

Review article

Cardiac Rehabilitation Programs and Health-Related Quality of Life. State of the Art

Roberto Cano de la Cuerda,^{a,*} Isabel María Alguacil Diego,^a Joaquín Jesús Alonso Martín,^{b,c} Alberto Molero Sánchez,^{a,d} and Juan Carlos Miangolarra Page^{a,e}

^a Departamento de Fisioterapia, Terapia Ocupacional, Rehabilitación y Medicina Física, Facultad de Ciencias de la Salud, Universidad Rey Juan Carlos, Alcorcón, Madrid, Spain

^b Servicio de Cardiología, Hospital Universitario de Fuenlabrada, Fuenlabrada, Madrid, Spain

^c Departamento de Medicina y Cirugía, Facultad de Ciencias de la Salud, Universidad Rey Juan Carlos, Alcorcón, Madrid, Spain

^d Servicio de Rehabilitación, Hospital Universitario Ramón y Cajal, Madrid, Spain

^e Servicio de Medicina Física y Rehabilitación, Hospital Universitario de Fuenlabrada, Fuenlabrada, Madrid, Spain

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ABSTRACT

Cardiovascular disease is the main health problem in developed countries. Prevention is presented as the most effective and efficient primary care intervention, whereas cardiac rehabilitation programs are considered the most effective of secondary prevention interventions; however, these are underused. This literature review examines the effectiveness and the levels of evidence of cardiac rehabilitation programs, their components, their development and role in developed countries, applications in different fields of research and treatment, including their psychological aspects, and their application in heart failure as a paradigm of disease care under this type of intervention. It is completed by a review of the impact of such programs on measures of health-related quality of life, describing the instruments involved in studies in recent scientific literature.

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Programas de rehabilitación cardíaca y calidad de vida relacionada con la salud. Situación actual

RESUMEN

Las enfermedades cardiovasculares constituyen el principal problema de salud en los países desarrollados. La prevención se presenta como la herramienta más eficaz y eficiente, mientras que los programas de rehabilitación cardíaca son considerados como los más eficaces entre las intervenciones de prevención secundaria; sin embargo estos están infrautilizados. La presente revisión de la literatura aborda la efectividad y los niveles de evidencia de los programas de rehabilitación cardíaca, sus componentes, el papel desempeñado y la evolución en los países desarrollados, las aplicaciones descritas en diferentes campos de investigación y tratamiento, aspectos psicológicos considerados en ellos, así como su aplicación en la insuficiencia cardíaca como enfermedad paradigma de atención en este tipo de intervención. Se completa con una revisión sobre el impacto de dichos programas en las medidas de calidad de vida relacionada con la salud y se describen los instrumentos implicados en los principales estudios científicos de la literatura científica reciente.

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INTRODUCTION AND CONCEPTS

Cardiovascular disease (CVD) is the major health problem in developed countries. According to the World Health Organization (WHO), approximately 17 million people die annually from CVD.¹ In 2005, heart disease was the leading cause of mortality in western countries.² Longevity and advances in treatment have led to an increase in the prevalence of heart disease. Its prognosis has improved due to prevention, treatment and rehabilitation programs. However, as a result of these interventions, morbidity has increased due to disease progression. Prevention appears to be the

most effective and efficient approach to managing CVD, whereas cardiac rehabilitation programs (CRPs) are the most effective for secondary prevention.³

The aims of prevention are to reduce morbidity and mortality in patients at high absolute risk and to help those at low risk to remain in this category, thereby maintaining the health of the population.⁴ CRPs were developed in the 1960s as recommended by the WHO to improve health-related quality of life (HRQOL) and the prognosis of patients with heart disease.⁴ These programs were defined as the set of therapeutic measures for the comprehensive care of patients with CVD, and are particularly useful and effective in patients with coronary disease and chronic heart failure (CHF).⁵

Any CRP should include specific components to optimize the reduction of cardiovascular risk and promote healthy behavior and

* Corresponding author: Facultad de Ciencias de la Salud, Universidad Rey Juan Carlos, Avda. de Atenas s/n, 28922 Alcorcón, Madrid, Spain.

E-mail address: roberto.cano@urjc.es (R. Cano de la Cuerda).

Abbreviations

CHF: chronic heart failure
 CR: cardiac rehabilitation
 CRP: cardiac rehabilitation program
 CVD: cardiovascular diseases
 ET: exercise training
 HF: heart failure
 HRQOL: health-related quality of life
 MLHFQ: Minnesota Living with Heart Failure Questionnaire

compliance by using educational programs that foster the active participation of patients in their own treatment and encourage CVD patients to have an active lifestyle, thereby reducing disability.⁶

To be optimally effective, CRPs should be based on a multidisciplinary approach and include exercise training (ET) and psychological counseling. In patients with coronary disease CRP should also include the control of risk factors.^{5,7-9}

Different societies and associations have recommended that both those working with cardiac rehabilitation (CR) groups and the training programs themselves should comply with professional standards. Guidelines recommend the development of programs that make access to CRPs easier and faster, in the sense that they should be automatically prescribed. The latest European Guidelines on Cardiovascular Disease Prevention in Clinical Practice¹⁰ recommend the increased involvement of physicians and primary health care professionals since they have more opportunity to significantly improve the prevention and treatment of CVD.

There is clear and sufficient evidence (class I) that CRPs significantly improve HRQOL, leading to a decrease in complications and mortality of around 40% in patients at low risk.⁴ Moreover, the risks of exercise (including sudden death) are considered acceptable because of its benefit to patients.⁴ Other authors⁷ suggest that the cost-effectiveness and cost-benefit ratio of CRPs are currently the best treatment or intervention in heart disease compared to any other. These authors also suggest the creation of follow-up and monitoring units due to the fact that the benefits of CRP decrease over time.

BENEFIT AND USE OF CARDIAC REHABILITATION PROGRAMS IN THE DEVELOPED WORLD

Despite these recommendations and results, CRPs are rarely implemented.³ In Spain, only 2% to 3% of the population with indications access CRP.^{4,11,12} According to the European Cardiac Rehabilitation Inventory Survey (2008),¹³ Spain is the European country with the fewest CR centers and with the lowest CR activity. In 2003, only 12 National Health Service hospitals offered CR, most of which were tertiary hospitals in Madrid, Catalonia, and Andalusia.¹¹ There are many reasons for this, the chief of which is that the majority of CVD patients are discharged from hospital without CRP being recommended.

