Step tests are feasible, safe, and can be used to evaluate exercise capacity at home after hospitalization for COVID-19

Os testes do degrau são viáveis, seguros e podem ser utilizados para avaliar a capacidade de exercício no domicílio após hospitalização por COVID-19

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Date of first submission: September 4, 2023
Last received: February 7, 2024
Accepted: February 19, 2024

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Abstract

Introduction: Step-based tests are commonly utilized to assess the exercise capacity of individuals with respiratory diseases. However, the feasibility and safety of the step tests have not yet been studied in individuals after COVID-19. **Objective:** To investigate the feasibility and safety of the six-minute step test (6MST) and the modified incremental step test (MIST) in assessing exercise capacity at home in individuals after hospitalization for COVID-19, and to identify factors associated with performance in these tests. **Methods:** Cross-sectional multicenter study with individuals hospitalized for COVID-19 fifteen days after hospital discharge. Participants performed spirometry, 6MST, and MIST during a single home visit. Adverse events were registered during and immediately after the tests. **Results:** Sixty-five participants were studied (50 ± 10 years old, 55% male). The feasibility was 96.9% and the incidence of adverse events was 13.8% in 6MST and 6.2% in MIST. The individuals performed 76.9% of the predicted on the 6MST, with 40% of the participants reaching 80% of the maximum HR and 31% presenting exercise-induced oxygen desaturation. In the MIST, the individuals performed 20% of the predicted, 23% of the participants reached 80% of the maximum heart rate, and 17% presented exercise-induced oxygen desaturation. Length of hospital stay and the use of mechanical ventilation were associated with test performance. **Conclusion:** 6MST and MIST are feasible, safe, and can be used to assess exercise capacity in a home environment in individuals after hospitalization for COVID-19. The performance in these tests was associated with a prolonged hospital stay and the use of mechanical ventilation.

Keywords: Assessment. COVID-19. Diagnosis. Exercise test. Physiotherapy. Safety.

Resumo

Introdução: *Testes baseados em degraus são comumente utilizados para avaliar a capacidade de exercício de indivíduos com doenças respiratórias. No entanto, a viabilidade e segurança dos testes de degrau ainda não foram estudadas em indivíduos após hospitalização por COVID-19.* ***Objetivo:*** *Investigar a viabilidade e segurança do teste do degrau de seis minutos (TD6) e do teste do degrau incremental modificado (TDIM) na avaliação da capacidade de exercício no domicílio em indivíduos após hospitalização por COVID-19, e identificar fatores associados ao desempenho nesses testes.* ***Métodos:*** *Estudo transversal multicêntrico com indivíduos internados por COVID-19 quinze dias após a alta hospitalar. Os participantes realizaram espirometria, TD6 e TDIM durante uma única visita domiciliar. Eventos adversos foram registrados durante e imediatamente após os testes.* ***Resultados:*** *Foram estudados 65 participantes (50 ± 10 anos, 55% do sexo masculino). A viabilidade foi de 96,9% e a incidência de eventos adversos foi de 13,8% no 6MST e 6,2% no TDIM. Os indivíduos realizaram 76,9% do previsto no TD6, sendo que 40% dos participantes atingiram 80% da frequência cardíaca máxima e 31% apresentaram dessaturação de oxigênio induzida pelo exercício. No TDIM, os indivíduos realizaram 20% do previsto, 23% dos participantes atingiram 80% da frequência cardíaca máxima e 17% apresentaram dessaturação de oxigênio induzida pelo exercício. O tempo de internação e o uso de ventilação mecânica estiveram associados ao desempenho do teste.* ***Conclusão:*** *O TD6 e o TDIM são viáveis, seguros e podem ser usados para avaliar a capacidade de exercício em ambiente domiciliar em indivíduos após hospitalização por COVID-19. O desempenho nesses testes esteve associado ao tempo prolongado de internação e ao uso de ventilação mecânica.*

Palavras-chave: *Avaliação. COVID 19. Diagnóstico. Teste de exercício. Fisioterapia. Segurança.*

Introduction

COVID-19 is an infectious disease, which in its severe form causes lung injury, changes in ventilation and gas diffusion, and a systemic inflammatory response that can affect the musculoskeletal system, leading to a reduction in muscle mass, strength, and endurance. These mechanisms can lead to a reduction in exercise capacity.[1-3]

