Fisioterapia & Saúde Funcional

Original Article

Hand Grip Test in Post-COVID-19 Patients: Late Impacts of the Infection

Teste de força de preensão manual em pacientes pós-COVID-19: Impactos tardios da infecção

Maria Alice Pereira Junqueira de Oliveira[1], Natã Sampaio Monteiro[1], Giovanna Montessi Amorim[1], Bruno Sant'Ana Costa[1], Juliana Mendonça Pereira Amaral[2], Vivian de Oliveira Sousa Corrêa[1]

1. Universidade Federal do Rio de Janeiro (UFRJ), Macaé, RJ, Brazil.
2. Escola Superior de Ensino Helena Antipoff - Pestalozzi, Niterói, RJ, Brazil.

ABSTRACT

This study aims to evaluate hand grip strength in individuals post-SARS-CoV-2 infection, comparing results with normative values from the literature. Twenty-three Brazilian participants aged 18-59 who had COVID-19 underwent hand grip testing using a dynamometer. Their results were compared to expected values based on gender and age. For the female participants in this study, the mean grip strength was 21.45 ± 5.94 kgf for the dominant hand and 21.06 ± 5.80 kgf for the non-dominant hand. In the male group, the mean grip strength was 23.65 ± 6.02 kgf for the dominant hand and 19.57 ± 2.53 kgf for the non-dominant hand. The comparison indicated that, for both genders, the average grip strength recorded in this study was significantly lower than the expected values for the population. SARS-CoV-2 infection leads to compromised muscle function. The hand grip test is a low-cost, easy-to-use tool for assessing and managing patients with various conditions.

Keywords: Fatigue. Muscle strength. Post-Acute COVID-19 Syndrome.

Corresponding author: Vivian de Oliveira Sousa Corrêa – sousa.vo@gmail.com.

Conflict of Interest: The authors declare no conflicts of interest.

Submitted on 11/26/2024 | Accepted on 06/23/2025 | Published on 07/18/2025

DOI: 10.36517/rfsf.v12i1.94473

INTRODUCTION

In March 2020, the World Health Organization (WHO) declared COVID-19 a pandemic[1], prompting a significant mobilization of human, financial, and technological resources worldwide. In the United States, approximately 4.1 million patients required hospitalization for COVID-19 between August 2020 and January 2023. Many of these patients faced prolonged hospital stays, including time in Intensive Care Units, due to complications from the initial illness.[2,3]

Amidst this public health crisis, numerous studies have highlighted the emergence of a secondary condition known as post-COVID syndrome, long COVID, or simply post-COVID. Evidence indicates that fatigue and sleep disturbances are among the most prevalent immediate lingering symptoms in these patients, while anxiety, dyspnea, and fatigue are more common in later stages.[4,5] This underscores that severe infections can lead to long-term sequelae, including physical and cognitive impairments, as well as mental health challenges, even in individuals who appear to have recovered from the initial infection.[6]

In the scientific community, the concept of fatigue is characterized by a lack of consensus among researchers, which can impede the advancement of knowledge on the subject[7]. While some experts attribute fatigue primarily to physical causes, others view it as a mental phenomenon. Nonetheless, fatigue is generally understood as a subjective and multifactorial condition, with its origins and manifestations influenced by physical, cognitive, and emotional factors.[8]

There are several methods to analyze components of fatigue, one of which is handgrip strength. This is a measure of maximum voluntary palmar muscle strength assessed using a dynamometer. It is commonly used in clinical practice to monitor rehabilitation processes,[9] and manage musculoskeletal disorders of the hand.[10] Handgrip strength is considered a simple, objective, and safe method for assessing muscle function. Additionally, evidence suggests it can predict muscle cell depletion, nutritional status, reduced functionality during hospitalization, postoperative complications, and mortality.[11]

This study aims to quantitatively analyze the handgrip strength values in individuals who were infected with SARS-CoV-2, comparing these results with the expected averages reported in the literature. The primary hypothesis is that these individuals will achieve lower than expected results in the test, based on evidence suggesting that more than half of the patients experience fatigue as a sequel.[12,13]In this context, fatigue includes both physical and mental aspects and can be defined as a debilitating and persistent sensation of tiredness or exhaustion, characterized by a lack of energy, muscle weakness, slow reactions, drowsiness, and concentration deficits.[14]

