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QUALITY OF LIFE, PSYCHOLOGICAL AND PHYSIOLOGICAL CHANGES FOLLOWING EXERCISE TRAINING IN PATIENTS WITH CHRONIC HEART FAILURE

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Objective: **To assess the physiological and psychosocial effects of exercise training in chronic heart failure.**

Subjects/Patients: **Twenty-six men with heart failure (New York Heart Association functional classes II and III) aged 52.5 (SD 9.8) years, were studied.**

Methods: **The subjects were randomized either to rehabilitation group (Group A: 16 patients), participating in a 6-month exercise training program, or to control group (Group B: 10 patients). A psychosocial assessment, which included affective (Beck Depression Inventory and Hospital Anxiety and Depression Scale), quality of life (Quality of Life Index, Minnesota Living with Heart Failure Questionnaire and the Scale of Life Satisfaction) and personality (Eysenck Personality Questionnaire) parameters, was performed at the beginning and the end of the study.**

Results: **After training VO_2 peak increased by 36% and exercise time by 35%, $p < 0.05$. A significant decrease in anxiety and depression was also observed. Moreover, trained patients demonstrated a significant improvement in quality of life. No significant correlations were found between ΔVO_2 peak and all psychosocial parameter gains. However, the more depressed patients showed the largest physiological responses.**

Conclusion: **An exercise rehabilitation program in patients with chronic heart failure is useful for improving their work capacity and psychosocial status. Improvements in psychological status seem to be independent of the aerobic gains.**

Key words: exercise training, heart failure, aerobic capacity, psychological status, quality of life.

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INTRODUCTION

Despite recent advances in pharmacological management, patients with chronic heart failure (CHF) experience progressively worsening disability and quality of life, frequent hospitalizations and high mortality (1). The patients' principal symptoms are fatigue and dyspnoea, which contribute to their poor health-adjusted quality of life. Moreover, patients experience severe psychological disorders, such as anxiety and depression, in accordance with the severity of symptoms (2). Therefore, the assessment of well-being in patients with CHF is important. For this reason, various questionnaires have been reported to assess overall health-related quality of life. Although a link between level of quality of life and clinical status of afflicted patients has been supported, the prognostic value of the measurement of quality of life has not been clearly defined (2). On the contrary, the level of patients' exercise capacity (particularly their peak oxygen consumption) is an established prognostic marker in CHF (3).

Therapeutic exercise training is an accepted adjunct to medical therapy in the management of many chronic diseases. It is supported that exercise training leads to potential central (cardiac) and, principal important peripheral (skeletal muscle) beneficial adaptations and, thus, can provoke significant improvements in exercise tolerance and symptoms in cardiac patients (4–6). Moreover, systematic physical activity may reduce anxiety and enhance well-being and quality of life in these patients (7, 8). Enhancing performance efficacy and health-adjusted quality of life are the major goals in the management of patients with CHF (1, 9). Therefore, cardiac rehabilitation programs attempt to restore and maintain patients with CHF at their optimal level of functioning physically, psychologically, socially and vocationally through exercise training and education (9). However, there are limited and distinguishing data concerning the links between physical performance and psychosocial gains following a long-term exercise training program in CHF (4, 7, 10).

Therefore, the aims of this study were: (a) to determine whether a 6-month exercise training rehabilitation program would affect the psychological profile and quality of life in patients with CHF and (b) to examine correlations between changes in their cardiorespiratory capacity and psychological status.

MATERIAL AND METHODS

Subjects

Twenty-nine men, mean age 52.6 (SD 9.7) years (range 36–66 years) were randomly recruited to participate in the study from a pool of

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volunteered subjects with chronic heart failure, referred to the Cardiological Clinic at AHEPA Hospital of Thessaloniki. The aetiology of CHF was either ischaemic heart disease or dilated cardiomyopathy. The diagnosis of CHF was mainly based on clinical signs (New York Heart Association functional classes II and III), radiological findings, and echocardiographically determined ejection fraction <40% and shortening fraction <30%. Patients having recent myocardial infarction or unstable angina, aortic stenosis, diabetes mellitus, uncontrolled hypertension, musculoskeletal limitations or other contraindications for participating in an exercise training program were excluded from the study as were patients with documented exercise-induced severe ischaemia and/or serious arrhythmias. The volunteers had to be in clinically stable condition for at least 3 months before entering the study and remained in a stable medication regimen and diet during the study. They were all on medication with diuretics and angiotensin-converting enzyme inhibitors and some of them on nitrates, digoxin and β-blockers. None of the patients was on antidepressants or other psychotropic agents. All patients completed baseline testing and were randomized to either a 6-month supervised physical rehabilitation program (18 patients – Group A) or control status (11 patients – Group B). The proportions between groups were by design unequal due to technical reasons. Three patients dropped out of the study after randomization: 2 in Group A and 1 in Group B. The reasons for dropping out were health ($n = 1$) and work/family ($n = 2$) problems. Informed consent was obtained from all participants prior to the study, which was approved by the Aristotle University Ethical Committee.

