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FUNCTIONAL, PULMONARY, METABOLIC AND QUALITY OF LIFE RESPONSES AFTER CARDIOVASCULAR REHABILITATION PROGRAM

RESPOSTAS FUNCIONAIS, PULMONARES, METABÓLICAS E DE QUALIDADE DE VIDA DEPOIS DO PROGRAMA DE REABILITAÇÃO CARDIOVASCULAR

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RESUMO | Introdução: ensaios clínicos mostraram melhora na capacidade funcional, qualidade de vida, morbidade e mortalidade após programa de reabilitação cardiovascular (RCV). **Objetivo:** verificar as respostas clínicas a um programa de RCV em um centro terciário. **Métodos:** 85 pacientes foram avaliados em um programa de RCV. Os resultados de capacidade funcional obtidos através do teste cardiopulmonar (TCP), teste da cadeira (TC2), teste do degrau (TD6), pressões inspiratórias e expiratórias (Pins e Pexp, respectivamente), peak-flow e escore de qualidade de vida (Minnesota Living With Heart Failure Quality of Life Score - MLWHFS) foram comparados antes e depois do programa. **Resultados:** 69% eram homens, a idade média foi 61 ± 15 anos e a fração de ejeção média foi de 61 ± 24%. Houve uma melhora absoluta de 2,4±3,5ml/kg/min no VO2 pico (p <0,001); 14±17 repetições no TC2 (p < 0,001), 44±41 degraus no TD6 (p <0,001). Na função pulmonar, houve uma melhora de -20±40 cmH2O na Pins (p <0,01), 9 ± 29 cmH2O (p <0,001) na Pexp e de 52 ± 77 L/min no peak-flow (p <0,01). Houve um ganho significativo na qualidade de vida com uma redução média de 21 ± 15 pontos no MLWHFS (p <0,001). **Conclusão:** RCV resultou em uma melhora na capacidade funcional, pulmonar e na qualidade de vida. Esses resultados reproduzem e reforçam os achados de ensaios clínicos randomizados na prática clínica real.

Palavras Chave: insuficiência cardíaca, reabilitação cardiovascular, capacidade funcional.

ABSTRACT | Background: clinical trials showed improvement in functional capacity, quality of life, morbidity and mortality with cardiovascular rehabilitation (CVR). **Objective:** to verify clinical responses of a CVR program in a tertiary center. **Methods:** 85 patients evaluated in a CVR program. Results for functional capacity obtained by cardiopulmonary exercise test (CPET), sitting rising chair test (SRCT), six minute step test (6MST), inspiratory pressure (Pins), expiratory pressure (Pexp), peak-flow and quality of life score (Minnesota Living With Heart Failure Quality of Life Score - MLWHFS) were compared before and after the program. **Results:** 69% were men, mean age was 61 ± 15 years and the mean ejection fraction was 61 ± 24%. There was an absolute mean increase of 2.4 ± 3.5 ml -1.kg -1.min -1 in peak VO2 (p <0.001), 14 ± 17 repetitions on the SRCT (p <0.001), 44 ± 41 steps on the 6MST (p <0.001). In pulmonary function, there was an increase of -20 ± 40 cmH2O in Pins (p <0.01) and of 9 ± 29 cmH2O (p <0.001) in Pexp and 52 ± 77 L.min-1 in peak-flow (p <0.01) and there was a significant gain in quality of life with a mean reduction of 21 ± 15 points in the MLWHFS (P <0.001). **Conclusion:** CVR program resulted in a increase in functional, pulmonary capacity and improvement of quality of life. These data reproduce and reinforce the findings of randomized clinical trials, but in a real and uncontrolled clinical setting.

Key Words: heart failure, cardiovascular rehabilitation, functional capacity.

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INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality around the world. According to the World Health Organization (WHO), CVD was responsible for approximately 17.5 million of deaths in 2012, accounting for 31% of all deaths worldwide, with three-quarters of these deaths occurring in low and middle-income countries[1]. At the same year, in Brazil, there were approximately 214 deaths per 100,000 inhabitants[2].

