Duarte A, Norcliffe-Kaufmann L. Is' happy hypoxia'in COVID-19 a disorder of autonomic interoception? A hypothesis. Clinical Autonomic Research. 2020 Aug;30(4):331-3.
10. Widysanto A, Wahyuni TD, Simanjuntak LH, Sunarso S, Siahaan SS, Haryanto H, Pandrya CO, Aritonang RC, Sudirman T, Christina NM, Adhiwidjaja B. Happy hypoxia in critical COVID-19 patient: A case report in Tangerang, Indonesia. Physiological Reports. 2020 Oct;8(20):e14619.
11. Collins JA, Rudenski A, Gibson J, Howard L, O'Driscoll R. Relating oxygen partial pressure, saturation and content: the haemoglobin–oxygen dissociation curve. Breathe. 2015 Sep 1;11(3):194-201.
12. Wilson-Baig N, McDonnell T, Bentley A. Discrepancy between SpO2 and SaO2 in patients with COVID-19. Anaesthesia. 2021 Mar;76(3):6.
13. Yang R, Li X, Liu H, Zhen Y, Zhang X, Xiong Q, Luo Y, Gao C, Zeng W. Chest CT severity score: an imaging tool for assessing severe COVID-19. Radiology: Cardiothoracic Imaging. 2020 Apr;2(2).
14. Zhao W, Zhong Z, Xie X, Yu Q, Liu J. Relation between chest CT findings and clinical conditions of coronavirus disease (COVID-19) pneumonia: a multicenter study. AJR Am J Roentgenol. 2020 May 1;214(5):1072-7.
15. Aalinezhad M, Alikhani F, Akbari P, Rezaei MH, Soleimani S, Hakamifard A. Relationship between CT severity score and capillary blood oxygen saturation in patients with COVID-19 infection. Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine. 2021 Mar;25(3):279.
16. Liu Y, Mao B, Liang S, Yang JW, Lu HW, Chai YH, Wang L, Zhang L, Li QH, Zhao L, He Y. Association between ages and clinical characteristics and outcomes of coronavirus disease 2019. European Respiratory Journal. 2020 Jan 1.
17. Greenhalgh T, Knight M, Inada-Kim M, Fulop NJ, Leach J, Vindrola-Padros C. Remote management of covid-19 using home pulse oximetry and virtual ward support. bmj. 2021 Mar 25;372.
18. Qaasemya A, Khajehpoura H, Galehb HE, Dorostkarb R, Assadollahic E, Alidadid S. Chest CT-scan findings in COVID-19 patients: the relationship between the duration of symptoms and correlation with the oxygen saturation level. Romanian Journal of Military Medicine. 2021;124(1):29-36.
19. Komatlapalli RS, Arora AJ, Thakur R. Semi-Quantitative Chest Computed tomography Score in Novel Coronavirus (SARS-Cov-2) Patients: Its Correlation with Oxygen Saturation (SpO2) and Role in Predicting Oxygen Therapy Requirement.
20. Qadir FI, Kakamad FH, Abdullah IY, Abdulla BA, Mohammed SH, Salih RQ, Ali RK, Salh AM. The relationship between CT severity infections and oxygen saturation in patients infected with COVID-19, a cohort study. Annals of Medicine and Surgery. 2022 Apr 1;76:103439.