Exercise testing

Cardiorespiratory capacity of all patients at the beginning and the end of the study was measured using an ergospirometric study. Measurements at peak exercise included heart rate (HR peak), blood pressure (sBP and dBP), double product (HRpeak × sBPpeak), which is an indirect measure of myocardial oxygen uptake, total exercise time, pulmonary ventilation (VE), oxygen consumption (VO_2peak), ventilatory anaerobic threshold (VO_2AT) and metabolic equivalents (METs). A symptom-limited cardiopulmonary exercise test was performed on a treadmill (Trackmaster, Jas Fitness Systems, USA) according to a modified Bruce protocol. Exercise testing was terminated when patients were physically exhausted or developed severe dyspnoea, dizziness or electrocardiographic abnormalities. A Cambridge Heart 12 ECG system (Kontron Instr.) was used for continuous ECG monitoring. Sphygmomanometric determination of blood pressure every 3 minutes was also performed. Indicators of peak effort included heart rate near to the age-predicted maximum (220 minus age in years), a rating of perceived exertion (RPE) of 19 to 20 values using the Borg scale, and a respiratory gas exchange ratio (RER) higher than 1.05. Expired gases were analysed on a breath by breath basis using a spiroergometer (Quark b^2, Cosmed, Italy). This system has fast O_2 and CO_2 analysers. Peak oxygen uptake (VO_2 peak) was considered, by 2 independent clinicians, as the highest VO_2 value obtained, characterized by a plateau of oxygen uptake before the patient had to stop exercising because of exhaustion or other symptoms. Ventilatory anaerobic threshold (VO_2AT) was determined as the intercept of the 2 slopes on a VCO_2 vs VO_2 graph in an incremental test. The software defines the VO_2 above which VCO_2 increases faster than VO_2 without hyperventilation.

Psychological testing

The psychological tests were assessed from all patients in the first week of admission, before randomization to study groups and the end of the study by the same physician, who was not familiar with the patients. The instruments included:

1. The Beck Depression Inventory (BDI), a reliable structured self report measure of the severity of affective, cognitive, behavioural, and physiological symptoms of depression, which was translated and standardized for the Greek population (11). This instrument has 21-item questionnaires. Each item consists of 4 self-evaluative statements of increasing severity. The meaning of scores is classified as follows: 0–9 = no to minimal depression; 10–15 = mild to moderate depression; 16–23 = moderate to severe depression; and ≥24 = severe depression.
2. The Hospital Anxiety and Depression Scale (HADS), a valid, 14-item self-administered questionnaire, which is specific for assessing depression and anxiety of general hospital patients (12). In order to avoid the confounding effect of symptoms of physical illness, the HADS excludes somatic items. There are separate 7-item subscales for anxiety and depression. The score for each subscale ranges from 0 to 21, since the score for each question ranges from 0 to 3 points. Score of 11 or above on the anxiety subscale best identifies individuals who may be at risk of a worse outcome.
3. The Quality of Life Index (QLI) – Spitzer Index, a valid, reliable, interviewer-administered questionnaire, which was translated for the Greek population. This health-related quality of life instrument has 5 domains measuring patient's activity, daily living, health, support and outlook (13). Its domain can be scored from 0 to 2 with the total score ranging between 0 (low level of well being) and 10 (high level of well being).
4. The Minnesota Living with Heart Failure Questionnaire (LHFQ), a valid, self-administered 21-item questionnaire measuring the impact of ill health behaviour in patients with CHF (14). It measures 3 dimensions (physical, socioeconomic and psychological) and how these have been influenced by the disease. A score is generated from option responses presented as 0- to 5-point scales.
5. The Scale of Life Satisfaction (LSI), a valid and reliable specific health-related quality of life instrument, which was translated and standardized for the Greek population (15). This multidimensional self-administered questionnaire has 12 items (physical and mental health, sexual life, support from family and friends, hobbies, appearance and a global evaluation for quality of life). Each item has an answer of 5 dimensions: 1 = Very disappointed; 2 = Disappointed; 3 = Not pleased or disappointed; 4 = Pleased; and 5 = Very pleased.
6. The Eysenck Personality Questionnaire (EPQ), a valid and reliable instrument, which was translated and standardized for the Greek population. It is composed of 84 self-evaluative statements (16). The statements cover 3 traits of personality, extroversion, neuroticism and psychoticism; there is also a lie scale.

