



Association of Cognitive Impairment and Handgrip Strength in Medical Undergraduate students during Covid-19 Pandemic

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Abstract

Background: SARS- CoV infection not only affected respiratory, gastrointestinal system but also musculoskeletal and neurological systems during COVID-19 pandemic. Handgrip muscle strength is the maximum force developed during maximal voluntary contraction. Not much attention has been given to assess the correlation of handgrip strength and cognitive impairment in younger generation. As neurological manifestation includes cognitive impairment in COVID 19 patients, so it was imperative to find this correlation in young adults.

Aim and Objective: Aim of the study was to assess the correlation of cognitive impairment if present, with maximal hand grip strength among young adult population during COVID-19 pandemic.

Materials and Methods: Present study was conducted on 150 Medical undergraduate students who represent young adults in 18–24 years age group in North India. The Mini-Mental State Examination & the Montreal Cognitive Assessment (MoCA) were used to measure and track cognitive decline. The grip strength of dominant hand was measured thrice at an interval of 1 min. Mean of these three readings was taken as maximal isometric tension (Tmax) for each participant.

Results: MoCA and the MMSE scores in the present study shows an alarming result of mild cognitive impairment in 41% of the participants. It was also noted that handgrip strength in both male and female students were decreased.

Conclusion: The present study suggests that there should be awareness of and sensitivity to the student's physical as well as mental health especially during the pandemic and appropriate management should be carried out.

Key Words: COVID-19 pandemic, Dynamometer; Handgrip Muscle Strength, Cognitive impairment, Mini-Mental State Examination, Montreal Cognitive Assessment

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INTRODUCTION

SARS-CoV-2 virus caused a contagious disease called Coronavirus disease- 2019 which spread from Wuhan, China in December 2019 throughout the world, resulting in Covid-19 Pandemic. Symptoms of this disease varied from mild, moderate to severe forms resulting in morbidity & mortality. SARS- CoV infection not only affected respiratory, gastrointestinal system but also musculoskeletal and neurological systems.

Handgrip strength test is a non-invasive, simple & inexpensive measurement of grip strength. It can be easily assessed, has high feasibility & validity of information. It is considered a powerful predictor of future disability, morbidity, and mortality in not only the elderly population but also in middle-aged and young people [1]. It thus provides information about frailty including physical, cognitive, and pulmonary impairments in Covid-19 patients especially with high-risk.

Cognitive function includes memory, language, attention, visuospatial and executive judgment, which can be impaired by neurodegeneration and vascular or dysthymia/dysphoria problems [2,3]. Several studies have shown cognitive impairment as a common problem in the old adults progressing to dementia and even Alzheimer's disease.

Recently some studies reported the neurological manifestations in COVID-19 patients during the pandemic [4]. Neurological manifestation in these patients included symptoms like dizziness, headache, alteration in consciousness, stroke, ataxia, and even epilepsy. Mao et al in 2020 found that patients with severe COVID disease developed disorders of consciousness, acute cerebrovascular disease, and musculoskeletal disease [5]. Some studies have mentioned about cognitive impairment as one of the neurological manifestations in COVID-19 patients during the pandemic.

One of the studies done in 2020 mentions about high C- reactive protein levels to be related to cognitive complaints during the acute phase of COVID-19 [6]. Alemanno et al in 2021 reported that 80% of COVID-19 patients had cognitive impairment by using various tools like Mini-Mental State Evaluation (MMSE), Montreal Cognitive Assessment (MoCA), Hamilton Rating Scale for Depression, and Functional Independence Measure (FIM)[7]. Some studies have mentioned that encephalopathy is associated with severe COVID [8] and akinetic mutism being associated with frontal hypometabolism [9]. Cognitive manifestations in patients with APOE 4 allele of ApolipoproteinE has also been described [10]. This association is significant since the same allele confers a higher risk of sporadic Alzheimer's disease [11].

