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Effect of an exercise consultation on maintenance of physical activity after completion of phase III exercise-based cardiac rehabilitation

Maintaining physical activity

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Abstract

Background Many patients do not maintain physical activity levels after completion of phase III exercise-based cardiac rehabilitation.

Design This study determined the effect of the exercise consultation on maintenance of physical activity and cardiorespiratory fitness 12 months after completion of a phase III exercise programme. Seventy cardiac patients were randomized to the experimental (exercise consultation and exercise information) or control groups (exercise information only).

Methods Outcomes recorded at baseline, six and 12 months were physical activity (stage of change, 7-day recall, accelerometer), cardiorespiratory fitness, lipids, quality of life, anxiety and depression.

Results Both groups were regularly active at baseline. The between group difference for the change in total activity (minutes/week) assessed by the 7-day recall was significant from baseline to 12 months (98%CI -295, -20). Total activity was maintained in the experimental group (98%CI -63, 154) and significantly decreased in the control group (115 minutes/week; 98%CI -228, -28) from baseline to 12 months. The between group difference for the change in accelerometer counts/week was not significant from baseline to six (98%CI -1143720, 607430) or 12 months (98%CI -1131128, 366473). A comparable, significant decrease in peak oxygen uptake occurred from baseline to 12 months in experimental (1.8 ml/kg/min; 98%CI -3.2, -0.3) and control participants (2.3 ml/kg/min; -3.8, -0.8). Lipids, quality of life, anxiety and depression were normal at baseline and did not significantly change in either group over time.

Conclusion Exercise consultation was effective in maintaining self-reported physical activity, but not peak oxygen uptake, for 12 months after completion of phase III.

Word count: 249

Keywords: physical activity, exercise consultation, phase IV cardiac rehabilitation, compliance

Introduction

The benefits of exercise-based cardiac rehabilitation in patients with established coronary artery disease are well documented [1]. Sustaining these benefits requires maintenance of regular physical activity after completion of phase III programmes [1]. In the UK, most phase III programmes typically involve 6 to 12 weeks of supervised exercise training in a hospital setting. However, many patients do not maintain an active lifestyle subsequent to phase III [2,3]. Stahle [3] reported a significant improvement in exercise capacity and physical activity in a group of cardiac patients after 3 months of supervised exercise training compared with usual care. However, physical activity levels and exercise capacity had declined in the rehabilitation group 12 months after programme completion [3]. Research is limited on effective and practical interventions to encourage individuals to remain active in phase IV.

Exercise consultation involves a one to one discussion, which is based on the Transtheoretical Model of behaviour change and Relapse Prevention Model, and uses cognitive and behavioural strategies to increase and maintain physical activity [4]. Several randomised-controlled trials have shown the exercise consultation to be effective in promoting and maintaining physical activity in the general population and in people with type 2 diabetes [5,6,7]. A randomised controlled pilot study found that the exercise consultation improved short-term (4 weeks) adherence to physical activity after completion of a phase III supervised exercise programme [8].

The aim of this randomised controlled trial was to compare the longer-term effect of the exercise consultation with standard exercise information on maintenance of physical activity and cardiorespiratory fitness for 12 months after completion of a phase III supervised exercise programme.

Methods

Participants

Eighty five patients were invited to participate in the study following completion of a phase III

exercise programme based at a district general hospital in Scotland. Fifteen patients refused to participate, thus the study group consisted of 56 men and 16 women (mean age 60.0, SD 10.7 years). Exclusion criteria were waiting for further cardiac investigation (i.e. angiography), coronary artery bypass surgery (CABG) or percutaneous transluminal coronary angioplasty (PTCA) or attended less than 70% of the exercise programme. The phase III programme included 11 weeks of supervised exercise (1 hour sessions, twice per week), medical evaluation, education and psychological support. The study was approved by the Argyll and Clyde Research Ethics Committee and written informed consent was obtained from all participants.

Procedures

The flow of participants through the trial is shown in Figure 1. Baseline assessments were conducted within one month of participants completing phase III and included: physical activity, cardiorespiratory fitness, full lipid profile, quality of life, anxiety and depression. All participants received an exercise leaflet called “Physical Activity and your Heart” published by the British Heart Foundation, which included information on benefits of regular activity, activity recommendations and ways to become more active. Patients usually receive this leaflet after completing phase III. Participants were then randomised by computer generated random numbers to experimental or control groups. A blocked randomisation procedure was carried out in blocks of 20 using sequentially numbered, sealed opaque envelopes. The experimental group received an exercise consultation after baseline and 6 month assessments and a support phone call three months after each consultation. To maintain equal contact time between the groups, control participants received a phone call on topics unrelated to exercise three and nine months after the baseline assessment. Outcome measures recorded at baseline were repeated at six and 12 months.