METHODS

This study is part of a project approved by the Ethics Committee for Research with Human Subjects (CAAE: 53346421.0.0000.5699). Volunteers were recruited from the Post-COVID Care and Rehabilitation Center (CARP) in Macaé, Rio de Janeiro, Brazil. The CARP primarily provided care to patients referred by the municipality or those presenting on a walk-in basis, which directly influenced the profile of individuals available for the study. We faced a significant limitation in recruitment, as it was challenging to obtain a larger number of participants, particularly due to the low attendance of men at the center during the study period. This referral dynamic, combined with the predominantly female demand for post-COVID-19 rehabilitation services, resulted in a final sample of 17 women and 6 men, all of whom met the inclusion and exclusion criteria. Assessments were conducted from March 2022 to September 2023. Each volunteer underwent a medical history review and physical examination, followed by a handgrip strength test using a dynamometer.

Inclusion and exclusion criteria

To be included in the study, participants needed to be between 18 and 59 years old and have a documented history of SARS-CoV-2 infection. The exclusion criteria focused on conditions that could interfere with the handgrip test or affect its results. These criteria included: neuromuscular diseases, chronic obstructive pulmonary disease, neurodegenerative diseases, dementia, history of traumatic brain injury or stroke, unstable angina, uncontrolled systemic arterial hypertension, recent pulmonary embolism, myocardial infarction within the month prior to evaluation, severe anemia, unstable oximetry measurements, and a resting heart rate greater than 120 bpm.

Recruitment and assessment

Recruitment began with an active search, primarily through reviewing medical records of potential volunteers, considering the study's inclusion and exclusion criteria. Additionally, a communication channel was established between the project team and CARP professionals to identify more potential volunteers and maintain engagement for research participation and clarification of any doubts. Once the selection process was completed, potential volunteers participated in individual conversations with the project team, where the study's risks, benefits, and questions were addressed. Those who agreed to participate signed the informed consent form.

Before conducting the handgrip test, volunteers underwent an initial assessment to collect personal data, including full name, age, gender, and dominant hand. They were also asked about any lingering symptoms or sequelae of COVID-19, pre-existing conditions, ongoing treatments, current physical exercise practices, diet, alcohol consumption, and smoking habits. A physical examination was conducted to gather data on Body Mass Index (BMI), oxygen saturation, and blood pressure.

Hand grip test

The hand grip test was conducted with the volunteer seated, arm parallel to the body, shoulder adducted, elbow flexed at 90 degrees, and forearm and wrist in a neutral position. Each hand was tested with three consecutive attempts, maintaining an isometric contraction for 3 to 5 seconds. The test utilized a handheld digital dynamometer, model DM-90, which has a range of 1 to 90 kgf and a graduation of 0.1 kgf. For analysis, the highest value obtained from each limb was recorded.

Data analysis

The volunteers' data were divided into two groups based on gender. The data were then analyzed using GraphPad Prism software. For each group, the mean of the highest values obtained in the hand grip test for each hand was calculated. A one-way ANOVA was conducted to assess differences among the groups. Following the ANOVA, Tukey's post hoc test was performed to identify specific group pairs with significant differences. Statistical significance was set at a p-value of less than 0.05.

To estimate the statistical power achieved by our study, we also conducted a post-hoc power analysis using the G*Power software version 3.1.9.7. The analysis was configured for a one-sample t-test ("Means: Difference from constant [one sample case]"), under the option "Post hoc: Compute achieved power – given α, sample size, and effect size," with two-tailed testing and a significance level of α = 0.05. This approach, in which the effect size is derived from the sample data to calculate the observed power, is sometimes referred to as retrospective power analysis.

RESULTS

A total of 23 individuals met the study's inclusion and exclusion criteria and underwent an initial assessment followed by a hand grip strength test using a dynamometer. The group consisted of 17 females and 6 males. The age range for female participants was 23 to 59 years, with a mean age of 43 ± 9 years. For the male participants, the mean age was 42 ± 9 years, with an age range of 25 to 58 years. All male volunteers were right-handed, whereas only one female participant was left-handed. Detailed sample characteristics are provided in Table 1.