Heart failure (HF) is the final common pathway of CVD and, therefore, represents one of the most important clinical challenges in the health field, characterizing an important public health problem on the rise[3]. Due to its high morbidity, HF is the main cause of hospitalization in Brazil among patients over 60 years of age. About one-third of hospitalized patients at the Public Health Care with heart disease have HF[4]. As a result, its cost of treatment is high, considering direct costs, such as hospital intervention, complementary exams, medications and professional fees[5].

The purpose of pharmacological and non-pharmacological treatment of HF is to reduce signs and symptoms, improve quality of life and increase patient survival. Pharmacological treatment is selected according to clinical condition and should improve symptoms and increase survival. On the other hand, non-pharmacological treatment, as well as pharmacological treatment, is an integral and indispensable part of the control of HF and consists in the adoption of measures that preserve and improve the functional capacity of the heart.

In this context, cardiovascular rehabilitation (CVR) is defined as "the set of activities necessary to assure people with cardiovascular diseases an optimal physical, mental and social condition that allows them to occupy their own means a place as normal as possible in society"[6]. Allied to therapy, it has been shown to play a predominant role in the management of patients with CVD and especially those with HF.

Belardinelli in 1998 showed improvement in functional capacity and quality of life and survival gain in patients with HF after a CVR program[11]. These findings were subsequently confirmed in another prospective study, with a prolonged follow-up of 10 years, and also confirmed in a population of patients with coronary disease[12,13]. The most important study regarding CVR, HF-ACTION, showed a reduction in the incidence of adverse events and an improvement in patients' quality of life, which led to the conclusion that regular physical activity in patients with HF is safe and should be encouraged[14].

However, despite the evidence in their favor, CVR is still poorly indicated by physicians[15]. In this way, clinical studies that bring routine data from an CVR program are important to verify the reproducibility and efficacy of CVR in the real world. The objective of this study is to verify the impact of a structured program of CVR in functional, pulmonary, metabolic and quality of life variables of patients followed up in an CVR program in a tertiary center.

METHODS

Study Design: retrospective cohort study which was based in data collected from review of patient charts followed up at the Cardiology Center of the Exercise Center at CVR program at Centro Médico Cárdio Pulmonar da Bahia before and after 12 weeks CVR sessions.

Population: The study was based on 85 consecutive patients from a CVR program in Salvador-BA who were evaluated and re-evaluated after a minimum period of 12 weeks of CVR sessions (classic program[6] as a clinical routine between August 2014 and March 2017. All patients underwent an initial evaluation and re-evaluation which consisted of: clinical evaluation (anamnesis and physical examination), cardiopulmonary exercise test (CPET), application of the Minnesota Living With Heart Failure Quality of Life Score (MLWHFS)[16], and physical therapist evaluation.

Inclusion criteria: Patients with a diagnosis of CVD or HF characterized by: previous acute myocardial infarction, coronary angioplasty, postoperative of cardiac or vascular surgery or patients with implantable devices such as pacemakers and cardiac defibrillators who were referred to the cardiovascular rehabilitation service and have undergone an initial evaluation with a cardiologist

and physiotherapist, have been engaged in the cardiovascular rehabilitation program for at least 12 weeks and have been re-evaluated by the cardiologist and physiotherapist. Diagnosis of CVD and HF was settled by medical history (past acute myocardial infarction, history of known coronary artery disease, past myocardial revascularization or angioplasty, dyspnea or angina), electrocardiographic abnormalities (electrically inactive zones) and echocardiographic abnormalities (ventricular dysfunction and segmental abnormalities).

Exclusion Criteria: Patients without an initial evaluation with a cardiologist and physiotherapist, patients who have not performed any functional capacity test before or after the 12 weeks period.

