Changes in cardiorespiratory fitness in patients receiving supervised outpatient cardiac rehabilitation either once or twice a week

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Exercise based cardiac rehabilitation (CR) reduces cardiovascular mortality by 15–25% [1]. Cardiorespiratory fitness (CRF) is the most powerful modifiable predictor of mortality and morbidity in cardiac patients [2]. In secondary prevention interventions like exercise-based CR, it has been shown that each 1% improvement in CRF is associated with a 10–20% potential reduction in cardiac-related mortality [3].

A recent meta-analysis [4] demonstrated impressive, 1.55 (95% confidence intervals [CI]: 1.21–1.89) metabolic equivalent (MET) improvements in the CRF of patients undertaking exercise-based CR programmes. Most of the CR programmes reviewed included 36 exercise sessions or more. In many clinical situations, however, it is more usual to prescribe many fewer exercise sessions. In the UK for instance, the median value is only 12 [5].

Data comparing training responses to differences in exercise frequency are rare in CR patients [4,6,7]. Arnold et al. [6] compared patients receiving six weeks of supervised CR twice-weekly with those receiving once-weekly exercise. While there were no statistically significant differences in CRF gains, results are difficult to interpret due to significant between-group differences in CRF at baseline and the wide age-range of patients; neither controlled for in statistical analyses.

If fewer supervised exercise sessions can result in comparable gains in CRF to those currently prescribed, it may have important implications for CR programme design. The present study compared improvements in CRF between two exercise frequencies (once versus twice per week) using robust statistical analyses to improve on existing data [6].

Data were obtained via retrospective analysis of 117 patient (69.7 ± 9.5 years) records from a UK National Health Service (NHS) Hospital. The study comprised two groups of CR patients, n = 58 received one session of exercise per week and n = 59 received two. Exercise prescription, inclusion and exclusion criteria, staffing and exercise class locations and timing were identical for both groups. Patients completed six weeks of exercise training with assessments of CRF and standard clinical outcomes at pre- and post-rehabilitation. The primary outcome measure was distance walked during an incremental shuttle-walking test (ISWT). Test performance was expressed as total distance (m) and METs. Mixed analysis of covariance (ANCOVA) was used to assess changes in ISWT performance between the two groups before and after CR, with sex and age as covariates. Additional analyses were performed between subgroups created based on patients' age [2,4].

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There was no between-group difference in distance walked at baseline ($F_{1,115}$ = .034, p = 0.85). Test performance improved in both groups whether expressed as distance walked or METs. There were no significant differences between exercise frequency groups ($F_{1,115}$ = 0.934, p = 0.34) (Table 1). ANCOVA confirmed age as a significant covariate ($F_{1,115}$ = 9.209, $p<0.05$), so we performed sub-group analyses by age. Two groups were created using a median split of patient age. Patients ≤65 years old improved more if they received rehabilitation twice-weekly (95% CI: 68–132 m) than once-weekly (95% CI: 30–103 m) (Fig. 1).

The statistical probability of accepting the null hypothesis may be misleading when used in isolation so we also visually inspected the mean (95% CI) changes in CRF for clinically meaningful differences. The very small differences in means and overlapping confidence intervals for between-group changes in CRF suggested that there was no meaningful difference in training response between groups.

Table 1 shows that improvements in both groups were well below the anticipated values based on previous studies [8,9]. Similar magnitude changes in CRF were reported by Robinson et al. [10], who demonstrated only modest gains in CRF measured using the ISWT. The authors reported improvements of 58 (± 12) m in those undertaking six once-weekly exercise sessions, values similar in magnitude to the once-weekly group in the present study.

The <0.5 MET mean improvement shown in the present study (Table 1) does not compare favourably with those of a recent meta-analysis [4] which reported changes in CRF equivalent to 1.2–1.8 METs. The large improvements reported previously [4] are most likely attributable to the greater number of exercise sessions (median n = 36) but may also relate to modality of exercise testing reviewed (treadmill protocol). Unfortunately, there is no comparable meta-analysis of studies using the ISWT, although such an analysis would be valuable.

Differences in CRF gains according to age suggest that treating CR patients as a homogenous group may be misleading. The differences shown in younger patients (≤65 years) suggest that there may be additional benefit to more frequent exercise training in patients of this age. It may be that younger patients retain a greater ability to adapt to exercise stimuli or there may be practical or social differences which account for between-age group differences. More research into how differently-aged CR patients respond to standard CR protocols is warranted.