Table 1. General characteristics of both groups

Variable	Female (n=21)	Male (n=6)
Age (average, years)	43,17 ± 9,78	42,33 ± 9,75
BMI (average, kg/m²)	29,57 ± 5,34	29,07 ± 4,70
Oxygen saturation (average, %)	97,68 ± 1,44	97 ± 0,81
Systolic blood pressure (average, mmHg)	118 ± 16,70	120 ± 11,54
Diastolic blood pressure (average, mmHg)	75 ± 9,39	73 ± 7,45

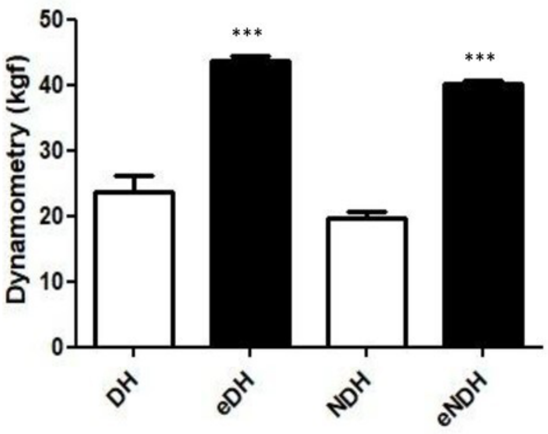
In terms of BMI, the female group recorded values ranging from 22.46 kg/m^2 to 39.49 kg/m^2, with a mean of 29.57 ± 5.34 kg/m^2. For male participants, BMI values ranged from 22.50 kg/m^2 to 36.00 kg/m^2, with an average of 29.07 ± 4.70 kg/m^2.

Peripheral oxygen saturation, measured with a pulse oximeter, averaged 97.6 ± 1% in females and 97 ± 0.8% in males. The mean systolic blood pressure, measured manually with a sphygmomanometer, was 118 ± 16 mmHg for females and 120 ± 11 mmHg for males. Diastolic pressure averaged 75 ± 9 mmHg in females and 73 ± 7 mmHg in males.

The hand grip strength results were compared to the expected values reported by Caporrino, which represent the average grip strength for healthy Brazilian adults aged 20-59 for both dominant and non-dominant hands[15]. In this study, female participants had a mean grip strength of 21.45 ± 5.94 kgf for the dominant hand and 21.06 ± 5.80 kgf for the non-dominant hand. Male participants had a mean grip strength of 23.65 ± 6.02 kgf for the dominant hand and 19.57 ± 2.53 kgf for the non-dominant hand. In contrast, Caporrino's study reported average grip strength values of 31.6 ± 7.5 kgf for the dominant hand and 28.4 ± 7.0 kgf for the non-dominant hand in women, and 44.2 ± 8.9 kgf and 40.5 ± 8.5 kgf for the dominant and non-dominant hands in men, respectively[15]. This comparison indicates that, for both genders, the average grip strength recorded in this study was significantly lower than the expected values for the population ($p < 0.0001$). The detailed performance of the volunteers is illustrated in Graphs 1 and 2.

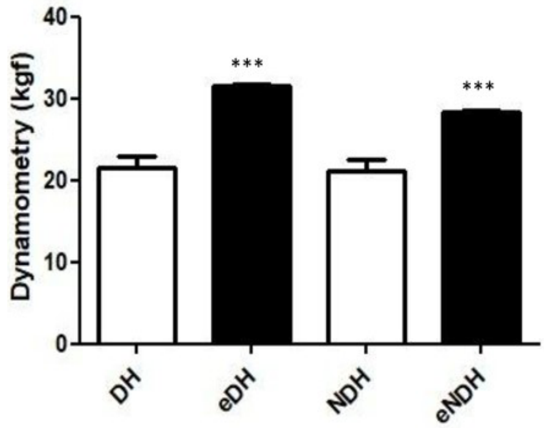
The post-hoc power analysis revealed that the study had high statistical power to detect the observed differences in handgrip strength. The calculated Cohen's d values for each comparison, based on the respective sample sizes, were approximately 1.709 and 1.266 for the dominant and non-dominant hands in females, respectively. In males, the effect sizes were 3.414 for the dominant hand and 8.273 for the non-dominant hand. Based on these effect sizes, the achieved power was approximately 0.9999981 for the female dominant hand, 0.9982873 for the female non-dominant hand, 0.9999948 for the male dominant hand, and 1.0000000 for the male non-dominant hand. These high power values are attributable to the large effect sizes (Cohen's d) observed across all comparisons.

