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Frailty and relationship with the six-minute walk test. Cardiovascular rehabilitation: Case series

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ABSTRACT

Objective: To evaluate frailty in patients with cardiovascular diseases and performance in the six-minute walk test (6MWT) in participants of the outpatient cardiovascular rehabilitation (CVR) program. Methods: Retrospective, descriptive study of patients over 60 years of age participating in CVR from April 2021 to April 2023. Data from the 6MWT and cardiorespiratory capacity (RCF) estimation and CFS scale were obtained before and after CVR, expressed as mean ± standard deviation. Results: Twelve medical records were evaluated: mean age of 68.3±6.58 years, 5 men and 7 women. The pre- and post-rehabilitation SFC were 5.0±1.28 and 3.75±1.48, respectively. The 6MWT distances before and after CVR were 292.33±88.86 and 375.16±111.80 meters (m), respectively. The mean velocity of the 6MWT before and after CVR was 48.71±14.80 and 62.52±18.64 m/min, respectively. Patients have a CFS scale between vulnerable, mildly frail, moderately frail, and very frail; with improvement after CVR to mildly frail, vulnerable, regular, active and very active. There was an increase in the distance covered and in the mean speed of execution of the 6MWT, which was also reflected in the improvement of cardiorespiratory fitness (CRF) estimated from very low to good after CVR. Conclusion: The greater the frailty, the lower the performance and speed in the 6MWT, and the supervised exercise program promoted an increase in functional capacity, making them more active, an important strategy to promote beneficial systemic adaptations that contribute to functional improvement.

RESUMO

Objetivo: avaliar a fragilidade em pacientes com doenças cardiovasculares e o desempenho no teste de caminhada de seis minutos (TC6) em participantes do programa de reabilitação cardiovascular ambulatorial (RCV). Métodos: Estudo retrospectivo, descritivo, de pacientes acima de 60 anos participantes da RCV no período de abril de 2021 até abril de 2023. Dados do TC6 e estimativa da capacidade cardiorrespiratória (ACR) e escala CFS foram obtidos pré e pós RCV, expressos em média±desvio padrão. Resultados: Doze prontuários foram avaliados: idade média de 68,3±6,58 anos, 5 homens e 7 mulheres. A CFS pré e pós reabilitação foi respectivamente de 5,0±1,28 e 3,75±1,48. As distâncias do TC6 pré e pós RCV foram de 292,33±88,86 e 375,16±111,80 metros (m), respectivamente. A velocidade média do TC6 pré e pós RCV foi de 48,71±14,80 e 62,52±18,64 m/min, respectivamente. Os pacientes apresentam escala CFS entre vulnerável, levemente frágil, moderadamente frágil e muito frágil; com melhora após RCV para levemente frágil, vulnerável, regular, ativo e muito ativo. Houve incremento na distância percorrida e na velocidade média de execução do TC6, o que refletiu também na melhora da aptidão cardiorrespiratória (ACR) estimada de muito baixa à boa após RCV. Conclusão: Quanto maior a fragilidade, menor foi o desempenho e a velocidade nos TC6 e o programa de exercícios supervisionados promoveu o incremento na capacidade funcional tornando-os mais ativos, uma estratégia importante para promover adaptações sistêmicas benéficas que contribuem para melhora funcional.

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Introduction

The demographic transition as a global phenomenon and the impact of population aging stand out in the need to promote balanced aging considering the process, limitations and potentialities of this population (Araújo *et al.*, 2021). It is also known that aging leads to various physiological changes of various systems in the body and that this makes them more vulnerable to disorders and pathologies (Leopoldino *et al.*, 2020). The vulnerability caused by aging is social, biological and psychological. Aging is a risk factor for the occurrence of chronic, non-communicable diseases, such as cardiovascular diseases (CVD), diabetes, and high blood pressure, which compromise your health and well-being (Araújo *et al.*, 2021).

The prevalence of CVD increases with age, and for those over 75 years of age with coexisting geriatric syndromes, the results are more negative, such as higher mortality rate, disability risk, and length of hospital stay (Ijaz *et al.*, 2021). One of these geriatric syndromes is the Frailty Syndrome, which represents a state of increased risk of adverse health events, such as dependence, disability, falls and injuries, acute illnesses, slow recovery from illness, hospitalization, and long-term institutionalization (Lourenço *et al.*, 2018). Thus, there is a strong bidirectional association between CVD and frailty syndrome, both are intertwined, as the presence of one drives the progression of the other.

