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VOLUME DE EXERCÍCIO REALIZADO POR DOENTES INTERNADOS COM INSUFICIÊNCIA CARDÍACA EM PROGRAMA DE REABILITAÇÃO CARDÍACA – UM ESTUDO QUASE EXPERIMENTAL

VOLUME OF EXERCISE PERFORMED BY HEART FAILURE INPATIENTS UNDERGOING CARDIAC REHABILITATION – A QUASI-EXPERIMENTAL STUDY

VOLUMEN DE EJERCICIO REALIZADO POR PACIENTES CON INSUFICIENCIA CARDÍACA EN REHABILITACIÓN CARDÍACA: UN ESTUDIO CUASIEXPERIMENTAL

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RESUMO

Introdução: Os doentes internados com insuficiência cardíaca apresentam uma dependência funcional significativa, comprometimento do desempenho nas atividades de vida diária e baixa tolerância ao exercício. A quantidade de Exercício está diretamente relacionada com os seus benefícios e o volume de exercício realizado deve ser ajustado aos parâmetros de segurança. O objetivo deste estudo é avaliar o volume de exercício realizado por doentes internados com insuficiência cardíaca e sua relação com a capacidade funcional, procurando encontrar um nível basal de volume de exercício seguro e eficaz.

Metodologia: Estudo quase-experimental envolvendo 50 doentes internados que realizaram um programa de exercício físico aeróbio. O volume de exercício foi registado em termos de número de voltas no cicloergómetro, metros caminhados, degraus subidos e tempo total de exercício. A perceção subjetiva de esforço foi avaliada em todas as sessões de treino no início e no final. Os doentes realizaram dois testes de 6 minutos de marcha (T6MM).

Resultados: Foram realizadas 987 sessões de treino. A maioria dos doentes apresentava uma capacidade funcional significativamente comprometida: 81,9% são NYHA III e 73,6% apresentam Insuficiência Cardíaca com fração de ejeção reduzida. A perceção subjetiva de esforço durante o internamento reduziu significativamente: 6 (±3) (admissão) e 2(±2) (alta). Os doentes que realizaram maior volume de exercício caminharam uma maior distância no T6MM à data da alta.

Conclusão: Um maior volume de exercício aeróbio está relacionado com melhores resultados em termos de funcionalidade. Uma média de mais de 10 minutos por sessão parece ser mais eficaz em termos de melhoria da capacidade funcional.

Descritores: Insuficiência Cardíaca, Exercício aeróbio, Volume de exercício, Reabilitação

ABSTRACT

Introduction: Heart Failure inpatients have a significant functional dependence, impairment of performance in activities of daily living, and low exercise tolerance. The amount of exercise is directly related to its benefits, and the exercise volume must be adjusted to address safety issues. This study aims to evaluate the volume of exercise performed and its relationship with functional capacity and determine a safe and effective baseline volume level.

Methodology: Quasi-experimental study involving 50 inpatients who performed an aerobic exercise training program. The exercise volume was registered regarding the number of cycle ergometer turns, meters walked, steps climbed, and the total time exercising. Subjective perception of exertion was evaluated in every training session at the beginning and the end. Patients performed two 6-minute walking tests (6MWT).

Results: 987 exercise sessions were performed. Most of the patients were significantly impaired: 81.9% are NYHA III, and 73.6% present HFrEF. Patients achieved lower levels of perceived exertion throughout the hospital stay: 6 (±3) (admission) and 2(±2) (discharge). Patients with more exercise volume walked a higher distance in the discharge 6MWT.

Conclusion: A higher volume of aerobic exercise is related to a better improvement in functional outcomes. An average of more than 10 minutes per session seems more effective in improving the functional capacity.