Physical Activity and Cardiorespiratory Fitness

A validated questionnaire [9] was used to determine the stages of exercise behaviour change;

Precontemplation (inactive, no intention to change), Contemplation (inactive, but intending to change in the next 6 months), Preparation (doing some activity, but not regularly), Action (regularly active, but only began in the past 6 months), and Maintenance (regularly active for more than six months). Regular physical activity was defined as at least 20 minutes of continuous, moderate to vigorous exercise on three days/week or 30 minutes of accumulated moderate intensity activity on five days/week [10].

The 7-day recall provides valid and reliable estimates of physical activity and was interview-administered using a standardised interview process [11]. The recall measures the minutes per week spent in moderate, hard and very hard physical activity [11]. Total physical activity per week is the sum of moderate, hard and very hard activities.

The uniaxial MTI accelerometer model 7164 (Florida) provides an objective and reliable measure of physical activity [12,13,14]. MTI accelerometers have been validated against criterion methods (i.e. energy expenditure) during free living activities in adults [12,13,14]. Although, these monitors are valid for measuring most types of physical activity, they are unable to accurately detect water activities, activities that increase energy expenditure without a proportional increase in bodily acceleration (e.g. walking uphill) and those requiring a large amount of upper body movement [12,13,14]. Participants wore the accelerometer on their right ankle during all waking hours for seven days, except during water activities. Accelerometers were set to record activity in 1 minute epochs [12,13,14]. Activity counts per minute recorded over the 7 monitored days were summed to produce total activity counts/week.

Peak exercise tests were performed on a motorized treadmill using an individualised protocol to achieve an optimal test duration of 8-12 minutes [15]. Participants performed a 3 minute warm-up, where the speed was individually adjusted to achieve a brisk pace (1 – 3.3 mph at 0% grade). Then the treadmill gradient was increased by 1% to 2% per minute (depending on fitness) to the limit of tolerance or in the event of significant electrocardiogram or blood pressure changes. Heart rate and

BP were monitored, and expired gases were sampled using a Cosmed K4b² metabolic system (Italy). Peak values for oxygen uptake were calculated by averaging the last 30 seconds of exercise. Total exercise duration (excluding the warm-up), and reasons for test termination were recorded.

Secondary Outcomes

A 12 hour fasting blood sample was obtained to determine total cholesterol concentration, triglycerides, HDL cholesterol and LDL cholesterol. Total cholesterol concentration, triglycerides and HDL cholesterol were directly quantified using enzymatic methods, and LDL cholesterol was calculated using the Friedewald equation [16]. The UK Short Form-36 v 2 [17] is a self-administered generic instrument which measures 8 quality of life dimensions: physical functioning (PF), social functioning (SF), role limitations due to physical problems (RPL), role limitations due to emotional problems (RLE), pain (P), energy/vitality (EV), mental health (MH) and general health perception (GHP). A score of 100 indicates best possible health. The Hospital Anxiety and Depression scale (HADS) is a self-report questionnaire measuring state anxiety and depression over the past week [18].

Intervention

Exercise consultations [4] involved a 30 minute one-to-one discussion with a trained researcher. As participants had recently completed the phase III exercise programme they were in the preparation, action or maintenance stages of change. Individuals in action and maintenance were encouraged to remain regularly active in phase IV, whereas those in preparation were encouraged to become regularly active. Strategies included: assessing current physical activity status, exploring pros and cons of being active, problem-solving barriers, social support, exploring activity options, setting realistic activity goals (for 1, 3 and 6 months) and preventing relapse. Relapse prevention involves identifying high-risk situations (e.g. bad weather) that may cause a lapse from activity and developing a plan to cope with these situations (e.g. having an alternative indoor activity in bad weather) to reduce the likelihood of a lapse in activity leading to an overall

decline in physical activity [19]. During the six month exercise consultations, participants were asked if they had achieved activity goals set at baseline. If not, the reasons for this were explored and new goals set. Barriers to activity, problem-solving barriers, goal setting and relapse prevention were discussed with all participants to ensure they had acquired the necessary skills to help them remain active over the next six months. Support phone calls given 3 months after each consultation lasted approximately 10 minutes and involved a discussion on barriers to activity, achieving activity goals and remaining active.

Sample Size

Sample size was calculated using a pilot study [20] comparing exercise consultation with exercise information on physical activity measured using MTI accelerometers in people with type II diabetes. In each group, 25 patients were required to have a 90% power of detecting a 22% difference in activity counts/week with a significance level of 5% (baseline mean = 1813893; mean difference = 409780; SD = 444779). To allow for dropout, 35 patients were recruited in each group.

