The effect of cardiac rehabilitation exercise programs on feelings of energy and fatigue: a meta-analysis of research from 1945 to 2005

Puetz T W, Beasman K M, O'Connor P J

CRD summary
This review assessed the effects of cardiac rehabilitation exercise programmes on energy and fatigue. The authors concluded that programmes almost always improved feelings of energy and fatigue, and that the effect size was moderately large and clinically meaningful. The review had several methodological weaknesses which suggest that it might not be reliable, and the authors' conclusions seem overstated given the data presented.

Authors' objectives
To examine the effects of cardiac rehabilitation exercise programmes on feelings of energy and fatigue.

Searching
Google Scholar, MEDLINE, PsycINFO, PubMed and Web of Science were searched for the period 1945 to May 2005; the search terms were reported. The reference lists of retrieved articles were also checked.

Study selection
Study designs of evaluations included in the review
Experimental, quasi-experimental and before-and-after study designs were eligible for inclusion.

Specific interventions included in the review
Studies evaluating cardiac rehabilitation or chronic exercise programmes of at least 4 weeks' duration were eligible for inclusion. The majority of the included studies were of multi-factor interventions; there were also a small number of exercise only interventions.

Participants included in the review
Studies of people with coronary heart disease, or who were recovering from a cardiac event or surgery, were eligible for inclusion. Details of the participants in the included studies were not provided.

Outcomes assessed in the review
Studies assessing energy or fatigue before and during or after the intervention were eligible for inclusion. Studies where the timing of the outcome assessment might have been confounded by the transient effects of an acute exercise bout were excluded, as were studies measuring vital exhaustion. The majority of the included studies used the vitality subscale of the SF36. The vigour and vitality subscales of the Profile of Mood States (POMS), the Beck Depression Inventory fatigue subscale and the Nottingham Health Profile were also used.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
Quality was assessed using a 15-item scale (score range: 0 to 15) that included items on randomisation, sample selection, outcome measures and statistical analysis. The authors did not state how the validity assessment was performed.

Data extraction
The authors did not state how many reviewers performed the data extraction.
For controlled studies, an effect size was calculated by subtracting the mean change score for the control group from that of the experimental group, then dividing the difference by the pooled standard deviation (SD) of the pre-test scores. To calculate the effect size for before-and-after studies, the baseline score was subtracted from the follow-up score and the difference was divided by the pooled SD of the pre-test scores. Where mean scores were not available, these were estimated from F-tests, t-tests or figures. Where the SD was not reported, it was drawn from published norms or from the largest study. Where studies reported more than one outcome measure or more than one intervention the effects were averaged. Scores were calculated such that increases in feelings of energy and decreases in feelings of fatigue resulted in positive effect sizes.

Methods of synthesis
How were the studies combined?
All effect sizes were adjusted using Hedge's small sample size bias correction before being pooled in a meta-analysis, using a random-effects model, to provide an overall effect size and 95% confidence interval (CI). To investigate the hypothetical impact of unpublished studies reporting no significant difference between the intervention and control, the 'fail-safe N' was estimated for the overall effect size.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the Q statistic. A regression analysis was used to investigate the influence of study design (controlled versus uncontrolled studies) and type of intervention (multi-factor versus exercise alone) on the effect size.

Results of the review
Thirty-six studies (n=4,765) were included: there appeared to have been 12 controlled trials and 24 before-and-after studies (the text and table were contradictory).

There was a statistically significant increase in self-reported energy and decrease in fatigue following participation in a cardiac rehabilitation programme (36 studies of mixed design; effect size 0.51, 95% CI: 0.42, 0.61); however, there was statistically significant heterogeneity (p<0.001). The 'fail-safe N' showed that 56 additional studies showing zero effect would be needed to reduce the effect size from 0.51 to 0.20. When controlled (n=12) and uncontrolled (n=24) trials were pooled separately, the treatment effect was smaller in the controlled studies (effect size 0.32, 95% CI: 0.14, 0.50) than in the uncontrolled studies (effect size 0.58, 95% CI: 0.47, 0.68). There was no significant relationship between type of rehabilitation programme and effect size.

Authors’ conclusions
Cardiac rehabilitation exercise programmes almost always improved feelings of energy and fatigue, and the effect size was moderately large and clinically meaningful.

CRD commentary
There was a clearly stated review question. Relevant databases were searched, though it was unclear whether language restrictions were applied and unpublished studies were not specifically sought. The authors found that a substantial number of studies with no significant treatment effect would have had to be missed to change the findings of the review. However, they based their analysis on the overall pooling of controlled and uncontrolled studies, which might not have been reliable. Few details of the review methods were reported, thus it is difficult to judge whether appropriate methods were used to reduce error and bias; the reliability of the data is therefore unclear. Although study quality was assessed, the review findings were not fully considered in the context of study quality.

The statistical pooling of different study designs needs to be viewed with considerable caution. Heterogeneity was investigated for the overall pooling but not for the pooling of controlled trials only; it was therefore unclear whether it was appropriate to pool the controlled studies. Since only limited details of the included studies were provided, it is unclear what type of exercise rehabilitation programme (e.g. duration and content) and type of participants the results might apply to. Given these limitations and the presence of significant statistical heterogeneity, the authors’ conclusions
would seem overstated and might not be reliable.

**Implications of the review for practice and research**
Practice: The authors did not state any implications for practice.

Research: The authors stated that controlled studies are required to investigate which aspects of exercise programmes play the most important role in improving energy and fatigue, and which physical and psychological characteristics of cardiac patients should be considered when tailoring programmes for specific patients.

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