Physical rehabilitation program

The 6-month supervised exercise training program in group A was based on the initial exercise tolerance test and further gradually modified by the patients' perceived exertion and adaptation to the training prescription. Clearly, after initial (2–4 weeks) institution-based training, all patients were exercised in subgroups. Each subgroup comprised 5 patients, and each exercise session consisted of various upper and lower body training modalities including stationary cycling, walking or jogging, calisthenics, stair climber and step-aerobic exercises. After the first 3 months of aerobic training, some resistance exercises with therabands and small weights (1 kg) for major muscle groups were added to the training prescription. Lifting light resistance with a great number of repetitions was chosen, in order to develop muscular endurance. Once patients had achieved desired loads, rate of progression was initiated by increasing the number of sets. Every training session began with a warm-up and ended with a cool-down period.

They were exercised at 50–70% of peak VO_2 or RPE between 12 and 14, for 60 min (plus 5 min per month), 3–4 times weekly. The RPE was considered merely as an adjunct to a training intensity determined by % of VO_2 peak, because many patients were unable to reliably use the RPE scale. The intensity of exercise was prescribed on an individual basis and the work load was progressively increased. Training intensity was readjusted when a patient was able to perform a given exercise intensity at a decreased RPE compared with baseline. Progression of exercise training was followed in this order: duration, then frequency and then intensity.

Statistics

All data are expressed as mean values (SD). Non-parametric tests were used to avoid potential errors from non-normal distribution of data. Wilcoxon signed-rank test was used to compare the baseline and final data within the same groups. Differences between groups were tested using either Mann-Whitney U test or chi-square test as appropriate. To analyse relationships between baseline values of psychosocial scores and aerobic capacity improvements in group A, linear regression analysis was used. Multivariate regression was also performed to examine the

Table I. *Clinical data of trained (group A) and untrained (group B) patients with chronic heart failure – values expressed as mean (SD) unless otherwise stated*

	Group A ($n = 16$)	Group B ($n = 10$)
Age (years)	52.3 (9.2)	52.8 (10.6)
Height (cm)	170.7 (4.7)	175.1 (7.2)
Weight (kg)	81 (13.9)	87 (14.6)
Patients with		
CAD&HF (II NYHA) (n)	9	6
CAD&HF (III NYHA) (n)	5	4
Dilated CM&HF (III NYHA) (n)	2	–

CAD&HF: coronary artery disease & heart failure; CM&HF: cardiomyopathy & heart failure. NYHA: New York Heart Association.

relationship between gains of psychosocial status (delta BDI, HADS, LHFQ, QLI and LSI scores) to delta VO_2 peak in group A. The Statistical Package for Social Sciences 10.0 for Windows was used (SPSS Inc. Chicago, IL.). The level of significance was fixed at $p < 0.05$.

Table III. *Data of psychosocial profile of trained (group A) and untrained (group B) patients with chronic heart failure at the beginning and the end of the study – scores, which are the products of the psychological tests, expressed as mean values (SD)*

	Group A		Group B	
	Baseline	After	Baseline	After
EPQ				
• Psychotism	6.19 (2.23)	6.7 (2.65)	7.7 (2.6)	7.7 (2.5)
• Neurotism	12.3 (5.47)	12.1 (5.25)	11.7 (4.4)	12.0 (4.0)
• Extroversion	13.7 (3.82)	13.6 (3.65)	13.6 (3.5)	13.9 (3.7)
• Lie	14.4 (3.25)	14.0 (3.32)	12.8 (1.6)	12.9 (2.0)
BDI				
• Depression	18.6 (4.65)	13.1 (3.13)*	18.5 (5.1)	18.8 (5.1)
HADS				
• Depression	13.1 (3.13)	8.6 (1.80)*	11.6 (2.3)	12.2 (1.8)
• Anxiety	12.4 (1.60)	9.12 (1.90)*	13.6 (3.7)	14.0 (3.7)

* $p < 0.05$ between baseline and final values.
EPQ: Eysenck Personality Questionnaire, BDI: Beck Depression Inventory questionnaire, HADS: Hospital Anxiety and Depression Scale questionnaire.