According to the World Health Organization, frailty can be defined as a state of impairment in dealing with daily stressors due to increased vulnerability, associated with declining function of various systems and organs. Cognitive decline, physical inactivity, poor nutrition and lack of social support are some of the risk factors for the development of frailty. Unintentional weight loss, muscle weakness, slow walking speed, low physical activity, and exhaustion are common features in this syndrome. It can be classified into three levels: Robust, which would be the absence of fragility; the pre-fragile; and frail, which can lead to disability (Ijaz *et al.*, 2021). Currently, it has been strongly considered as a multidimensional syndrome, which involves several factors: Biological, physical, cognitive, social, economic, and environmental. It is a type of syndrome that can be avoided when identified early or, at least, contained by intervening based on its indicators (Coelho *et al.*, 2009).

In Brazil, there is a great variation in the data regarding the prevalence of frailty, with values between 6.7% and 74.1%, these variations were attributed to different instruments used for classification, heterogeneous population, and research scenarios (Lourenço *et al.*, 2018). That said, there are means of intervention and various assessment instruments with the aim of health promotion and prevention to improve or reverse vulnerability in the elderly (Ijaz *et al.*, 2021).

There are a number of instruments used to identify frail older adults. Fried's frailty phenotype is one of the most used in research and involves five items: Unintentional weight loss, low muscle strength, slow walking, fatigue and low level of physical activity. Patients who meet one or two criteria are considered pre-frail and those who meet three or more are considered frail (Drey *et al.*, 2011). The physical frailty phenotype formed the basis of the frailty assessment of the Cardiovascular Health Study (CHS) and is the most widely used instrument. Although the Fried scale accurately predicts mortality in patients with CVD, it is not easily measurable in acute clinical situations because it includes a grip strength measure, a walk test, and a detailed quality of life questionnaire (Chung *et al.*, 2021).

Taking into account that functional decline is the main marker of frailty, it can be assessed by instruments that stratify the degree of frailty according to performance in activities of daily living (ADLs). The Clinical Frailty Scale (CFS) is based on a holistic view of the patient, focusing on their overall health and functional capacity. Unlike other scoring systems, this scale does not focus on issues of attitudes towards health, but rather on the functional status of the individual. Studies have shown that the CFS can measure the impact of adverse events on the lives of the elderly, with correlations with the standard SF-36 questionnaires. The CFS is an instrument that classifies the elderly as frail, pre-frail and non-frail according to the observation of a health professional and the verification of the information of the patient in question. They are considered without frailty when the score is less than or equal to 3, pre-frail if the score is 4, frail if the classification is 5, and moderate to severely frail if the score is 6–8 (Pinheiro *et al.*, 2021; Rodrigues *et al.*, 2021).

Functional capacity is an important aspect in the assessment of frailty, being an important marker of morbidity and mortality in patients with cardiopulmonary diseases. Although the direct measurement of peak oxygen consumption (VO_2 peak) by means of cardiopulmonary tests is the most indicated method to assess functional capacity, its use in clinical practice is still restricted, due to its high cost (Farah *et al.*, 2021).

Thus, functional physical tests have been considered essential components in the clinical evaluation routine, as an alternative form. The six-minute submaximal walk functional test (6MWT) stands out because it is an easy-to-perform, low-complexity option, in addition to not requiring high-cost equipment, and is easy to apply in clinical practice (Pessoa *et al.*, 2014). This test assesses exercise tolerance and has a good sensitivity for detecting changes after interventions, as it is representative of daily physical activity.

Given some assessment instruments and their relationship with frailty, it is important to emphasize that this screening in the general population is essential since it identifies individuals at higher risk of unfavorable outcomes after cardiovascular events, consequently, it is capable of impacting individualized care (Lourenço *et al.*, 2018). These assessments

provide opportunities to identify specific targets that need to be addressed before a rehabilitation program is defined and applied (Flint *et al.*, 2020).

Therefore, this study seeks to evaluate whether individuals, after a cardiovascular event, have a higher frailty index demonstrated through the evaluation scale and performance in the functional capacity test. And whether the effect of the cardiovascular rehabilitation program will contribute to the reduction of frailty in heart disease patients.