A set of measures has been established to improve compliance with the recommendations regarding CRP. These measures refer to patient selection and inclusion, the structure and operation of the program, and compliance with its objectives. In countries such as the USA, where less than 30% of patients with indications participate in CRPs,⁵ nonobligatory CRP accreditation systems exist. In fact, only 37% of the CR units are accredited by the American Association of Cardiovascular and Pulmonary Rehabilitation. This association has proposed measures to standardize

patient referral to CR and to ensure that the CRP unit has a good infrastructure which functions optimally.

In 2009, Brown et al.¹⁴ presented the results of a study that identified the predictors of CR referral in patients with coronary disease. This study analyzed 72 817 patients discharged from 156 hospitals between 2000 and 2007 after myocardial infarction or percutaneous or surgical coronary revascularization. Only 56% of patients were referred to CR. The authors conclude that the probability of referral to a CR is lower if the patient is older, has non-ST-segment elevation myocardial infarction, or there are comorbidities. They recommend raising medical awareness on the benefits of CR, overcoming barriers related to treatment costs, reducing the time patients need to invest in the program, and shortening travel times to the CRP unit.

The third study conducted by the European Action on Primary and Secondary Prevention by Intervention to Reduce Events (EUROASPIRE III) study group¹⁵ was designed to determine whether the European guidelines on cardiovascular prevention in patients with coronary disease were being followed in everyday clinical practice in Europe in relation to risk factor and therapeutic management and to describe the patients' lifestyle. This study was conducted between 2006 and 2007 in 76 centers in 22 European countries; patients with a clinical diagnosis of coronary disease were retrospectively identified. A total of 8966 patients were interviewed. A high percentage of these patients did not achieve the lifestyle or therapeutic targets for CVD prevention (17% smoked, 35% were obese, 56% had high blood pressure, and 51% had dyslipidemia) and only one-third of patients had access to any form of CR. A study published in *The Lancet*¹⁶ compared the results of the EUROASPIRE III study to those obtained by EUROASPIRE I and II (1995¹⁷ and 2000,¹⁸ respectively) and showed that after 12 years, the aims of secondary prevention of coronary disease had still not been achieved in Europe. It is essential that patients understand the nature of their disease and the best way to manage it, and this can be achieved through a comprehensive program of prevention and rehabilitation that should be offered automatically.

Traditionally, CR has been indicated for patients after infarction or revascularization. Currently, with the exception of patients with dissecting aortic aneurysm and severe left ventricular outflow tract obstruction, all patients with heart disease may benefit from CR, particularly those who are older or who have severe disease.⁷ This includes patients with heart failure (HF),¹⁹ pacemakers, or implantable cardioverter-defibrillators. In the latter two groups, rehabilitation is indicated not because of the implanted device but because of the underlying disease, since these patients normally have poor ventricular function.¹²

PHYSICAL ACTIVITY IN CARDIAC REHABILITATION PROGRAMS

In a recent review article, Grima et al.¹² reported that secondary prevention delivered as ET-based CR was the intervention strategy with the greatest amount of scientific evidence in support of its reducing morbidity and mortality in coronary disease, particularly after myocardial infarction. The European Society of Cardiology, the American Heart Association, and the American College of Cardiology classify such evidence as class I. There is also class I evidence for other types of cardiac intervention and stable CHF.

Several studies^{20,21} have shown a correlation between physical activity, and particularly physical fitness, in children and adolescents and a lower prevalence of isolated or combined cardiovascular risk factors (blood pressure and blood lipid concentration). The American Heart Association and American College of Sports Medicine guidelines have described the amount and type of physical activity to be performed by older individuals.²² They recommended

moderate to intense aerobic physical activity and muscle strengthening to decrease the risk of chronic disease, premature death, and disability. This activity should be performed for at least 30 min 5 times a week or 20 min 3 times a week if the activity is vigorous.⁵ To maintain physical independence, resistance training at least 2 days per week should be added to preserve or increase muscle strength using 25% to 40% loads involving all major muscle groups at a moderate to high level of effort.²³ Flexibility should be maintained by stretching exercises at least twice a week.

Current evidence also recommends including isometric and dynamic exercises for increasing muscle mass in CRPs. It also appears that intense physical activity may have more effect on reducing cardiovascular morbidity and mortality than moderate exercise, an effect that is independent of energy consumption.¹³

The increasing incorporation of resistance training in aerobic exercise in CRPs improves muscle strength in elderly patients and patients with CHF, and provides greater autonomy in everyday activities. Resistance exercise improves functional capacity, independence, and HRQOL. It also increases physical strength and endurance and reduces disability in individuals with and without CVD.¹² However, this type of training is underused despite evidence suggesting any patient may safely participate in CRPs.

Numerous studies^{7,12,13,24} have demonstrated that the risk of cardiovascular death is lower in physically active patients with heart disease, with a reduction in risk of up to 35%. Improved functional capacity has also been observed, and the number of patients able to return to work was 3 times higher than those who did not follow a CRP (85% vs 30%).⁷

This improvement in functional capacity involves a significant improvement in HRQOL. However, this can be difficult to assess because it depends on improved clinical monitoring, increased self-confidence, or improved metabolic performance, among other factors. In contrast, HF is associated with poor HRQOL, increased dependency, and frequent and prolonged hospital stays.²

DURATION OF CARDIAC REHABILITATION PROGRAMS

The benefits of CRPs are obvious. However, there is great variability in the duration of CRPs, and the optimal duration to obtain their benefits remains unknown. Grima et al.¹² showed that the duration of CR was significant, as indicated by 19% and 47% decreases in mortality after at least 25 or 36 CR sessions, respectively, and great improvements in recurrent heart problems 4 years to 5 years after CR phase II. The duration of CR varies widely from country to country and is usually determined by economic conditions rather than scientific evidence. Since one of the main aims of CR is to change the patient's behavior patterns, prolonged CRP and constant encouragement by the CR team is required to achieve the maximum effect. Leung et al.²⁵ recently published the results of a study designed to compare the effect on HRQOL of CRPs shorter than 6 months, longer than 6 months, or no CRP. Nine months after completion of the different programs, HRQOL was significantly higher among patients who had undergone CR, regardless of duration, and there were no significantly different effects between CRPs of more than or less than 6 months. The authors note that the increased patient compliance observed in the shorter programs may have influenced the results.

