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Original Article

Physical Medicine and Rehabilitation Section

Correlation of Chest CT Scan Severity Score and Disability in Post-COVID-19 Patients: A Cross-sectional Study

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ABSTRACT

Introduction: After recovering from Coronavirus Disease 2019 (COVID-19) patients face various problems like cognitive difficulties, mobility, and self-care. COVID-19 affects the respiratory system at varying severity. The severity of the lung infection was assessed by Chest Computed Tomography (CT) Severity Score (CTSS)- higher the score higher the severity of the disease.

Aim: To identify if the CTSS that is done during active disease has any correlation with post-COVID-19 illness disabilities and fatigue.

Materials and Methods: A cross-sectional study was conducted in the post-COVID-19 rehabilitation clinic of the Department of Physical Medicine and Rehabilitation, All India Institute of Medical Sciences, Jodhpur, Rajasthan, India. Total of 36, post-COVID-19 patients were included from December 2020 to June 2021. Fatigueness was assessed on Fatigue Severity Score (FSS) and disability was assessed on World Health Organisation Disability Assessment Scale 2.0 (WHODAS 2.0). CTSS was recorded from the patient's non contrast Chest CT scan report. This CT scan of chest scan was done during active COVID-19 disease. Spearman rank-order Correlation Coefficient (SCC) was used to identify correlations.

Results: There was no positive correlation of CTSS (10.3±6.4) with disability (11.3±11.8, p-value- 0.424) and fatigue (3.3±1.8, p-value- 0.225). There was no correlation found between post-COVID-19 disabilities (11.3±11.8) and fatigue (3.3±1.8, p-value- 0.993).

Conclusion: There was no positive correlation found between lung infection severity and disabilities, fatigue after COVID-19.

Keywords: Activities of daily living, Cognitive symptoms, Fatigue, Rehabilitation, Self-care

INTRODUCTION

COVID-19 has spread worldwide, including India, resulting in a pandemic [1]. Clinical presentation varies from asymptomatic to the need for ventilator support and intensive care unit admissions. Patients with COVID-19 are at risk of developing long-term impairments and disabilities [2]. After discharge from the hospital, many patients have difficulty in activities of daily living and might develop disabilities, such as those that affect cognition, mobility, self-care, and social participation [2-8]. The extent of these impairments and disabilities is not yet known [2]. The aetiopathogenesis of fatigueness after COVID-19 is poorly understood. There is not a single cause of fatigue that can explain why patients are having fatigue after recovering from illness. Fatigue may be due to changes in the central, peripheral, or psychological environment of the human body system. Central factors include decreased dopamine and serotonin neurotransmitter levels, demyelination, inflammation, and decreased motor neuron excitability. Psychological factors like stress, anxiety, depression, and sleep disorders may affect neurotransmitter levels in the brain. Peripheral factors like skeletal muscle dysfunction and myopathies [9,10].

This new disease is commonly diagnosed by Reverse Transcription-Polymerase Chain Reaction (RT-PCR) analysis of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus on nasopharyngeal swabs from patients. In some patients, RT-PCR gives false negatives [11]. In these cases, a chest Computed Tomography (CT) scan is valuable for the diagnosis of COVID-19. The Chest CTSS is a 25-point visual quantitative assessment tool that is useful in disease management, monitoring, and prognosis [12,13]. Some studies have examined the correlation between CTSS and the clinical severity of patients [14-16]. CTSS can grade disease severity in the acute stage of COVID-19. After recovering from illness, it is seen that patients are facing sequelae of COVID-19 like fatigue, difficulty in functions, and psychological problems [6-9]. The study's hypothesis was that those patients having high CTSS, would be more prone to these impairments/disabilities, fatigue, and psychological issues. During a pandemic, the thought that was commonly prevalent among patients and the medical fraternity was that patients with high CTSS have high chances of post-COVID-19 illness and more severe symptoms. This prompted the author to conduct a study on this topic. However, to our knowledge, no published study has correlated CTSS with fatigue and disability in patients after COVID-19. The study's aim was to assess correlations of the CTSS measured during active infections with disability and fatigue after COVID-19.