The authors of this manuscript have certified that they comply with the principles of ethical publishing in the International Journal of Cardiology (Shewan and Coats 2010; 144: 1–2).

Table 1
Incremental shuttle walking test performance, between groups data (n = 117).

	Group	Once a week	Twice a week	p-Value
Distance (m)	Pre-rehabilitation Mean (SD)	288 (139)	297 (137)	0.85
	Post-rehabilitation Mean (SD)	358 (161)	370 (159)	0.34
	95% CI	47.1–91.4	53.1–92.6	
METs	Pre-rehabilitation Mean (SD)	4.56 (0.70)	4.63 (0.69)	0.62
	Post-rehabilitation Mean (SD)	4.92 (0.79)	4.97 (0.72)	0.72
	95% CI	4.60–4.88	4.67–4.93	

METs = metabolic equivalents; SD = standard deviation; and CI = confidence interval.

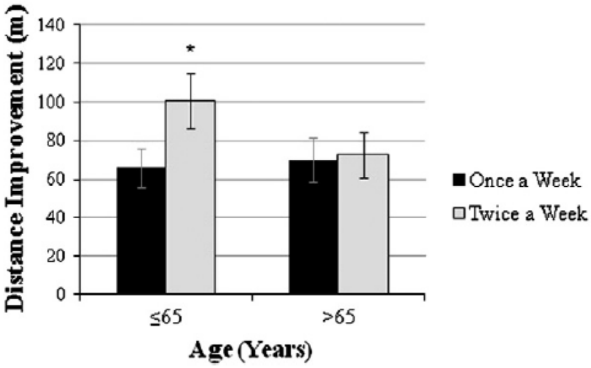

Fig. 1. Changes in cardiorespiratory fitness according to exercise frequency and age group. Error bars represent ± 1SD. *Significant improvement twice a week compared with once a week group (p<0.05).

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Transient reduction and activation of circulating dendritic cells in patients with acute myocardial infarction☆

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Besides direct myocardial damage following ischemia, the heart suffers from subsequent indirect damages via improper immune-mediated inflammatory responses including the induction of autoantibodies and the accumulation of leukocytes after acute myocardial infarction (AMI) [1–3]. Experimental studies have demonstrated that activated T lymphocytes derived from rats

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Table 1
Clinical characteristics of study at admission.

	Controls	SAP	AMI
Age (years)	66.2 ± 10.1	67.7 ± 8.9	69.3 ± 11.9
Gender (male, female)	10, 9	15, 4	19, 7
BMI (kg/m^2)	24.1 ± 3.4	24.3 ± 2.8	23.7 ± 3.4
Systolic BP (mm Hg)	132.3 ± 11.0	125.9 ± 15.4	117.2 ± 26.8*
Hypertension (n)	10 (52.6%)	13 (68.4%)	20 (76.9%)
WBC (× 10^2/μL)	5105 ± 954	5774 ± 1226	10,088 ± 2781†§
CRP (mg/dL)	0.12 ± 0.17	0.26 ± 0.60	0.38 ± 0.6
CPK (IU/L)	112.9 ± 50.3	117.3 ± 89.7	741 ± 1030*§
CK-MB (IU/L)	8.6 ± 5.7	10.1 ± 4.4	75.8 ± 109.3*‡
Triglycerides (mg/dL)	135.3 ± 55.8	158.7 ± 80.2	91.1 ± 46.6*§
HDL cholesterol (mg/dL)	55.0 ± 14.7	48.9 ± 9.8	46.3 ± 10.5
LDL cholesterol (mg/dL)	120.9 ± 31.7	107.3 ± 15.7	102.2 ± 29.0
HbA1c (%)	5.9 ± 1.3	6.3 ± 1.3	6.0 ± 1.2

BMI, body mass index; BP, blood pressure; WBC, white blood cells; CRP, C-reactive protein; CPK, creatine phosphokinase; CK-MB, creatine kinase-MB; SAP, stable angina pectoris; AMI, acute myocardial infarction.
* $P<0.05$ vs. controls.
† $P<0.01$ vs. controls.
§ $P<0.01$ vs. SAP.
‡ $P<0.05$ vs. SAP.