PSYCHOLOGICAL ASPECTS OF CARDIAC REHABILITATION PROGRAMS

Psychological support is one of the main features of CR. It has been shown that the results of these programs can be influenced by specific personality types, particularly in terms of HRQOL.^{26,27} The

treatment of postinfarction depression improves HRQOL²⁸ at the mental level more significantly than at the physical level.²⁹ Farin et al.³⁰ investigated personality as a predictor of HRQOL using various HRQOL instruments and scales after 3 weeks of CR. Sociodemographic variables accounted for 5% of the variation in different HRQOL measurements and were the most important predictors. The next most important predictors were the characteristics of the disease and cardiac risk factors, followed by the patient's personality, which accounted for about 2% of the variation. This suggests the need for more research into which rehabilitation therapies are more effective for patients disadvantaged by their personality type. Gary et al.³¹ compared the effectiveness of a 12-week therapy program for HF patients diagnosed with depression that combined home exercise and cognitive behavioral therapy vs exercise-only therapy, cognitive behavioral therapy, and standard therapeutic care. All the therapies reduced the intensity of depressive symptoms. The largest reduction occurred in the combined therapy group, although no significant differences were observed. The greatest improvements in HRQOL were also observed in the combined therapy group.

HOME CARDIAC REHABILITATION PROGRAMS

Recently, more flexible alternatives have been developed that facilitate access to and participation in CRPs. This is the case of home-based CRPs. The most well-known of these and the only one validated by the National Institute for Health and Clinical Excellence in the UK is the Heart Manual program.³²

In 2010, Taylor et al.³³ presented the results of a systematic review of randomized trials published between 2001 and 2008. This review investigated the effectiveness of home-based CRP on mortality, morbidity, modifiable risk factors, and HRQOL compared to conventional CRP. The review included 12 studies (1938 participants), the majority of which included low-risk patients after myocardial infarction or revascularization. No differences were found between any of the parameters assessed. Similarly, the costs of home-based CRPs and conventional CRPs did not significantly differ. It was concluded that home-based CRPs are clinically effective, improve HRQOL, and do not involve increased costs. Thus, the choice of home or conventional CRP should be based on the patient's preferences. Dalal et al.³⁴ confirmed these results in a systematic review that included the aforementioned review and a meta-analysis. However, they found increased adherence and better follow-up in home-based CRPs than in conventional CRPs (87% vs 49%). Other studies³⁵⁻³⁷ report similar results. Clark et al.³⁸ conducted a meta-analysis of 39 randomized clinical trials to compare the costs and benefits of home-based CRP and conventional care. Home-based CRP significantly improved HRQOL and reduced blood pressure, cholesterol levels, depression, and smoking compared to conventional care. However, the methodological quality of these trials ranged from low to moderate and home-based CRPs could not be compared to conventional CR due to their marked heterogeneity. The authors suggest that hospital-supervised CRP was chosen based on access to specialists, the availability of more sophisticated individualized programs, and the patient's perceived sense of safety when in a center. This sense of safety in supervised CRP is well attested and is due to correct risk stratification. Thus, the patient can be offered an individualized training program and the degree of supervision required during the CRP can be assessed.¹⁹

Brotons et al.³⁹ investigated whether home interventions performed by nurses reduced mortality and hospital readmissions and improved the quality of life of patients with HF. They conducted a randomized open study in which 283 patients diagnosed with HF who had been admitted to hospital were

assigned to a home-care group (intervention group) or a conventional care group (control group). The primary outcome variable at 1-year follow-up was the composite of all-cause mortality and hospital readmission due to worsening HF. The results indicate that an intensive, well-structured home intervention by specially trained nurses is effective in reducing morbidity and mortality and improving HRQOL in patients with HF.

Kerse et al.³⁵ described home-based CRP as an alternative for patients with access problems or work conflicts. It was most frequently applied to older patients, those with low socioeconomic status, ethnic minorities, and patients from rural areas. A new model of home-based telemonitored CRP was applied by Piotrowicz et al.⁴⁰ for 8 weeks in 152 patients with HF. The experimental group received telemonitored walking training and the control group received conventional CRP. The results indicated increased adherence with the home program and similar improvements in both groups in all the parameters studied.

Other alternatives based on technological advances include the use of GPS systems, ECG, and smartphones to remotely monitor the physical activity of the cardiac patient at home and in the workplace.⁴¹ These alternatives appear to obtain good results with very good adherence and improved HRQOL. Seto et al.⁴² reported that patients had a very good attitude towards monitoring via mobile phones in a study that included 94 HF patients. These information and communication technologies promote self-care in patients with chronic disease.⁴³ However, a recent study systematically reviewed⁴⁴ studies published between 1966 and 2008. It was designed to assess the clinical effects of home telemonitoring in the context of diabetes mellitus, asthma, hypertension, and HF, and concluded that more research is needed to confirm the clinical benefits of these technologies. Schmidt et al.⁴⁵ were also unable to confirm the effectiveness of home telemonitoring in CHF. Copeland et al.⁴⁶ measured the effect of a 1-year telephone intervention program on HRQOL in 458 patients with congestive HF. Although the intervention resulted in behavioral improvements, there was no survival benefit. The internet has also been proposed for telemonitoring; positive effects in self-care were obtained but not in functional capacity and HRQOL.⁴⁷ The use of the internet and other technological resources, understood as tools to assess follow-up and adherence to the different elements of a CRP, requires further research to confirm their applicability in CVD.

CARDIAC REHABILITATION PROGRAMS AND QUALITY OF LIFE

The WHO defines quality of life as individuals' perception of their situation within their cultural context and set of beliefs in relation to their goals, expectations, values, and life interests.⁴⁸ This concept is, therefore, multidimensional. HRQOL, as a concept, was created in the context of clinical assessment and management. It is used to summarize specific aspects of well-being and performance capacity in individuals with health limitations or chronic disease. The usefulness of assessing HRQOL in CRP stems from its potential in planning future care, as a predictor of response to treatment, and as an aid in decision-making regarding treatment, which makes it a very promising outcome measure in studies on the effectiveness of CRP. This application of the HRQOL concept combines two aims: first, to allow the patients to express themselves, as quality of life can only be properly evaluated by the patient; second, to measure different qualitative situations that can be individually variable and of varying intensity using a standardized measurement method. Thus, HRQOL goes beyond purely objective measures that are limited to very obvious phenomena, such as mortality or myocardial infarction rate. Instead, it can gauge less apparent, more subtle phenomena that are nevertheless of great importance in determining the patient's

health. However, the measurement of quality of life can still be improved.⁴⁹ This justifies studies on the effectiveness of CRP in improving the quality of HRQOL parameters as outcome measures as well as determining the reliability and validity of the HRQOL questionnaires administered to cardiac patients.