MATERIALS AND METHODS

This was a single-centre cross-sectional observational study conducted in the post-COVID-19 rehabilitation clinic of the Department of Physical Medicine and Rehabilitation, All India Institute of Medical Sciences, Jodhpur, Rajasthan, India from December 2020 to June 2021. The Institutional Ethical Committee (IEC) accepted and approved (IEC/2020/3405) the study protocol, and written informed consent was obtained before the commencement of the study.

Inclusion criteria: Patient ≥18-year-old who had experienced COVID-19 and who had undergone chest High-Resolution CT (HRCT) during an active COVID-19 virus infection irrespective of whether or not they had an RT-PCR result were included in the study.

Exclusion criteria: The exclusion criteria were lack of chest CT scan during active COVID-19 infection; unwillingness to participate in the study; and presence of pre-COVID-19 neurological diseases, such as Parkinson disease, stroke, multiple sclerosis, or spinal cord injury; and presence of paralysis after COVID-19, such as that caused by stroke were excluded from the study.

Sample size estimation: A non randomised convenience sampling method was used to recruit patients. During the study period, a total

of 100 patients attended the post-COVID-19 rehabilitation clinic, out of which only 36 patients met study inclusion criteria.

Evaluation Measures

CTSS were used for quantitative estimates of pulmonary involvement, which were based on the lung area affected by symptoms. The CTSS ranges from 0 to 25, where zero indicates no lung involvement and 25 indicates maximum lung involvement [12,13]. In this study, all 36 patients' chest CT scans were done during active COVID-19 virus infections, and this CTSS score was recorded in data sheet. At the time of the study, there was limited access to CT scan facilities and fear of spreading infection also. So, no new chest CT scans were done in any patient during data collection and assessment of disabilities and fatigue.

WHODAS-2.0 is a self-administered, 36-item six domains questionnaire. It is used to assess the impact on health and functions due to various diseases and related interventions in a general population [17]. Data were recorded for any complaints experienced by patients in the last 30 days from the date of data assessment. WHODAS 2.0 intraclass correlation coefficients ranges from 0.82 to 0.99 and Cronbach's α reliability >0.70 [18]. Patients who recovered from this illness were only taken to study and these patients either had post-COVID-19 illness symptoms or asymptomatic irrespective of their post illness duration. These patients were either discharged from the hospital after recovery from acute illness or referred to post-COVID-19 rehabilitation or their 14 days isolation period was over.

FSS is a nine-item questionnaire that is used to assess fatigue in various disorders. The scale focuses on fatigue's effects on daily functioning, motivation, physical activity, work, family, and social life, and asks respondents to rate the ease with which they are fatigued and the degree to which the symptom poses a problem for them. FSS is an agreement scale ranging from 1 ("completely disagree") to 7 ("completely agree") to indicate their agreement with nine statements about fatigue. Higher scores were suggestive of more severe fatigue [19].

Based on Body Mass Index (BMI) patients were categorised into Normal (BMI 18.5-24.9), Preobese (BMI 25-29.9), Obese (BMI 30-40) [20].

STATISTICAL ANALYSIS

Statistical analysis was done using Statistical Package for the Social Sciences (SPSS) version 23.0 software (IBM SPSS Statistics for Windows, IBM Corp., Armonk, NY). A descriptive analysis of the patient demographics and clinical characteristics was also performed. Due to the non normality of the data, the relation between discrete and continuous variables was measured by the SCC. The normality of data was tested by Shapiro-Wilk test. A p-value <0.05 were considered statistical significance.

RESULTS

The mean age of the study population was 55.11±12.09 years. In the study population, 36.1% of the patients were diabetic and 41.7% were hypertensive [Table/Fig-1].

Characteristics	N	Frequency (%)
Male	27	75.0
Female	9	25.0
Diabetic (Type 2)	13	36.1
Hypertensive	15	41.7
Hospitalised	26	72.2
Home isolation	10	27.8
Body Mass Index-Normal	13	36.1
Body Mass Index-Pre-obese	7	19.4
Body Mass Index-Obese	16	44.5

[Table/Fig-1]: Baseline demographics and patient characteristics.