Several studies have been done on handgrip strength and cognitive impairment in the elderly population and not much literature is available on the handgrip strength and cognition in children and young adults. As neurological manifestation includes cognitive impairment in COVID 19 patients, so it was imperative to find this correlation in young adults. During the restrictions enforced nationwide following the COVID-19 pandemic, this study was conducted on medical undergraduate students in North India.

This forms the first and foremost study in India that aimed to determine the relationship between cognition and handgrip strength during COVID-19 pandemic in medical undergraduate students who represent the young adult population. Evaluation of association between relative handgrip strength and cognitive impairment was also carried out in the above participants.

MATERIALS AND METHODS

By convenient sampling method, 150 medical undergraduates (both male and female) in the age group of 18–24 years from a medical

college in North India participated in the present study in the month of April- June 2022. Institutional Ethical clearance was taken before the start of the research.

Tools for the study included Handgrip dynamometry test as well as the Mini mental state examination & Montreal Cognitive Assessment (MoCA) test under a proper healthy, sanitized environment keeping all the Covid-19 protocols in mind.

Inclusion criteria: - Voluntary participation of young adults (medical undergraduate students) aged 18-24 years

Exclusion criteria: -Any history of medical illness
-Any history of psychotic drug use
-History of any medications affecting motor function
-History of injury or nerve damage to upper limbs
-Those with musculoskeletal disorder

The purpose and procedure of this study were explained to all the participants. Informed written consent was taken from all the subjects. The subjects were assured of complete confidentiality throughout the study.

Maximum handgrip strength (HGS) was measured with handgrip dynamometer (INCO Ambala India). The participants were asked to indicate their dominant hand during the data collection process. Subjects were then asked to compress the handgrip dynamometer with maximum effort for a brief duration of 4–5 sec and thus isometric contraction was recorded. The participants were motivated to generate the maximum force with their hands during the test. For the purpose of statistical analysis, the maximum HGS, measured in kilogram force, on the dominant hand was utilized. Three attempts were given to each subject with a pause of 10 sec between each attempt to prevent their fatigue. Mean of these three readings was taken as maximal isometric tension (Tmax).

After a rest of 5 min, the subject was asked to perform the isometric contraction at 30% of Tmax for a maximum of 3 min.

The Mini-mental state examination is used to screen for cognitive impairment, to estimate the severity of cognitive impairment at a given point of time, to follow the course of cognitive changes in an individual over time, and to document an individual's response to treatment [12]. It assesses different subset of cognitive status including attention, language, [memory](#), orientation, visuospatial proficiency. It has also been recommended for the screening of cognition in [depressed](#) patients. It takes about 10-15 minutes to administer.

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It is scored on a scale of 0-30 with scores > 25 interpreted as normal cognitive status.

- Severe cognitive impairment: 0-17
- Mild cognitive impairment: 18-23
- No cognitive impairment: 24-30

The Montreal Cognitive Assessment (MoCA) is one of the most commonly used tests to measure and track cognitive decline. MoCA Test developed by Dr. Ziad Nasreddine, detects mild cognitive impairment and other conditions that can affect cognitive functioning[13].

It consists of questions and tasks that can test a person's short-term memory, orientation to time and place, language, abstraction capabilities, attention span, problem-solving, and visual-spatial abilities. The scale consists of seven parts: visual space (0–5 points), naming (0–3 points), attention (0–6 points), language (0–3 points), abstract ability (0–2 points), delayed recall (0–5 points) and orientation (0–6 points). If the number of years of education is less than 12 years, then 1 point can be added. It takes about 10 to 15 minutes and has a maximum score of 30.

This tool is NOT designed to provide a definitive diagnosis but to help in detecting mild cognitive impairment. The following result ranges may indicate the level of cognitive impairment:

26-30 points: Normal (no impairment in cognition)

18–25 points: Mild cognitive impairment.

10–17 points: Moderate cognitive impairment.

Fewer than 10 points: Severe cognitive impairment.

As mentioned earlier the person’s level of educational attainment can however affect the final score.

Although the MoCA test is good at determining whether a person performs thinking-based activities at a suitable level, it might not be as good at telling whether a person has impaired thinking.