Despite its limitations, measuring HRQOL in cardiac patients has already led to some significant results that have confirmed its value as an outcome measure in various clinical situations.⁵⁰

INSTRUMENTS FOR MEASURING HEALTH-RELATED QUALITY OF LIFE

Three basic approaches have led to the development of 3 types of instruments for measuring HRQOL: generic instruments, utility measures, and specific instruments.

Generic Instruments

Generic instruments are used to broadly explore all aspects of physical, mental or social functioning, disability and discomfort. They are applicable to different populations, diseases or health conditions and thus can be used to make valid comparisons. These instruments consist of health profiles covering different areas or dimensions. Each of these areas has an individual score, but can be combined into an overall score. Among others, these health profiles include the Sickness Impact Profile, the Nottingham Health Profile, the Medical Outcomes Study 36-item Short-Form Health Survey, and its shortened version Short Form-12.⁵¹⁻⁵⁷ An advantage of generic instruments is that they can be used to compare the HRQOL of patients with heart disease to that of patients with other diseases⁵⁸ or to that of the general population matched by age and sex.^{59,60}

Utility Measures

Utility measures can also be considered as generic instruments, but unlike health profiles their aim is to measure the quality of life as a unit, expressed as a single value using a scale that summarizes the concept simply and numerically. They express the patient's evaluation of his or her health as a single score. An example of this type of measure is Quality-Adjusted Life Years, in which a raw survival rate is adjusted as a function of the quality of life during this period. They are very useful as an outcome measure in cost-effectiveness studies analyzing a given therapy. Other utility measures, based on the patient's choice of theoretically more or less ideal outcomes (standard gamble), are used more frequently in decision models than in effectiveness studies.

Specific Instruments

Specific instruments focus on those aspects of quality of life which are specific to a particular disease. They do not have the range of generic instruments, but can be more sensitive to those aspects of quality of life (either at a given moment or over time) that are determined by the effects of a particular disease. The specific instruments used to assess HRQOL include items that address the unique aspects of a given disease, and so should *a priori* be more sensitive to clinical changes.

Questionnaires used in HF patients⁴⁹ include the Quality of Life in Severe Heart Failure Questionnaire⁶¹; the Chronic Heart Failure Questionnaire,⁶² which has demonstrated sensitivity to the different classes of severity of CHF; the Left Ventricular Dysfunction Questionnaire⁶³; and the Minnesota Living with Heart Failure

Questionnaire (MLHFQ),⁶⁴ which is one of the most widely used specific questionnaires for assessing HRQOL in HF patients. This questionnaire assesses the effect of HF and its treatment on the quality of life of HF patients. It includes physical, psychological, and social variables. The patient's perception of these variables is measured on a scale between 0 and 5 where higher scores indicate worse quality of life. The difference between the MLHFQ and other general questionnaires is that the MLHFQ includes characteristic signs and symptoms of HF, such as dyspnea, edema in the lower extremities, or adverse effects of medication. However, it does not discriminate between different levels of severity of CHF. The patient's ability to distinguish between secondary HF symptoms and those associated with comorbidities may also affect the usefulness of the MLHFQ.

Other questionnaires have been developed to specifically assess HF, such as the Kansas City Cardiomyopathy Questionnaire,⁶⁵ an effective instrument which has been validated for HF. Several studies in patients with left ventricular dysfunction have shown that patients with poor quality of life related to HF have higher mortality rates and are more frequently hospitalized.^{66,67}

The purpose of the Sawicki Questionnaire⁶⁸ is to measure the quality of life of patients receiving oral anticoagulant therapy. It analyzes 5 dimensions: satisfaction with treatment, self-efficacy in its management, psychological stress, impaired social life, and everyday problems.

Other examples of specific questionnaires include the Quality of Life after Myocardial Infarction Questionnaire, originally developed for patients who had suffered a myocardial infarction and were referred to CR; the Self-Assessment Questionnaire, a measure that has proven reliability in HRQOL for patients with coronary disease and that has been used in many clinical trials due to its predictive value; and the Spanish Survey on Quality of Life in Post-Infarction Patients, which was developed to make available a specific measure of HRQOL in patients after myocardial infarction, given the absence of validated questionnaires of this type and the frequent use of questionnaires originally designed for other diseases.⁶⁸

The choice of whether to use generic or specific questionnaires in a specific study should be based on their advantages and disadvantages. Their features are relatively complementary and so it is usual to combine both types of measure⁶⁹ to include all the areas that can influence quality of life.

Clinical trials on CR often include HRQOL as a variable, since improved quality of life can be perceived as being more important than a small improvement in patient survival rate in relation to the disease assessed. In addition, estimated quality of life has been shown to be predictive of response to treatment, and is thus an aid in decision-making regarding treatment and planning future care.^{65-67, 70}

HEART FAILURE. CARDIAC REHABILITATION PROGRAMS AND HEALTH-RELATED QUALITY OF LIFE

It has been demonstrated that HF is one of the diseases that has the greatest impact on HRQOL, which is one of the core targets of CRP. Many patients with advanced HF place more importance on quality of life than on extending their estimated life expectancy. Moreover, as in other chronic diseases, numerous clinical indicators have been used to monitor the development of the functional status of HF patients.⁷¹ However, changes in the patients' perceptions of their health status may not be perceptible to the clinician. This is another reason why HRQOL is increasingly used as a source of information on the health of the patient or group of patients.^{72,73} Thus, HRQOL is an important outcome measure in clinical trials assessing the effectiveness of CRP.⁷⁴⁻⁷⁶

A systematic review of 120 randomized trials published between 1996 and 2005 showed that the MLHFQ was the most commonly used measure specific to HRQOL in HF patients.⁷⁷ The psychometric properties of the MLHFQ, particularly its reliability and validity, have been extensively described. Among adult patients with HF, the MLHFQ shows good internal consistency, with Cronbach alpha values of >0.80 ,⁷⁸ and shows good correlation with other measures of HRQOL. However, although the psychometric properties of MLHFQ have been studied, the results do not definitively confirm the goodness-of-fit of this instrument, particularly for several items on the emotional subscale.⁷⁹

As previously described, ET intolerance is the primary chronic symptom of HF patients with preserved left ventricular ejection fraction and is also a determinant of HRQOL among these patients. Although ET programs improve exercise tolerance and HRQOL in patients with reduced ejection fraction, the effect of ET on HRQOL has not been examined in randomized trials. In a study published in 2010, Kitzman et al.⁸⁰ investigated whether a 16-week program of physical activity administered to 53 patients improved HRQOL, compared to 24 control participants who received follow-up telephone calls. There were significant improvements in maximal oxygen uptake (VO_{2max}), exercise time, 6-minute walk test, ventilatory anaerobic threshold, and the physical HRQOL score in the experimental group compared to the control group. There were no adverse effects related to training.