Cardiopulmonary exercise testing is considered the gold standard for evaluating exercise capacity, but its use is limited due to cost, the need for specific equipment, and qualified personnel. For this reason, the 6-minute walk test (6MWT) has been widely used for evaluating individuals with chronic respiratory diseases.[4] The 6MWT has also been performed in individuals after COVID-19 and is a test capable of detecting a reduction in exercise capacity in this population.[5] However, the performance of the 6MWT may encounter some barriers, including the requirement for a spacious area, suitable corridor without inclinations or obstacles, difficulties in evaluating patients with supplemental oxygen, and dependence on good weather conditions if performed outdoors.[4]

In this context, step-based tests may be an alternative to overcome these barriers. The six-minute step test (6MST) and modified incremental step test (MIST) are used to evaluate the exercise capacity of individuals with respiratory diseases, such as chronic obstructive pulmonary disease,[6] bronchiectasis,[7] idiopathic pulmonary fibrosis,[8] and asthma.[9] However, the feasibility and safety of these tests in evaluating physical performance have not yet been studied in individuals after COVID-19 in home environment. The use of these tests could be an alternative for evaluating exercise capacity in this population. This study aimed to investigate the feasibility and safety of the 6MST and MIST in assessing exercise capacity at home in individuals after discharge from the hospital for COVID-19, and secondarily, to identify factors associated with performance in these tests.

Methods

This is a cross-sectional multicenter study following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines,[10] conducted with individuals who were hospitalized for COVID-19. After 15 days of hospital discharge, assessments were conducted in a single stage during a visit to the participants' homes by researchers who had been previously trained. The 6MST andMIST were performed in a randomized order with at least 30 minutes of rest between each test. The recruitment, exposure, follow-up, and data collection were realized between June 2020 and October 2021.

The study protocol was approved by each participant hospital's Human Research Ethics Committee (No. 4. 002.358; 4.056.210, 4.013.533). All participants signed

an informed consent form, and all data were preserved in accordance with ethical norms and professional standards of confidentiality, following Brazilian legislation (General Data Protection Law).

Participants

Individuals were recruited from three public general hospitals in Juiz de Fora/MG, Brazil: University Hospital of the Federal University of Juiz de Fora, Hospital Santa Casa de Misericórdia de Juiz de Fora, and Hospital Doutor João Penido.

The participants were recruited by the research team, which also consisted of clinical physiotherapists working in the participating hospitals of the study. The team systematically reviewed the records of the three participating hospitals daily. They personally examined the COVID-19 patients who were hospitalized and monitored their progress until discharge. Subsequently, using this information, all patients were contacted via phone after their hospital discharge and were extended an invitation to participate in the study.

This study included a convenience sample of patients with COVID-19 confirmed by RT-PCR, aged ≥ 18 years, who were discharged from the participant hospitals. The exclusion criteria were as follows: physical limitations, including neurological, musculoskeletal, and osteoarticular diseases that prevented the correct execution of the tests; severe and unstable cardiovascular disease; and cognitive disorders.

The eligibility criteria were assessed by a single researcher (CVA) at two stages: first, during the initial phone call after hospital discharge, when individuals were invited to participate in the study. At this point, the individual's clinical condition, comprehension ability through appropriate responses in conversation, bed confinement status, and compliance with all eligibility criteria were queried. Secondly, during the subsequent home visit, when the individual was thoroughly evaluated, and both inclusion and exclusion criteria were confirmed.

Outcomes and procedures

The assessments were conducted in a single visit by physiotherapists who were trained and qualified to perform evaluations and respond to emergencies. The procedures were conducted at the participant's residence, with the specific location chosen through collaborative analysis and decision-making between the researcher and the participant. The selection of these locations depended on factors such as available space, furniture arrangement, absence of obstacles, and safety considerations. The chosen areas were appropriately prepared for test administration and participant safety. The day and time of assessments were scheduled based on the participant's preference and availability, allowing for flexibility on any day of the week, either in the morning or afternoon. Uniformity was maintained in the evaluation and monitoring equipment used, as identical devices were employed for all participants. The instruments included a 20 cm high and 50 cm wide step, a blood pressure monitor, a stethoscope, a modified Borg symptom perception scale, a pulse oximeter, and printed protocols for annotation. The instruments were duly calibrated and transported in the researcher's personal vehicle.