The objective of this study was to evaluate the frailty index associated with Cardiovascular Disease (CVD) and the performance in the 6MWT walk test used to obtain the functional capacity of participants in an outpatient cardiovascular rehabilitation program by collecting data from the CFS (Clinical Frailty Scale), the distance covered in the 6MWT and the average gait speed at two moments: at admission and discharge from the program.

Methodology

Individual design and selection

This is a descriptive and retrospective study of the medical records of patients who participated in the cardiovascular rehabilitation program of the Physical Therapy course at the Federal University of Uberlândia. Data were collected by consulting the patients medical records to obtain the results of the 6MWT functional test applied in the routine of the outpatient clinic and the frailty scale (CFS).

Inclusion and exclusion criteria

Inclusion: Elderly people aged 60 years or older, both genders, who were able to understand and perform the functional test, as of April 2021, totaling so far x medical records, a reduced number of patients due to the conditions of face-to-face return, were included in this study. This initial period for data collection was at the time when the face-to-face activities of the outpatient clinic were resumed at the University and the routine with the updating of the test and questionnaires was reorganized. Data collection ended in April 2023. The rehabilitation sector works as an internship area for the Physiotherapy course and maintains patient care during the academic calendar and in extension actions.

Exclusion: Participants under the age of 60, who did not complete the cardiovascular rehabilitation program, or who did not perform the functional test were excluded.

Experimental procedures

The results of the 6MWT, its predictive values, and the average gait speed were recorded. In addition, the following variables were collected: Age, gender, weight, height, BMI, heart disease and risk factors, rehabilitation time and the frailty scale (CFS) of the participants.

Below is a brief description of the test and scale used in the evaluation and reevaluation in the routine of the cardiovascular rehabilitation program:

6-minute walk test (6MWT): Instructions for preparing for the test were given: Appropriate clothing, time, having a light meal before the test, not drinking drinks or stimulating foods such as coffee, chocolate, mate tea, soda, taking the prescribed medication normally. The subject was taken to the test site and for the evaluation of systolic and diastolic blood pressure parameters at rest. To determine the heart rate (HR), the heart rate monitor was placed in the chest region, so that the signal is transmitted to the heart watch/monitor throughout the test. To determine arterial oxygen saturation (SpO_2), a portable pulse oximeter was used. Blood pressure and pulse oximetry were assessed in the sitting position. The test was carried out in a 30-meter corridor with a course marked by two cones and markings every 3 meters, according to the recommendations of the American Thoracic Society (2002).

Participants were instructed to walk as fast as possible along the route for six minutes, with standardized verbal encouragement given every minute. Before and at the end of the test, respiratory rate, heart rate, arterial oxygen saturation, blood pressure, and perception of exertion were recorded using the modified Borg Scale.

The 6MWT can be interpreted by comparing its results with reference values, which are expected results in a test for a given individual calculated using demographic and anthropometric parameters, based on a series of tests performed in a healthy population. The reference values of the six-minute walk test have already been studied for Brazilians and other populations. The variables commonly included in the equations to predict the distance of the 6MWT are gender, age, body mass index (BMI), height, and weight. The reference equation elaborated is the most appropriate to assess the exercise capacity of Brazilian patients with chronic diseases. TC6m = 622.461 - (1.846 x Age Years) + (61.503 x male = 1; female = 0) (Iwama *et al.*, 2009). To calculate the average walking speed from the 6MWT, it is enough to divide the distance covered by the patient in meters, by the time spent, which in this case was 6 minutes. In this way, it was possible to find out the value of the average speed during the test through the equation $\Delta D/\Delta T$, that is, division of distance by time (Kamiya *et al.*, 2018).

The Clinical Frailty Scale (CFS), developed by Rockwood *et al.*, translated and culturally adapted to the Portuguese language, consists of nine scores evaluated by the professional based on the observation and clinical data of the individual. The SFC stratifies the degree of frailty according to performance in activities of daily living (ADLs), considering the individual's functional capacity. This instrument classifies the elderly as frail if the classification is 5, pre-frail if the score is 4 and non-frail when the score is 3 and moderate to severely frail if the score is 6–8 (Rodrigues *et al.*, 2021).

Ethical and legal aspects

Data were collected from the medical records of patients participating in the rehabilitation program and placed in worksheets, without identifying the participant.