Recently, Beckie et al.⁸¹ studied women with HF and its influence on HRQOL. The effects of a conventional CRP were compared to those of a tailored CRP that included motivational interviewing to modify behavior and lifestyle. Two instruments were used to assess HRQOL in the participants, the Multiple Discrepancies Theory Questionnaire and the Self-Anchoring Striving Scale, administered at baseline, halfway through the program, and at 6-month follow-up. The tailored program improved overall HRQOL scores compared to the conventional program.

Yohannes et al.⁸² investigated the long-term effects of a 6-week CRP on physical activity, psychological well-being, and HRQOL in 147 HF patients. Follow-up was performed 12 months after completion of the program. The MacNew Questionnaire was administered as a measure of HRQOL and the Hospital Anxiety and Depression Scale was used to assess depression. The results demonstrated the benefits of CRP in improving HRQOL and physical activity, and in reducing anxiety and depression. Furthermore, these benefits were maintained at 12-month follow-up. The authors noted that the high levels of depression were significantly associated with low HRQOL, and therefore future research on HRQOL should take into account the psychological characteristics of the patients.

Belardinelli et al.⁸³ demonstrated that programmed ET led to permanent improvements in functional capacity and HRQOL and was associated with lower mortality and rehospitalization in patients with ventricular dysfunction and HF. The 110 participants (mean age, 59 years) were randomized into 2 groups (control and experimental). The experimental group underwent ET on a cycle ergometer at 60% of VO_{2max} , 3 times a week for 8 weeks, then twice a week for 1 year. The control group did not receive ET. The MLHFQ showed an increase in HRQOL at 2 months that remained stable after 12 months of follow-up. The authors suggest that changes in HRQOL corresponded to improvements in VO_{2max} . The ventilatory threshold and improved VO_{2max} were evident at 2 months and subsequently maintained. The authors suggest that a low weekly session rate may be sufficient to maintain high functional capacity, similar to that achieved with brief training programs at the same intensity. They also suggest that having a few sessions per week could improve adherence. HRQOL and functional capacity improved more in

patients with higher myocardial perfusion at the beginning of the CRP.

However, the effect of ET on HRQOL in CHF patients remains a matter of debate. McKelvie et al.⁸⁴ did not observe changes, whereas Kavanagh et al.⁸⁵ observed an improvement in HRQOL in a study on the long-term benefits and safety of aerobic training in CHF. The latter study administered the Chronic Heart Failure Questionnaire to 21 cardiac patients with 22% left ventricular ejection fraction who performed aerobic walking exercise for 52 weeks. The results showed a decrease in fatigue and dyspnea and an increase in emotional function at 4 weeks with continuous improvement during the following 26 weeks. These benefits correlated with those observed in aerobic capacity. The response to exercise was also greater in those with worse baseline HRQOL. Similarly, there were weak correlations between adherence to the program and initial clinical parameters (worse symptoms and greater adherence) and between adherence and HRQOL (greater benefits in HRQOL and greater adherence).

Improvement in HRQOL is thought to be due to improved myocardial perfusion and/or increased functional capacity that can encourage a more active lifestyle, thereby helping to maintain a higher VO_{2max} . The HRQOL improves as VO_{2max} improves, but is not an independent predictor of cardiac events. Important psychological benefits, together with improvements in oxygen uptake of 7 mL/kg/min, have been described in patients with disabling HF.

Recently, Frank et al.⁸⁶ conducted a descriptive retrospective analysis of demographic and clinical factors in patients receiving CRPs as predictors of HRQOL improvement. The results suggested that patients with worse physical abilities at baseline would obtain greater benefits in HRQOL.

Both ET and training programs have been shown to produce beneficial effects on psychological and clinical variables in patients with HF. Reports indicate that CRP improves VO_{2max} , submaximal aerobic endurance, muscular strength, HRQOL, and musculoskeletal features in patients with HF. In addition, aerobic and resistance training appear to involve very little risk to HF patients, providing the patients undergo initial assessment. New therapies described as being of use in CRP in HF patients include electrostimulation and inspiratory muscle training. They appear to improve psychological well-being, physical exercise capacity, symptoms, and HRQOL. To date, there have been 19 studies (13 on electrostimulation of the lower limb muscles and 6 on inspiratory muscle training) in patients with HF.⁸⁷ Other forms of exercise have been proposed as adjunctive therapies in CRP, such as tai chi.⁸⁸ This would be easy to implement and has produced encouraging results in Phase III CR, leading to improved balance, HRQOL, and perceived fitness.

CONCLUSIONS

CRP is an effective secondary prevention measure in patients with CVD. These programs should offer a multidisciplinary approach, including ET, psychological counseling, and the control of cardiovascular risk factors.

The bulk of scientific evidence shows that, of all interventions, ET is the most effective in reducing morbidity and mortality in patients with coronary disease. Resistance training should be considered a fundamental part of any ET aimed at improving quality of life. The optimal duration of CR remains to be determined, but some evidence suggests that adherence is higher in CRPs that include fewer sessions and in home-based CRPs. Moreover, these home-based CRPs are equally effective and involve the same costs as hospital-supervised programs. Despite evidence of the effectiveness of CRPs, these programs are

underused, as shown by the fact that in Spain they are accessed by less than 3% of patients with indications for them.

The HRQOL is an important factor to take into account since it provides information on how patients perceive their illness and the limitations it entails. Perceived quality of life depends on the patients' expectations regarding their functional capacity and lifestyle.

For patients enrolled in CRPs, HRQOL assessment may be of use in identifying individuals at an increased risk of readmission and mortality, along with stricter follow-up of the effects of the CRP on the patient and a better understanding of the patient's subjective response to their clinical condition. It also appears that improvements in HRQOL achieved through CRP correlate with the improvements observed in aerobic potential.

CONFLICTS OF INTEREST

None declared.