Statistical Analysis

Data were analysed using Minitab 13.0. Repeated measures two-way ANOVA models are based on the assumption that the data come from normal distributions within the groups and that the variances of these distributions are the same. Normal probability plots of the residuals, plots of residuals versus fitted values and the Bartlett's test of equal variance showed that these assumptions were not met for the measured outcomes. Transformed data did not meet these assumptions either. Not normally distributed data were analysed using Wilcoxon signed rank tests for within group differences and Mann Whitney tests for differences between groups. To control for Type 1 errors due to the number of comparisons being conducted 98% confidence intervals were used. Categorical data were analysed using chi square tests.

Results

Table 1 displays the baseline characteristics of the groups. The median number of days between completion of phase III and the baseline assessment was 18 days (IQ range 6, 23) in each group.

Physical Activity and Cardiorespiratory Fitness

No participants were in precontemplation or contemplation stages at baseline, six or 12 months. At baseline, 88% (31/35) of the experimental group and 77% (27/25) of the control group were regularly active ($\chi^2=1.6$, $p=0.2$). At six months, 84% (27/32) of the experimental group and 69% (22/32) of the control group were regularly active ($\chi^2=2.2$, $p=0.1$). At 12 months, more experimental participants (85%) were in action or maintenance compared to controls (67%); this difference was borderline significant ($\chi^2=3.0$, $p=0.08$).

At baseline, total activity measured by the 7-day recall was 300 minutes/week in the experimental group and 275 minutes/week in the control group, thus both groups were exceeding guidelines for regular physical activity (Fig. 2). Total activity was maintained from baseline to six months (47 mins/week; 98%CI -43, 191) and 12 months (23 mins/week; 98%CI -63, 154) in the experimental group. In the control group, total activity significantly decreased by 115 mins/week from baseline to 12 months (98%CI -228, -28) and 63mins/week from 6 to 12 months (98%CI -126, -5). The between group difference for the change in total activity was significant from baseline to 12 months (130 mins/week; 98%CI -295, -20).

Total activity counts/week measured by accelerometry did not significantly change from baseline to six months (98%CI -705643, 860599) and 12 months (98%CI -381927, 504719) in the experimental group (Fig. 3). In the control group, total activity counts/week decreased from baseline to six and 12 months by 5.2% (-215141/4105603) and 8% (-328116/4105603), respectively. However, this decline was not significant from baseline to six months (98%CI -680366, 349212) or 12 months (98%CI -906564, 268168).

Peak VO_2 (ml/kg/min) declined from baseline to six months by 3.7% in the experimental group (not significant) and significantly declined by 6.5% in the control group (Table 2). From baseline to 12 months, peak VO_2 significantly decreased by 6.7% in the experimental group and 9.4% in the control group. This decrease was similar between the groups from baseline to six (98%CI -2.4, 1.2) and 12 months (98%CI -2.5, 1.5). Exercise duration did not significantly change from baseline to six and 12 months in either group.

Secondary Outcomes

At baseline, median values for total cholesterol concentration, triglycerides, LDL cholesterol and HDL cholesterol were within the normal range (Table 1), 88% of controls and 100% of the experimental group were taking lipid lowering medication. The only significant change was a small increase in HDL cholesterol by 0.11 mmol/l from baseline to 12 months in the experimental group (Table 2). Quality of life [17], anxiety and depression were normal at baseline (Table 1) and did not significantly change over time in either group (Table 2).

Discussion

This study demonstrated that the exercise consultation was more effective than standard exercise information in maintaining self-reported physical activity for 12 months after completion of a phase III exercise programme.

We found that both groups were exceeding guidelines for regular physical activity at baseline (i.e. within 1 month of completing phase III). Total physical activity measured by the 7-day recall and accelerometry was maintained in the experimental group over 12 months. In the control group, self-reported physical activity significantly decreased from baseline to 12 months. However, the decline in total activity counts/week measured by accelerometry did not parallel the marked decrease in self-reported physical activity in the controls. This discrepancy may be due to limitations of accelerometers. Accelerometers cannot record water activities, activities that increase energy expenditure without a proportional increase in bodily acceleration (e.g. walking

uphill) and those requiring a large amount of upper body movement (e.g. washing windows) [13]. Whereas the 7-day recall can record these types of activities. In the present study, we observed correlations ranging from 0.2 to 0.5 between accelerometer counts and self-reported physical activity. Thus, the decrease in self-reported activity in the controls could reflect a decline in these activities, which would not be detected by accelerometers. An alternative explanation for this discrepancy may be that the experimental group may have over-estimated the duration and/or intensity of their activities at six and 12 months. However, physical activity was also measured objectively using accelerometers over the same monitoring period as the 7-day recall, thus individuals may have been less likely to over-estimate their activities. In addition, a standardised interview process was followed when administering the questionnaire to minimise guessing and over- or underestimating physical activity levels [11].

