European Heart Journal (1999) **20,** 1475–1484
Article No. euhj.1999.1581, available online at http://www.idealibrary.com on IDEAL

Improved physical fitness and quality of life following training of elderly patients after acute coronary events

A 1 year follow-up randomized controlled study

A. Ståhle*†, E. Mattsson*, L. Rydén†, A.-L. Unden‡ and R. Nordlander†

**Departments of Physical Therapy, †Cardiology, and ‡Research Center for General Health Care, Karolinska Hospital, Karolinska Institutet, Stockholm, Sweden*

Aims Cardiac rehabilitation including exercise training is of proven value in ischaemic heart disease. However, elderly patients frequently are not encouraged to participate in such programmes. This study evaluates the physiological effects and self-reported quality of life after an aerobic outpatient group-training programme in subjects above the age of 65 years.

Methods and Results A consecutive series of 101 patients (males 80%) aged 65–84 (mean 71) years recovering from an acute coronary event were randomized to either a supervised out patient group-training programme (n=50) or to a control group (n=51). The two groups were well balanced as regards clinical characteristics. The compliance in the training group was 87%. Exercise tolerance increased in the trained group from 104 to 122 and 111 W after 3 and 12 months respectively. The corresponding values were 102, 105 and 105 W among controls. Parameters, such as quality of life, self-estimated level of physical activity, fitness and well-being were graded higher by the trained patients than those who served as controls on the two occasions of follow-up.

Conclusions Aerobic group-training of elderly patients recovering from an acute coronary event beneficially influences physical fitness and several parameters expressing quality of life. Great care has to be taken to preserve the initial effects by continued training.
(Eur Heart J 1999; 20: 1475–1484)

Key Words: Elderly, acute coronary event, exercise training/capacity, quality of life, randomized controlled trial, cardiac rehabilitation.

See page 1448 for the Editorial comment on this article

Introduction

In the early years of exercise rehabilitation of patients with coronary heart disease, an age exceeding 65 years was, on arbitrary grounds, a frequently used exclusion criterion[1]. In 1985 Williams *et al.*[2] reported that men older than 65 years increased their physical capacity and their psychological response to exertion as much as younger patients when included in a training programme initiated within 6 weeks after a myocardial infarction or coronary bypass grafting. A limitation with this and other similar studies[3,4] is that they compared the elderly with younger patients or with normal subjects in the same age-cohort[5] without any randomization[6,7]. Thus, there are no properly designed trials that have specifically addressed the efficacy and safety of exercise training in an elderly population with coronary artery disease[8]. Coronary heart disease imposes restrictions in terms not only of physical, but also of psychological and social functioning. This often induces an overall reduction in the quality of life of the patient as well as the family[9]. Thus, assessment of physical outcome alone may not be sufficient patient management[10]. Quality of life aspects ought to be included in a comprehensive evaluation of a cardiac rehabilitation programme designed for elderly subjects.

We recently demonstrated that it is safe and effective for the elderly ($\geqslant$65 years) to participate in an aerobic group training programme after acute coronary

Revision submitted 8 February 1999, and accepted 17 February 1999.

Correspondence: Agneta Ståhle, PT, MSc, Dept. of Physical Therapy, Karolinska Hospital, SE-171 76 Stockholm, Sweden.

0195-668X/99/201475+10 $18.00/0

events[11]. If this programme also has an effect on health-related quality of life and if the effects on physical fitness and self-reported quality of life are sustained during a long period of follow-up remains to be studied. The aim of this extended report of our prospective randomized study of training elderly patients with unstable coronary artery disease was to evaluate physiological effects and health-related self-reported quality of life during 12 months of follow-up.

Material and Methods

Patients

Consecutive patients ≥65 years who were admitted to the Coronary Care Unit at the Karolinska Hospital, Stockholm, because of an acute coronary event during the period October 1994 to June 1997 were eligible for the study.

An acute coronary event was defined as either an acute myocardial infarction or an episode of unstable angina pectoris. At least two of the following criteria should be fulfilled for the diagnosis acute myocardial infarction: chest pain for >15 min; at least two S-CK and S-CKB values above the reference; the development of new Q waves in at least two of the standard ECG leads. The diagnosis unstable angina pectoris required an episode of anginal chest pain combined with dynamic ECG changes at rest (transient/manifest T-wave inversion and/or ST-depression >1 mm in at least two adjacent leads), but without any release of cardiac enzymes. To be included the patients had to perform a predischarge exercise test at a workload ≥70 W in males and ≥50 W in females. For the group with unstable angina pectoris a ST60 depression of >1 mm in ≥two adjacent leads had to be documented at the exercise test.

The inclusion criteria were met by 252 patients. Patients with neurological sequelae (n=6), memory dysfunction (n=3), orthopaedic disability (n=7), inability to understand Swedish (n=6), coronary intervention planned within 3 months (n=37) and other complicating diseases (n=19) were excluded, while 65 patients refused participation (42 men and 23 women, mean age 73·5 years, 41 with an acute myocardial infarction and 24 with unstable angina pectoris). In all, 109 patients (males 80%), 64 with an acute myocardial infarction and 45 with unstable angina pectoris remained as the study population.

Prior to discharge, all patients received verbal and written information about the importance of regular physical activity. They were recommended to take a daily walk at a comfortable speed, and to gradually increase this effort. All patients were invited to monthly information meetings at the department. Here they would have the opportunity to ask questions about their disease, and together with information on how to cope would also have received information on pharmacological therapy. The patients could also discuss their problems with a professional team specialized in cardiac rehabilitation, and were encouraged to contact this team at any time during the study period. The medical follow-up, at the outpatient clinic was the same for all patients. The patients were stratified according to diagnosis (acute myocardial infarction or unstable angina pectoris) to be randomized into an intervention group (Group I) or a control group (Group C) after discharge and after a baseline exercise test conducted within 6 weeks after the acute event. This protocol was chosen to avoid the influence that group allocation of individual patients could have on their performance at the baseline investigation. The median time between the initial hospital admission and the time of randomization was 18 days.