Descriptors: Heart Failure, Aerobic exercise, Volume of exercise, Rehabilitation

RESUMEN

Introducción: Los pacientes hospitalizados con insuficiencia cardíaca presentan una importante dependencia funcional, deterioro del rendimiento en las actividades de la vida diaria y baja tolerancia al ejercicio. La cantidad de ejercicio está directamente relacionada con sus beneficios y el volumen de ejercicio realizado debe ajustarse a cuestiones de seguridad. El objetivo de este estudio es evaluar el volumen de ejercicio realizado y su relación con la capacidad funcional y encontrar un nivel basal de volumen seguro y efectivo.

Metodología: Estudio cuasiexperimental con 50 pacientes hospitalizados que realizaron un programa de entrenamiento con ejercicios aeróbicos. El volumen de ejercicio se registró en términos de número de vueltas cicloergómetro, metros caminados, escalones subidos y el tiempo total de ejercicio. La percepción subjetiva del esfuerzo se evaluó en cada sesión de entrenamiento al inicio y al final. Los pacientes realizaron dos pruebas de caminata de 6 minutos (6MWT).

Resultados: Se realizaron 987 sesiones de ejercicio. La mayoría de los pacientes presentaban un deterioro significativo: el 81,9% son NYHA III y el 73,6% presentan ICFEr. Los pacientes alcanzaron menores niveles de esfuerzo percibido a lo largo de la estancia hospitalaria: 6 (±3) (ingreso) y 2(±2) (alta). Los pacientes que realizaron más volumen de ejercicio caminaron una mayor distancia en el alta de 6MWT.

Comclusión: Un mayor volumen de ejercicio aeróbico se relaciona con una mejor mejoría en los resultados funcionales. Una media de más de 10 minutos por sesión parece ser más eficaz en términos de mejora de la capacidad funcional.

Descriptores: Insuficiencia cardíaca, Ejercicio aeróbico, Volumen de ejercicio, Rehabilitación

INTRODUCTION

Heart failure (HF) can be defined as an abnormality of the heart function or structure leading to reduced oxygen delivery throughout the body[1]. The primary symptoms are exercise intolerance, dyspnea, and fatigue. Decreased exercise tolerance is a hallmark feature in HF patients and may have many contributing factors, such as decreased cardiac output, peripheral muscle wasting, and autonomic imbalance[2]. It is a significant healthcare problem associated with high morbidity, mortality, and reduced quality of life[1].

HF is a progressive disease, demonstrated by the patient's physical impairment. Exercise intolerance pushes the patient towards sedentary behaviors. Consequently, these behaviors lead to an even more significant decline in functional capacity, with loss of aerobic capacity, muscle mass, and muscle strength[3].

Regular and systematic exercise training is prescribed to manage this disease and its symptoms and signs. Within consensus, European guidelines have incorporated a class IA recommendation for regular aerobic exercise in HF patients. This non-pharmacological treatment has several benefits and improves functional capacity, symptom relief, and health-related quality of life. It also reduces mortality and rates of hospital readmission for decompensated HF[4].

Due to this evidence, patients with heart failure should be enrolled in an exercise training program as early as their clinical status allows. The exercise prescription is designed for a specific purpose, and it is usually developed by rehabilitation specialists based on the patient's condition, motivation, and goals. This program can be carried out in an inpatient or outpatient phase and should be planned according to the FITT-VP principle (Frequency, Intensity, Time, Type, Volume, and Progression)[4,5]. This principle aims to assist professionals in developing an individualized training plan optimized for the patient's clinical condition and comorbidities, aiming to improve physical fitness and health[5].

To prescribe safe, progressive, and adequate exercise, knowing the optimal dose of exercise a given individual must fulfill to achieve the desired goals is essential. The results of several studies have demonstrated a positive association between the volume of exercise and health and fitness outcomes, which means that with a more significant amount of exercise, the outcomes also improve, even though the optimal dose is difficult to measure precisely[5]. Conceptually, the exercise Volume is the product of the defined Frequency, Intensity, and Time[4].

Although the health and scientific communities accept exercise training well, there is still a lack of studies that describe and validate the ideal exercise volume for patients with heart failure during the clinical stabilization phase[6].