The study did not include provisions for emergency oxygen supplementation during its execution. Nevertheless, examiners were instructed to suspend procedures if the peripheral oxygen saturation (SpO_2) dropped below 85%, representing a key safety criterion. In the case of a serious adverse event, emergency response procedures in accordance with the procedures outlined by the Brazilian Unified Health System (SUS) would be initiated, involving communication with the Mobile Emergency Care Service (SAMU).

Sociodemographic information, health conditions, comorbidity index,[11] and data related to the hospitalization were recorded (laboratory tests, hospital and ICU stay, and use of mechanical ventilation).

Spirometry was performed using a portable spirometer following technical procedures, acceptability, and reproducibility criteria determined by the ERS/ATS technical standard for lung function tests.[12] Forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and FEV1/FVC ratio were recorded. The data were expressed in absolute values and percentages of predicted values.[13]

The 6MST test requires the individual to ascend and descend a single step with a height of 20 cm as quickly as possible for six minutes. It is a self-paced, submaximal test that allows individuals to adjust their pace during exercise according to their limitations. The test was performed according to the standardized procedures previously described.[6] The primary outcome of the test was the number of steps climbed during the six minutes, which were compared to predicted values.[14]

The MIST test requires the individual to ascend and descend a single step with a height of 20 cm at a progressively increasing and externally paced rate. The test was performed according to the standardized procedures previously described.[15] The pace of the test was determined by previously recorded sound signals, starting at 10 steps per minute and increasing by one step every 30 seconds. The participant was encouraged to reach their maximum performance capacity, and the test was completed when the individual could no longer keep up with the pace dictated by the sound signals. The primary outcome was the number of steps climbed during the test and compared to predicted values.[16]

The physiological responses of participants were recorded before, during, and after each test, monitoring heart rate (HR), arterial blood pressure, and SpO_2. Based on this information, exercise capacity, cardiovascular responses, and oxygen desaturation during the step tests were analyzed. HR was presented in absolute values and as a percentage of the predicted maximum (220-age).[17] Target HR was calculated using the Karvonen formula, using 60 and 80% of HR reserve: HR = HRrest + 60 or 80% (HRpeak - HRrest).[17] Rate pressure product was calculated by multiplying the HR by the systolic blood pressure.[17]

Before and after the tests, the perception of dyspnea and lower limb fatigue were measured using the modified Borg scale.[18] Exercise-induced oxygen desaturation was defined as a decrease in SpO_2 by 4% or more compared to the initial value.[19] Additionally, individuals who reached or did not reach 80% of predicted number of steps in the 6MST were compared.

Feasibility and safety assessment

The feasibility of each step test was determined by the number of participants who were able to complete the test properly divided by the total number of participants. To assess the adequacy of participants in completing the tests without risks or with the lowest possible risk to their health status, safety criteria were established, including tachycardia or bradycardia, $SpO_2 < 85\%$, irregular pulse, chest pain, self-reported intolerable dyspnea and extreme weakness, pallor, dizziness, fainting, loss of balance, sweating, bronchospasm, intense back pain or lower limb pain, signs of neurological changes, palpitations, and cramps.[4,20] Safety was analyzed by the proportion of adverse events that occurred during each test.

Data analysis

Data analysis was performed using IBM Statistical Package for the Social Science software (version 22.0; SPSS Inc., Chicago, IL, USA). The normality of the data was analyzed using the Shapiro-Wilk test. Variables with a normal distribution were expressed as mean and standard deviation, variables without a normal distribution were expressed as median and interquartile range, and categorical variables were expressed as frequency and percentage. The feasibility of each step test was obtained by the number of participants who were able to perform the test properly divided by the total number of participants. Safety was analyzed by the frequency of adverse events that occurred during each test. Comparisons between the tests regarding the number of individuals who reached 80% of the predicted HR and the number of individuals who desaturated were performed using the chi-square test. Comparisons between individuals who reached and those who did not reach 80% of the predicted number of steps during the 6MST were performed using the Student's t-test for independent samples, Mann-Whitney test, and chi-square test, when appropriate. Multivariate linear regression was performed to evaluate factors associated with performance in the tests by inserting variables that had a $p < 0.1$ in the univariate regression analysis into the model. A $p < 0.05$ was considered significant.

