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## The effect of exercise in clinically depressed adults: systematic review and meta-analysis of randomized controlled trials

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### CRD summary

This review concluded that exercise may have small, short-term effects in relieving symptoms of patients experiencing depression, but there was no effect after ten weeks of intervention and no long-term effect after the intervention. These conclusions reflect the data presented, but should be interpreted cautiously given the limited number of small, low-quality and varied trials included.

### Authors' objectives

To assess the effectiveness of exercise in adults with clinical depression.

### Searching

MEDLINE, EMBASE, PsycINFO, CINAHL, and the Cochrane Library were searched, with no language restrictions, from inception to September 2008; search terms were reported. Bibliographies of review articles were screened. Experts in the field were contacted for additional studies. On-line trials registries were searched. Eleven key journals were handsearched from June to September 2008.

### Study selection

Randomised controlled trials (RCTs) that compared exercise with no treatment or a control (waiting list or placebo), or where exercise was used as an adjunct with both treatment and control groups that received conventional treatment, were eligible for inclusion. Trial participants had to be adults diagnosed with depression using a standard diagnostic system (such as the International Classification of Diseases, 10th revision, Research Diagnostic Criteria), but could be diagnosed in any setting.

Outcome measures were depression or depressive symptoms, measured by any means; standardised mean difference in depression symptoms was the primary outcome measure.

Studies that measured outcomes immediately before and after a single exercise session were excluded.

All but one of the included studies recruited participants from community settings. The mean age of trial participants ranged from 28.5 to 71 years. Most trials included more women than men. Exercise interventions were aerobic in most trials, with a median of three exercise sessions per week (range two to five) and a median duration of intervention of 10 weeks (range eight to 16). Adherence levels ranged from 42 to 100% (where reported).

Two reviewers assessed studies for inclusion.

### Assessment of study quality

The methodological quality of included trials was assessed based on the inclusion of a sample size calculation, allocation concealment, use of intention-to-treat analysis, blinding, and inter-rater reliability for outcomes that were not self-reported.

Two authors independently assessed trial quality; any disagreements were resolved by discussion with all authors.

### Data extraction

Data were extracted to calculate the standardised mean difference (SMD) in depression symptoms, with 95% confidence intervals (CIs), between treatment and control groups, for all trials and for trials that reported long-term outcomes; where trials reported data for more than one depression measurement tool, only data for the primary measure were included. For trials with more than one intervention group, one intervention (that with the 'strongest dose') was selected for inclusion, with the selection designed to minimise effect size. Standardised mean difference measures were calculated using Hedges' *g*. Data were also extracted for the number of participants experiencing remission (free of depressive symptoms) in each group; these data were used to calculate the odds ratio (OR) with 95% confidence

intervals (CIs) for remission. Trial authors were contacted for missing data as necessary.

Two authors independently extracted data, using a pre-piloted form. Any disagreements were resolved by discussion with all authors.

### Methods of synthesis

Pooled effect sizes were calculated using a random-effects model. The extent of between-trial heterogeneity was assessed using  $I^2$ .

Meta-regression analysis was used to investigate the possible effects of exercise type (aerobic or anaerobic), exercise format (group or alone), duration of intervention, adherence to intervention, control group (no treatment, placebo, standard treatment, other) and each methodological quality criterion, upon effect size.

Subgroup analyses were conducted for patients diagnosed in a clinical setting and high-quality trials (adequately concealed randomisation, blinded outcome assessment and intention-to-treat analysis).

Publication bias was assessed using the Begg and Egger tests.

### Results of the review

Thirteen trials (n=687 participants, range 15 to 110) were included in the review. Allocation concealment was adequate in eight trials. Outcome assessment was blinded in six trials and was self-assessed in all others. Five trials used intention-to-treat analyses. Six trials reported sample size calculations. One trial appeared to be missing from the trial details table.

When all thirteen studies were pooled, there was a reduction in depressive symptoms associated with exercise (SMD -0.40, 95% CI -0.66 to -0.14). There was evidence of between-trial heterogeneity and an inverse correlation between duration of intervention and effect size; no other variables were significant in the meta-regression analysis. The pooled standardised mean differences for the four trials of patients diagnosed in clinical settings ( $I^2=79%$ ) and for the three high-quality trials showed no significant effect of exercise.

Five trials that reported long-term follow-up of participants (n=338), to investigate the effects of exercise after its completion, showed no significant effect (pooled SMD -0.01, 95% CI -0.28 to 0.26;  $I^2=23.4%$ ).

Five trials (n=340) reported on the numbers of participants that experienced remission; the pooled odds ratio showed no significant effect of exercise (OR 1.31, 95% CI 0.63 to 2.71;  $I^2=53.5%$ ).

There was no evidence of publication bias.

### Authors' conclusions

Exercise interventions may have a small, short-term beneficial effect in relieving symptoms of patients experiencing depression. There was no evidence that this small effect for interventions continued beyond 10 weeks; there was no long-term effect beyond the end of the intervention.

### CRD commentary

The review provided a clear research objective and defined broad inclusion criteria which were appropriate to the small number of trials in the area. A range of sources were searched for relevant studies. No language restrictions were applied. There was no evidence of publication bias. Measures were taken throughout the review process to minimise the potential for error and/or bias.

The methodological quality of included trials was assessed and incorporated in the analysis and summary of results; methodological quality was generally low and some trials appeared to have high drop-out rates. The meta-analysis methods were broadly appropriate, although the value of pooling of data from many different types of exercise program was questionable.

The authors' conclusions reflect the data presented, but (as noted by the authors) should be interpreted cautiously given the limited number of small trials identified.

### **Implications of the review for practice and research**

**Practice:** The authors stated that the available evidence did not support the use of exercise for long-term benefit in patients with clinical depression.

**Research:** The authors stated that very large high-quality trials, particularly in health care settings, with long-term follow-up were needed to be sure about whether exercise has any important antidepressant effects.

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