RCV Protocol: Patients underwent supervised physical activity that were divided into: warm-up phase, aerobic exercise phase, resisted exercise phase and cool down phase in sessions lasting 1 hour at least 3 times a week[6]. The whole program is supervised by a specialized physician in Exercise Cardiology, being applied by a multidisciplinary team that includes physicians and specialized physiotherapists. The data were obtained through clinical evaluation of a chart review obtained at the initial evaluation consultation performed by the cardiologist and physiotherapist of the CVR service, which included: identification, comorbidities, medications in use, vital and anthropometric data, estimation of functional capacity (New York Heart Association – NYHA) and cardiovascular risk assessment (American Heart Association - AHA), in addition to the following tests:

- Sitting rising chair test (SRCT): performed using a chair with backrest, without upper limb support. The test begins with the patient sitting in the chair, with his back resting on the backrest and feet resting on the floor. The patient is then instructed to sit completely in the chair, stand up fully extending the knees, without performing postural compensations, keeping the arms crossed in front of the thorax. All patients were advised to repeat the procedure as fast as possible, as many times as possible, within a two-minute period[17].
- Six-minute step test (6MST): It was performed on a 20 cm high step with non-slip rubber floor. The patient is instructed to go up and down the step as fast as possible for 6 minutes, inserting the lower limbs without support from the upper limbs and decreasing the cadence or finishing the test in case of intense fatigue or a submaximal heart rate[17].
- Peak Flow: The measurements were made with the patients seated and with the nostrils occluded. For such, the peak flow apparatus of Healthdyne Technologies® - USA was used. The patients were instructed to perform a maximal expiration and then a maximal inspiration before proceeding to forced expiration, which would give rise to the documented value. We chose to select the best result obtained from three procedures performed to serve as a peak flow value[18].
- Maximum inspiratory and expiratory pressures: The measurements were performed with the patients seated and with the nostrils occluded. With the manuvacuometer (Famabras®) positioned in the mouth, patients were instructed to perform forced breathing and exhalation. The maximum expiratory pressure (Pexp) was measured during the effort initiated at the total lung capacity, while the maximum inspiratory pressure (Pins) was measured during the effort initiated at the residual volume. We chose to select the best result obtained among three procedures performed to serve as Pexp and Pins value.
- Cardiopulmonary Exercise Test (CPET): The tests were performed in a symptom-limited manner, on a treadmill and with a gas analyzer (Cortex inc, Leipzig) capable of performing breath-to-breath measurements. An individualized ramp protocol was used for the functional class of each patient, aiming a duration between 8 and 12 minutes of the exercise phase. The ventilatory data collected were tabulated and analyzed at 10-second intervals. The analyzed variables were VO2 at peak exercise and VO2 at the anaerobic threshold[19].
- Quality of Life: To estimate the quality of life, the specific questionnaire for HF ("Minnesota Living With Heart Failure Questionnaire" - MLWHFS). This questionnaire was validated in Portuguese and consists of 21 objective questions, which assess physical, socioeconomic and emotional limitations. For each question, the patient selects a number from 0 to 5, in which zero indicates no limitation and 5 indicates a large limitation. In this way, the final score ranges from 0 to 105 and higher values indicate worse quality of life.

The questionnaire was applied individually in each patient, in which the patient himself read and answered the questions. For those with reading difficulties, this could be done with a third party help[16].

Statistical analysis: The program SPSS version 20.0 was used for all analyzes. To describe the population, a descriptive analysis was used; continuous variables were presented with mean ± standard deviation (SD) for normal distribution or median ± interquartile range (IQ) for non-normal distribution variables; the categorical variables were presented in proportion or percentage form. The means for maximum functional capacity (peak VO_2) and submaximal VO_2 (VO_2 at the anaerobic threshold - $ATVO_2$) obtained by CPET, besides the results of the SRCT, 6MST, inspiratory pressures, expiratory pressures, peak flow, body mass index and quality of life score (MLWHFS) were compared at initial and subsequent evaluations by the paired Student's t test (parametric variables) or Mann Whitney (for non-parametric variables). A $p < 0.05$ was adopted as a significant standard for all analyzes.

Ethical aspects: The protocol was approved by the Research Ethics Committee Celso Figueiroa at Hospital Santa Izabel under the number of opinion 1,711,505; in accordance with the Helsinki Guidelines for conducting clinical research and resolution 466/12 of the National Health Council. An informed consent exemption was anticipated as it was a retrospective database analysis.