All patients gave their informed consent to participate. The study was approved by the Local Ethics Committee.

Training programme

The patients in Group I participated in a 50 min aerobic outpatient group-training programme (including warm-up and cool-down) three times a week for 3 months. The complete programme was supervised by a specialized physiotherapist and supported by music which guided the intensity of the performance during the session. A detailed description of the training programme has been given elsewhere[11]. The training was followed by 10 min of music-supported relaxation. After the initial 3 months, the patients had the possibility of participating in the programme once a week for another 3 months. Leaving the programme, all patients were encouraged to contact training facilities outside the hospital, such as those offered by the National Association for Heart and Lung Patients.

The patients in Group C received instructions as already outlined, and were encouraged to re-start their usual/prior physical activity as soon as they felt fit enough for this. After the 3 month follow-up, they were encouraged to contact the local National Association for Heart and Lung Patients concerning taking part in its training programme for heart patients.

Exercise capacity

Maximal exercise capacity was assessed on three occasions, at baseline and 3 and 12 months thereafter. All tests were conducted until symptom limitation on an electrically braked bicycle ergometer (Siemens Elema, Ergomed 840, Sweden) starting at 30 W with a stepwise increase of the workload by 10 W . min^{-1}[12]. A 12-lead ECG was continuously monitored during the test using a computerized electrocardiograph (Siemens Megacart, Sweden). Systolic blood pressure was recorded every minute, as were subjective symptoms. Perceived exertion was rated according to a 6–20 graded scale (Borg's

RPE-scale)[13], while chest pain, shortness of breath and leg fatigue were assessed with a 0–10 graded scale (Borg's Category Ratio scale; CR-10-scale)[14]. The test was terminated due to fatigue (defined as a ratings of perceived exertion-score of 15–17/20), or severe angina (grade ≥ 5 of 10), arrhythmia causing subjective symptoms, a fall in blood pressure >10 mmHg on two consecutive workloads or an ST 60-depression >2 mm. All exercise tests were conducted between noon and 1500 h and after at least 1 h following a heavy meal. They were supervized by a medical technologist who had no information on group allocation.

The RPE score at 30 and 60% of maximal exercise capacity was analysed as an indicator of the patients' tolerance to submaximal levels of exercise. The RPE score at the maximal identical workload was also calculated from the three exercise tests.

Self-reported health-related quality of life

Self-reported health-related quality of life was assessed before randomization, and at the 3 and 12 months follow-up by a self-administrated questionnaire, the Karolinska Questionnaire. This questionnaire has been validated for patients paced for bradyarrhythmias and for elderly patients undergoing valve replacement due to aortic stenosis and patients with ischaemic heart disease[15–17]. It consists of 125 questions and covers a broad range of quality of life determinants, including subscales measuring cardiovascular symptoms, quality of sleep, physical ability, daily activity, depression, self-perceived health and alertness. For the cardiovascular symptoms there are 16 specific questions including subscales for chest pain, breathlessness, dizziness, palpitations and cognitive ability. These are based on visual analogue scales from 0–100 mm to estimate the severity of symptoms (zero mm indicating freedom from symptoms, and progressive symptoms indicated by increases in mm). To facilitate the completion of the visual analogue scales the scale was accompanied by numbers from 1–7. The 'ladder of life', presented as a 10-point scale, defined expectations for the present and future, with the first grade representing the worst possible and the tenth the best possible life. Fitness was assessed with a seven-point scale in which 1 meant 'very bad' and 7 'excellent, could not be better'[18].

The reliability of the cardiovascular symptoms and activity evaluated in the Karolinska Questionnaire was tested by Gadler *et al.*[19], using the Crohnbachs alpha coefficient. A value of 0·60 was obtained for the sum of all cardiovascular symptoms and the corresponding value for the sum of scores concerning activity was 0·75.

All questions referred to symptoms or quality of life parameters during the preceding weeks (baseline) or months (follow-up). The questionnaires were administered by a medical technologist and answered by the patients. To ensure the visual analogue scale was understood by participants the questionnaire started with three test questions that were not evaluated. These were completed with the medical technologist, while the rest of the questionnaire was completed in privacy at home; however, on returning the questionnaire, questions could be explained by the technician.

Physical activity and well-being

Before randomization, and after 3 and 12 months the patients estimated their level of physical activity according to a six-point scale[20] where 1 corresponds to sedentary and 6 to strenuous exercise comprising at least 3 h a week on such activities as jogging, skiing, tennis, swimming and aerobic training.

Self-graded well-being was assessed using a visual analogue scales of 0 to 100 mm with the extremes 'not good at all' to 'very good' at the 3 month follow-up. At the time of this follow-up, relatives were asked how they thought the patient felt now, using the same question concerning well-being as for the patients. They answered the questionnaire at home and mailed it back.

Statistical methods

Results are presented as mean, standard deviation (SD) and range, or median and range. Analyses were performed using a two-way ANOVA with repeated measures on one factor, and two-sided Student's paired and unpaired t-tests. All variables were tested with ANOVA for changes over time within and between the two groups. Differences at baseline were explored by Student's t-test.

Quality of life data were tested with two sided Student's paired and unpaired t-tests[21]. Intra-individual data were calculated as the differences between the second and the first questionnaire and the differences between the third and the first questionnaire. The distribution for some of the clinical variables, i.e. triglycerides and HDL levels, were skewed. These data were ln-transformed in order to meet the requirements for an adequate ANOVA. Analyses were also performed using the Mann–Whitney U-test for the comparison between the treatment groups concerning the effect of intervention after 3 and 12 months. Statistically significant differences were assumed when $P \leq 0{\cdot}05$.