We aim to measure the volume of exercise a sample of HF inpatients performed during the in-hospital stay and relate it to the functional capacity achieved to understand the optimal exercise volume for these patients, defining a reference value.

METHODOLOGY

This is a single-center, quasi-experimental study[7], aiming to measure the volume of exercise performed by HF inpatients according to the ERIC-HF program[8], seeking to understand the relation between the volume of exercise and patient's improvement of functional capacity and to create reference values for the volume of exercise. A sample of 50 patients, enrolled from January 2019 to December 2019, performed an aerobic exercise training program – ERIC-HF[9], consisting of five sequential stages of increasing intensity, beginning with respiratory training and progressing into aerobic training. The different stages are presented in Table 1. A functional evaluation was performed at admission and discharge using the Barthel index (BI) and the London Chest Activity of Daily Living Scale (LCADL); also, a six-minute walking test (6MWT) was performed twice: as soon as the patient was capable of it and at discharge.

Table 1 – ERIC-HF Protocol Stages

Stage	Exercise
I	Respiratory and callisthenic exercises performed in supine or orthostatic position
II	5 to 10 min on cycloergometer
III	5 to 10 min walking
IV	10 to 15 min walking
V	10 to 15 min walking and 5 min climbing stairs (patients may stop for recovery)

PARTICIPANTS

This study conforms with the principles outlined in the Declaration of Helsinki[10]. The local ethical commission approved the study (Ref 2016.172(145-DEFI/134-CES)), and all patients gave written informed consent to participate.

All the patients admitted to the cardiology ward are usually enrolled in a cardiac rehabilitation phase one program to promote their functional capacity, improve their skills in self-care, and optimize the treatment. A cardiologist and a rehabilitation nurse evaluated the patients involved in this study to decide if they could perform the exercise and fulfill the inclusion criteria; rehabilitation nurses performed the exercise training sessions and subsequent evaluations.

The inclusion criteria were: 1) diagnosis of decompensated HF, independently of the etiology or the systolic left ventricular function during clinical stabilization phase; 2) age >18 years; 3) ability to provide informed consent. Exclusion criteria were: 1) inability to understand the exercises due to cognitive impairment, 2) transfer to another ward, and 3) osteoarticular impairment for walking.

VOLUME OF EXERCISE

The exercise volume is often defined as metabolic equivalents or steps per day[4], which is the recommendation for outpatients. Since this study was developed with inpatients, it was not possible to use the referred measurements because of the lack of adequate equipment; for this reason, it was decided to measure the volume of exercise in terms of the number of turns on the cycle ergometer, meters walked, number of steps climbed, and the total amount of time spent exercising. At the end of every training session, which must be performed twice a day, five days per week, the exercise volume was registered according to the stage of the program. At discharge, an analysis of the total amount of exercise performed, the total time in minutes spent exercising, and the stage reached by the patient was performed.

COMPARISONS

The patient's performance was compared according to the ERIC-HF stage that the patient reached. Patients were divided into two groups: Group A – a group of patients that reached the fourth stage, and Group B - a group of patients that reached the fifth stage. No patient was discharged at a lower stage than the fourth. After this division, patients were compared in terms of 1) age, 2) duration of the in-hospital stay, 3) number of sessions of exercise, 4) total time spent exercising, 5) mean duration of each training session, 6) total meters walked, 7) BI and LCADL at discharge, 8) variation of the BI and the LCADL (difference between the score at admission and discharge), 9) distance walked in the 6MWT; 10) difference between the distance walked at the first 6MWT and discharge, 11) etiology of HF and 12) ventricular function.

The main objective of these comparisons was to understand if the patients that reached a higher stage of the program increased their functional capacity, measured by the 6MWT, the LCADL, and the BI, and if there are any significant clinical or sociodemographic differences between them.