RESULTS

The mean age was 61 ± 15 years and there was a prevalence of male gender (69.4%). The main reason for indication of cardiac rehabilitation was coronary artery disease (CAD), present in 76.2% of the patients, HF was present in 25%. The mean left ventricular ejection fraction was 61 ± 24%. Most patients were at risk B AHA category for physical activity (63.9%), while the most patients were at NYHA functional class was Class I or II respectively 57.5% and 30%. Beta-blocker, statin, angiotensin-converting enzyme inhibitor or renin angiotensin blocker and aspirin were prescribed respectively in 84.5%, 71.4%, 31% and 69.4% of patients (Table 1), 60% were using some type of antiplatelet agent while 38.1% were using anticoagulant.

Table 1. General Population Characteristics.

General Features	**Total Population**
Age (means ± SD)	61±15
Male sex (%)	59 (69.4%)
Comorbidities (%)	
Coronary Artery Disease	64 (76.2%)
Hypertension	48 (56.5%)
Congestive Heart Failure	21 (25%)
Diabetes	18 (21.2%)
Smoking	4 (4.8%)
Dyslipidemia	59 (69.4%)
Valvulopathy	11 (13.1%)
Chronic obstructive pulmonary disease	4 (4.8%)
Drugs (%)	
Aspirin	59 (69.4%)
ACEI	26 (31%)
ARB	29 (34.5%)
Statin	60 (71.4%)

Table 1. General Population Characteristics. (continuation)

General Features	Total Population
Drugs (%)	
Beta-blockers	71 (84.5%)
Antiplatelet agent	51 (60%)
Anticoagulant	32 (38.1%)
AHA Risk (%)	
Risk A	6 (8.3%)
Risk B	46 (63.9%)
Risk C	20 (27.8%)
Classe Funcional NYHA (%)	
I	46 (57.5%)
II	24 (30%)
III	7 (8.8%)
IV	0 (0%)

Angiotensin-converting enzyme inhibitor. ARB = Angiotensin II receptor blockers.

ACEI =

The comparative results of the initial evaluations and re-evaluation of patients are described in Table 2. From the functional point of view, there was an absolute mean increase of 2.4 ± 3.5 ml -1.kg -1.min -1 in peak VO_2 (p <0.001) and 1.3 ± 2.6 ml -1.kg -1.min -1 in $ATVO_2$ (p <0.001), 14 ± 17 repetitions at SRCT (p <0.001) and 44 ± 41 steps at 6MST (p <0.001). Regarding lung function, there was an mean increase of -20 ± 40 cmH_2O in Pins (p <0.01) and 9.4 ± 29 cmH2O (p <0.01) in Pexp and 52 ± 77 ± L / min in peak-flow (p <0.01). The BMI reduced on average 0.9 ± 3.2 kg.m-2 (p <0.01). There was a significant gain in quality of life with a mean reduction of 21 ± 15 points in the MLWHFS (p <0.001).

Table 2. Variables before and after CVR

Variable	Initial Evaluation	Re-evaluation	Percentage change	p
Peak VO_2 (ml $^{-1}$.kg $^{-1}$.min $^{-1}$) ▲	19.4 ± 6.4	21.9 ± 6.8	+ 12.3%	< 0.001
$ATVO_2$ (ml $^{-1}$.kg $^{-1}$.min $^{-1}$) Δ	12.1 (3.6)	13.3 (4.5)	+ 10%	< 0.001
Slope Δ	35 (10)	33.4 (9)	- 4.5%	0.04
SRCT (repetitions) ▲	30 ± 11	44 ± 20	+ 46.6%	< 0.001
6MST (steps)▲	75 ± 47	119 ± 57	+ 58.6%	< 0.001
Pins (mmH_2O) Δ	-110 (80)	-140 (120)	+ 27%	< 0.001

Table 2. Variables before and after CVR (continuation)