STATISTICAL ANALYSIS

Was carried out on Microsoft Excel sheet.

RESULTS

A total of 150 medical undergraduate students took part in the study. The demographic profile is shown in Table 1. Figure 1 shows the MoCA score of the medical undergraduate students. Figure 2 shows the MMSE score of the medical undergraduate students. Table 2 shows the regression analysis of Handgrip strength and grade of cognition obtained through MoCA score.

Table 1: Demographic profile and Handgrip strength of participants

Gender	Male	Female
Participants number	87	63
Age	21.4±1.2	21.2±1.7
BMI (kg/ m ²)	23.2±1.7	22.34±1.3
Handgrip strength (Kg)	39.4±1.1	26.4±1.7
Endurance time (sec)	38.54±18.85	27.38±14.51

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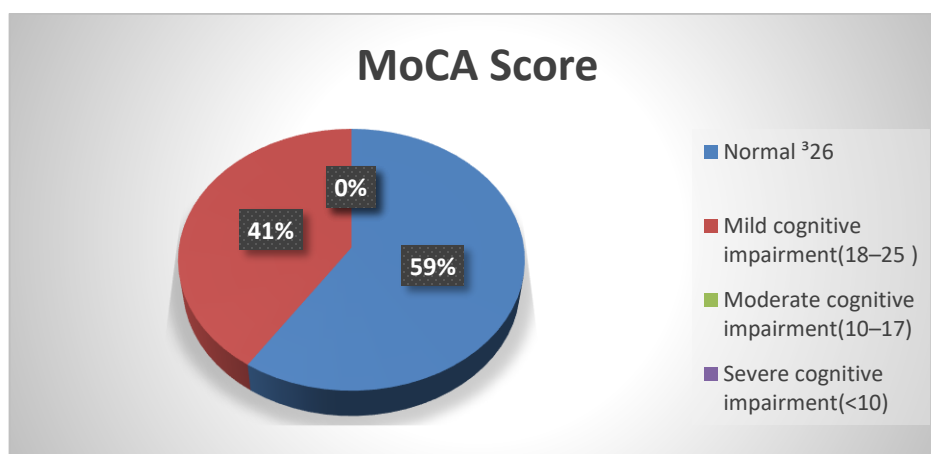


Figure 1: MoCA score of participants

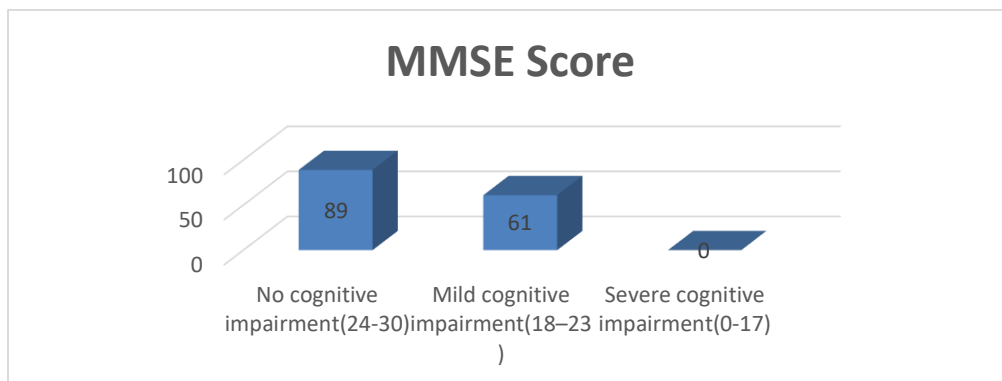


Figure 2: MMSE score of participants

Table 2: Regression analysis of MoCA score and Tmax of participants

Regression Statistics								
Multiple R	0.86							
R Square	0.74634117							
Adjusted R Square	0.74462726							
Standard Error	3.25968051							
Observations	150							
ANOVA								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	1	4626.99681	4626.9968	435.460862	6.21051E-46			
Residual	148	1572.576524	10.625517					
Total	149	6199.573333						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-17.5865382	2.584215906	-6.8053672	2.3382E-10	-22.6932654	-12.479811	-22.6932654	-12.47981105
MOCA Score	2.06625083	0.099016707	20.867699	6.2105E-46	1.870581689	2.26192	1.870581689	2.261919972

DISCUSSION

In the present study, the average age of male participants was 21.4±1.2years and that of female participants was 21.2±1.7years. There is not much data on handgrip strength and psychiatric ailment in young adults during COVID Pandemic.