Results

A total of 191 individuals were considered eligible for the study, of which 126 were excluded (68 refused to participate, 37 could not be located, 18 were transferred to other hospitals, two were readmitted, and one could not perform spirometry). At the end of the study, 65 participants were evaluated, with a mean age of 55 ± 12 years; 55% male; body mass index: 28.8 ± 6.7 kg/m2; VEF1: 76.2 ± 16.7% predicted; FVC: 74.8 ± 15.3% of prediddcted; VEF1/FVC: 82%. Sample characteristics during hospitalization are described in Table 1.

The two-step tests were completed by 63 participants, demonstrating a feasibility of 96.9%. Two participants were unable to perform the step tests adequately due to self-reported extreme fatigue and dyspnea. In the safety assessment of the tests, there were no severe adverse events, and there was no need to activate

emergency medical services. The incidence of adverse events during 6MST was 13.8%, with nine events observed during the test (joint pain = 3, desaturation = 2, extreme fatigue in the lower limbs = 2, dyspnea = 2). The incidence of adverse events during MIST was 6.2%, with four events observed during the test (dyspnea = 2, knee joint pain = 1, desaturation = 1). These adverse events were completely resolved with rest. The total time to conduct both tests averaged one hour.

Table 1 - Sample characteristics during hospitalization (n = 65)

Variables	Results
Age (years)	55 ± 12
Gender (male/female)	36/29
Comorbidity index (points)	1.0 (0.0, 2.0)
Length of hospital stay (days)	10.0 (6.5, 15.5)
Use of mechanical ventilation, n (%)	11 (17)
Mechanical ventilation time (n = 11), days	11.0 (7.0, 19.0)
Length of ICU stay (n = 11), days	5.5 ± 9.1
Use of corticosteroids, n (%)	51 (78)
Laboratory tests at hospital admission	
PaO_2 (mmHg)	91.0 (73.5, 108.0)
SaO_2 (%)	97.0 (95.0, 98.0)
Hemoglobin (g/dL)	13.3 ± 1.8

Note: ICU = intensive care unit; PaO_2 = partial pressure of oxygen; mmHg = millimeters of mercury; SaO_2 = peripheral oxygen saturation; g/dL = gram per deciliter. Data presented as mean ± standard deviation, median (interquartile range), and frequency (%).

Participants achieved 72.7% of predicted performance on 6MST and 23.9% on MIST. The HR reached 80% of the maximum in 40% of individuals on 6MST and 23% on MIST (chi-square test with $r^2 = 4.311$; $p = 0.029$). Desaturation occurred in 31% of individuals on 6MST and 17% on MIST (chi-square test with $r^2 = 3.431$; $p = 0.049$). The results of performance and physiological responses observed in the step tests are described in Table 2. No differences were found in demographic variables, clinical data, and laboratory tests when comparing individuals who had a performance in 6MST higher and lower than 80% of predicted (Table 3).

The stepwise multiple linear regression model demonstrated that length of hospital stay and the use of mechanical ventilation were independent predictors of the number of steps climbed in 6MST, explaining 15% of the variance in this test. The length of hospital stay was the independent predictor of the number of steps reached in MIST, explaining 8% of the variance in the performance of this test.

Table 2 - Results of step tests (n = 63)

Variables	6MST	MIST
Steps (n)	96.0 ± 29.5	50.8 ± 41.5
Steps (% of pred.)	72.7 ± 22.6	23.9 ± 18.1
HR rest	83.8 ± 13.2	86.7 ± 14.4
HR peak	123.0 ± 20.1	112.9 ± 22.3
HR reserve	39.2 ± 14.5	26.3 ± 18.7
% of max. HR	75.2 ± 12.6	69.2 ± 13.9
80% of max. HR#	26 (41)	15 (24)
HR Karv 60%	107.3 ± 16.2	102.4 ± 17.8
HR Karv 80%	115.2 ± 18.0	107.7 ± 17.3
Initial SBP	120.0 (110.0, 131.0)	120.0 (110.0, 130.0)
Final SBP	140.0 (126.0, 149.0)	130.0 (120.5, 142.0)
Initial DBP	70.0 (60.0, 80.0)	80.0 (70.0, 85.5)
Final DBP	70.0 (60.0, 80.0)	80.0 (70.0, 90.0)
Initial RPP	10289.9 ± 1859.2	10557.3 ± 2121.3
Final RPP	17544.1 ± 4072.8	15325.9 ± 4564.7
Initial dyspnea	0.0 (0.0, 1.5)	0.0 (0.0, 2.0)
Final dyspnea	3.9 ± 2.4	3.3 ± 2.3
Initial LLF	0.0 (0.0, 1.0)	0.0 (0.0, 2.0)
Final LLF	3.6 ± 2.9	3.1 ± 2.4
Initial SpO_2 (%)	95.5 ± 1.8	95.3 ± 2.1
Final SpO_2 (%)	92.9 ± 4.3	93.5 ± 3.4
O_2 desat.#	20 (32)	11 (17)
Delta O_2 desat.	6.8 ± 2.8	7.2 ± 2.6