According to the principles of exercise, specifically the overload principle, more exercise is expected to promote more improvement in functional capacity[4]. It is also known that even small volumes of exercise may have benefits, even though many epidemiologic studies demonstrated that the greater the volume of exercise, the greater the health/fitness benefits[4].

The 6MWT is an easy-to-administer, inexpensive, and safe test that assesses a patient's submaximal functional capacity[11]. The test was performed according to the American Thoracic Society guidelines, and the patients were asked to walk at their usual speed[11] since ADLs are not performed at full speed.

INTENSITY AND SAFETY OF EXERCISE

Many parameters can be used to determine the intensity of exercise[4]; however, the ACSM guidelines recommend the use of subjective perception of exertion (SPE), using the modified Borg scale and the heart rate (HR) variation during exercise. The patient must present an SPE between 1 and 3.5 in a low-intensity phase, progressing from 4 to 7 in a moderate-intensity phase; the HR must be measured at rest and during effort. However, if the patient has atrial fibrillation, only SPE should be used[4]. Also, blood pressure (BP) can be significant when analyzed at rest and immediately after effort interruption. Besides SPE and HR, during the exercise session, some physiological responses must be routinely monitored to guarantee the safety of the patients, namely: 1) diastolic blood pressure (DBP) ≥110 mm Hg; 2) decrease in systolic blood pressure (SBP) >10 mmHg during exercise with increasing workload; 3) significant ventricular or atrial arrhythmias with or without associated signs/symptoms; 4) second- or third-degree heart block; 5) signs/symptoms of exercise intolerance such as SPE greater than 8 in the modified Borg scale, angina, marked dyspnea, and electrocardiogram (ECG) changes suggestive of ischemia[4]. Falls and any muscular damage from exercise training, such as muscle spasms or pain, should also be considered[8]. In case of any previously described situation, the health care team interrupted the exercise session, considering the number of laps/meters/steps carried out until that time.

Under rehabilitation nurse supervision, patients performed the exercise training sessions under cardiac monitoring, with an evaluation of HR, blood pressure, and SPE at rest and after effort.

STATISTICAL METHODS

The data was analyzed with SPSS v. 24.0. Normality of the data distribution was ensured; descriptive statistic results are presented with average, standard deviation, minimum, and maximum. Comparison between patients was performed using the paired sample T-test. A significance level of $p<0.05$ was assumed.

RESULTS

Baseline characteristics of the patients, such as age, functional capacity, and pathophysiological status, are presented in Table 2. Most patients have reduced ejection fraction (HFrEF), representing 73.6% of the sample, and the primary etiology of HF is ischemic disease (25 patients). Patients have an average of 4 CVRF, with the sedentary lifestyle being the most prevalent, followed by hypertension; only 17% of patients referred to perform regular physical activity. Patients presented a significant functional dependence according to the BI and the LCADL, and the in-hospital stay period was 19 (±8) days (Table 2).

Table 2 – Baseline characteristics of the patients

Parameter	Value
Age (years)	69.3 (±9.5)
Gender	35M 15 F
In-hospital stay (days)	19 (±8.7)
CVRF*	4
Functional status	
LCADL** admission	32 (±8.5)
Barthel admission	73.3 (±19.9)
First 6MWT (m)	199.9 (±115.9)
Functional class	
NYHA† III	41 (82%)
NYHA†IV	9 (18%)
Etiology	
Dilated	9 (18%)
Atrial fibrillation	4 (8%)
Valvular disease	16 (32%)
Ischemic disease	18 (36%)
Other	3 (6%)

Parameter	Value
LVEF††	
	N (%)
HFpEF§	6 (12%)
HFmEF§§	8 (16%)
HFrEF§§§	36 (72%)

***Cardiovascular risk factors, ** London Chest of Activities of Daily Living, ⊠ New York Heart Association, ⊠⊠Left ventricular ejection fraction, § heart failure with preserved ejection fraction, §§ heart failure with mild ejection fraction, §§§ heart failure with reduced ejection fraction**

A total amount of 987 sessions of exercise was performed, with an average of 14 (±5) sessions for each patient. More than half of the sample reached the final stage of the program, so there were 22 patients in group A and 28 in group B (Table 3).