WHODAS 2.0 has six domains for disability assessment and three questions for the effects of difficulties (H1-H3). Questions from H1-H3 in WHODAS 2.0 measured the amount of which the several difficulties the patients faced had impacted their lives. The mean WHODAS 2.0 score was 11.3±11.8. The least affected domain of WHODAS 2.0 was self-care (1.90±6.6) and worst affected domain was participation in society (17.1±16.8) [Table/Fig-2].

A total of 12 (33.3%) had no difficulties in all H domains of WHODAS 2.0, and 66.7% had some difficulty in all three domains [Table/Fig-3].

Characteristics	Mean±SD	Minimum	Maximum
Age (years)	55.1±12.1	26.0	80.0
Weight (kilogram)	78.2±13.9	56.0	124.0
Height (centimetre)	166.3±11.1	134.6	188.0
BMI (kilogram/metre^2)	28.3±5.6	19.6	38.6
Duration at assessment (weeks)	13.1±5.8	4.0	33.0
CTSS	10.3±6.4	0	21.0
WHODAS 2.0 (%)	11.3±11.8	0	45.1
Cognition (%)	10.1±13.6	0	58.3
Mobility (%)	16.3±17.4	0	65.0
Self-care (%)	1.9±6.6	0	31.2
Getting along (%)	5.4±10.7	0	50.0
Life activities (%)	11.6±17.7	0	75.0
Participation (%)	17.1±16.8	0	59.3
FSS	3.3±1.8	1.00	6.5

[Table/Fig-2]: Baseline demographics and patient characteristics (categorical variables).
CTSS: Chest computed tomography scan score; BMI: Body mass index; WHODAS 2.0: World health organisation disability assessment score 2.0; FSS: Fatigue severity score

Effect of difficulties domain	N	%
Only H1	1	2.8
Only H2	5	13.9
Only H3	1	2.8
H2 and H3	11	30.5
All zero	12	33.3
All filled (Not zero)	6	16.7

[Table/Fig-3]: Zero responses in H1/H2/H3 (Effect of Difficulties) of WHODAS 2.0.
H1: Overall, in the past 30 days, how many days were these difficulties present; H2: In the past 30 days, for how many days were patient totally unable to carry out their usual activities or work because of any health condition; H3: In the past 30 days, not counting the days that patient were totally unable, for how many days did patient cut back or reduce their usual activities or work because of any health condition.

Overall, these difficulties were present in a mean 11.19±11.17 days out of the 30 days prior to the assessment. The patients were not completely able to carry out their usual tasks for a mean 3.13±7.07 days out of the previous 30 days [Table/Fig-4].

Domain	N	Minimum	Maximum	Mean±SD
H1	36	0	30.0	11.19±11.8
H2	36	0	30.0	3.13±7.1
H3	36	0	30.0	5.80±9.6

[Table/Fig-4]: Responses on effects of difficulties (in days, Mean±SD) of WHODAS 2.0.

There was no correlations between WHODAS 2.0 with the CTSS (SCC-=0.138, p-value=0.424) and FSS (SCC=-0.001, p-value=0.993). There was no correlation between the FSS with CTSS (SCC=-O.207, p-value=0.225) or between any individual domains (D1-D6) of the WHODAS 2.0 with the FSS and CTSS [Table/Fig-5].

Domain	FSS		CTSS	
	SCC	p-value	SCC	p-value
D1	0.087	0.614	-0.174	0.309
D2	0.143	0.405	-0.063	0.716

D3	-0.242	0.154	-0.082	0.634
D4	0.000	0.998	-0.223	0.192
D5	-0.032	0.851	-0.240	0.158
D6	-0.051	0.767	-0.122	0.480
FSS	1.000	-	-0.207	0.225
WHODAS 2.0	-0.001	0.993	-0.138	0.424
CTSS	-0.207	0.225	1.000	-

[Table/Fig-5]: Correlation of CTSS, FSS, and WHODAS 2.0 using Spearman Rank order Correlation coefficient.
SCC: Spearman rank order correlation coefficient; CTSS: Chest computed tomography severity score; BMI: Body mass index; WHODAS 2.0: World Health Organisation disability assessment score 2.0; D1: cognition; D2: mobility; D3: self-care; D4: Domain 4 (getting along); D5: life activities; D6: participation; FSS: Fatigue severity score

