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Effect of Severity of COVID-19 Infections on Grip Strength among Post-COVID Survivors

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Abstract: ***Background: Although several studies have addressed the relationship between SARS-COV-2 infection and decrease in muscle strength but temporal relationship between them has not been studied in detail. Aim: To find out the effect of severity of COVID-19 infection on handgrip strength among post-COVID survivors. Design: cross-sectional. Setting: This study took place from June 10, 2020 to December 01, 2022 at the Rajiv Gandhi University of Health Science, Bangalore Karnataka, India. Population: Subjects with a history of SARS-COV-2 confirmed by positive result on real-time reverse-transcription polymerase chain reaction analysis of throat swab specimen and/or radiologic evaluations. Methods: The severity of COVID-19 was classified as mild, moderate and severe disease defined according to the guidelines issued by the National Institutes of Health (2020) and duration of COVID-19 infection. Handheld dynamometer was used to measure Handgrip strength. Results: 248 patients, means of Right Handgrip strength and Left Handgrip strength compared between mild to moderate, mild to severe and moderate to severe there is a statistically significance difference between the severity of Handgrip strength affected among post COVID-19 Survivors (p<0.000). Conclusion: Handgrip strength showed statistically significant reduction in severely affected post-COVID survivors than mild and moderately affected post-COVID survivors. This study suggests that handgrip strength assessment need to be considered in various conditions to know the prognosis of COVID-19.***

Keywords: COVID-19, Handgrip strength, Handheld dynamometer

1. Introduction

Coronavirus is a novel disease spread rapidly, resulting in a global pandemic.1More than 536 million peoples were diagnosed and more than 11.5 billion people got vaccinated with doses as of June 2022 and over 6 million have lost their lives as a result of the COVID-19 infection.2 Corona viruses are enclosed, single-stranded large RNA viruses that infect humans as well as a variety of other species.[3] The primary mode of transmission remains person-to-person transmission. The common symptoms of COVID-19 are Fever, dry cough, and fatigue, upper respiratory symptoms include pharyngalgia, headaches, and myalgia and asymptomatic also.[4] Patients with moderate and severe SARS infections have reported a significant musculoskeletal symptoms.[5] The inflammatory response in the airway can cause systemic inflammation, affect almost every organ system, including the musculoskeletal system.[6] COVID-19 increases mitochondrial dysfunction & autophagy, that decrease mitochondrial biogenesis and muscle synthesis, thereby increasing myofibrillar breakdown that cause more and more muscle degradation. Hence, Hand grip strength (HGS) get affected.[7]

Muscle loss due to lack of nutrition, lack of mobility, systemic inflammation, and muscle protein loss can lead to impairment of respiratory muscle strength as well, delaying of weaning from mechanical ventilation, longer ICU and hospital stay associated with decreased functional status, and eventually result to loss of independence and quality of life.[8]

Muscle function assessments provide organ-level information for the early phases of physical function impairments.[9] Grip Strength, not only directly represents hand muscle strength but also is an indicator of global muscle function, future disability, falls, morbidity, and fatality.[10]Handgrip strength (HGS) is a simple and valid measure of muscle function that requires individuals to squeeze an isometric dynamometer at maximum effort for a brief period of time (e. g., 3-5 seconds) for 3 trials. Hand-held dynamometers (HHD) are portable, non-invasive, quick, simple to use, do not need expertisation and has minimal intra-observer variability as well as excellent test-retest reliability.[11, 12]

Decrease in HGS (recorded in kg) is associated with decreased in immune system and increase susceptibility to SARS-CoV-2 and other viral infections. Due to paucity of literatures & uncertainty about relationship between decreased muscle strength depending on severity of SARS-CoV-2 infection.[13]This study can be predictive for increased morbidity/mortality, treatment response and prevention of further detoriation.

2. Method

Study design and participants

This cross-sectional study was studied on 248 male subjects aged between 31 to 40 years old at Rajiv Gandhi University of health sciences (RGUHS), Goutham physiotherapy clinic, Bangalore from June 10, 2020 to Dec 1, 2022.

Disease severity

The severity of COVID-19 was defined by guideline of National Institutes of Health (2020) and was classified as mild disease (show various signs and symptoms of fever, cough, sore throat, malaise, headache, muscle pain without shortness of breath, dyspnoea, or abnormal chest imaging); moderate disease (evidence of lower respiratory disease by clinical assessment or imaging and SpO2 ≥ 94% on room air at sea level) and severe disease (respiratory frequency >30 breaths per minute, SpO2 < 94% on room air at sea level, a ratio of the arterial partial pressure of oxygen to fraction of inspired oxygen (PaO2/FiO2) < 300 mmHg or lung infiltrates > 50%).[14]

Procedure

Demographic data such as age, BMI, hand dominance and associated co-morbities was collected, then grip strength of both hands was measured. The subjects were seated in a chair without armrests and feet resting on ground; hips against the back of the chair; shoulder adducted, elbow flexed at 90 degrees, forearm in mid-prone position, wrist between 0-30 degrees of extension and 0-15 degrees of ulnar deviation. The subjects were instructed to grip the dynamometer and squeeze as hard enough to break it. Three trials were performed in both hand with 15 second and average of all three trials were considered as final reading. Since the normative values for HGS for male subjects aged between 31 to 40 years old is 41.56 ± 2.24 kgs (dominant hand) and 36 ± 1.95 kgs (non-dominant hand).[15], the same was used as the reference values to assess the effect of COVID-19 on grip strength. The dependant variables were Handgrip strength and independent variables were post COVID-19 survivors.