Table 3 – Volume of exercise

	Number of sessions	Total time	Duration per session	Cycloergometer (total)	Meters walked (total)	Steps climbed (total)	Borg
Group A (n=22)							
Mean	14.3	97.9	7.9	1065.5	2118.7	-	3.9
SD	6.9	73.2	2.8	1570.2	1906.5	-	1.66
Min	5.0	27.0	2.1	0.0	485.0	-	1
Max	28.0	268.0	15.4	6686.0	6315.0	-	9
Group B (n=28)							
Mean	12.6	153.3	11.3	1256.7	5144.9	369.7	3.9
SD	5.2	55.7	3.9	754.8	2549.6	288.3	1.52
Min	5.0	62.0	5.9	0.0	545.0	20.0	2
Max	24.0	277.0	21.3	3076.0	12770.0	1176.0	7
Total (n=50)							
Mean	13.8	130.1	9.7	1155.6	3706.7	369.7	4
SD	6.0	65.7	3.8	1188.1	2547.0	288.3	1.57
Min	5.0	27.0	2.1	0.0	485.0	20.0	1
Max	28.0	277.0	21.3	6686.0	12770.0	1176.0	9

Moreover, considering the whole sample, patients performed progressive periods of exercise with lower levels of perceived exertion (Borg modified scale), presenting an average of 6 (±3) in the first session and 2 (±2) on the discharge day. No major adverse events occurred during the exercise sessions, like precordial pain, cardiac arrest, or arrhythmic events (ventricular fibrillation or ventricular tachycardia) (Table 4).

Table 4 – Safety parameters (987 sessions)

Adverse Event	N (%)
Atrial fibrillation (rapid ventricular response)	27 (2.7%)
Decrease of SBP*> 10mmHg	38 (3.9%)
Clinical worsening	0 (0%)
SPE** ≥ 8	57 (5.8%)
Precordial pain	0 (0%)
Cardiac arrest	0 (0%)
Major arrhythmic events	0 (0%)

***Systolic blood pressure, **Subjective perception of effort**

Regarding comparisons, significant differences were found at a 95% confidence interval between the two patient groups, as shown in Table 5. Statistically significant comparisons were found regarding the distance walked in the 6MWT at discharge, the BI at discharge, total meters walked, total time spent exercising, and the duration per exercise session. No other variable presented a significant difference.

Table 5 – Comparisons between groups of patients (T-test – 95% confidence interval)

Parameter	Group A Mean ± SD	Group B Mean ± SD	P value
Age	71.3±10	67.7±9	0.197
In-hospital stay	19,3±9.5	18.1±6.7	0.646
Sessions of exercise	12.7±6.9	14.3±5.1	0.307
Total time exercising	97.9±73.1	153.3±55.6	0.001*
Duration per session	7.9±2.7	11.3±3.9	0.001*
Meters walked	2118.7±1906.4	7144.9±2549.5	<0.001*
NYHA class			
III	16	24	0.987
IV	5	4	0.545

Parameter	Group A Mean ± SD	Group B Mean ± SD	P value
BI			
Discharge	93.3±7.1	97.7±4.9	0.016*
Variation	23.4±13.3	21.6±18.4	0.698
LCADL			
Discharge	13.3±4.1	11.4±3.6	0.087
Variation	19±6	19.19±7.8	0.726
6MWT			
First test	185.9±126	210.7±108.8	0.476
Discharge teste	224.4±106.1	341.5±123.5	0.001*
Difference between tests	29.6±150.6	137.1±173.6	0.023*

***Statistical significant with p<0.05**

DISCUSSION

Until now, no other study has addressed the volume of exercise that an HF inpatient could perform during the stabilization phase. This study gives us general orientations to develop exercise training programs to safely improve inpatients' functional capacity.