Graph 1. Comparison of the obtained and expected values in the palmar grasp test with male volunteers



Legend: DH = dominant hand; eDH = expected in the dominant hand; NDH = non-dominant hand; eNDH = expected in the non-dominant hand.*** p<0.0001.

Graph 2. Comparison of the obtained and expected values in the palmar grasp test with female volunteers



Legend: DH = dominant hand; eDH = expected in the dominant hand; NDH = non-dominant hand; eNDH = expected in the non-dominant hand.*** p<0.0001.

DISCUSSION

This study demonstrates that individuals previously infected with SARS-CoV-2, regardless of gender, exhibit a reduction in upper limb muscle strength, as evidenced by the handgrip test. Despite this finding, there is a notable gap in scientific research regarding the pathophysiological mechanisms underlying fatigue as a sequela of the infection. Furthermore, there is a lack of objective methods for identifying and managing this symptom effectively.

Studies have demonstrated that hand grip strength serves as an indicator of both muscle strength and power, influencing mortality rates across various scenarios.[16,17] Therefore, a single hand grip test can provide valuable results for comparing the effectiveness of different interventions, establishing therapeutic goals, and assessing an individual's functionality.[18] Conducting the hand grip test in post-COVID-19 patients may thus represent a simple and cost-effective method for early identification of lingering symptoms of the infection. This approach can facilitate the timely treatment of these patients, reducing the negative impacts of the syndrome in question, such as the impairment of individuals' quality of life, workplace absenteeism, and difficulty in returning to work.[19]

Another study involving 93 volunteers demonstrated low grip strength readings among elderly individuals who had recovered from COVID-19, particularly in the older age group. This finding suggests the necessity for monitoring and implementing rehabilitation interventions for older adults affected by COVID-19.[20] Additionally, a study conducted with 144 female volunteers concluded that impaired palmar grasp strength serves as an objective marker of physical function in patients with post-COVID syndrome. These findings underscore the importance of using the palmar grasp test in managing these patients.[21]

It has already been demonstrated that fatigue can be one of the main symptoms, both acute and chronic, of SARS-CoV-2 infection[22,23], or even the primary residual clinical finding of the viral condition.[19,24,25] This symptom is often influenced by the subjectivity of both individuals and healthcare professionals, which can lead to it being overlooked in healthcare settings and causing impairments in the daily lives of those affected. In this context, measuring hand grip strength provides an objective method to assess the degree of muscle fatigue in these patients, potentially minimizing the impact of subjective factors from both the patient and the healthcare professional.

In the study sample, male participants predominantly exhibited lower-than-expected results in the hand grip test using a dynamometer. Conversely, while most female participants also showed lower-than-expected results, the extent was less pronounced compared to the male group. This finding may suggest a delayed impact of SARS-CoV-2 infection on muscle function, indicating that different sexes may experience varying degrees of this impact. These findings warrant further studies to better understand the underlying pathophysiological mechanisms.

The post-hoc power analysis revealed the following statistical power values for the comparisons performed: female dominant hand (0.9999981), female non-dominant hand (0.9982873), male dominant hand (0.9999948), and male non-dominant hand (1.0000000). These high power values are a direct consequence of the large effect sizes (Cohen's d) observed in our sample for each comparison. It is important to emphasize that, although the detection of large effect sizes leads to high statistical power, small sample sizes are more susceptible to random variability. As a result, significant findings in smaller samples may produce inflated effect size estimates—that is, they may overestimate the true magnitude of the effect in the population. This implies that the actual difference in the broader population may not be as pronounced as the Cohen's d values observed in our study suggest. While the power is high to detect the observed differences, generalization of these results to the wider population should be approached with caution due to the sample's limitations.

We acknowledge that the sample size (n = 23) is relatively small and that the gender imbalance (17 women and 6 men) represents a significant limitation. This disproportion reflects the recruitment challenges encountered, as the study was conducted with volunteers from the Post-COVID Rehabilitation and Care Center (CARP) in Macaé, Rio de Janeiro. The center's service dynamics—receiving patients primarily through municipal referrals—combined with the low demand from male patients during the data collection period (March 2022 to September 2023), directly influenced the final sample profile. Additionally, during this period, there was already a notable reduction in the severity of COVID-19 cases, which contributed to decreased demand for specialized rehabilitation services and, consequently, a reduced availability of participants for the study.

