

Clinical Research

The Health Benefits of a 12-Week Home-Based Interval Training Cardiac Rehabilitation Program in Patients With Heart Failure

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ABSTRACT

Background: Recently, high-intensity interval training has been advocated for the rehabilitation of persons living with heart failure (HF). Home-based training is more convenient for many patients and could augment compliance. However, the safety and efficacy of home-based interval training remains unclear.

Methods: We evaluated the safety and efficacy of a supervised home-based exercise program involving a combination of interval and resistance training. Measures of aerobic power, endurance capacity, ventilatory threshold, and quality of life in 40 patients with HF, were taken at baseline and after 12 weeks. Patients were matched and randomized to either control (CTL; n = 20) or experimental (EXP; n = 20) conditions. The EXP group underwent a 12-week high-intensity

RÉSUMÉ

Introduction : Récemment, l'entraînement par intervalles à haute intensité a été recommandé pour la réadaptation des personnes qui vivent avec une insuffisance cardiaque (IC). L'entraînement à domicile s'avère plus pratique pour plusieurs patients et pourrait accroître leur adhésion. Cependant, la sécurité et l'efficacité de l'entraînement par intervalles à domicile demeurent obscures.

Méthodes : Nous avons évalué la sécurité et l'efficacité d'un programme supervisé d'exercices à domicile qui comportait une combinaison d'entraînement par intervalles et de musculation. Nous avons pris des mesures de la puissance aérobie, de la capacité d'endurance, du seuil ventilatoire et de la qualité de vie de 40 patients souffrant d'IC au début et après 12 semaines. Nous avons apparié et réparti de

Heart failure (HF) is a major public health problem in North America. It is associated with significant morbidity, mortality, frequent hospital admission, and marked health care costs. In Canada, approximately 3.5% of adults aged 40 or older have HF with an incidence rate of 511 per 100,000.¹ There is a lifetime risk of 1 in 5 of developing HF with most cases and related deaths being observed in those aged 65 or older.²

Despite gains in the treatment and prevention of cardiovascular disease, the prevalence of HF is anticipated to continue to increase as the result (in part) of an aging

population, improvements in the treatment of acute HF, and improved survival in patients with hypertension and coronary artery disease.² As such the burden of HF will continue to be of great concern including increased hospitalizations and rehospitalizations, and increased costs to society and the individual.²

Exercise training is a widely accepted intervention for HF leading to marked health benefits.^{3,4} Most cardiac rehabilitation programs within Canada use hospital-based, moderate-intensity, continuous exercise training for 2 days per week for 12–16 weeks.⁵ Various research groups have recently advocated interval training for the rehabilitation of patients with cardiovascular disease including patients with HF.^{5–12} A growing body of evidence has examined the safety and efficacy of interval training in HF in medically supervised settings.^{6,13–17} A recent meta-analysis¹⁸ reported that interval training was more effective for improving peak aerobic power (VO_{2peak}) vs traditional training patients with HF. Despite continuous aerobic training being the mainstay of

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interval and resistance training program while the CTL group maintained their usual activities of daily living.

Results: In the EXP group, we found a significant improvement in aerobic power, endurance capacity, ventilatory threshold, and quality of life. There were no significant changes in the CTL group.

Conclusions: We have shown that a home-based cardiac rehabilitation program involving interval and resistance training is associated with improved aerobic capacity and quality of life in patients with HF. This research has important implications for the treatment of HF.

rehabilitation, recommendations have increasingly incorporated messaging related to the potential health benefits of interval training. For instance, various agencies (including the Canadian Association of Cardiovascular Prevention and Rehabilitation, the American Association of Cardiovascular and Pulmonary Rehabilitation, the Canadian Cardiovascular Society, and the European Association for Cardiovascular Prevention and Rehabilitation) have included messaging on high-intensity interval training for implementation within cardiac rehabilitation settings.^{3,19}

Researchers have begun to examine the efficacy and effectiveness of interval training in home-based settings in patients living with coronary heart disease.^{11,20,21} This research has shown the potential for long-term exercise adherence and the maintenance of $\text{VO}_{2\text{peak}}$ over a 1-year period.²¹ Recently, home-based exercise interventions have also been advocated for the treatment of stable HF.²²⁻²⁵ However, the optimal home-based exercise intervention has yet to be clearly established.