With these results, it can be defined a training protocol according to the FITT-VP parameters: F) twice a day, five days a week, I) using SPE and HR, T) from 5 to 20 minutes of continuous training, T) aerobic exercise with cycle ergometer, gait training and stairs climbing, V) table 5 can be used to compare the performance of other patients with similar periods of in-hospital stay and similar pathophysiologic characteristics, P) first increase the complexity of exercise – cycle ergometer first, than gait training and then stairs climbing; increase the duration every day if possible and then increase the intensity, performing exercise with more speed.

STUDY SAMPLE

Our study was inclusive of patients with multiple comorbidities, different functional capacities at baseline, reduced and preserved ejection fraction, and a significant decompensation of heart failure. The lack of previous studies with these patients reveals the need to study this population[12]. It is necessary to build new knowledge and guarantee the possibility of having reference values for comparison, stimulating the development of other exercise training programs for HF inpatients and complying with the guidelines that recommend the involvement of patients in cardiac rehabilitation[13].

Very impaired patients represented the sample of patients in this study according to the BI and the LCADL scores; a mean of 73.3 points (minimum 31 points) in BI represents moderate dependence[14], and 32 points in LCADL represents significant exertion in performing activities of daily living[15]. Regarding 6MWT, there is a lack of information about the reference distance walked by inpatients since they are usually excluded from clinical trials involving exercise[6]. Compared to the reference values of stable outpatients, there is an enormous difference[16]: in a study involving 444 subjects, with ages ranging from 40 to 80 years, the mean distance was 571± 90 meters (range 380 to 782 meters), where males presenting an average of 30 meters farther than females[17]. The absence of information about the average distance walked by inpatients makes this work more remarkable once it contributes to the body of knowledge in his field.

Most of the patients were sedentary and with hypertension, which is in line with the regular characteristics of these types of patients.

VOLUME OF EXERCISE

Since this is a study developed with patients during the stabilization phase of the disease, it was impossible to measure the metabolic equivalents

during exercise, so the exercise volume was measured in terms of the total exercise duration. The mean duration per training session, the number of turns on the cycle ergometer, meters walked, and stairs climbed. Guidelines only give us imprecise orientations about the amount of exercise that patients must perform; there is recommended walking short-to-moderate distances, with minimal or no assistance, three to four times a day, progressing to independent ambulation; upper body movement exercises and minimal stair climbing, but are unclear about the time and duration of it[4].

Our program aims to improve functional capacity and make the patients more aware of the importance of exercise training[18], so it was structured into progressive levels of intensity to allow the patients to perform even more volume of exercise and gradually adapt to it[19]. To improve aerobic capacity, the mode of exercise and its volume must be taken into account[20]. All patients began the program in the first or second stage and have progressed until at least the fourth stage, with 42 of them reaching the last stage, which means that patients performed progressive volumes of exercise. Almost every patient trained twice a day, as expected, for at least 65% of the period of the in-hospital stay. Patients could not always perform the exercise training twice a day as planned since sometimes they had to perform some medical exams during the shift.

The most frequent type of exercise was walking continuously since it is one of the best exercises for improving aerobic fitness and functional capacity[1]. Also, stair climbing is part of the program since it is a usual daily living activity for most patients. Stair climbing also requires aerobic capacity and leg strength[21], which is crucial for developing functional capacity[22]. Initially, a cycle ergometer was used since the patients could not perform gait training. The few sessions at the program's second stage represent that patients could progress positively. This progression to levels of a more significant volume of exercise is in line with the overload principle of exercise, which is related to the amount of load or volume of exercise; to improve physical fitness continuously, it is necessary to increase every time the workload/volume of exercise[4]. In this study, patients performed even more exercise than the recommended for more deconditioned outpatients, the so-called "start low and go slow," which suggests 5 to 10 minutes of low intensity twice a week, progressing first in terms of duration of the session and then in the number of sessions per week[23]. This point may show us that patients can go beyond the defined limits of exercise training volume with correct progression and supervision.