REFERENCES

1. Braig S, Peter R, Nagel G, Hermann S, Rohrmann S, Linseisen J. The impact of social status inconsistency on cardiovascular risk factors, myocardial infarction and stroke in the EPIC-Heidelberg cohort. *BMC Public Health*. 2011;11:104.
2. Dunderdale K, Thompson DR, Miles JN, Beer SF, Furze G. Quality-of-life measurement in chronic heart failure: do we take account of the patient perspective? *Eur J Heart Fail*. 2005;7:572-82.
3. García E, Andrés E, De Pablo C, León M. Cardiología preventiva y rehabilitación. *Rev Esp Cardiol*. 2010;63 Supl 1:40-8.
4. De Pablo C, Maroto JM. El consentimiento informado en la rehabilitación cardiaca. *Rev Esp Cardiol*. 1999;52:362.
5. De Pablo C, Del Río A, García E, Boraita A, Stachurska A. Prevención cardiovascular y rehabilitación cardiaca. *Rev Esp Cardiol*. 2008;61 Supl 1:97-108.
6. Laprerie AL, Trochu JN. Non-medical and non-instrumental therapy in heart failure. *Rev Prat*. 2010;60:935-9.
7. Plaza I. Estado actual de los programas de prevención secundaria y rehabilitación cardiaca en España. *Rev Esp Cardiol*. 2003;56:757-60.
8. Yu DS, Lee DT, Woo J. Improving health-related quality of life of patients with chronic heart failure: effects of relaxation therapy. *J Adv Nurs*. 2010;66:392-403.
9. Volz A, Schmid JP, Zwahlen M, Kohls S, Saner H, Barth J. Predictors of readmission and health related quality of life in patients with chronic heart failure: a comparison of different psychosocial aspects. *J Behav Med*. 2011;34:13-22.
10. Graham I, Atar D, Borch-Johnsen K, Boysen G, Burell G, Cifkova R, et al. Guías europeas sobre prevención cardiovascular en la práctica clínica: versión resumida. *Rev Esp Cardiol*. 2008;61:82.e1-49.
11. Márquez S, Villegas R, Briones E, Sarmiento V, Reina M, Sáinz I, et al. Implantación y características de los programas de rehabilitación cardiaca en el Sistema Nacional de Salud español. *Rev Esp Cardiol*. 2003;56:775-82.
12. Grima A, García E, Luengo E, León M. Cardiología preventiva y rehabilitación cardiaca. *Rev Esp Cardiol*. 2011;64 Supl 1:66-72.
13. León M, Mazón P, Marcos E, García E. Temas de actualidad en prevención cardiovascular y rehabilitación cardiaca. *Rev Esp Cardiol*. 2009;62 Supl 1:4-13.
14. Brown TM, Hernandez AF, Bittner V, Cannon CP, Ellrodt G, Liang L, et al.; American Heart Association Get With The Guidelines Investigators. Predictors of cardiac rehabilitation referral in coronary artery disease patients: findings from the American Heart Association's Get With The Guidelines Program. *J Am Coll Cardiol*. 2009;54:515-21.
15. Kotseva K, Wood D, De Backer G, De Bacquer D, Pyörälä K, Keil U; EUROASPIRE Study Group. EUROASPIRE III: a survey on the lifestyle, risk factors and use of cardioprotective drug therapies in coronary patients from 22 European countries. *Eur J Cardiovasc Prev Rehabil*. 2009;16:121-37.
16. EUROASPIRE I and II Group. European Action on Secondary Prevention by Intervention to Reduce Events. Clinical reality of coronary prevention guidelines: a comparison of EUROASPIRE I and II in nine countries. EUROASPIRE I and II Group. European Action on Secondary Prevention by Intervention to Reduce Events. *Lancet*. 2001;357:995-1001.
17. EUROASPIRE Study Group. EUROASPIRE: a European Society of Cardiology survey of secondary prevention of coronary heart disease, principal results. *Eur Heart J*. 1997;18:1569-82.
18. EUROASPIRE II Group. Lifestyle and risk factor management and use of drug therapies in coronary patients from 15 countries: principal results from EUROASPIRE II. *Eur Heart J*. 2001;22:554-72.
19. De Pablo C, Grima A, Luengo E, Mazón P. Prevención cardiovascular y rehabilitación cardiaca. *Rev Esp Cardiol*. 2007;60 Supl 1:68-78.
20. Hurting-Wennlöf A, Ruiz JR, Harro M, Sjöström M. Cardiorespiratory fitness relates more strongly than physical activity to cardiovascular disease risk