To our knowledge, no study has examined the efficacy of a high-intensity home-based cardiac rehabilitation program in HF. Accordingly, the primary purpose of this research was to evaluate the safety and efficacy of a comprehensive home-based cardiac rehabilitation program involving interval training on the health status of patients with HF. We hypothesized that a novel home-based exercise intervention (involving high-intensity interval training) would lead to significant improvements in aerobic power, exercise capacity, and overall quality of life in patients with HF compared with control (CTL) conditions.

Methods

Forty patients with HF were recruited, stratified (according to body mass, $\text{VO}_{2\text{peak}}$, age, and New York Heart Association classification) and randomized to CTL ($n = 20$) or experimental (EXP; $n = 20$) conditions. Twenty-nine patients completed the trial (CTL = 15; EXP = 14; see [Supplemental Table S1](#) for inclusion and exclusion criteria). Ethical approval and written informed consent were obtained.

Measures of $\text{VO}_{2\text{peak}}$, cardiorespiratory responses at ventilatory threshold (V-slope method), endurance capacity (6-minute walk test), and self-reported quality of life were assessed at baseline and after the 12-week training program. The EXP group underwent a 12-week high-intensity interval

manière aléatoire les patients entre le groupe témoin (TEM; $n = 20$) ou expérimental (EXP; $n = 20$). Le groupe EXP suivait un programme d'entraînement par intervalles à haute intensité et de musculation de 12 semaines tandis que le groupe TEM maintenait leurs activités habituelles de la vie quotidienne.

Résultats : Dans le groupe EXP, nous avons observé une amélioration significative de la puissance aérobie, de la capacité d'endurance, du seuil ventilatoire et de la qualité de vie. Nous n'avons observé aucun changement significatif dans le groupe TEM.

Conclusions : Nous avons montré que le programme de réadaptation cardiaque à domicile qui comportait l'entraînement par intervalles et la musculation est associé à l'amélioration de la capacité aérobie et de la qualité de vie des patients souffrant d'IC. Cette recherche a des répercussions importantes sur le traitement de l'IC.

aerobic and resistance training program. The CTL patients were asked to maintain usual activities of daily living; however, this was not documented.

Measurements

Exercise capacity. Submaximal exercise capacity was estimated using the 6-minute walk test.²⁶ The 6-minute walk test was performed on a flat, noncarpeted, unobstructed, indoor 20-m walking course. Participants were required to cover as much distance as possible during 6 minutes with no verbal encouragement. All participants were provided a practice session to minimize the learning effect. A tester who was blind to the treatment allocation of the participants performed all tests.

Cardiopulmonary stress testing. All patients performed an incremental exercise test using an electronically braked cycle ergometer with direct gas monitoring to assess $\text{VO}_{2\text{peak}}$. The patients completed a symptom-limited incremental exercise protocol (10 W/min) with continuous 12-lead electrocardiography and the assessment of blood pressure and oxygen saturation every 2 minutes. Criteria for terminating the exercise test included electrocardiogram changes associated with myocardial ischemia, volitional fatigue, a respiratory exchange ratio of > 1.1 , a leveling off in oxygen consumption, systolic blood pressure > 200 mm Hg, diastolic blood pressure > 100 mm Hg, dyspnea, or calf/thigh pain.

Quality of life. Quality of life was assessed via self-report using the Minnesota Living with Heart Failure Questionnaire.²⁷ This validated questionnaire contains 21 questions related to physical, socioeconomic, and psychological impairments. It is scored on a 6-point Likert scale (0-5) with total scores ranging from 0 to 105 with higher scores reflecting greater impairment.

Exercise program

The EXP group was enrolled in a 12-week supervised home-based walking program that was individualized according to the stress test, medications, and activity level. Participants exercised using bouts of high-intensity work phases (80%-85% $\text{VO}_{2\text{peak}}$) followed by periods of active recovery (40%-50% $\text{VO}_{2\text{peak}}$). The duration of each interval

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