The gender imbalance in our sample, with 17 women and only 6 men, is a significant limitation that directly affects the robustness of sex-based comparisons. This disproportion limits the ability to make generalizable inferences regarding the differential impact of SARS-CoV-2 infection on handgrip strength between men and women. Although the data suggest a more pronounced impairment in the male group, this observation is preliminary and cannot be generalized without future studies involving larger and more representative male samples, which would allow for more robust and conclusive comparative analyses.

The assessment of participants at different time points post-infection, without clear stratification by time elapsed or initial disease severity, is a limitation that may introduce bias. Factors such as the post-infection interval and the severity of COVID-19 are known to influence functional recovery and the persistence of muscular sequelae. This temporal and clinical heterogeneity may have diluted relevant associations. Furthermore, the absence of pre-infection handgrip strength values prevents an accurate evaluation of the degree of strength loss at the individual level.

We conclude the discussion by reaffirming the value of this study as a preliminary investigation and the utility of handgrip strength testing. We emphasize the need for future studies with larger, more homogeneous samples—in terms of time since infection and disease severity—and balanced gender distribution to validate and expand upon the findings. Additionally, we acknowledge the challenge of rigorously controlling for prior SARS-CoV-2 infection history in the general population, given that most individuals have been exposed to the virus at some point, often more than once. Many may have been infected without undergoing diagnostic testing, particularly due to the reduced severity of acute symptoms as a result of immunization and viral evolution.

CONCLUSION

Infection with the SARS-CoV-2 virus leads to a range of long-term sequelae, including fatigue and impaired muscle function. This study suggests that patients, particularly males, experience a reduction in handgrip strength following infection. The use of handgrip strength testing with a dynamometer should be highlighted as a low-cost and easy-to-use tool for healthcare professionals in the assessment and management of patients with a history of COVID-19, as well as other conditions.

Although this study represents a pioneering effort to evaluate handgrip strength in post-COVID-19 patients in our region, its inherent limitations—such as the small sample size, gender imbalance, temporal heterogeneity of cases, and absence of baseline data—must be taken into account when interpreting the findings. These limitations underscore the urgent need for future, more robust studies with larger, more homogeneous and gender-balanced samples to validate and deepen the understanding of the long-term impact of SARS-CoV-2 infection on muscle function.