Note: 6MST = six-minute step test; MIST = modified incremental step test; pred. = predicted; HR = heart rate (bpm = beats per minute); max. = maximum; HRKarv= HR calculated with the Karvonen formula using 60% and 80% of heart rate reserve; SBP = systolic blood pressure (mmHg = millimeters of mercury); DBP = diastolic blood pressure (mmHg); RPP = rate-pressure product (bpm*mmHg); LLF = lower limb fatigue SpO_2 = peripheral oxygen saturation; desat. = desaturation. Data presented as mean ± standard deviation, median (interquartile range), and in frequency (%). #n (%).

Table 3 - Comparison between individuals with six-minute step test (6MST) greater and lower than 80% of predicted (n = 63)

Variables	6MST ≥ 80% predicted (n = 25)	6MST < 80% predicted (n = 38)	p-value
Age (years)	56.5 ± 12.2	54.5 ± 12.9	0.54
Gender (male/female)	10/15	24/14	0.13
BMI (kg/m^2)	27.6 ± 5.3	29.6 ± 7.5	0.21
Length of ICU stay (n = 28), days	5.6 ± 10.0	5.4 ± 8.6	0.94
Length of hospital stay (days)	7.0 (5.7, 13.0)	11.0 (7.0, 16.0)	0.19
Use of mechanical ventilation (n =11), n (%)	3 (27.3)	8 (72.7)	0.50
Mechanical ventilation time (n =11), days	7.0 (3.0, 7.0)	14.0 (7.5, 19.7)	0.15
Comorbidity index (points)	2.0 (0.0, 3.0)	1.0 (0.0, 2.0)	0.29
PaO_2 (n = 61), mmHg	96.0 (79.0, 109.5)	88.5 (70.5, 100.0)	0.24
SaO_2 (n = 61), %	98.0 (95.0, 98.0)	97.0 (94.2, 98.0)	0.47
Hemoglobin (n = 61), g/dL	13.1 ± 1.5	13.4 ± 2.0	0.55

Note: BMI = body mass index; ICU: intensive care unit; PaO_2 = arterial oxygen pressure; SaO_2 = arterial oxygen saturation; mmHg = millimeters of mercury; g/dL = gram per deciliter. Data presented as mean ± standard deviation, median (interquartile range), and frequency (%).

Discussion

This study showed that the 6MST and MIST are feasible and safe for assessing exercise capacity in individuals after hospitalization for COVID-19 in a home environment. Length of hospital stay and use of mechanical ventilation were variables associated with performance on the tests.

In our study, 96.9% of individuals were able to complete both step tests, demonstrating their high feasibility. The same individuals who were unable to perform one test were also unable to perform the other, due to debilitating fatigue. Post-COVID-19 individuals undergoing the 6MWT and sit-to-stand test were unable or failed to complete the tests in a proportion of 16%.[21] Therefore, the tested step tests were appropriate to be used in this population, which presents a new health condition with scarce evidence of the feasibility and safety of functional tests.

The tests also proved to be safe. This also implies the possibility of performing the tests even in the home environment, where the study was conducted. No severe adverse events were recorded, and any adverse events that occurred were quickly reversed with rest. Due to the aim of assessing the safety of step tests and analyzing the incidence of adverse events during the tests, participants who experienced any adverse events were not excluded from the study. The characteristics of the tests enable this.[6,15] In the 6MST, individuals may pause to rest if needed, and this interruption can last until the end of the six minutes. In the MIST, participants may stop if necessary or if they can no longer keep up with the pace of the signal, concluding the test. In either case, the tests are considered adequately performed and successful.