- factors in healthy children and adolescents: the European Youth Heart Study. *Eur J Cardiovasc Prev Rehabil.* 2007;14:575-81.
21. Anderssen SA, Cooper AR, Riddoch C, Sardinha LB, Harro M, Brage S, et al. Low cardiorespiratory fitness is a strong predictor for clustering of cardiovascular disease risk factors in children independent of country, age and sex. *Eur J Cardiovasc Prev Rehabil.* 2007;14:526-31.
 22. Nelson ME, Rejeski JR, Blair SN, Duncan PW, Judge JO, King AC, et al. Physical activity and public health in older adults. Recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation.* 2007;116:1094-105.
 23. Maroto JM. Rehabilitación en la insuficiencia cardíaca crónica. *Rev Esp Cardiol.* 1995;48 Supl 1:71-8.
 24. Del Río A. Cardiología preventiva y rehabilitación. *Rev Esp Cardiol.* 2006; 59 Supl 1:50-4.
 25. Leung YW, Grewal K, Gravely-Witte S, Suskin N, Stewart DE, Grace SL. Quality of life following participation in cardiac rehabilitation programs of longer or shorter than 6 months: does duration matter? *Popul Health Manag.* 2011;14:181-8. Epub 2011 Jan 17.
 26. Sogaro E, Schinina F, Burgisser C, Orso F, Pallante R, Aloï T, et al. Type D personality impairs quality of life, coping and short-term psychological outcome in patients attending an outpatient intensive program of cardiac rehabilitation. *Monaldi Arch Chest Dis.* 2010;74:181-91.
 27. Kupper N, Denollet J. Type D personality—a prognostic factor in heart disease: assessment and mediating mechanism. *J Pers Assess.* 2007;89:265-76.
 28. Mierzynska A, Kowalska M, Stepnowska M, Piotrowicz R. Psychological support for patients following myocardial infarction. *Cardiol J.* 2010;17:319-24.
 29. O'Neil A, Sanderson K, Oldenburg B, Taylor CB. Impact of depression treatment on mental and physical health-related quality of life of cardiac patients: a meta-analysis. *J Cardiopulm Rehabil Prev.* 2011;31:146-56.
 30. Farin E, Meder M. Personality and the physician-patient relationship as predictors of quality of life of cardiac patients after rehabilitation. *Health Qual Life Outcomes.* 2010;8:100.
 31. Gary RA, Dunbar SB, Higgins MK, Musselman DL, Smith AL. Combined exercise and cognitive behavioral therapy improves outcomes in patients with heart failure. *J Psychosom Res.* 2010;69:119-31.
 32. National Institute for Health and Clinical Excellence. Secondary prevention in primary and secondary care for patients following a myocardial infarction. London: NICE; 2007. Available from: <http://www.nice.org.uk/CG48>
 33. Taylor RS, Dalal H, Jolly K, Moxham T, Zawada A. Home-based versus centre-based cardiac rehabilitation. *Cochrane Database Syst Rev.* 2010;CD007130.
 34. Dalal H, Zawada A, Jolly K, Moxham T, Taylor R. Home based versus centre based cardiac rehabilitation: Cochrane systematic review and meta-analysis. *BMJ.* 2010;340:b5631.
 35. Kerse N, Hayman KJ, Moyes SA, Peri K, Robinson E, Dowell A, et al. Home-based activity program for older people with depressive symptoms: DeLLITE—a randomized controlled trial. *Ann Fam Med.* 2010;8:214-23.
 36. Clark AM, Haykowsky M, Kryworuchko J, MacClure T, Scott J, DesMeules M, et al. A meta-analysis of randomized control trials of home-based secondary prevention programs for coronary artery disease. *Eur J Cardiovasc Prev Rehabil.* 2010;17:261-70.
 37. Arthur HM, Smith KM, Kodis J, McKelvie R. A controlled trial of hospital versus home-based exercise in cardiac patients. *Med Sci Sports Exerc.* 2002;34: 1544-50.
 38. Clark AM. Home based cardiac rehabilitation. *BMJ.* 2010;340:b5510.
 39. Brotons C, Falces C, Alegre J, Ballarín E, Casanovas J, Catà T, et al. Ensayo clínico aleatorizado para evaluar la efectividad de una intervención domiciliar en pacientes con insuficiencia cardíaca: estudio IC-DOM. *Rev Esp Cardiol.* 2009;62:400-8.
 40. Piotrowicz E, Baranowski R, Bilinska M, Stepnowska M, Piotrowska M, Wójcik A, et al. A new model of home-based telemonitored cardiac rehabilitation in patients with heart failure: effectiveness, quality of life, and adherence. *Eur J Heart Fail.* 2010;12:164-71.
 41. Worringham C, Rojek A, Stewart I. Development and feasibility of a smart-phone, ECG and GPS based system for remotely monitoring exercise in cardiac rehabilitation. *PLoS One.* 2011;6:e14669.
 42. Seto E, Leonard KJ, Masino C, Cafazzo JA, Barnsley J, Ross HJ. Attitudes of heart failure patients and health care providers towards mobile phone-based remote monitoring. *J Med Internet Res.* 2010;12:e55.
 43. Ilioudi S, Lazakidou A, Tsironi M. Information and communication technologies for better patient self-management and self-efficacy. *Int J Electron Health.* 2010;5:327-39.
 44. Paré G, Moqadem K, Pineau G, St-Hilaire C. Clinical effects of home telemonitoring in the context of diabetes, asthma, heart failure and hypertension: a systematic review. *J Med Internet Res.* 2010;12:e21.
 45. Schmidt S, Schuchert A, Krieg T, Oeff M. Home telemonitoring in patients with chronic heart failure: a chance to improve patient care? *Dtsch Arztebl Int.* 2010;107:131-8.
 46. Copeland LA, Berg GD, Johnson DM, Bauer RL. An intervention for VA patients with congestive heart failure. *Am J Manag Care.* 2010;16:158-65.
 47. Maric B, Kaan A, Araki Y, Ignaszewski A, Lear SA. The use of the Internet to remotely monitor patients with heart failure. *Telemed J Electron Health.* 2010;16:26-33.
 48. WHO. Adherence to Long Term Therapies Project II. Global Adherence Interdisciplinary Network. Geneva: World Health Organization; 2003.
 49. McHorney CA, Tarlov AR. Individual-patient monitoring in clinical practice. Are available health surveys adequate? *Qual Life Res.* 1995;4:293-307.
 50. Brotons C, Permanyer C. La evaluación de resultados (*outcomes*) y de su relevancia clínica en cardiología: especial referencia a la calidad de vida. *Rev Esp Cardiol.* 1997;50:192-200.
 51. McDowell I, Newell C. *Measuring health: a guide to rating scales and questionnaires.* New York: Oxford University Press; 1987.
 52. Hunt SM, McEwen J, McKenna SP. *Measuring health status: a new tool for clinicians and epidemiologists.* J R Coll Gen Pract. 1985;35:185-8.
 53. Alonso J, Prieto L, Antó JM. The Spanish version of the Nottingham Health Profile: a review of adaptation and instrument characteristics. *Qual Life Res.* 1994;3:385-93.
 54. Ware Jr JE, Sherbourne CD. The MOS 36-Item Short Form Health Survey (SF-36). *Med Care.* 1992;30:473-82.
 55. Alonso J, Prieto L, Antó JM. La versión española del SF-36 Health Survey (Cuestionario de Salud SF-36): un instrumento para la medida de los resultados clínicos. *Med Clin (Barc).* 1995;104:771-6.
 56. Jenkinson C, Layte R, Wright L, Coulter A. *The UK SF-36: an analysis and interpretation manual.* Oxford: Health Services Research Unit, Department of Public Health and Primary Care, University of Oxford; 1996.
 57. Johansson P, Agnebrink M, Dahlström U, Broström A. Measurement of health-related quality of life in chronic heart failure, from a nursing perspective — a review of the literature. *Eur J Cardiovasc Nursing.* 2004;3:7-20.
 58. Feinstein AR. *Clinimetrics.* New Haven: Yale University Press; 1987.
 59. Alonso J, Ferrer M, Gandek B, Ware Jr JE, Aaronson NK, Mosconi P, et al.; IQOLA Project Group. Health-related quality of life associated with chronic conditions in eight countries: results from the International Quality of Life Assessment (IQOLA) Project. *Qual Life Res.* 2004;13:283-98.
 60. López-García E, Banegas JR, Graciani Pérez-Regadera A, Gutiérrez-Fisac JL, Alonso J, Rodríguez-Artalejo F. Valores de referencia de la versión española del Cuestionario de Salud SF- 36 en población adulta mayor. *Med Clin (Barc).* 2003;120:568-73.
 61. Wiklund I, Lindvall K, Swedberg K. Self assessment of quality of life in severe heart failure. *Scand J Psychol.* 1987;28:220-5.
 62. Guyatt G, Nogradi S, Harlow S, Sullivan M, Fallen E. Development and testing of a new measure of health status for clinical trials in heart failure. *J Gen Intern Med.* 1989;4:101-7.
 63. O'Leary C, Jones P. The left ventricular dysfunction questionnaire (LVD-36): reliability, validity and responsiveness. *Heart.* 2000;83:634-40.
 64. Garin O, Soriano N, Ribera A, Ferrer M, Pont A, Alonso J, et al. Validación de la versión española del Minnesota Living with Heart Failure Questionnaire (MLHFQ). *Rev Esp Cardiol.* 2008;61:251-9.
 65. Faller H, Steinbuechel T, Schowalter M, Spertus JA, Stork S, Angermann CE. The Kansas City Cardiomyopathy Questionnaire (KCCQ): a new disease-specific quality of life measure for patients with chronic heart failure. *Psychoter Psychosom Med Psychol.* 2005;55:200-8.
 66. Stull DE, Clough LA, Van Dussen D. Self report quality of life as a predictor of hospitalization for patients with LV dysfunction: a life course approach. *Res Nurs Health.* 2001;24:460-9.
 67. Hulsman M, Berger R, Sturm B, Bojic A, Woloszczuk W, Bergler-Klein J, et al. Prediction of outcome by neurohormonal activation, the six minute walk test and The Minnesota Living With Heart Failure Questionnaire in an outpatient cohort with congestive heart failure. *Eur Heart J.* 2002;23:886-91.
 68. Badia X, Alonso J. La medida de la salud. Guía de escalas de medida en español. Barcelona: Edimac; 2008.
 69. Rector TS, Johnson G, Dunkman B, Daniels G, Farrell L, Henrick A, et al. Evaluation by patients with heart failure of the effects of enalapril compared with hydralazine plus isosorbide dinitrate on quality of life. V-HeFT II. *Circulation.* 1993;87 Suppl 4:71-7.
 70. Konstam V, Salem D, Pouleur H, Kostis J, Gorkin L, Shumaker S, et al. Baseline quality of life as a predictor of mortality and hospitalization in 5,025 patients with congestive heart failure. SOLVD Investigations. *Studies of Left Ventricular Dysfunction Investigators.* Am J Cardiol. 1996;78:890-5.
 71. Spertus J, Peterson E, Conard MW, Heidenreich PA, Krumholz HM, Jones P, et al. Monitoring clinical changes in patients with heart failure: a comparison of methods. *Am Heart J.* 2005;150:707-15.
 72. Morris J, Perez D, McNoe B. The use of quality of life data in clinical practice. *Qual Life Res.* 1998;7:85-91.
 73. Lewis EF, Johnson PA, Johnson W, Collins C, Griffin L, Stevenson LW. Preferences for quality of life or survival expressed by patients with heart failure. *J Heart Lung Transplant.* 2001;20:1016-24.
 74. Leidy NK, Rentz AM, Zyczynski TM. Evaluating health-related quality-of-life outcomes in patients with congestive heart failure: a review of recent randomised controlled trials. *Pharmacoeconomics.* 1999;15:19-46.
 75. Phillips CO, Wright SM, Kern DE, Singa RM, Shepperd S, Rubin HR. Comprehensive discharge planning with postdischarge support for older patients with congestive heart failure: a meta-analysis. *JAMA.* 2004;291: 1358-67.
 76. Gonseth J, Guallar P, Banegas JR, Rodríguez-Artalejo F. The effectiveness of disease management programmes in reducing hospital re-admission in older patients with heart failure: a systematic review and meta-analysis of published reports. *Eur Heart J.* 2004;25:1570-95.
 77. Morgan K, McGee H, Shelley E. Quality of life assessment in heart failure interventions: a 10-year (1996-2005) review. *Eur J Cardiovasc Prev Rehabil.* 2007;14:589-607.
 78. Parajón T, Lupón J, González B, Urrutia A, Altimir S, Coll R, et al. Aplicación en España del cuestionario sobre calidad de vida «Minnesota Living With Heart Failure» para la insuficiencia cardíaca. *Rev Esp Cardiol.* 2004;57:155-60.