As it coincided with the collection of data from the medical records of patients who are still in rehab care, the informed consent form (ICF) was applied to these individuals.

The research was submitted to and approved by the Human Research Ethics Committee No. CAAE: 64984722.2.0000.5152.

The researchers involved followed the biosafety standards guided by the National Health Surveillance Agency and the Committee to Combat Covid-19, in addition to social distancing, hand hygiene with 70% alcohol, use of respiratory protection masks (standard N95 or PFF2 or PFF3, or equivalent), valuing the safety of the professional, the student and the participant in the cardiovascular rehabilitation program.

Results

There was a survey of 37 medical records, as of April 2021, 14 of which were excluded due to age under 60 years; 11 because they do not have some data. A total of 12 medical records with 6-minute walk test (6MWT) results, mean speed and its predictive values, in addition to the age, gender, weight, height, BMI, heart disease and risk factors, rehabilitation time and the frailty scale (CFS) of the participants.

Of these 12 medical records, their results were evaluated and described: mean age of 68.3±6.58 years, 5 men and 7 women. The pre- and post-rehabilitation SFC were 5.0±1.28 and 3.75±1.48, respectively. The 6MWT distances before and after CVR were 292.33±88.86 and 375.16±111.80 meters (m), respectively. The mean velocity of the 6MWT before and after CVR was 48.71±14.80 and 62.52±18.64 m/min, respectively. Patients present with a CFS scale ranging from vulnerable (4), mildly frail (5), moderately frail (6), and very frail (7) with improvement after CVR to mildly frail (5), vulnerable (4), regular (3), active (2), and very active (1). There was an increase in the distance covered and in the mean speed of execution of the 6MWT, which was also reflected in the improvement of cardiorespiratory fitness (CRF) estimated from very low to good after CVR.

Table 1.

Patient data and 6MWT results and CFS scale.

Sample	Age	Gender	DP TC6 (meters)	TC6 (meters)		CR Aptitude		Average speed TC6 (m/min)		CFS Scale	
				Pre-Reab	Post-Reab	Pre-Reab	Post-Reab	Pre-Reab	Post-Reab	Pre-Reab	Post-Reab
Patient 01	61	F	509	405	507	Low	Regular	67.5	84.5	4	1
Patient 02	64	F	504	213	357	Very low	Very low	35.5	59.5	5	4
Patient 03	63	F	506	381	393	Low	Low	63.5	65.5	3	2
Patient 04	71	F	491	336	360	Very low	Very low	56	60	5	4
Patient 05	70	F	493	282	330	Very low	Very low	47	55	4	3
Patient 06	75	F	484	225	208	Very low	Very low	37.5	34.6	6	5
Patient 07	69	M	556	180	606	Very low	Good	30	101	5	4
Patient 08	80	M	536	291	279	Very low	Very low	48.5	46.5	6	6
Patient 09	68	F	496	168	300	Very low	Very low	28	50	5	4
Patient 10	62	M	569	420	477	Very low	Low	70	79.5	4	2
Patient 11	77	M	418	237	277	Very low	Very low	39.5	46.1	7	5
Patient 12	60	M	573	370	408	Very low	Very low	61.6	68	7	5

Note: SD: Predicted distance; 6MWT: 6-minute walk test; CR: Cardiorespiratory; Reab: Rehabilitation.

Description of cases

Patient 1: Female, 61 years old, BMI 23 kg/m² with the following risk factors: Dyslipidemia, hypothyroidism, valvular heart disease. She was diagnosed with heart failure (HF) and Chagas cardiomyopathy. The value in meters predicted in the 6MWT for her age and gender is 509. Its pre-RCV result was 405 meters and after RCV it was 507 meters. Thus evolving from low to regular CR fitness. Its average speed went from 67.5 m/minute to 84.5 m/minute. And their CFS score evolved from 4 (vulnerable: A person who, despite not depending on others for daily help, often limited their activities. A common complaint is feeling slower and/or more tired throughout the day) to 1 (very active: Robust, active, energetic and motivated person. Usually exercises regularly. She is among the most active for her age). Her rehabilitation time was 28 weeks.