The safety of step tests has already been attested in a previous study that performed them even in the hospital environment and with individuals in the acute phase of respiratory diseases.[22] Complications associated with the performance of the field tests are unusual. In individuals attending an outpatient pulmonary rehabilitation program who completed the 6MWT, adverse events were noted in 6% of patients. The most common adverse event was oxygen desaturation < 80%.[20] The step tests were successfully conducted in the home environment, with a quick application time, and only one evaluator is required. The tests were per-formed in the participants' living room, bedroom, or backyard, with minor adaptations to the surroundings, such as removing rugs, repositioning furniture, and improving lighting. These adaptations were minimal because step tests require little space and resources for implementation.[6,15]

Our participants presented a reduction in exercise capacity, measured both in the 6MST and the step test, demonstrated by a performance 80% below of predicted. This may be explained by the fact that COVID-19 presents systemic manifestations, particularly in the musculoskeletal system.[3] COVID-19 stimulates the formation of a potent systemic inflammation, which affects, among other structures, the peripheral muscles,[3] reducing muscle mass by decreasing protein synthesis and inducing proteolysis of muscle fibers and causing fibrosis.[23,24] Prolonged bed rest and immobility, common in hospitalized individuals, may exacerbate deleterious muscular effects.[25,26] In addition, exercise-induced hypoxemia can also reduce the performance of the musculoskeletal system.[27] Our findings corroborate a study that investigated other functional tests, such as the 6-minute walk test, the 1-minute sit-to-stand test, and the Chester step test in post-COVID-19 patients, all of which showed impaired functional performance in these patients compared to the healthy control group.[28]

The performance in the step tests was associated with the length of hospital stay. Additionally, individuals who used mechanical ventilation during their hospital stay exhibited a poorer performance in the number of steps climbed in the MIST compared to those who did not use mechanical ventilation. Although we did not find significant differences when comparing performance in the 6MST (20 steps), the difference in the number of steps is considered clinically significant (11 steps).[29]

The smaller portion of participants reached 80% of the maximum HR in the step tests (41% in the 6MST and 24% in the MIST). This may be explained by the reduction in exercise capacity caused by the deleterious effects caused by the disease, influencing test performance and causing individuals to not reach the expected maximum HR.[3,23-27] It was also expected that the chronotropic response in the MIST, a maximal test, would be greater than the response presented in the 6MWT, which is characterized as a submaximal test. This may have occurred due to the low tolerance that individuals exhibited for performing the MIST because it is an incremental test, characterized by load increments every minute, causing greater exercise intolerance and early test termination.[15]

After COVID-19, individuals may exhibit good arterial oxygenation at rest but are susceptible to a decrease in oxygenation during exertion.[30] It is known that about 50% of individuals hospitalized for COVID-19 present exercise-induced hypoxemia.[31] Our study included indi-viduals without resting hypoxemia, but 31% of them showed desaturation when submitted to 6MST. However, only 17% of our sample showed desaturation in MIST. This can be explained by the early termination of the test, which did not provide enough time for substantial desaturation. When undergoing a maximal test, such as MIST, individuals could not tolerate a long enough test period to present a substantial drop in saturation. Our findings agree with the Vittaca et al.,[32] who showed that survivors of COVID-19 also had exercise-induced desaturation despite normal resting oxygen saturation.

Our study provides information on the feasibility and safety of performing step tests on individuals who were hospitalized for COVID-19. This allows these tests to be used by professionals involved in clinical practice, providing a simple and practical option for assessing exercise capacity in this population. A large number of individuals with COVID-19 and new individuals who may develop the disease require specialized attention from rehabilitation teams with knowledge about the disease's sequelae.

This study has some limitations. A large number of individuals were excluded due to refusal and individuals who could not be located. The main reasons were fear of COVID-19 reinfection and relocation to more isolated areas. The participants were recruited through convenience sample and were not stratified by severity level due to a lack of available data. The assessments were conducted by different researchers, which may introduce variability in the measured variables of the tests. We attempted to minimize this effect by providing adequate training to the assessors and strictly adhering to international guidelines for the step tests administration. Finally, only survivors of the disease were evaluated, so the feasibility of the tests in the intra-hospital environment still needs to be investigated.

Conclusion

We conclude that both the 6MST and MIST are feasible and safe tests and can be used for assessing exercise capacity in a home environment in individuals after hospitalization for COVID-19. Poor performance in these tests was associated with the length of hospital stay and the use of mechanical ventilation.

Authors' contributions

The authors would like to thank Empresa Brasileira de Serviços Hospitalares (Ebserh) for the funding (01/2020), as well as the University Hospital of Juiz de Fora, Yuri Augusto de Sousa Miranda, Rafaella Polato, and Alice Carvalho Gomes.

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