Variable	Initial Evaluation	Re-evaluation	Percentage change	p
Pexp (mmH_2O) ▲	104 ± 45	113 ± 42	+ 8.6%	< 0.001
Peak-flow ($L.mL^{-1}$) ▲	431 ± 114	483 ± 125	+ 12%	< 0.01
BMI ($kg.m^{-2}$) ▲	28.1 ± 4.2	27.1 ± 5.3	- 3.5%	< 0.05
MLWHFS ▲	36 ± 20	15 ± 12	- 58.3%	< 0.001

▲ = mean ± SD; Δ = median (IR). $ATVO_2$ = VO_2 at the anaerobic threshold. SRCT = Sitting rising chair test. 6MST = Step Test. BMI = Body mass index. MLWHFS = Minnesota Living with Heart Failure Score.

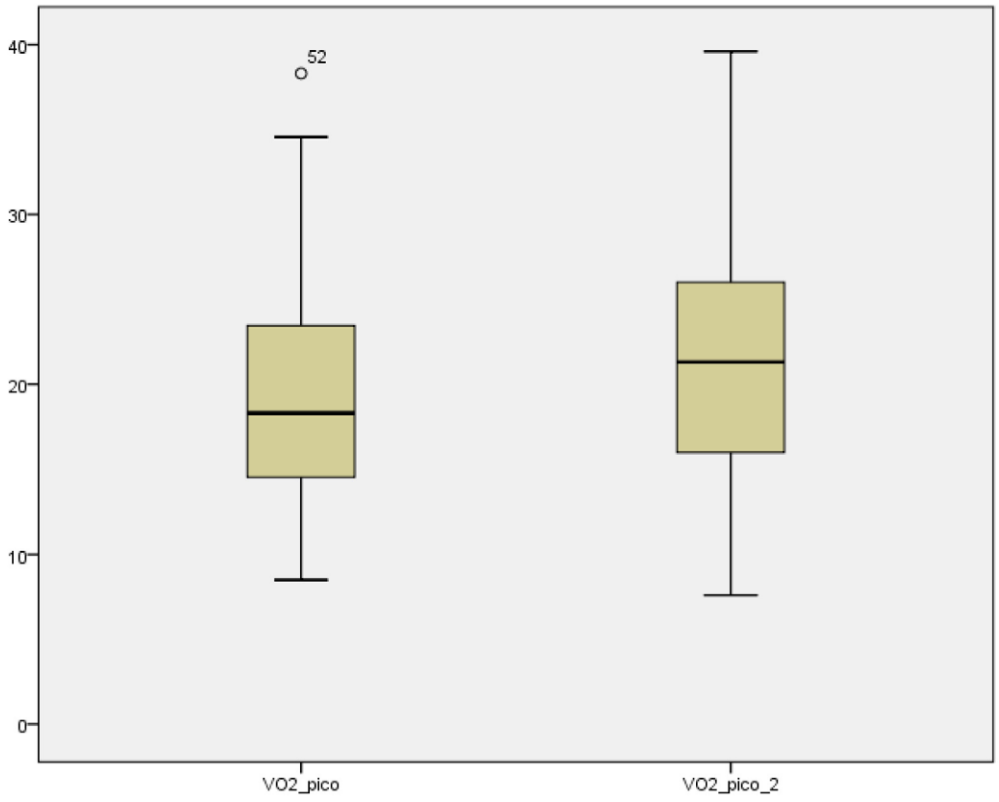

Figure 1. Graphic representation of means of peak VO2 before and after CVR program.

DISCUSSION

It was possible to demonstrate a gain in the functional, pulmonary, metabolic and quality of life variables, reproducing findings similar to international multicenter randomized clinical trials. Going beyond efficacy, it was possible to show the effectiveness of a structured CVR program at a tertiary center.

Regarding the functional capacity, we showed an absolute gain of 12.3 % in peak VO_2 and 10% in $ATVO_2$, a result similar according to demonstrated by Belardinelli (13), in which he evidenced in a follow up of 12 months a gain of 14.7% and in a follow up of 10 years a gain of 21.8% in peak VO_2. The data demonstrated by the present study agrees with the literature if we relate it to the physical activity performed for a short period of time.