Small significant decreases in peak VO_2 were observed in both groups after completion of phase III. It is not clear whether the magnitude of the decrease in peak VO_2 is clinically important. Evidence suggests that a low fitness level (< 4 METs or < 15 ml/kg/min) measured before entry to exercise-based cardiac rehabilitation is a significant predictor of total and cardiac death [21,22]. Thus, a decline in peak VO_2 may not be clinically important as long as patients maintain their exercise capacity above 15 ml/kg/min in the long-term [22]. Despite a decrease in peak VO_2 in the present study, the average peak VO_2 at 12 months in the experimental and control groups was 25.1 and 22.0 ml/kg/min, respectively. Conversely, small increases in peak VO_2 , of approximately 1ml/kg/min, have a marked effect on survival [21]. Thus, the decline in peak VO_2 by 1.8 ml/kg/min in experimental participants and 2.3 ml/kg/min in controls over the study period may be clinically relevant.

Despite the decline in peak VO_2 , total exercise duration (an indicator of peak workrate), was maintained over the study period in both groups. It is possible that participants may have become more economical in their movement due to improved efficiency of the oxygen delivery mechanisms, therefore the same workrate was maintained with less overall demand of VO_2 [15],

although we did not measure movement economy. Alternatively, as cardiac patients are often reluctant to exert themselves to their maximal capacity, they generally reach a peak VO_2 rather than a “true” VO_2 max [15]. Therefore, patients may have pushed themselves further during the exercise test at 6 and 12 months compared to baseline, thus managing the same workrate despite a lower peak VO_2 . This concept is supported by a significantly higher respiratory exchange ratio at 6 and 12 months compared with baseline (data not shown).

In the experimental group, self-reported and objectively measured physical activity was maintained, whereas peak VO_2 significantly declined after completion of phase III. Studies in healthy adults report that missing an exercise session periodically or reducing the frequency and duration of training will not adversely affect cardiorespiratory fitness as long as training intensity is maintained [10]. In the present study, the intensity of patients’ physical activity in phase IV may have been lower than the intensity of exercise training in phase III, which resulted in a decline in peak VO_2 , whilst the level of physical activity was maintained. At the time of the study, few phase IV supervised exercise programmes were available in the community. Thus, most participants stayed active by engaging in moderate intensity activities, such as walking. Alternatively, experimental patients may not have met activity guidelines every week throughout the 12-months, which may have caused the decline in peak VO_2 . Frequent lapses from activity would not have been detected, as physical activity was only measured three times over 12 months. Thus, patients should be informed of the importance of engaging in regular activity of appropriate intensity every week to maintain fitness.

The intervention compared to standard exercise information had no significant effect on blood lipids and psychological function, which may be because these variables were normal at baseline (as patients had recently completed a phase III programme) and were maintained over the 12 month study period in the control group.

The results of this study suggest that the exercise consultation may help patients to remain active after completion of phase III hospital-based exercise programmes. Phase IV community exercise programmes are not available in all areas and some patients may not be able to attend these programmes due to barriers associated with supervised exercise training including transportation problems, work and domestic responsibilities. Thus, this intervention may provide an alternative to supervised exercise in phase IV or could be used to facilitate patients' progression from phase III hospital-based exercise programmes to community-based programmes or independent exercise. This is a minimal intervention that could feasibly be incorporated into existing cardiac rehabilitation services to encourage patients to remain active in phase IV. With minimal training, any member of the cardiac rehabilitation team could deliver the intervention.

Study Limitations

This study was powered to detect a 22% difference in accelerometer counts between the experimental and control group. However, only a 10% (392946/4025432) difference in accelerometer counts was observed from baseline to 12 months between groups. We expected to find greater differences in physical activity and secondary outcomes, however physical activity and the secondary variables did not decline in the control group as much we anticipated. It is possible that assessing physical activity, cardiorespiratory fitness and other variables at regular intervals could have encouraged control participants to remain active over the study period. Without this level of monitoring, a greater decline in physical activity may have occurred in the control group. In fact, several control patients stated that participating in the study "encouraged them to keep active after phase III". Brubaker [23] reported that a number of patients stated that knowing they were being reassessed at 12 months motivated them to maintain lifestyle changes.

Conclusion

This study demonstrates that the exercise consultation was more effective than standard exercise information in maintaining self-reported physical activity, but not peak VO_2 . These findings are consistent with other randomized controlled trials reporting the exercise consultation to promote and maintain physical activity in the general population and people with type 2 diabetes [5,6,7]. Therefore, this study provides further evidence for the efficacy of the exercise consultation process and suggests the intervention may be used in cardiac rehabilitation settings to maintain physical activity as recommended in cardiac rehabilitation guidelines [24].

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Figure 2 Total physical activity (PA) in minutes/week measured by the 7-day recall at baseline, six and 12 months by group. Data are medians.

Figure 3 Total activity counts/week measured by the CSA accelerometer at baseline, six and 12 months by group. Data are medians.