Handgrip strength is one of the simplest indicators of body muscle strength and physical state [14]. The two factors influencing handgrip strength are sex and age, where sex represents the largest proportion of the total variability [15]. In the current study, the handgrip strength is slightly decreased in both males as well as female medical undergraduate students. Endurance time in the participants is also decreased in the current study.

During the COVID-19 pandemic, the term brain fog has been used to describe difficulty in concentrating, memory problems, and sometimes confusion, hypersensitivity to light and sound, and tinnitus [16]. It is well known that cognitive function is critical for daily behaviour and is essential to health-related quality of life [17]. The MoCA test is used for examining a person’s cognitive functioning, that is their ability to think. The test examines several thinking processes, including calculations, visuospatial or executive awareness, language, naming, abstraction, short-term and working memory, attention span, and orientation (to time and place).



Mild Cognitive Impairment (MCI) is a syndrome defined as cognitive decline more than expected for an individual's age and education level which does not interfere notably with activities of daily life. It is a condition that affects cognitive functions such as language, visuospatial, memory, and frontal executive functions [18]. People who have Mild Cognitive Impairment are often found to have a slight decline in the performance of the instrumental activities of daily living, but the basic activities of daily living remain independent.

In the present study, the MMSE as well as MoCA score shows mild cognitive impairment in 41% of the participants and it is an alarming result. Mild cognitive impairment is normally seen in the elderly population and rarely in young adults. Longitudinal cognitive data from pre- to post-COVID-19 sickness is rare because this infection is unpredictable.

The MoCA score and the handgrip strength in the participants is strongly correlated as the Pearson's correlation, r value, is equal to 0.86 and the p value also shows significant correlation between the two in the present study. This evidence shows that there is an association between physical and cognitive function as the physical activity of students had decreased following the COVID-19 movement restrictions. Even their studies had switched on to online mode from traditional classroom teaching-learning activity.

Previous studies have reported that poor handgrip strength is associated with a greater risk of cognitive impairment especially in the elderly population [19-22]. Low physical activity increases the risk of MCI and dementia [23]. Similarly strong positive correlation between mild cognitive impairment and handgrip strength in the current study done during the COVID pandemic in the medical undergraduates comprising the young adult population can be related to lack of physical activity following COVID 19 movement restrictions. Some studies

have reported the association between HGS and the risk of cognition decline [24 ,25].

During the COVID-19 pandemic, the lockdown or restrictions following COVID protocol were there for more than two years to protect the vulnerable populations who were at high risk [26,27]. As a result, most of the people including medical undergraduates representing the young adult population spent a long time at home. This worsened their physical performance. Therefore, young adult students, their parents and teachers need to be aware of the adverse effects of decrease in physical activity and corrective measures should be promptly undertaken by all.

LIMITATIONS

Limitations in the present study include: being a cross sectional study, it cannot be established whether there is any causal association between handgrip strength and mild cognitive impairment. Data of COVID-19 infection among participants should have been collected & cause of mild cognitive impairment be correlated to the status of infection with COVID 19 virus. The study used questionnaire to investigate cognitive impairment, follow up should be done with better diagnostic tool. As the number of participants is less, so it cannot be established on general population.

CONCLUSION

As an isometric handgrip force, measures of handgrip strength are intricately linked to cognitive functioning. The present study suggests that there should be awareness of and sensitivity to student's mental and physical health during the COVID-19 pandemic. As different strains of Corona virus are causing infection again and again, this study can also help in early detection of neurological & musculoskeletal deficits at an early age.

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