Besides the functional improvement verified by CPET in relation to the $ATVO_2$ and the peak VO_2 gain, we could show an improvement in the functional capacity measured by SRCT and 6MST of 46.6% and 58.6%, respectively. A study of our group showed in a pioneering way that SRCT and 6MST correlated with VO_2 and were able to predict patients with better functional capacity based on peak VO_2 (20). The importance of these tests lies in the ability to predict classical variables with simple tests that can be performed with few technical resources and low cost. The data presented here also reinforce that these simple tests can be used for pre and post intervention follow-up and for monitoring responses during a CVR program.

It was possible to demonstrate an increase in pulmonary functional capacity measured by inspiratory pressure in 27% and by expiratory pressure in 8.6%. These data have already been demonstrated as a predictive factor in previous studies as a result of a specific lung muscle work[21].

However, in the present study, we can demonstrate a gain not necessarily related to a specific work of inspiratory and expiratory musculature, but to a work of physical conditioning based on aerobic and resistance training.

Regarding quality of life, there was an increment of in the Minnesota Score, which was represented as a decrease of 58.3%. This result was also demonstrated in the Belardinelli study in which it was possible to establish a correlation between the improvement in quality of life and the increase in peak VO_2[11].

Although statistically significant, the reduction in BMI was not so impressive, representing only a reduction of 3.5%. This might be associated to a heterogeneous nutritional approach of the studied public.

Limitations and future perspectives:

Since it is a work that is based on a retrospective database and we did not had a control group, we can not affirm causality.

We did not have a longer follow up information, this would be interesting to look the effects of CVR and look after cardiac events in a longer follow up and to compare those who were still active on the CVR program.

We had a limited number of patients which do not let us to make subgroups analyzes, for example, a specific analyzes by adherence would be interesting.

AUTHOR CONTRIBUTIONS

Porto JS participated in the conception, study design, data collection, analysis and interpretation and translation of the paper to English. Bastos GLD and Borges QS participated in the data collection, analysis and interpretation. Claro TC, Feitosa C, Feitosa G and Prado E coordinated the sessions and tests. Darze ES participated in the conception, study design and dataset verification. Ritt LE participated in the conception, data analysis, writing and translation of the paper to English, also coordinating the sessions and tests.

COMPETING INTERESTS

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

REFERENCES

1. World Health Organization. Cardiovascular diseases (CVDs) [Internet]. 2016 [cited 2016 Nov 15]. Available from: http://www.who.int/mediacentre/factsheets/fs317/en/

2. World Health Organization. World Health Organization [Internet]. 2012 [cited 2016 Nov 15]. Available from: http://gamapserver.who.int/gho/interactive_charts/ncd/mortality/cvd/atlas.html

3. Bocchi EA, Braga FGM, Ferreira SMA, Rohde LEP, de Oliveira WA, de Almeida DR et al. III Diretriz de Insuficiência Cardíaca Crônica. Arq Bras Cardiol. 2009;93(1 supl.1):1–71.

4. Barretto ACP, Neto CD, Mady C, de Albuquerque DC, Filho DFB, Braile DM et al. Revisão das II Diretrizes da Sociedade Brasileira de Cardiologia para o Diagnóstico e Tratamento da Insuficiência Cardíaca. Arq Bras Cardiol. 2002;79(supl IV):1-30.

5. Araujo DV, Tavares LR, Veríssimo R, Ferraz MB, Mesquita ET. Custo da insuficiência cardíaca no Sistema Único de Saúde. Arq Bras Cardiol. 2005;84(5):422-7. doi: 10.1590/S0066-782X2005000500013

6. Herdy AH, López-Jiménez F, Terzic CP, Milani M, Stein R, Carvalho T et al. Consenso Sul-Americano de prevenção e reabilitação cardiovascular. Arq Bras Cardiol. 2014;103(2 supl 1):1-31.