Results

Fifty-six patients were randomized to Group I and 53 to Group C. Eight patients were withdrawn before the 3 month follow-up because of coronary artery bypass graft surgery (CABG) (n=4; two from each group after 8, 8, 9 and 12 weeks), lack of time participating in the training programme (n=2; from Group I after 1 and 6 weeks), moved from the area (n=1; from Group I after 4 weeks) or for orthopaedic reason (n=1; from Group I after 5 weeks). In all, 101 patients completed the

Table 1 Characteristics of the patients in the intervention group (Group I) and the control group (Group C) at time of randomization. Variables are presented as mean (age) and number (n) of patients

	Group I (n=50)	Group C (n=51)
Age [years; mean (SD)]	71 (3·9)	71 (4·7)
Range	65–84	65–83
Sex (M/F)	41/9	40/11
Diabetes mellitus	10	6
Hyperlipidaemia	9	8
Hypertension	18	14
Congestive heart failure	2	5
Previous AMI	18	11
Angina pectoris	20	21
Previous PTCA	7	5
Previous CABG	9	9

AMI=acute myocardial infarction; PTCA=percutaneous transluminal coronary angioplasty; CABG=coronary artery bypass graft surgery.

3 month follow-up, 50 in Group I (acute myocardial infarction=29, unstable angina pectoris=21) and 51 in Group C (acute myocardial infarction=31, unstable angina pectoris=20). One patient in Group C was lost to the 1 year follow-up. At baseline the two groups were well balanced as regards clinical characteristics (Tables 1 and 2) and pharmacological treatment (Table 3). There were no significant changes over time in any of the two groups, apart from lipid lowering therapy (Table 3).

Six patients, two in Group I and four in Group C, underwent CABG during the follow-up between 3 and 12 months. Two patients in Group I and one in Group C underwent PTCA between baseline and the 3 month follow-up and two additional patients in Group I between the 3 and 12 month follow-ups.

The average compliance (actually performed training sessions divided by possible sessions) in the intervention group was 87% (range 64–100). There were no complications of any kind during the training sessions. Forty-seven of the 50 Group I patients continued the training programme once a week for the second 3 months period.

Exercise capacity

Two patients were unable to perform the exercise test at the 1 year follow-up, one due to a pulmonary infection (Group I) and one because of lumbago (Group C). Exercise capacity did not differ between the two groups at baseline. After 3 months it had increased significantly from 104 (SD 24; range 60–160) to 122 (27; 60–170) W ($P<0·001$) in Group I. No such increase was noted in Group C, in which the corresponding values were 102 (30; 60–170) at baseline and 105 (37; 50–200) W at 3 months (Fig. 1 A). The maximal exercise capacity in Group I (n=49) decreased somewhat to 111 (SD 24; range 60–160) W during the remaining period of follow-up, but was still significantly higher after 12 months than at baseline ($P<0·05$). In Group C (n=49) exercise capacity remained unchanged 105 (36; 40–180) W. The difference over time between the two groups was statistically significant ($P<0·001$) although the actual difference between the two groups was not significant at 12 months (Fig. 1 A).

Table 2 Patient characteristics and laboratory data in the intervention group (Group I) and the control group (Group C) at time of randomization and after 3 and 12 months of follow-up. Variables are presented as mean, standard deviation (SD) or number (n) of patients. There were no significant differences at baseline and no significant changes over time

	Randomization		3 months		12 months	
	Group I (n=50)	Group C (n=51)	Group I (n=50)	Group C (n=51)	Group I (n=50)	Group C (n=50)
Smokers	6	6	4	4	3	4
Body mass index (kg . m^{-2})	26·3 (3·2)	25·2 (2·7)	26·1 (2·8)	25·1 (2·6)	26·2 (2·9)	25·1 (2·7)
Systolic blood pressure (mmHg)	138 (23)	138 (24)	140 (19)	142 (23)	143 (25)	141 (28)
Heart rate, max. (beats . min^{-1})*	116 (18)	118 (16)	119 (17)	121 (18)	117 (14)	120 (17)
CCS class†	1·3 (0·6)	1·5 (0·6)	1·3 (0·5)	1·5 (0·6)	1·2 (0·4)	1·3 (0·6)
NYHA class‡	1·4 (0·5)	1·5 (0·6)	1·4 (0·5)	1·5 (0·6)	1·4 (0·5)	1·5 (0·6)
Cholesterol (mmol . l^{-1}) Group I (n=43); Group C (n=47)	5·6 (1·1)	5·6 (1·0)	5·7 (0·9)	5·7 (1·0)	5·5 (0·9)	5·3 (1·0)
Triglycerides (mmol . l^{-1})§ Group I (n=43); Group C (n=46)	1·4 (0·9–2·1)	1·4 (1·0–1·9)	1·6 (1·2–1·9)	1·5 (1·1–1·9)	1·6 (1·2–2·1)	1·5 (1·2–2·0)
HDL (mmol . l^{-1})§ Group I (n=42); Group C (n=45)	1·1 (0·8–1·3)	1·1 (1·0–1·4)	1·1 (0·9–1·3)	1·2 (1·0–1·5)	1·2 (1·0–1·5)	1·3 (1·1–1·6)
LDL (mmol . l^{-1}) Group I (n=42); Group C (n=45)	3·5 (0·9)	3·7 (1·0)	3·7 (0·9)	3·8 (1·0)	3·4 (0·8)	3·3 (0·8)

*During the exercise tests.
†According to the Canadian Cardiovascular Society's classification system.
‡According to the New York Heart Association's classification system.
§Data are presented as median and the interquartile range.