Statistical Analysis

Descriptive statistical analysis was done in this study. The outcome measurements such Hand Grip Strength (measured in kilograms) among post-COVID19survivors were analysed and presented as mean ± SD.

Significance is assessed at 5 % level of significance with p value 0.05 less than this is considered as statistically significant difference.

Statistical tests:

Chi-Square test and has been used to analyse the significant of basic characteristic of age of the subjects studied.

ANOVA test has been used to compare the significance among different severity of post COVID19 infection survivors.

Bonferroni Post Hoc Tests has been used for Multiple Comparisons.

Paired 't' test as a parametric was used to analysis the variables between right and left side.

Statistical software: The Statistical software used is SPSS 16.0 and Microsoft word and Excel have been used to generate graphs, tables etc.

3. Results and Interpretation

The mild post COVID-19 survivor's, there were 83 subjects with mean age is 34.55 years. In Mild group mean right side hand grip strength is 50.68kg; mean left side hand grip strength is 46.06kg. In the moderate post-COVID19 survivors, there were 83 subjects with mean age is 35.57 years. In moderate group mean right side hand grip strength is 41.05kg; mean left side hand grip strength is 37.16kg. In the severe post-COVID-19 survivors, there were 82 subjects with mean age is 35.01 years. In severe group mean right side hand grip strength is 33.67kg; mean left side hand grip strength is 31.76kg. when means of Right-Hand Grip Strength and Left-Hand Grip Strength compared between mild to moderate, mild to severe, moderate to severe there is a statistically significance difference between the severity of HGS affected among post COVID-19 Survivors. When the right hand and left-hand grip strength compared within the different severities of post COVID-19, there is no difference in grip strength between right and left hand within mild, moderate and severe post COVID-19.

4. Discussion

The current study found that Hand Grip Strength is decreased depending on the mild to moderate, mild to severe, moderate to severe COVID-19 survivors. The result showed moderate and severe COVID-19 survivors exhibited statistically more significant differences in Hand Grip Strength than mild post COVID-19 survivors. The result of current study supported with a similar study conducted on association between SARS-CoV-2 infection and decreased hand grip strength (HGS) by Oscar et al. in 2021. In their study, they also found a significant difference in the HGS in post COVID-19. They explained this could be because of chronic damage to skeletal muscle.[16] One more study conducted to classify the symptoms of musculoskeletal system in COVID-19 patients, to evaluate myalgia, arthralgia and physical/mental fatigue, to assess handgrip muscle strength, and to examine the relationship of these parameters with the severity and laboratory values of the disease by Tuzun et al. in 2020. This study also explained reduction of Hand Grip Strength and Muscular involvement in post COVID-19 infection.[14]The physiological explanations behind this result could be decrease in mitochondrial biogenesis and muscle synthesis that causes mitochondrial dysfunction and autophagy, myofibrillar breakdown and muscle degradation. This results in myalgia, atrophy, fatigue and weakness of skeletal muscle as literature proven by Piotrowick K, et al. in 2021.[7]

During the data collection most of the subjects were denying of having COVID-19 infection before HGS Measurement, could be due to fear of isolation. Most of the subjects complained of fatigue and pain in hand and forearm after 3 trials of grip strength measurements during the present study. This could be due to COVID-19 pandemic as all the subjects were compromised to reduced level of physical activity and muscle weakness. Finally, the current study indicates considerable decrease in Hand Grip Strength among COVID-19 survivors with respect to severity of infection. Hence, we accept the alternate hypothesis and reject the Null hypothesis that there is significant effect of

severity of COVID-19 infection on Hand grip strength among post-COVID survivors. This study provides unique opportunity to evaluate Hand Grip Strength with severity of COVID-19 infection.

5. Limitation of the Study

The subjects were assessed only once but the result that we acquire suggests a need for a follow up study. The study did not assess the female patient which could have affected the result. The study was included only limited age group which led to missing the comparative effects among adult age group subjects.

6. Suggestions for Further Study

The study should be done to find effect of COVID-19 on HGS in different age group subjects. Needed more study in mild, moderate and severe COVID-19 to find out reason behind decrease in muscle strength. Further study can include both genders and find the effect of gender on HGS post COVID-19 infection.

7. Conclusion

This present study concludes that Hand Grip Strength shown statistically significant reduction on depending on the severity of COVID-19 among mild, moderate and severely affected post-COVID survivors. This study suggests that Hand grip strength assessment need to be considered in various conditions using the upper limb to know the prognosis of COVID-19 as it is a most important key element.

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Conflicts of Interest
The author certifies that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Author Disclosures:

There was no external funding in the preparation of this manuscript.

Author certifies that he, or a member of his immediate family, has no commercial association (i. e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

Compliance with Ethical Standards:

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with declaration and its later amendments or comparable ethical standards.

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