RESULTS

The 2 groups of patients participating in the study (group A: $n = 16$; group B: $n = 10$) were similar as regards their clinical data (Table I). In 22 patients the baseline treadmill tests were discontinued because of leg fatigue and the remainder 4 because of shortness of breath or exhaustion. After the 6-month training program the repeated exercise test discontinued because of leg fatigue only in 5 out of the 16 patients in group A and in 9 patients of group B. At baseline there were also no differences regarding the main measured parameters of the cardiorespiratory capacity, the psychosocial status and health-related quality of life between the groups (Tables II–V). The mean level of anxiety was 12.4 (1.60) and depression was 13.1 (3.13) according to HADS in both groups. Furthermore, the mean BDI score for all patients was 18.5 (5.3). Specifically, 1 patient was found without depression (scores 0–9), 7 with mild depression (scores 10–15), 14 with moderate (scores 16–23) and 4 with severe depression (score $\geq$24) (Table IV). All patients had low scores in quality of life as ensued from the 3 related questionnaires: The mean LHFQ score was 45.5 (17.1), the mean QLI score was 7.8 (1.1) and the mean LSI score was 50.1 (3.9) (Table V).

After the 6-month exercise rehabilitation program patients of group A had marked improvements in estimated exercise capacity; exercise time was increased by 34.7% ($p < 0.05$), VO_2 peak by 35.9% ($p < 0.05$), VO_2AT by 34.8% ($p < 0.05$)

Table II. *Ergospirometric data of both groups at the beginning and the end of the study – mean values (SD)*

	Group A		Group B	
Measurements	Baseline	After	Baseline	After
Resting HR (beats/min)	80.1 (10.4)	74.9 (8.8)*	79.2 (2.7)	79.2 (3.0)
Resting sBP (mmHg)	130.9 (10.9)	129.0 (10.3)	130.5 (9.0)	130.5 (9.5)
Resting dBP (mmHg)	80.9 (7.1)	76.2 (5.0)*	80.5 (6.4)	80.5 (6.0)
VE/VO_2 peak	29.5 (5.3)	27.8 (4.3)	33.5 (7.6)	33.0 (7.5)
VO_2 peak (ml/kg/min)	22.3 (4.9)	30.3 (4.3)*	23.4 (5.0)	22.8 (5.1)
VO_2AT (ml/kg/min)	19.8 (3.8)	26.7 (4.8)*	20.1 (4.2)	19.6 (4.4)
RER	1.11 (0.13)	1.13 (0.11)	1.09 (0.12)	1.10 (0.13)
HR peak (beats/min)	148.3 (16.9)	156.5 (10.1)	147.6 (7.7)	147.2 (7.7)
sBP peak (mmHg)	190.3 (15.2)	185.9 (10.0)	185.0 (13.5)	184.5 (11.8)
dBP peak (mmHg)	81.5 (6.5)	78.7 (5.0)	83 (5.4)	84.0 (5.1)
Double product ($\times 10^3$)	28.1 (3.6)	29.0 (3.6)	27.5 (2.4)	27.1 (2.4)
VE max (l/min)	59.3 (20.0)	75.3 (23.5)*	52.4 (12.4)	50.3 (11.0)
Exercise time (min)	19.0 (6.5)	25.6 (4.6)*	17.5 (2.4)	17.2 (2.5)
METs	9.5 (4.1)	12.8 (2.5)*	9.7 (1.2)	9.5 (1.2)

* $p < 0.05$ between baseline and final values.
HR: heart rate, sBP: systolic blood pressure, dBP: diastolic blood pressure, VE: ventilation, VO_2 peak: peak oxygen consumption, VO_2AT: anaerobic threshold, RER: respiratory exchange ratio, METs: metabolic equivalents, double product: heart rate peak $\times$ systolic blood pressure peak.