Table 3 Pharmacological treatment of the patients in the intervention group (Group I) and the control group (Group C) at randomization and after 3 and 12 months of follow-up. Variables are presented as number (n) of patients

Type of drug	Randomization		3 months		12 months	
	Group I (n=50)	Group C (n=51)	Group I (n=50)	Group C (n=51)	Group I (n=50)	Group C (n=50)
Beta-blocker	38	44	41	41	39	37
Digitalis	3	3	2	3	2	1
Long-acting nitrate	30	26	29	27	29	21
Diuretic	11	14	11	12	12	12
ACE inhibitor	12	9	11	9	10	10
Calcium antagonist	11	9	12	11	11	12
Aspirin	45	49	46	47	47	46
Lipid-lowering	8	6	8	9	18	19
Sedative	4	7	2	7	1	6

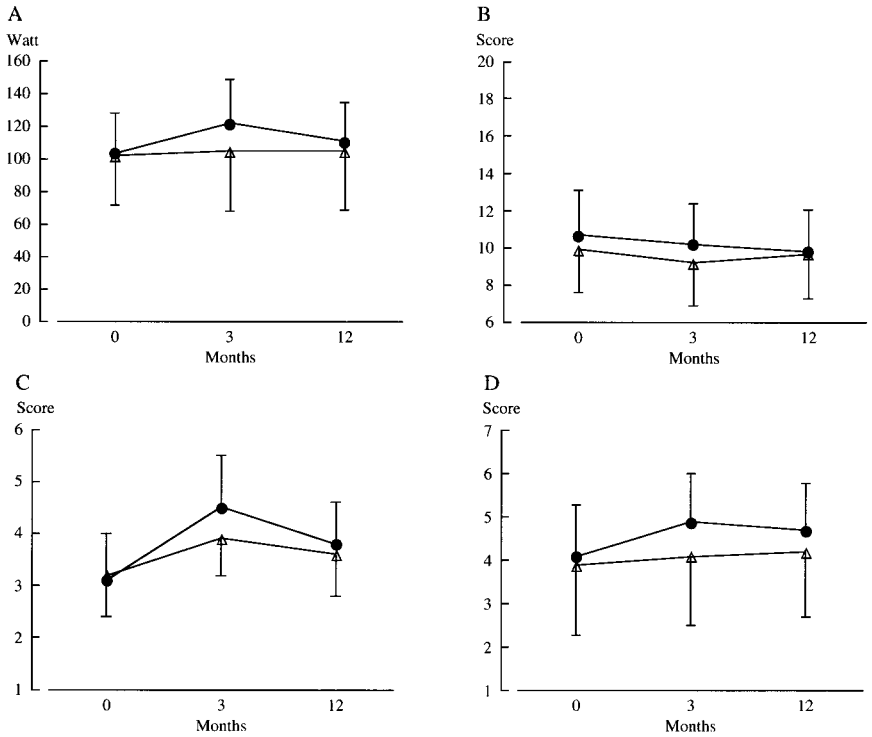

Figure 1 **Maximal exercise capacity (A), graded ratings of perceived exertion (RPE) score (6–20) at 60% of maximal exercise capacity (B), self-estimated level of physical activity (score 1–6) (C) and self-estimated fitness (score 1–7) (D) in the intervention group (Group I=—●—) and the control group (Group C=—△—) followed over time. Values are presented as mean (SD).**

Fifteen subjects in each group had signs of ischaemic ST depression during the exercise test at the 3 month follow-up, and 14 in Group I and 15 in Group C at 12 months. Maximally scored chest pain, shortness of breath or leg fatigue did not differ between the groups at the three exercise tests and there were no significant changes over time in these values, except for shortness of breath, which was more pronounced in Group C than Group I at the 12 month follow-up ($P<0{\cdot}05$).

Ratings of perceived exertion

The ratings of perceived exertion scores at 30 and 60% of maximal exercise capacity were slightly higher at baseline in Group I compared to Group C (Table 4). The RPE score at 30% of maximal exercise capacity had decreased in both groups at the 3 month follow-up, ($P<0{\cdot}05$ in Group I; $P=0{\cdot}07$ in Group C). After 12 months of follow-up it was still decreased in Group I

Table 4 Ratings of perceived exertion (RPE score; 6–20) at 30 and 60% of maximal exercise capacity and at maximal identical workload at randomization and after 3 and 12 months follow-up in the intervention group (Group I) and the control group (Group C). Variables are presented as median (range) and changes over time

	Randomization		3 months		12 months		Changes over time	
	Group I (n=50)	Group C (n=51)	Group I (n=50)	Group C (n=51)	Group I (n=49)	Group C (n=49)	Group I *P* value	Group C *P* value
RPE at 30%	8 (6–13)	7 (6–11)	7 (6–11)	7 (6–11)	6 (6–11)	6 (6–13)	$P<0.05$	ns
RPE at 60%	11 (6–15)	9 (6–13)	10 (6–15)	9 (6–14)	9 (6–14)	9 (6–15)	$P<0.05$	ns
RPE at max. id. workload	15 (8–19)	14 (8–18)	12 (7–17)	13 (7–17)	13 (7–18)	13 (7–19)	$P<0.001$	ns

Table 5 Quality of life variables at randomization in the intervention group (Group I) and in the control group (Group C). Variables are presented as mean, standard deviation (SD) and range. There were significant differences between the two groups at baseline

	Score (min.–max.)	Favourable value	Group I (n=50)	Group C (n=51)
Symptoms				
Chest pain	1–7	low	2·7 (1·3) 1–5·7	2·6 (1·3) 1–6·0
Shortness of breath	1–7	low	2·9 (1·3) 1–5·8	2·7 (1·2) 1–6·6
Dizziness	1–7	low	1·8 (1·0) 1–5·5	1·9 (1·1) 1–5·0
Palpitation	1–7	low	1·7 (0·9) 1–4·7	1·6 (0·8) 1–4·0
Cognitive ability	1–7	low	2·2 (1·0) 1–4·7	2·0 (0·9) 1–5·3
Alertness	1–4	low	2·5 (0·8) 1–4·0	2·5 (0·8) 1–4·0
Quality of sleep	1–4	low	2·2 (0·6) 1–3·5	2·2 (0·7) 1–3·8
Physical ability	1–5	low	1·5 (0·8) 1–5·0	1·3 (0·4) 1–3·0
Daily activity	1–5	low	1·7 (0·6) 1–3·5	1·5 (0·5) 1–3·1
Depression	0–1	low	0·3 (0·3) 0–1·0	0·3 (0·2) 1–0·8
Self perceived health	1–4	low	2·1 (1·0) 1–4·0	1·9 (0·9) 1–4·0
'Ladder of life'; Present	1–10	high	6·2 (1·8) 3–9·0	6·5 (1·9) 3–10
'Ladder of life'; Future	1–10	high	7·7 (1·6) 3–10	7·8 (1·6) 4–10
Fitness	1–7	high	4·1 (1·2) 2–7·0	3·9 (1·6) 1–7·0
Physical activity	1–6	high	3·1 (0·9) 1–4·0	3·2 (0·8) 1–5·0