Patient 2: Female, 64 years old, BMI 33 kg/m² with the following risk factors: Hypothyroidism, dyslipidemia, obesity, rheumatic fever. She was diagnosed with aortic and tricuspid valve (IV) insufficiency. The value in meters predicted in the 6MWT for her age and gender is 504. Its pre-RCV result was 213 meters and post-RCV was 357 meters. Her CR fitness was very low and yet remained very low. Its average speed went from 35.5 m/minute to 59.5 m/minute. And their CFS score evolved from 5 (mildly frail: Person who frequently has evident slowness and needs help for more complex instrumental activities of daily living) to 4 (vulnerable: Person who, despite not depending on others for daily help, often limits activities. A common complaint is feeling slower and/or tired throughout the day). Her rehabilitation time was 28 weeks.

Patient 3: Female, 63 years old, BMI 22 kg/m² with the following risk factors: Diabetes. Diagnosed with HF, severe ventricular dysfunction, CAD. The value in meters predicted in the 6MWT for her age and gender is 506. Its pre-CVR result was 381 meters and post-CVR was 393 meters. Her CR fitness was low and still remained low. Her average speed

went from 63.5 m/minute to 65.5 m/minute. And her CFS score evolved from 4 (vulnerable: A person who, despite not depending on others for daily help, often limited her activities. A common complaint is feeling slower and/or more tired throughout the day) to 2 (active: A person who does not have any active symptoms of illness, but is less active than those in category 1. Frequently exercises). Her rehabilitation time was 8 weeks.

Patient 4: Female, 71 years old, BMI 46 kg/m² with the following risk factors: Diabetes, dyslipidemia, obesity, renal hypertension, pulmonary dysfunction (post-Covid). Diagnosed with acute myocardial infarction (AMI), she underwent revascularization surgery. The value in meters predicted in the 6MWT for her age and gender is 491. Her pre-RCV result was 336 meters and post-RCV was 360 meters. Her CR fitness was very low and yet remained very low. Its average speed went from 56.0 m/minute to 60.0 m/minute. And her CFS score evolved from 5 (mildly frail: Person who frequently has evident slowness and needs help for more complex instrumental activities of daily living) to 4 (vulnerable: Person who, despite not depending on others for daily help, often limits activities. A common complaint is feeling slower and/or tired throughout the day). Her rehabilitation time was 48 weeks.

Patient 5: Female, 70 years old, BMI 26 kg/m² with the following risk factors: Hypertension, pulmonary dysfunction, thyroid alteration, peripheral vascular disease. Diagnosed with HF with reduced ejection fraction (HFrEF). The value in meters predicted in the 6MWT for her age and gender is 493. Her pre-RCV result was 282 meters and post-RCV was 330 meters. Her CR fitness was very low and yet remained very low. Her average speed went from 47.0 m/minute to 55.0 m/minute. And her CFS score evolved from 4 (vulnerable: A person who, despite not depending on others for daily help, often limited their activities. A common complaint is feeling slower and/or tired throughout the day) to 3 (regular: Person with well-controlled health problems, but does not exercise regularly). Her rehabilitation time was 8 weeks.

Patient 6: Female, 75 years old, BMI 27 kg/m² with the following risk factors: Diabetes, hypertension, peripheral arterial obstructive disease. Diagnosed with coronary artery disease (CAD), she underwent revascularization surgery. The value in meters predicted in the 6MWT for her age and gender is 484. Her pre-RCV result was 225 meters and post-RCV was 208 meters. Her CR fitness was very low and yet remained very low. Her average speed went from 37.5 m/minute to 34.6 m/minute. And their CFS score evolved from 6 (moderately frail: Person who needs help with all outside activities and home maintenance. Frequently has difficulty with stairs, needs help with bathing, and may need minimal help/support to get dressed) to 5 (mildly frail: Person who often has obvious slowness and needs help with more complex instrumental activities of daily living). Her rehabilitation time was 40 weeks.

Patient 7: Male, 69 years old, BMI 35 kg/m² with the following risk factors: Dyslipidemia, obesity, hypertension. Diagnosed with unilateral CAD. The value in meters predicted in the 6MWT for his age and gender is 556. His pre-RCV result was 180 meters and post-RCV was 606 meters. Thus evolving from very low to good CR fitness. His average speed went from 30.0 m/minute to 101.0 m/minute. And his CFS score evolved from 5 (mildly frail: Person who frequently has evident slowness and needs help for more complex instrumental activities of daily living) to 4 (vulnerable: Person who, despite not depending on others for daily help, often limits activities. A common complaint is feeling slower and/or tired throughout the day). His rehabilitation time was 16 weeks.