79. Heo S, Moser DK, Riegel B, Hall LA, Christman N. Testing the psychometric properties of the Minnesota Living with Heart Failure questionnaire. *Nurs Res*. 2005;54:265–72.
80. Kitzman DW, Brubaker PH, Morgan TM, Stewart KP, Little WC. Exercise training in older patients with heart failure and preserved ejection fraction: a randomized, controlled, single-blind trial. *Circ Heart Fail*. 2010;3:659–67.
81. Beckie TM, Beckstead JW. The effects of a cardiac rehabilitation program tailored for women on global quality of life: a randomized clinical trial. *J Womens Health (Larchmt)*. 2010;19:1977–85.
82. Yohannes AM, Doherty P, Bundy C, Yalfani A. The long-term benefits of cardiac rehabilitation on depression, anxiety, physical activity and quality of life. *J Clin Nurs*. 2010;19:2806–13.
83. 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;99:1173–82.
84. McKelvie RS, Teo KK, McCartney RS, Roberts RS, Costantini LA, Montague TJ, et al. Randomized controlled trial of exercise training in patients with congestive heart failure (EXERT). *J Am Coll Cardiol*. 1998;31 Suppl A:1226–31.
85. Kavanagh T, Myers MG, Baigrie RS, Mertens DJ, Sawyer P, Shephard RJ. Quality of life and cardiorespiratory function in chronic heart failure: effects of 12 months' aerobic training. *Heart*. 1996;76:42–6.
86. Frank AM, McConnell TR, Rawson ES, Fradkin A. Clinical and functional predictors of health-related quality of life during cardiac rehabilitation. *J Cardiopulm Rehabil Prev*. 2011;31:223–9.
87. Arena R, Pinkstaff S, Wheeler E, Peberdy MA, Guazzi M, Myers J. Neuromuscular electrical stimulation and inspiratory muscle training as potential adjunctive rehabilitation options for patients with heart failure. *J Cardiopulm Rehabil Prev*. 2010;30:209–23.
88. Taylor-Piliae RE, Silva E, Sheremeta SP. Tai Chi as an adjunct physical activity for adults aged 45years and older enrolled in phase III cardiac rehabilitation. *Eur J Cardiovasc Nurs*. 2010 Nov 20 [Epub ahead of print].