($P<0.001$), but had increased in Group C. The difference was in favour of Group I when measuring over time ($P<0.05$). The RPE score at 60% of maximal exercise capacity showed a similar pattern, with a significant improvement over time in Group I ($P<0.05$; Table 4 and Fig. 1 B). For the RPE score at maximal identical workload, which was slightly higher in Group I at baseline, there was a decrease in both groups at 3 months, however this was more pronounced in Group I ($P<0.001$). An increase was seen in both groups at the 12 month follow-up, still with a significant improvement ($P<0.001$) in favour of Group I when measuring over time (Table 4). Differences between the two groups were $P<0.05$ at 30% and 60% and the rated RPE score at the maximal identical workloads at 3 months favoured Group I. There were no significant differences between the two groups at the 12 month follow-up at either of the 30% and 60% levels of maximal exercise capacity, or for the rated RPE score at maximal identical workload.

Self-reported health-related quality of life

Quality of life at baseline was similar in the two groups (Table 5). Changes from baseline (mean values) to 3 and 12 months together with differences in changes between the groups, are presented in Table 6. From baseline to 3 months, patients in Group I experienced a marked improvement in chest pain and shortness of breath ($P<0.001$) at submaximal leisure time activities. A certain improvement in chest pain was also seen in Group C ($P<0.05$). Patients in Group I reported improved alertness ($P<0.05$), physical ability ($P<0.05$), daily activities ($P<0.01$) and fitness ($P<0.001$). Regarding depression, self-perceived health and 'ladder of life' improvements were seen in both groups. Relative changes are presented in Fig. 2 A, which demonstrates an overall positive trend for patients in Group I. When considering the overall trend in changes over 12 months, no further improvements occurred, apart from what was observed after 3 months. Some of the benefits gained in

Table 6 Changes in quality of life variables from baseline to three and twelve months of follow-up in the intervention group (Group I) and in the control group (Group C). Variables are presented as mean and standard deviation (SD). Positive values denote improvement and negative values impairment

	Differences within the groups over time								Differences between the groups	
	0 to 3 months				0 to 12 months				at 3 months	at 12 months
	Group I (n=50)	*P*-value	Group C (n=51)	*P*-value	Group I (n=50)	*P*-value	Group C (n=50)	*P*-value	*P*-value	*P*-value
Symptoms										
Chest pain	0·8 (1·2)	<0·001	0·3 (1·0)	<0·05	0·6 (1·2)	<0·001	0·4 (1·3)	<0·05	ns	ns
Shortness of breath	0·8 (1·0)	<0·001	0·3 (0·9)	ns	0·4 (1·1)	<0·01	0·2 (1·0)	ns	<0·05	ns
Dizziness	0·1 (1·1)	ns	0·1 (1·0)	ns	− 0·1 (1·1)	ns	0·2 (0·9)	ns	ns	ns
Palpitation	0·2 (1·0)	ns	− 0·1 (0·7)	ns	− 0·1 (1·0)	ns	0·1 (0·9)	ns	<0·05	ns
Cognitive ability	0·1 (1·0)	ns	− 0·1 (0·7)	ns	− 0·1 (0·6)	ns	0·0 (0·7)	ns	ns	ns
Alertness	0·3 (0·8)	<0·05	0·2 (0·8)	ns	0·0 (0·9)	ns	0·1 (0·8)	ns	ns	ns
Quality of sleep	0·0 (0·5)	ns	0·0 (0·5)	ns	0·0 (0·5)	ns	0·1 (0·5)	ns	ns	ns
Physical ability	0·2 (0·7)	<0·05	0·0 (0·4)	ns	0·2 (0·7)	<0·05	0·1 (0·4)	ns	ns	ns
Daily activity	0·2 (0·5)	<0·01	0·1 (0·4)	ns	0·3 (0·5)	<0·01	0·1 (0·5)	ns	ns	ns
Depression	0·1 (0·2)	<0·05	0·1 (0·2)	<0·05	0·1 (0·3)	<0·05	0·1 (0·2)	<0·05	ns	ns
Self perceived health	0·5 (1·3)	<0·01	0·4 (0·9)	<0·01	0·5 (1·3)	<0·01	0·3 (1·0)	<0·05	ns	ns
'Ladder of Life'; Present	1·0 (1·9)	<0·001	0·9 (1·9)	<0·01	1·2 (1·2)	<0·001	0·9 (1·8)	<0·01	ns	ns
'Ladder of life'; Future	0·4 (2·8)	ns	− 0·1 (2·2)	ns	0·8 (2·7)	ns	0·4 (2·3)	ns	ns	ns
Fitness	0·8 (1·3)	<0·001	0·2 (1·1)	ns	0·6 (1·4)	<0·01	0·4 (1·0)	<0·01	<0·05	ns
Physical activity	1·4 (1·2)	<0·001	0·7 (1·0)	<0·001	0·7 (1·0)	<0·001	0·4 (1·1)	<0·05	<0·01	ns

Group I were, however, lost during continued follow-up, although the improvements in Group I were maintained as regards chest pain ($P<0·001$) and shortness of breath ($P<0·01$) at submaximal leisure time activities compared to baseline. Some improvement in chest pain ($P<0·05$) was also seen over time in Group C. Patients in both groups estimated their physical activity and fitness higher on the two follow-up occasions compared to baseline (Fig. 1 D). None of these changes differed significantly between the two groups at 12 months. Figure 2 B shows the overall changes from baseline to 12 months follow-up.