Patient 8: Male, 80 years old, BMI kg/m² with the following risk factors: Diabetes, dyslipidemia, hypertension, CAD. The patient was diagnosed with non-ST-elevation AMI. The 6MWT predicted for his age and gender is 536. His pre-RCV result was 291 meters and post-RCV was 279 meters. His CR fitness was very low and yet remained very low. His average speed

went from 48.5 m/minute to 46.5 m/minute. And his CFS score was 6 and remained the same (moderately frail: Person who needs help with all outside activities and home maintenance. Often has difficulty with stairs, needs help in bathing and may need minimal help/support to get dressed). His rehabilitation time was 20 weeks.

Patient 9: Female, 68 years old, BMI 30 kg/m² with the following risk factors: Diabetes. Diagnosed with CAD. The value in meters predicted in the 6MWT for her age and gender is 496. Her pre-CVR result was 168 meters and post-RCV was 300 meters. Her CR fitness was very low and yet remained very low. Her average speed went from 28.0 m/minute to 50.0 m/minute. And her CFS score evolved from 5 (mildly frail: Person who frequently has evident slowness and needs help for more complex instrumental activities of daily living) to 4 (vulnerable: Person who, despite not depending on others for daily help, often limits activities. A common complaint is feeling slower and/or tired throughout the day). Her rehabilitation time was 28 weeks.

Patient 10: Male, 62 years old, BMI 28 kg/m² with the following risk factors: Dyslipidemia, hypertension Diagnosed with IV mitre. The value in meters predicted in the 6MWT for his age and gender is 569. His pre-CVR result was 420 meters and post-RCV was 477 meters. Thus evolving from very low to low CR aptitude. His average speed went from 70.0 m/minute to 79.5 m/minute. And his CFS score evolved from 4 (vulnerable: A person who, despite not depending on others for daily help, often limited their activities. A common complaint is feeling slower and/or more tired throughout the day) to 2 (active: A person who does not have any active symptoms of illness, but is less active than those in category 1. They often exercise). His rehabilitation time was 8 weeks.

Patient 11: Male, 77 years old, BMI 22 kg/m² with the following risk factors: Stroke. Diagnosed with HF. The value in meters predicted in the 6MWT for his age and gender is 418. His pre-RCV result was 237 meters and post-RCV was 277 meters. His CR fitness was very low and yet remained very low. His average speed went from 39.5 m/minute to 46.1 m/minute. And his CFS score was 7 (very frail: Completely dependent for personal care for any physical or cognitive cause) and evolved to 5 (slightly frail: Person who frequently has evident slowness and needs help with more complex instrumental activities of daily living). His rehabilitation time was 12 weeks.

Patient 12: Male, 60 years old, with the following risk factors: Type II diabetes, sedentary lifestyle, dyslipidemia. Diagnosed with multivessel CAD. The value in meters predicted in the 6MWT for his age and gender is 573 meters. His pre-CVR result was 360 meters and post-RCV was 408 meters. His CR fitness was very low and yet remained very low. His average speed went from 61.6 m/minute to 68 m/minute. And his CFS score was 7 (very frail: Completely dependent for personal care for any physical or cognitive cause) and evolved to 5 (slightly frail: Person who frequently has evident slowness and needs help with more complex instrumental activities of daily living). His rehabilitation time was 4 weeks.

All cardiovascular patients included in the study had some degree of frailty assessed by the CFS; and after rehabilitation there was a reduction in the score in almost the entire sample, only one patient maintained the score. It was also observed that all patients did not obtain 6MWT results according to what was predicted for their age, but after rehabilitation there was an increase in the distance covered and in the mean speed during the test.

Discussion

Population aging, sarcopenia, and frailty have been identified as reliable markers of poor prognosis among elderly patients with CVD (Kamiya *et al.*, 2018). Aging added to disturbances in muscle homeostasis lead to satellite cell senescence and neuronal

degeneration, in addition to preferential loss of type II fibers (IIa-fast, oxidative and relatively resistant to fatigue. Type IIb-rapid glycolytic, functional in fast, high-intensity movements and susceptible to fatigue) collectively associated with muscle atrophy and decreased contractile force capacity, leading to muscle weakness and slowness. Sarcopenia is the loss of muscle strength, mass, and function, often exacerbated by chronic comorbidities, including cardiovascular disease, chronic kidney disease, and cancer. It is associated with the faster progression of cardiovascular diseases and a higher risk of mortality, falls, and reduced quality of life, especially among the elderly (Damluji *et al.*, 2023).