REFERENCES

1. Cucinotta D, Vanelli M: WHO declares COVID-19 a pandemic. Acta Biomed 2020;91: 157–60.
2. Gold JAW et al. Race, Ethnicity, and Age Trends in Persons Who Died from COVID-19 — United States, May–August 2020. Morbidity and Mortality Weekly Report.2020; v. 69, n. 42, p. 1517-1521. doi:10.15585/mmwr.mm6942e1.
3. Centers for Disease Control and Prevention: COVID data tracker. 2022. https://covid. cdc.gov/covid-data-tracker/#new-hospital-admissions.
4. Iqbal, FM et al. Characteristics and predictors of acute and chronic post-COVID syndrome: A systematic review and meta-analysis. EClinicalMedicine.2021; v. 36, p. 100899. doi:10.1016/j.eclinm.2021.100899.
5. Ceban F et al. Fatigue and cognitive impairment in Post-COVID-19 Syndrome: A systematic review and meta-analysis. Brain, Behavior, and Immunity. 2022; v. 101, p. 93-135. doi:10.1016/j.bbi.2021.12.020.
6. Herridge MS et al. Functional Disability 5 Years after Acute Respiratory Distress Syndrome. New England Journal of Medicine. 2011; v. 364, n. 14, p. 1293-1304. doi:10.1056/nejmoa1011802.
7. Mota DDCF, Cruz DALM, Pimenta CAM. Fadiga: uma análise do conceito. Acta Paulista de Enfermagem. 2005; v. 18, n. 3, p. 285-293. doi:10.1590/s0103-21002005000300009.
8. Mota DDCF, Pimenta CAM. Fadiga em pacientes com câncer avançado: conceito, avaliação e intervenção. Revista Brasileira de Cancerologia. 2002; v. 48, n. 4, p. 577-583. doi:10.32635/2176-9745.rbc.2002v48n4.2172.
9. Tredgett MW, Davis TRC. Rapid Repeat Testing of Grip Strength for Detection of Faked Hand Weakness. Journal of Hand Surgery. 2000; v. 25, n. 4, p. 372-375. doi:10.1054/jhsb.2000.0433.
10. Sande LP et al. Effect of musculoskeletal disorders on prehension strength. Applied Ergonomics. 2001; v. 32, n. 6, p. 609-616. doi:10.1016/s0003-6870(01)00035-7.
11. Schlüssel MM et al. Reference values of handgrip dynamometry of healthy adults: A population-based study. Clinical Nutrition. 2008; v. 27, n. 4, p. 601-607. doi:10.1016/j.clnu.2008.04.004.
12. Carfi A, Bernabei R, Landi F. Persistent Symptoms in Patients After Acute COVID-19. JAMA. 2020; v. 324, n. 6, p. 603. doi:10.1001/jama.2020.12603.
13. Mandal S et al. 'Long-COVID': a cross-sectional study of persisting symptoms, biomarker and imaging abnormalities following hospitalisation for COVID-19. Thorax, p. thoraxjnl. 2020;215818. doi:10.1136/thoraxjnl-2020-215818.
14. Ortelli P et al. Neuropsychological and neurophysiological correlates of fatigue in post-acute patients with neurological manifestations of COVID-19: Insights into a challenging symptom. Journal of the Neurological Sciences. 2021; v. 420, p. 117271. doi:10.1016/j.jns.2020.117271.
15. Caporrino FA, Faloppa F, Santos JB et al. Estudo populacional da força de preensão palmar com dinamômetro Jamar. Rev Bras Ortop. 1998; 33(2):1-1.
16. Ikemoto Y et al. Force-time parameters during explosive isometric grip correlate with muscle power. Sport Sciences for Health. 2007; v. 2, n. 2, p. 64-70. doi:10.1007/s11332-007-0041-3.
17. Rantanen T et al. Handgrip Strength and Cause-Specific and Total Mortality in Older Disabled Women: Exploring the Mechanism. Journal of the American Geriatrics Society. 2003; v. 51, n. 5, p. 636-641. doi:10.1034/j.1600-0579.2003.00207.x.
18. Figueiredo IM et al. Test of grip strength using the Jamar dynamometer. Acta Fisiátrica. 2007; v. 14, n. 2. doi:10.5935/0104-7795.20070002.
19. Ida FS et al. Síndrome pós-COVID-19: sintomas persistentes, impacto funcional, qualidade de vida, retorno laboral e custos indiretos - estudo prospectivo de casos 12 meses após a infecção. Cadernos de Saúde Pública. 2024; v. 40, n. 2. doi:10.1590/0102-311xpt026623.
20. Tai MH et al. 1041 Hand Grip Strength Among Post-Acute COVID-19 Older Adults. Age and Ageing. 2022; v. 51, Supplement_2. doi:10.1093/ageing/afac126.060.
21. Paffrath A et al. Impaired Hand Grip Strength Correlates with Greater Disability and Symptom Severity in Post-COVID Myalgic Encephalomyelitis/Chronic Fatigue Syndrome. Journal of Clinical Medicine. 2024; v. 13, n. 7, p. 2153. doi:10.3390/jcm13072153.
22. Blomberg B et al. Long COVID in a prospective cohort of home-isolated patients. Nature Medicine. 2021; v. 27, n. 9, p. 1607-1613. doi:10.1038/s41591-021-01433-3.
23. Salari N et al. Global prevalence of chronic fatigue syndrome among long COVID-19 patients: A systematic review and meta-analysis. BioPsychoSocial Medicine.2022; v. 16, n. 1. doi: https://doi.org/10.1186/s13030-022-00250-5.
24. Tabacof L et al. Post-acute COVID-19 Syndrome Negatively Impacts Physical Function, Cognitive Function, Health-Related Quality of Life, and

Participation. American Journal of Physical Medicine & Rehabilitation. 2022; v. 101, n. 1, p. 48-52. doi:10.1097/phm.0000000000001910.
25. Peter RS et al. Post-acute sequelae of covid-19 six to 12 months after infection: population based study. BMJ. 2022;p. e071050. doi:10.1136/bmj-2022-071050.

Universidade Federal do Ceará
Departamento de Fisioterapia da Faculdade de Medicina
Revista Fisioterapia & Saúde Funcional
Fortaleza, volume 12, número 1 | ISSN 2238-8028
Contato: revista.fisioterapia@ufc.br
https://periodicos.ufc.br/fisioterapiaesaudefuncional