7. Nogueira PR, Rassi S, Corrêa KS. Perfil epidemiológico, clínico e terapêutico da insuficiência cardíaca em hospital terciário. Arq Bras Cardiol. 2010;95(3):392-8. doi: 10.1590/S0066-782X2010005000102

8. Morris JN, Heady JA, Raffle PA, Roberts CG, Parks JW. Coronary heart-disease and physical activity of work. Lancet. 1953;265(6796):1111-20.

9. Piepoli MF. Exercise training in chronic heart failure: mechanisms and therapies. Neth Hear J. 2013;21(2):85-90. doi: 10.1007/s12471-012-0367-6

10. Meyers J, Prakash M, Froelicher V, Do D, Partington S, Atwood E. Exercise capacity and mortality among men referred for exercise testing. N Engl J Med. 2002;346(11):793-801. doi: 10.1056/NEJMoa011858

11. Belardinelli R, Georgiou D, Cianci G, Purcaro A. Randomized, controlled trial of long-term moderate exercise training in chronic heart failure: effects on functional capacity, quality of life, and clinical outcome. Circulation. 1999;99(9):1173-82.

12. Belardinelli R, Georgiou D, Cianci G, Purcaro A. 10-year exercise training in chronic heart failure: A randomized controlled trial. J Am Coll Cardiol. 2012;60(16):1521-8. doi: 10.1016/j.jacc.2012.06.036

13. Belardinelli R, Lacalaprice F, Cianci G, Piva R, Purcaro A. Exercise training intervention after coronary angioplasty (The ETICA trial): Ten-year follow-up. Circulation. 2007;116(Suppl 16).

14. O'Connor CM, Whellan DJ, Lee KL, Keteyian SJ, Cooper LS, Ellis SJ et al. Efficacy and Safety of Exercise Training in Patients With Chronic Heart Failure: HF-ACTION Randomized Controlled Trial. Jama. 2009;301(14):1439-50. doi: 10.1001/jama.2009.454

15. Arena R, Williams M, Forman DE, Cahalin LP, Coke L, Myers J et al. Increasing referral and participation rates to outpatient cardiac rehabilitation: The valuable role of healthcare professionals in the inpatient and home health settings: A science advisory from the american heart association. Circulation. 2012;125(10):1321-9. doi: 10.1161/CIR.0b013e318246b1e5

16. Carvalho VO, Guimarães GV, Carrara D, Bacal F, Bocchi EA. Validação da versão em português do Minnesota Living with Heart Failure Questionnaire. Arq Bras Cardiol. 2009;93(1):39-44. doi: 10.1590/S0066-782X2009000700008

17. Pessoa BV, Jamami M, Basso RP, Regueiro EMG, Di Lorenzo VAP, Costa D. Teste do degrau e teste da cadeira: comportamento das respostas metábolo-ventilatórias e cardiovasculares na DPOC. Fisioter Mov. 2012;25(1):105-15. doi: 10.1590/S0103-51502012000100011

18. Paschoal MA, Petrelluzzi KFS, Gonçalves NVO. Estudo da variabilidade da frequência cardíaca em pacientes com doença pulmonar obstrutiva crônica. Rev Ciênc Méd. 2002;11(1):27-37.

19. Ritt LE, Carvalho AC, Feitosa GS, Pinho-Filho JA, Macedo CRB, Vilas-Boas F et al. Heart Failure Survival Score in Patients With Chagas Disease: Correlation With Functional Variables. Rev Esp Cardiol. 2012;65(6):538-43. doi: 10.1016/j.rec.2011.12.020

20. Ritt LE, Porto JS, Claro TC, Cavalcante DBS, Feitosa CM, Prado EPF et al. Stair Step Test and Sitting Rising Chair Test As Predictors of Maximal Oxigen Uptake. J Am Coll Cardiol. 2017;69(11):1733. doi: 10.1016/S0735-1097(17)35122-7

21. Neto MG, Martinez BP, Conceição CS, Silva PE, Carvalho VO. Combined Exercise and Inspiratory Muscle Training in Patients With Heart Failure. J Cardiopulm Rehabil Prev. 2016;36(6):395-401. doi: 10.1097/HCR.0000000000000184