Therefore, frailty is like a vicious cycle, where sarcopenia, common in the elderly, generates a loss of mobility, which causes changes in gait and balance disorders, leaving them more vulnerable, then there is a reduction in physical activity, which leads to the worsening of sarcopenia itself. This process, associated with the reduction of the individual's ability to meet the imposed demand, culminates in fragility (Jardim, 2014). So, it is understood that skeletal muscle mass and muscle strength are significant determinants in this syndrome and that they are essential in performing functional tests. Thus, mobility limitation has been recognized as a key component in the assessment of frailty.

Recent evidence demonstrates that reduced gait speed and decreased level of physical activity are among the first clinical manifestations of the syndrome. There are therefore associations between gait speed, sarcopenia and exercise capacity, the latter being one of the strongest predictors of mortality in healthy individuals and patients with CVD (Jardim, 2014).

Pedrosa *et al.* (2009), in an observational study, demonstrated in their results that gait speed has a strong positive correlation with the 6MWT in elderly patients with CVD, that both were predictors of mortality and that they have prognostic abilities.

Importantly, the number of patients with sarcopenia is expected to increase over the next 30 years. Therefore, clinically relevant physical function tests for elderly patients are necessary and relevant (Kamiya *et al.*, 2018).

All patients in this case series presented a certain degree of vulnerability, in addition to values below the predicted and reduction in gait speed. Another important aspect was that the patients with shorter distance walked had scores of 5, 6 and 7 in the frailty assessment, which shows a low level of physical activity, a reduction in functionality and consequently a greater need for help in the activities of daily living of these individuals.

In another study, the results indicated that gait speed was lower in older patients, and slow walking was observed more frequently in women with higher prevalence rates of previous heart failure and compromised nutritional status. These multiple comorbidities and frailty likely contribute to morbidity and mortality. Exercise capacity was one of the strongest predictors of mortality in healthy individuals and patients with CVD (Kamiya *et al.*, 2018).

The mechanism underlying the association between idling speed and mortality involves sarcopenia, frailty, and exercise capacity. With the aging of the population, it becomes increasingly important to integrate these points as a vital sign in elderly patients to guide management and coordinate better care. Both skeletal muscle mass and muscle strength are significant determinants of gait speed in patients with CVD, and higher values of both have been shown to have protective effects against CVD. In addition, both muscle mass and strength are strongly correlated with circulating inflammatory markers in patients with chronic diseases (Kamiya *et al.*, 2018).

These data indicate that sarcopenia and frailty are critical determinants of exercise capacity and prognosis, and suggest that this instrument may represent an adequate assessment of a single item to be implemented as a routine clinical assessment.

In Brazil and worldwide, sedentary lifestyle has a high prevalence and is strongly related to CVD and early mortality. On the other hand, a better quality of life and longer life expectancy is associated with higher volumes of physical activity, and there is therefore a strong and inverse association of the different components of physical fitness with all-cause mortality and the occurrence of unfavorable cardiovascular events (Carvalho *et al.*, 2020).

Physical exercise is an important strategy because it promotes beneficial systemic adaptations that contribute to functional improvement. It exerts a therapeutic effect on physiological restructuring with a reduction in oxidative stress and inflammation, correction of baroreflex dysfunction, increase in vagal tone, decrease in sympathetic activity, reversal of arteriolar hypertrophic remodeling in exercised tissues, and reduction in peripheral vascular resistance, with a consequent decrease in blood pressure (Carvalho *et al.*, 2020). In addition to hemodynamic changes, it includes strength and endurance gains, psychological changes and is thus associated with the control of risk factors and improved quality of life.

Promoting cardiovascular health through education, risk factor management, physical training, and psychosocial health is one of the goals of CVR. It has the potential to target risk factors that contribute to the progression of muscle wasting disorders, such as sedentary lifestyle, malnutrition, and polypharmacy, as well as improve muscle strength and performance (Carvalho *et al.*, 2020). Therefore, physical training leads to an improvement in the components of physical fitness, both aerobic and non-aerobic (muscle strength/power, flexibility, balance), when there is a combination of different training modalities.