Physical activity and well-being

Self-estimated level of physical activity was similar in the two groups at baseline (Table 5). After 3 months, patients in Group I, as well as those in Group C, had improved their self-estimated physical activity, but patients in Group I (mean 4·5), significantly ($P<0·01$) more than patients in Group C (mean 3·9). After 1 year the average self-estimated level of physical activity was 3·8 in Group I and 3·6 in Group C. See Fig. 1(c) for changes over time. Self-graded well-being, assessed at the 3 month follow-up, was graded higher in Group I, median 9·0 (range 1·8–10) than in Group C, median 7·8 (2·5–10), ($P<0·05$). Forty-seven answers from relatives were obtained from Group I and 46 from Group C. The relatives in Group I scored well-being higher (median 8; range 0·3–9·8), than relatives in Group C (median 6; 1·0–9·9); $P<0·05$).

Discussion

The main findings in this study are that elderly patients recovering from acute coronary events are improved by aerobic group training as regards exercise capacity, subjective feelings of well-being and in several measures of quality of life. The full magnitude of these effects do not, however, persist over time. Continued and supervized training may be needed to avoid a decline in achieved improvements.

Patient selection is a prerequisite for the conduction of a training programme. This is apparent in this cohort (see Table 5). Thus, the present results cannot be generalized to all patients above the age of 65, but they should be representative of those who are able to exercise at a level corresponding to a brisk walk for some minutes. Patients were recruited from a standard population as seen in coronary care units. Out of the eligible study group, 65 patients declined participation mostly for practical reasons. As realised from the reasons for stopping participation in the training, it is important to inform patients before joining a training programme about time needed for allocation for training and orthopaedic problems that may become an obstacle.

Exercise capacity increased in the trained group, indicating considerably improved physical capacity of a magnitude similar to that shown in other studies of exercise training in coronary patients[2,3,22]. The magnitude corresponds to that accepted as clinically significant in pharmacological studies in patients with stable angina pectoris[23–26]. It was also comparable to data from

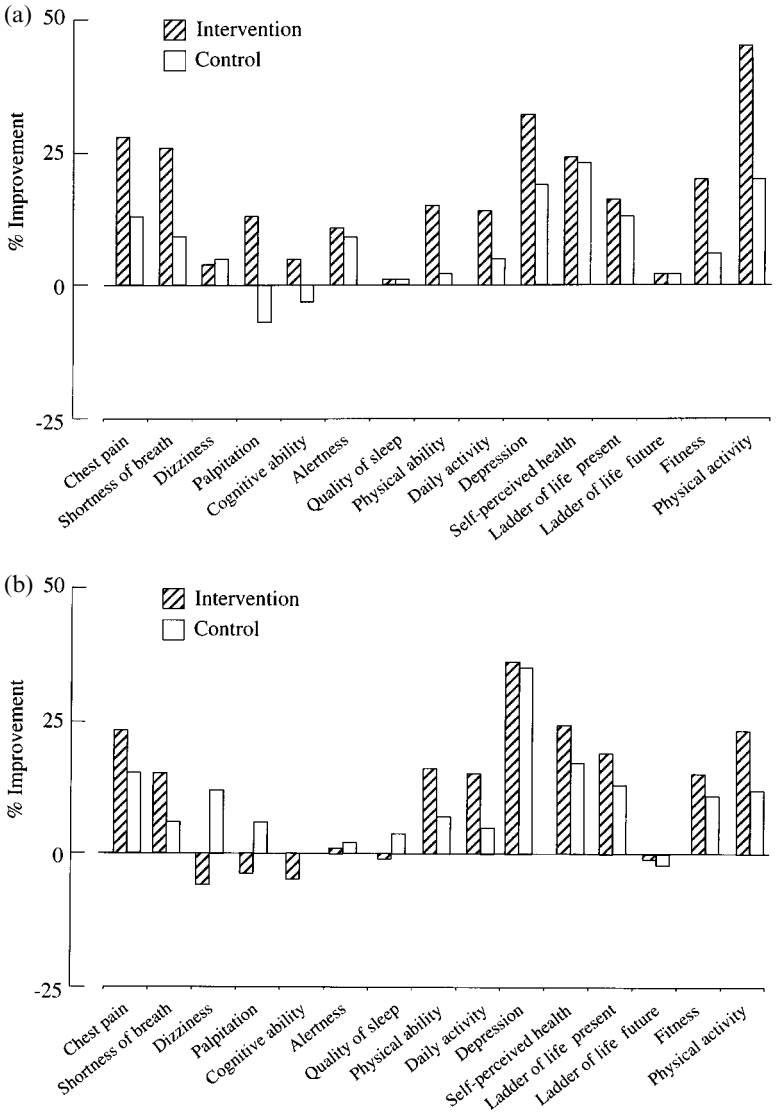

Figure 2 **Relative changes in quality of life variables in the intervention group (Group I=▨) and the control group (Group C=□) from baseline to 3 (a) and 12 (b) months of follow-up.**

younger and healthy subjects training according to principles similar to those applied in the present population[27].

It has been reported that patients participating in training programmes limited to 8 to 12 weeks generally reach a degree of exercise capacity 1 year after an acute myocardial infarction similar to that of non-trained controls[28–30]. Accordingly, the role of exercise in early cardiac rehabilitation is primarily to motivate patients to resume their previous levels of activity[29]. Longer periods of training (12 months) combined with an increasing number of sessions per week restores and improves the training effects[31]. Our patients participated in a fairly extensive programme during the first 3 months. This was followed by voluntary participation once a week for another 3 months. This was planned as a step-down period combined with active encouragement of the patients to continue training on their own. Thus, the attempt was to gradually convince the patients to take responsibility for their own physical well-being.