DISCUSSION

The current COVID-19 pandemic has significantly altered patients' lifestyle and Quality of Life (QoL). Many COVID-19 survivors were at increased risk of cardiovascular complications [21]. It is observed that most patients after COVID-19 have difficulty in performing moderate- to high-intensity work, such as stair climbing, walking for more than 1 km, and standing for ≥30 minutes [22]. Some patients even had difficulty performing mild activities, such as bathing and going outside [22]. A few studies have shown that many patients after COVID-19 have physical and psychological problems, such as difficulties in social participation, outdoor activities, anxiety, and distress [23,24]. The role of CTSS in diagnosis was initially highly debated and is not a first-line investigation to detect COVID-19 infection [12]. Observations of this study were that there was no significant correlation between disabilities, CTSS and fatigue. Chest CT in patients with active COVID-19 has a strong positive correlation of CTSS with male sex and age [24,25]. Few studies have shown that hypertension, diabetes, lung, and coronary artery disease are major risk factors for greater disease severity. The presence of multiple risk factors can further worsen the outcome [26,27]. The psychological health of patients with cardiovascular disorders significantly worsened by COVID-19 pandemic [28]. In this observational study, it was found that the majority of patients were diabetic (36.1%) and hypertensive (41.7%).

In this research, the length of time the patients had experienced symptoms after recovery from COVID-19 ranged from minimum of four weeks to maximum of 33 weeks. WHODAS version 2.0 was used to assess the patient's difficulties and disabilities related to performing activities. This showed that even 33 weeks after illness, patients still had difficulty in community participation and mobility. These patients were having difficulties in climbing stairs and walking, and experienced breathlessness. Patients were also having difficulties in activities of daily living, cognition, and getting along in decreasing severity, respectively. The activity that was least affected after COVID-19 was self-care. The authors observation was that residual disabilities post-COVID-19 significantly reduced some patient's capacity to perform routine activities in daily living. Various post-acute COVID-19 symptoms were very common presenting complaints in rehabilitation clinic in different severity [25].

Individuals' anxiety about COVID-19 and personal identity has a significant effect on the QoL and these factors can predict QoL [26]. The COVID-19 pandemic has negatively influenced the physical and psychological health of the survivors. The QoL after suffering from this infection has also decreased in the majority of patients. Community-based programs are necessary to reduce the pandemic's negative impacts and to improve the well-being and life quality of the population [24]. A thorough, early assessment and early interventions are very important in patients recovering from symptoms like severe fatigue due to COVID-19, no matter what was the severity of the initial disease [27]. Author observed during the study that recognising symptoms and prescribing early rehabilitation protocol in post-illness patients helped in recovering or improving their symptoms. Proper counselling, education, and awareness about various post-illness symptoms and their effect and available rehabilitative treatment options should be discussed with patients.

Limitation(s)

First, the sample size was small (n=36). Results with a small patient population may lead to the lower statistical power of correlation between study variables. So, further studies with a larger sample size should be done. Second, present study included only symptomatic post-COVID-19 patients in whom chest HRCT scans were performed during active COVID-19 infections either for confirmation of the diagnosis or to assess the extent of COVID-19 disease. There was a possibility that asymptomatic patients with high or low CTSS may not have reached the institute's post-COVID-19 rehabilitation clinic. This may have an effect on associations between variables. Third, the patients were from the author's department post-COVID-19 rehabilitation clinic and had post-COVID-19 complaints, such as breathlessness, fatigue, various pains, and difficulty in doing household and office work, so the results may not be generalisable to other populations. So, more studies including both symptomatic and asymptomatic patients should be done. Fourth, this was a single-centre cross-sectional study, and follow-ups were not performed to evaluate the persistence of post-COVID-19 disabilities. Multicentre studies with large patient populations with follow-ups will give more reliable results. Fifth, pulmonary-function testing was not performed in any post-COVID-19 patients because of the fear of spreading the virus. These post-COVID-19 symptoms may be due to impaired pulmonary function tests. Further studies including pulmonary function tests may provide more comprehensive and informative data for a better understanding of correlations.

CONCLUSION(S)

Patients after COVID-19 had many complaints, such as breathlessness on exertion, fatigue, pain, anxiety, and difficulty in performing day-to-day activities. This study showed that post-COVID-19 disability and fatigue were not significantly correlated with HRCT CTSS.

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