Table IV. *Distribution of trained (group A) and untrained (group B) patients with chronic heart failure according to the Beck Depression Inventory depressive morbidity at the beginning and the end of the study. No statistical significance could be found between the baseline scores of group A vs B*

	Group A			Group B		
Scores	Baseline *n*	After *n*	*p*	Baseline *n*	After *n*	*p*
Not depressed (0–9)	1	7	<0.05	0	0	ns
Mildly depressed (10–15)	4	2	<0.05	3	2	ns
Moderately depressed (16–23)	8	6	<0.05	6	7	ns
Severely depressed (≥24)	3	1	<0.05	1	1	ns

Table V. *Scores from the 3 questionnaires of quality of life in trained (group A) and untrained (group B) patients with chronic heart failure at the beginning and the end of the study – mean values (SD)*

	Group A		Group B	
	Baseline	After	Baseline	After
LHFQ	45.5 (17.1)	34.1 (13.0)*	45.1 (9.9)	45.2 (9.0)
Physical dimension	28.3 (1.3)	15.3 (0.9)*	28.3 (1.1)	29.7 (1.3)
Emotional dimension	18.5 (1.4)	11.0 (0.8)*	17.9 (1.0)	17.8 (1.1)
QLI	7.8 (1.1)	9.1 (1.1) *	7.1 (1.0)	7.1 (1.1)
Patient activity	1.4 (0.3)	1.8 (0.4)*	1.4 (0.4)	1.3 (0.3)
Daily living	1.2 (0.3)	1.9 (0.4)*	1.3 (0.5)	1.2 (0.4)
Health	1.0 (0.2)	1.5 (0.3)*	1.1 (0.3)	1.0 (0.3)
Support	1.5 (0.4)	1.8 (0.5)*	1.4 (0.4)	1.4 (0.5)
Outlook	1.0 (0.3)	1.4 (0.4)*	1.1 (0.3)	1.1 (0.4)
LSI	50.1 (3.9)	55.0 (3.4)*	49.0 (3.1)	48.7 (2.8)

* $p < 0.05$ between baseline and final values.
LHFQ: Minnesota Living with Heart Failure Questionnaire, QLI: Quality of Life Index – Spitzer Index questionnaire, LSI: Scale of Life Satisfaction questionnaire.

and METs by 34.7% ($p < 0.05$). In contrast, there was no statistically significant difference observed in the functional capacity of the controls at the end of the study (Table II).

Likewise, the exercised group had statistically significant improvements in depression, anxiety and quality of life (Tables III–V). Scores of all areas in the QLI showing improvement. Neither training nor sedentary lifestyle affected the traits of patients' personality (Table III). Clearly, the level of depression was significantly decreased by 29.6% (according to BDI questionnaire) and by 34.7% (according to HADS) and, also, the level of anxiety was by 26.5% ($p < 0.05$) decreased. Furthermore, the number of depressed patients in group A was reduced significantly according to their BDI scores (Table IV). The health-related quality of life was by 27% ($p < 0.05$) improved, as ensued from LHFQ scores, by 15% ($p < 0.05$) according to QLI and by 30% ($p < 0.05$) to LSI scores (Table V). No changes were observed in these traits in the controls over 6 months. In the exercised group, from the regression analysis between the gain developed in aerobic capacity (delta VO_2peak intake) and the baseline values of HADS, LHFQ, QLI and LSI scores, as well as the psychosocial improvements after training (delta BDI, HADS, LHFQ, QLI and LSI scores) no significant differences were found. However, patients with higher baseline depression scores (more depressed according to BDI) got the greatest improvement in aerobic capacity after training (r = 0.56, $p = 0.12$). All patients in group A undergoing training attended 78% of the exercise sessions (range 67–89%). The most common reasons for absences were medical disorders, such as infections, transportation problems and occupational obligations. There were no adverse effects or complications associated with training.

DISCUSSION

The present study shows that a 6-month exercise rehabilitation program in chronic heart failure patients increases their exercise capacity, diminishes depression and anxiety and improves their health-related quality of life. Although it seems logical that the improvement in exercise tolerance following training is associated with an enhanced feeling of well-being, a significant positive correlation between gains of cardiorespiratory and psychosocial indices was not demonstrable. Interestingly, the most initially depressed patients showed the greatest improvements in the aerobic capacity.

Patients with CHF generally describe a perceived poor health-adjusted quality of life (1). It is known that factors likely to influence quality of life in congestive CHF are fatigue and dyspnoea during everyday activities, frequent hospitalizations, frustration, anxiety and depression (2). Progressive impairment of exercise capacity commonly occurs in patients with CHF and is concerted as a primary factor responsible for the worsening of health-related quality of life (3, 9).