Considering the marked initial improvement[11] the present results from continued observation was somewhat disappointing. They demonstrate that continued organised training seems necessary for the preservation of achieved success. In this respect our programme failed, because it was too limited. This opens the question about duration of hospital-based training to assure long-term effects and what action to take to maintain achieved effects in this age cohort. In a non-randomized study, post-myocardial infarction patients below the age of 65 years have been shown to preserve the achieved level of physical capacity with 9 months training twice a week followed by monthly training sessions for another year[32].

With the present results at hand, it is a limitation that our protocol did not include an exercise test after 6 months. This was omitted because of the risk of obtaining an adaptation to the test procedure that could influence the outcome. Unfortunately, it is not possible to find out if there was a difference between the groups after 6 months. A positive outcome would have indicated that our step-down programme was of sufficient intensity. In future trials (and clinical practice) supervized training should be recommended to continue for longer periods, or actively encourage recreational or patient organisations to participate during the training sessions to stimulate recruitment to organised training outside hospital.

Despite the diminishing difference in exercise capacity after 1 year, trained subjects claimed to be more physically active. It can be argued, is it the level of physical activity or the regularity of training that is important for well-being? Although all patients received similar information about physical activity, patients in the trained group reached a higher level of physical capacity than control patients. Thus, to base physical rehabilitation on information only was insufficient. Elderly patients should be included in an active cardiac rehabilitation and training programme. Support was given by the fact that the intervention group at the 1 year follow-up scored lower in shortness of breath. This may be related to a more active lifestyle among the patients who became more accustomed to physical reactions during exercise. Interestingly, the trained group scored lower in shortness of breath at submaximal leisure-time activities, a finding similar to that found in trained patients in younger age groups 1 year after acute myocardial infarction[30].

Although both groups improved, the overall improvement in quality of life variables was substantially more marked in the intervention group. This may, at least partly, be related to the opportunity for the trained patients to repeatedly stress themselves under professional supervision, thereby reinforcing their ability to separate symptoms due to physical exertion from those resulting from ischaemic heart disease. In the long-term, the training programme obviously influenced exercise habits, as patients in the trained group reported a higher level of physical activity at the 1 year follow-up. In contrast, a study on lifestyle changes in 50–70 year-old post-myocardial patients trained for 12 weeks and followed for 1 year[33], did not reveal any changes in exercise habits.

Exercise-based programmes have been shown not only to affect physical exercise capacity. They also have implications on every day life by positively affecting the musculo-skeletal system, improving osteoporosis, joint flexibility, muscle strength and endurance, as well as balance. An improved gluco-metabolic state in diabetics and favourable effects on blood lipids are other beneficial effects related to physical activity[34,35]. In the present cohort, HDL cholesterol and triglycerides did not differ between the two groups. This may be because these levels were fairly normal at the start of the study, the high age of the group and some interaction of lipid lowering therapy given to patients in both groups who had the highest cholesterol levels. More important is that training of the elderly may decrease immobility and social isolation[34]. Considering this, investment in training programmes should be cost-effective and is important, a factor to be addressed in future trials. Exertion in the daily life of the elderly seldom demands maximal effort. Therefore, programmes should not only focus on improved maximal exercise tolerance, but also on other positive effects of regular exercise. The present programme was successful in this respect.

Physical training cannot be completely separated from more multifactorial rehabilitative and preventive interventions. All patients had access to a professional team specialized in cardiac rehabilitation, including medical follow-up at the outpatient clinic. In addition, the intervention group had the opportunity to discuss problems before and after the training sessions. Patients in both groups may have benefited from this increased attention, which reasonably influenced self-rated health and quality of life. Patients in the control group had access to more help and support than customary for this age group in Swedish general practice. If anything, this should have blunted the differences between the two groups. In this perspective the outcome of the training programme is even more encouraging. It emphasizes the importance of maintaining its effects long term.

In conclusion, many patients in the large and increasing group of elderly subjects recovering from acute coronary events are eligible for active rehabilitation. An aerobic group training programme seems to be an efficient tool to improve their physical fitness and feeling of well-being. Great care has to be taken to preserve initial effects by continued training.

This work was supported by grants from the National Association for Heart and Lung Patients, the Swedish Heart and Lung Foundation, the Swedish Foundation of Health Care Sciences and Allergy Research, and the King Gustaf V and Queen Victoria Foundation. Thanks to Stig Elofsson, PhD, Institution for Social Work Stockholm University for constructive discussions and criticism and Associate Professor Per Tornvall for taking care of the patients medical follow-up. The professional skills of Eva Wallgren, Medical Technologist, are in particular acknowledged.

References

[1] Wenger NK. Guidelines for exercise training of elderly patients with coronary artery disease. South Med J 1994; 87: S66–S69.

[2] Williams MA, Maresh CM, Esterbrooks DJ, Harbrecht JJ, Sketch MH. Early exercise training in patients older than age 65 years compared with that in younger patients after acute myocardial infarction or coronary bypass grafting. Am J Cardiol 1985; 55: 263–6.

[3] Lavie CJ, Milani RV, Littman AB. Benefits of cardiac rehabilitation and exercise training in secondary coronary prevention in the elderly. J Am Coll Cardiol 1993; 22: 678–83.

[4] Hellman EA, Williams MA. Outpatient cardiac rehabilitation in elderly patients. Heart & Lung 1994; 23: 506–13.

