The anxiolytic effects of exercise: a meta-analysis of randomized trials and dose-response analysis

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CRD summary
This review evaluated exercise interventions as a treatment for anxiety. The authors concluded that there was support for such interventions, when compared with no-treatment or with other anxiety-reducing treatments. Given several methodological concerns relating to the reporting of the review process, unclear study quality, and variations between studies, the authors' conclusion appears to be overstated and its reliability unclear.

Authors' objectives
To evaluate the effectiveness of exercise interventions as a treatment for anxiety.

Searching
PubMed, SPORTDiscus, PsycINFO and Dissertation Abstracts International were searched to January 2006 for relevant English-language studies. Search terms were reported. The reference lists from previous reviews, meta-analyses and retrieved studies were handsearched for further material of interest.

Study selection
Randomised controlled trials (RCTs) that included a self-report measure of anxiety and independent exercise interventions (those that did not include additional interventions) were eligible for inclusion in the review. Psycho-physiological measures were excluded. The comparators of interest were exercise compared with a no-treatment control, or with another form of anxiety-reducing treatment (included were cognitive-behaviour therapy; group therapy; light exercise or relaxation/mediation; stress management; pharmacotherapy; or music therapy).

The majority of trials included participants who were not clinically diagnosed or receiving treatment for anxiety. Included interventions were largely aerobic exercise programmes, with a frequency of three to four times per week, lasting between 10 and 90 minutes, with follow-up ranging from one session to 52 weeks. Most trials included men and women, with a mean age (where reported) of 16.5 to 71.7 years. The most frequently reported outcome measure was the State Trait Anxiety Inventory (Spielberger & Krasner).

The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
Post-test means and standard deviations were extracted in order to calculate effect sizes, with a negative value representing a reduction in anxiety. Gains effect sizes were also calculated for the exercise and control groups. Data necessary to carry out a dose-response analysis were also collected.

The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction.

Methods of synthesis
A random-effects meta-analysis, weighted by the inverse of the variance, was used to synthesise the effect sizes. Studies were grouped according to the comparisons of exercise, with no treatment or alternative treatment, for anxiety. Heterogeneity was assessed using the Q and $\chi^2$ statistics. In the presence of significant heterogeneity, an analysis of moderator variables was carried out to examine the influences of gender, age, whether participants were part of a clinical or non clinical population, and frequency of exercise intervention per week. The relationship between exercise
Results of the review
Forty-nine trials (n=3,566 participants) were included in the meta-analysis. Sample sizes ranged from 11 to 300. The average attrition rate was 7.1% for exercise and 4.4% for control groups.

Exercise versus no-treatment (49 trials): The pooled effect size was -0.48 (95% confidence interval (CI): -0.63 to -0.33), indicating that participants in the exercise group had statistically significant reductions in anxiety when compared to control. The overall weighted gains effect sizes for exercise was -0.43 (95% CI: -0.46 to -0.36) and for control groups was -0.08 (95% CI: -0.13 to -0.04). The authors indicated that there was no significant publication bias. There was significant heterogeneity (p<0.001). Moderator analysis revealed that statistically significant higher effect sizes were reported in participants aged 31 to 45 years, and in those who exercised three to four times per week.

Exercise versus other treatments (27 trials): The pooled effect size was -0.19 (95% CI not reported; p<0.05), indicating that participants in the exercise group had equal or slightly greater reductions in anxiety in all comparison groups, except for pharmacotherapy.

A non-significant trend for the relationship between increased effect size and early rises in exercise dose (but not for higher doses) was noted in the dose-response analysis (12 trials).

Authors' conclusions
There was evidence to support the use of exercise interventions for the alleviation of anxiety.

CRD commentary
The review addressed a clear research question. Inclusion criteria were lacking for participants, and were broad for the interventions of interest. Little detail appeared to be available on the types of exercise included in the aerobic category. The reliance on self-reported outcome measures was a potential source of bias. The search strategy appeared to include some relevant sources, but restriction to English-language studies means that language bias cannot be ruled out. The consideration of published and unpublished studies in the analysis minimised the potential for publication bias, which was explored by a recognised method. There was no formal validity assessment, nor any reporting on the review processes. This makes it difficult to judge the reliability of the review findings. The presence of statistical heterogeneity, along with the potential for significant heterogeneity in practice, means that the pooling of data may not have been appropriate. The authors' conclusion appears to be overstated and its reliability unclear, in light of the identified methodological weaknesses above.

Implications of the review for practice and research
Practice: The authors stated that there was support for the use of exercise as one the front-line treatments for anxiety.

Research: The authors stated that future randomised controlled trials should report clearly on different intensities of exercise, and explore the impact of anaerobic interventions, in participants who have clinically diagnosed anxiety disorders. The mechanism by which exercise influences anxiety is a further area of interest.

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