SAFETY PARAMETERS

Safety concerns are even more critical since this study's patients were in a stabilization phase. No major adverse events occurred, and the number of adverse events in the 987 exercise sessions was low insignificant (low percentage of rapid ventricular response in atrial fibrillation patients and SPE greater than 8). Atrial fibrillation events allowed the recognition of risk patients and, consequently, their stabilization. Regarding SPE, some patients experienced significant exertion during exercise training. However, the recovery time was very short, and patients could feel low exertion levels in less than 3 min. Reaching such levels of SPE should not be interpreted as something harmful. Since HF patients need a higher percentage of their peak VO2 to perform their activities of daily living, many studies used an intensity above the first ventilatory anaerobic threshold to improve the aerobic capacity of patients best, allowing them to feel less exertion[23]. This low percentage of events demonstrates the program's safety and enables us to infer that HF inpatients can perform exercise training sessions safely while increasing their workload. However, these exercise sessions must always be conducted and supervised by appropriate healthcare teams with experience in the field, like trained cardiologists and rehabilitation nurses[24].

COMPARISONS

Analyzing the comparisons between the two groups of patients, it is possible to conclude that, remarkably, more than half of the sample reached the program's final stage, which is the most intense and last the longest. Regarding the paired sample T-test, it was found that patients of group B presented a better functional capacity, accessed by the 6MWT, with a mean score of 117.1 meters at discharge (p=0.001). Also, the BI mean score was 4.4 points higher (p=0.016). This result shows that the more exercise patients perform, the more they will improve their functional capacity until a certain point. The LCADL score does not present a statistically significant difference, which is expected since patients must only be discharged when they do not feel breathless performing daily activities. It could be said that the patients who reached the final stage had better pathophysiologic characteristics. However, these results show us that in terms of age, gender, number of days of in-hospital stay, number of sessions, NYHA functional class, etiology of HF, and ventricular function, there are no differences between the two groups. The total time spent exercising and the duration of each session is higher in group B because the last stage implies a more extended exercise session.

IMPLICATIONS FOR PRACTICE

Our study's results can help define some reference values for the volume of exercise that HF inpatients can perform, allowing the comparison with

future studies with similar samples of patients. These results can help other healthcare provider teams who work with HF patients to prescribe exercise training sessions since this is a tested program with good results in terms of safety and efficacy. Our study increases the existing knowledge in the field, promoting cardiac rehabilitation phase I. Other combinations of exercises may promote the same level of functional capacity or even more; however, this combination is now known to be safe and effective and presents reference values in terms of time, duration, volume, and progression of exercise.

STRENGTHS AND LIMITATIONS

The absence of studies and objective recommendations about the volume of exercise that patients should or could perform was the major limitation of our research, which has also become the greatest strength. Our study defined reference values for exercise volume to HF inpatients, revealing that this volume can be performed safely.

Regarding limitations, we consider the following: 1) patients did not perform the same number of sessions and volume of exercise due to the duration of in-hospital stay; 2) the relatively small study sample; 3) the inability to perform subgroup analysis for important characteristics, namely left ventricular ejection fraction; 4) the lack of devices that could evaluate the metabolic equivalents during exercise, namely accelerometers; 5) the absence of a 6MWT at admission. Patients performed their first 6MWT in different periods of the in-hospital stay, and the variability of the number of days of hospitalization may cause a potential bias regarding improving their functional capacity. However, patients who performed more exercise improved their functional capacity significantly. This study can show an association between exercise volume and functional capacity but not a cause-effect relation.

CONCLUSION

HF inpatients can perform aerobic exercise training, safely incrementing daily total exercise. Apparently, patients who perform a greater exercise volume can improve their functional capacity after an in-hospital stay to stabilize decompensated HF in this sample of patients.

Aerobic exercise training, performed twice a day, five days a week, with a range of 10 to 20 minutes per session, seems well tolerated and improves functional capacity.

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