[5] Opasich C, Cobelli F, Assandri J *et al*. Is old age a contraindication to cardiac rehabilitation after acute myocardial infarction? Eur Heart J 1984; 5 (Suppl E): 105–7.
[6] Marchionni N, Fattirolli F, Valoti P *et al*. Improved exercise tolerance by cardiac rehabilitation after myocardial infarction in the elderly: results from a preliminary, controlled study. Aging Clin Exp Res 1994; 6: 175–80.
[7] Ades PA, Waldman ML, Gillespie C. A controlled trial of exercise training in older coronary patients. J Gerontol A Biol Sci Med Sci 1995; 50A: M7–11.
[8] Yusuf S, Cairns JA, Camm JA, Fallen EL, Gersh BJ, eds. Evidenced Based Cardiology. London: BMJ Books, 1998.
[9] Ebbesen LS, Guyatt GH, McCartney N, Oldridge NB. Measuring quality of life in cardiac spouses. J Clin Epidemiol 1990; 43: 482–7.
[10] Thompson DR, Meadows KA, Lewin RJP. Measuring quality of life in patients with coronary heart disease. Eur Heart J 1998; 19: 693–5.
[11] Ståhle A, Nordlander R, Rydén L, Mattsson E. Effects of organized group aerobic training in elderly patients discharged after an acute coronary syndrome. A randomized controlled study. Scand J Rehab Med 1999; 31: 101–7.
[12] Åström H, Jonsson B. Design of exercise tests, with special reference to heart patients. Br Heart J 1976; 38: 795–800.
[13] Borg G. Perceived exertion as an indicator of somatic stress. Scand J Rehab Med 1970; 2: 92–8.
[14] Borg G. A category scale with ratio properties for intermodal and interindividual comparisons. In: Geissler HG, Petzolds P, eds. Psychophysical judgement and the process of perception. Berlin: VEB Verlag der Wissenschaften., 1982.
[15] Linde-Edelstam C, Nordlander R, Unden A, Orth-Gomer K, Ryden L. Quality-of-life in patients treated with atrioventricular synchronous pacing compared to rate modulated ventricular pacing: a long-term double-blind, crossover study. Pacing Clin Electrophysiol 1992; 15: 1467–76.
[16] Olsson M, Janfjell H, Orth-Gomer K, Unden A, Rosenqvist M. Quality of life in octogenarians after valve replacement due to aortic stenosis. A prospective comparison with younger patients. Eur Heart J 1996; 17: 583–9.
[17] Unden A, Schenck-Gustavsson K, Axelsson P, Karlsson I, Orth-Gomer K, Ydrefors A. Positive effects of increased nurse support for male patients after acute myocardial infarction. Qual Life Res 1993; 2: 121–7.
[18] Tibblin G, Tibblin B, Peciva S, Kullman S, Svärdsudd K. The Goteborg quality of life instrument — an assessment of well-being and symptoms among men born in 1913 and 1923 Methods and validity. Scand J Prim Health Care 1990; (Suppl 1): 33–8.
[19] Gadler F. Atrioventricular synchronous pacing in hypertrophic obstructive cardiomyopathy. Stockholm, Sweden: Karolinska Institute, 1997.
[20] Frändin K, Grimby G. Assessment of physical activity, fitness and performance in 76-years-olds. Scand J Med Sci Sports 1994; 4: 41–6.
[21] Bland M. An introduction to medical statistics, 2nd edn. Oxford: Oxford University Press, 1995.
[22] Ades PA, Grunvald MH. Cardiopulmonary exercise testing before and after conditioning in older coronary patients. Am Heart J 1990; 120: 585–9.
[23] Arnman K, Rydén L. Comparison of Metoprolol and Verapamil in the treatment of angina pectoris. Am J Cardiol 1982; 49: 821–7.
[24] Nyberg G, Carlsens P, Lindström E *et al*. The effect of isosorbide-5-mononitrate (5-ISMN) Durules on exercise tolerance in patients with exertional angina pectoris. A placebo controlled study. Eur Heart J 1986; 7: 835–42.
[25] Nyberg G, Holmberg B. Haemodynamic, anti-anginal and anti-ischemic effects of sublingual nitroglycerin: Dose-response, duration and time of onset of action. Eur J Clin Pharmacol 1988; 34: 561–7.
[26] Nordlander R, Walter M. for the Swedish Multicentre Group. Once- versus twice-daily administration of controlled-release isorbide-5-mononitrate 60 mg in the treatment of stable angina pectoris. A randomized, double-blind, cross-over study. Eur Heart J 1994; 15: 108–13.
[27] Åstrand P-O, Rodahl K. Textbook of Work Physiology. 3rd edn. Singapore: McGraw-Hill Co., 1986.
[28] Goble AJ, Hare DL, Macdonald PS, Oliver RG, Reid MA, Worcester MC. Effect of early programmes of high and low intensity exercise on physical performance after transmural acute myocardial infarction. Br Heart J 1991; 65: 126–31.
[29] Worcester MC, Hare DL, Oliver RG, Reid MA, Goble AJ. Early programmes of high and low intensity exercise and quality of life after acute myocardial infarction. BMJ 1993; 307: 1244–7.
[30] Holmbäck AM, Säwe U, Fagher B. Training after myocardial infarction: Lack of long-term effects on physical capacity and psychological variables. Arch Phys Med Rehabil 1994; 75: 551–4.
[31] Ehsani AA, Biello DR, Schultz J, Sobel BE, Holoszy JO. Improvement of left ventricular contractile function by exercise training in patients with coronary artery disease. Circulation 1986; 74: 350–8.
[32] Hedbäck B, Perk J. 5-year results of a comprehensive rehabilitation programme after myocardial infarction. Eur Heart J 1987; 8: 234–42.
[33] Carlsson R, Lindberg G, Westin L, Israelsson B. Influence of coronary nursing management follow up on lifestyle after acute myocardial infarction. Heart 1997; 77: 256–9.
[34] Young A, Dinan S. Fitness for older people. BMJ 1994; 309: 331–4.
[35] Fletcher GF, Balady G, Blair SN *et al*. Statement on exercise: Benefits and recommendations for physical activity programs for all Americans. Circulation 1996; 94: 857–62.