Traditionally, CVR is divided into phases, with phase 1 being in-hospital and phases 2 to 4 being outpatient. In phase 1, the objective is that the patient is discharged from the hospital with the best possible physical and psychological conditions, providing relevant information about lifestyle and physical exercise, in addition to directing him to the outpatient phases. Phase 2 begins immediately after hospital discharge and lasts an average of 3 months. Phase 3 usually lasts 3 to 6 months and phase 4 lasts for a long time. In all phases, the objective is progression or, at least, the maintenance of the gains obtained (Carvalho *et al.*, 2020).

The mean CVR period of the patients in the sample was 20 weeks. Time in which specific exercise programs were applied aiming to improve physical fitness, with individualized planning of aerobic exercises (treadmill, bicycle, outdoor training) and resistance exercises (lower and upper limbs with elastic bands, shin guards and dumbbells), in sessions with an average duration of 50 minutes. None of the patients reached the distance predicted for their age during this time, but 9 out of 11 increased the distance covered in the test and consequently there was an increase in the average speed.

It was also possible to observe that all patients who performed better on the 6MWT after CVR also had an improvement in the frailty score, going to 1, 2, 3, 4 and 5. For them, the CVR program provided an improvement in functional capacity and reduced frailty.

CVR is an effective adjuvant therapy in the treatment of patients after acute coronary event, CABG and HF. A systematic review and meta-analysis of 63 studies involving 14,486 patients aged 47 to 71 years revealed that CVR reduced cardiovascular mortality by 26% and overall hospitalization by 18%, with further improvement in quality of life in this population, and should be encouraged whenever possible (Anderson *et al.*, 2016).

In a retrospective study of 322 Japanese older adults with CVD who attended a CVR program that included exercise training (aerobic, resistance, and balance) and nutritional intervention, sarcopenia was present in 28% of participants, and those with sarcopenia tended to be female and older. Participants with and without sarcopenia saw a significant improvement in muscle strength and gait speed, this suggests that CVR programs have the potential to reverse or slow the progression of sarcopenia (Damluji *et al.*, 2023).

CVD is a group that causes high expenses with hospitalizations in the Unified Health System (*Sistema Único de Saúde* - SUS), being the main cause of disability retirements. In 2015, in relation to CVD, it is estimated that public spending on hospital admissions and consultations was more than 5 billion reais and spending on temporary or permanent leaves of absence was more than 380 million reais. Therefore, in view of the economic impact caused by CVD, the implementation of low-cost models, such as CVR, enabling the care of a greater number of patients is indeed important. In addition, its use on a larger scale provides a reduction in health expenditures, leading to a decrease in new cardiovascular events, hospital readmissions and interventional treatments. Thus, its dissemination should be considered a priority public health strategy (Carvalho *et al.*, 2020).

Frailty syndrome has the potential to affect all aspects of the elderly person's life. Their functional independence, which can be understood as the ability to perform essential activities for life, including self-care, living independently in a home, and performing activities important for quality of life. In addition, it is an event whose effects extend beyond the elderly themselves, and can cause family and caregivers overload, and high costs to health services (Freitas *et al.*, 2016).

Screening for this syndrome is essential since it identifies individuals at higher risk of unfavorable outcomes after cardiovascular events, consequently, it is able to impact individualized care, with the identification of specific targets that need to be addressed in the planning of a rehabilitation program. On the other hand, screening for the syndrome in the elderly population in general would be interesting, since these fragile individuals are the ones who most need health care, and, for this reason, frailty can be used as a potential organizer of health management for the elderly. With this, investment priorities could be established, aligning financial aspects and quality of life conditions, by considering the frail individual as a target of health policies (Lourenço *et al.*, 2018). Therefore, it is essential that the health professional, who assists the elderly and cardiovascular patients, knows the syndrome, its consequences, forms of evaluation, prevention and rehabilitation.

Conclusion

The individuals in this study, after a cardiovascular event, had a higher frailty index demonstrated by the CFS scale and a worse performance in the pre-rehabilitation functional capacity test. A supervised exercise program promoted an increase in functional capacity, making them more active and less fragile. With the 6MWT, it was possible to carry out an evaluation in which frail individuals were identified through walking speed, which is accessible, quick to apply and low cost, allowing a continuous evaluation of this group.

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