At the time of enrolment, all our patients showed impaired aerobic capacity, as their peak oxygen consumption was only the half of the expected values for referred sedentary healthy individuals. Previous studies have strongly suggested that the levels of aerobic capacity, as well as of exertional symptoms exhibited by patients with mild or severe CHF, are poorly correlated with the level of haemodynamic dysfunction (5). On the other hand, alterations in skeletal muscles play the most important role in the pathophysiology of exercise intolerance in these patients (5). Moreover, it is likely that physical performance is influenced by psychosocial factors, including psychological characteristics, such as anxiety and depression, and life experiences, such as acute cardiac events (17).

Moderate to severe levels of depression were found in 14 of 26 patients with CHF in this study. Many of these patients had poor subjective perception of indicators of quality of life, when entered the study (i.e. daily living and activity, health, psychosocial sequelae, etc.). It is reported that depressive symptoms and other psychosocial disorders occur in 10–30% of patients after myocardial infarction and in up to 40% of patients with stable coronary artery disease and/or CHF (2, 18). For patients with CHF, avoidance of normal physical activity and emotional function has been advocated for a long time, often resulting in further disability and a decrease in the quality-adjusted lifespan. In a prospective study of 391 CHF patients, Vaccarino et al. (17) supported that the higher the level of depressive symptoms, the higher the rate of death or functional decline. However, even low levels of depression are associated with functional disability in cardiac patients (17, 18).

Several reports have previously shown that exercise training is safe and beneficial in compensated CHF (4, 5, 8, 9, 19). In the present study 6 months of exercise training led to a significant increase in patients' aerobic and functional capacity, resulting in a 36% increase in VO_2peak and exercise time. Moreover, exercise training caused a reduction in anxiety and depression and an improvement in general well-being, social interaction, mood and other indicators of quality of life in our patients. The increases in the various indices of quality of life appear to be related with the initial physiological and psychological status and seem to show a "ceiling" effect. Therefore, gains in aerobic capacity were more demonstrable in the most depressed patients. Similar greater improvements after rehabilitation in areas of depression, anxiety and quality of life were reported in patients with greater levels of distress initially (10). Our results also indicate that aerobic training can help patients with CHF to feel better and to improve the perception of health-related quality of life, no matter the physical capacity level. Similarly, Gottlieb et al. (19) did not find improvements in quality of life and daily energy expenditure to the same extent as peak oxygen consumption improvement following 6-month supervised exercise training in patients with CHF. Improvements regarding exercise capacity and global quality of life, but not regarding VO_2 peak or the dyspnoea-fatigue index, were found in patients with ischaemic aetiology CHF (8). Moreover, Quittan et al. (7) demonstrated only weak correlations between improvements of physical performance and quality of life domains after a regular exercise program in CHF patients. On the contrary, Belardinelli et al. (6) showed that exercise training in CHF patients led to a significant improvement in quality of life parallel to peak VO_2 gain. Exercise training was found to be associated with low mortality, relative risk and hospital readmission. Furthermore, Tyni-Lenne et al. (20) observed that the effects on quality of life were related to the volume of exercise training in addition to a possible placebo-related effect. Kavanagh et al. (21) also supported that the gains in aerobic capacity following a 52-week exercise training program were negatively correlated with symptoms scores of fatigue, dyspnoea, emotional function and mastery. Moreover, improvements in quality of life appeared a trend to be greater when compliance was high. Wielenga et al. (22) also found significant correlations between improvements in exercise tolerance and decrease in feelings of being disabled and increase in the general well-being following exercise training in patients with CHF. On the other hand, no improvements in quality of life or psychosocial function were found for cardiac rehabilitation participants in a home exercise program (23). Significantly, Willenheimer et al. demonstrated no significant sustained benefits in physical capacity and quality of life 6 months after termination of a 4-month exercise training program in patients with CHF (24). Thus, exercise training obviously has to be continued to result in sustained benefit.

In conclusion, the application of an exercise training rehabilitation program in patients with CHF augments their aerobic capacity, diminishes their depression and anxiety and improves their health-related quality of life. Gains in physio-logical response in trained patients showed a strong positive correlation with their initial level of depression. However, no correlation was registered between improvements of physical performance and psychosocial domains after an exercise program in these patients.

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