**How effective are physical activity interventions for alleviating depressive symptoms in older people? A systematic review**

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**Abstract**

*Background*: The benefits of physical exercise in reducing clinically defined depression in the general population have been established, although a review of the evidence for older adults is needed.

*Objectives*: To assess the efficacy of physical exercise for the treatment of depressive symptoms in older adults (460 years).

*Data sources*: We searched: MEDLINE (1966–May 2008); EMBASE (1980–May 2008); Cumulative Index to Nursing & Allied Health Literature (CINAHL; 1982–May 2008); PsycINFO (1966–May 2008), The Cochrane Library (Issue 2, 2008), and National Research Register (NRR; Issue 2, 2008).

*Review methods*: Randomized controlled trials and quasi-experimental studies of physical exercise interventions for depression were included where 80% or more of participants were >60 years. Abstracts were assessed to determine whether they met specified inclusion criteria. Primary analysis focused on the prevalence of diagnosable depressive disorder following intervention. Secondary outcome was depression or mood scores on standardized scales.

*Results*: Eleven randomized controlled trials with a total of 641 participants were included in the review. Short-term positive outcome for depression or depressive symptoms was found in nine studies, although the mode, intensity and duration of intervention varied across studies. Medium- to long-term effects of intervention

were less clear.

*Conclusion*: Physical exercise programmes obtain clinically relevant outcomes in the treatment of depressive symptoms in depressed older people. Exercise, though not appropriate for all in this population, may improve mood in this group. Further research is needed to establish medium- to long-term effects and cost-effectiveness.

## Introduction

Depression is common in old age,[1],[2] and is often associated with a range of social, demographic and physical factors.[3] Depression is a treatable condition, although if left untreated, there is evidence of an increased risk of morbidity [4] and mortality,[5],[6] with an associated economic and societal burden.[7] Effective treatments for depression in older age include antidepressants, electroconvulsive therapy, cognitive behaviour therapy, psychodynamic psychotherapy, reminiscence therapy, problem solving therapy, bibliotherapy (for mild to moderate depression) and exercise.[8] However, depression in older adults often goes undiagnosed or may be inadequately treated.[9–11] Although some psychological treatments for depression can be effective [12] they can be demanding on resources. For example, while antidepressant treatments are effective for some, they may also have undesirable side-effects and can be associated with an increased risk of falls.[13] Concordance also remains a significant issue.[14] Exercise has been proposed as an alternative treatment over the past decade [15] and such interventions are showing promise for this age group. The link between physical activity and health is well-documented in diverse populations [16] with moderate exercise associated with reduced cardiovascular risk, body mass index and blood pressure, improved respiration, psychological health and pain management [17[ and also reduced clinically defined depression.[18],[19]

Studies have shown that increasing physical activity in older age is important due to the range of associated health benefits such as improving balance, strength and gait endurance and may positively affect quality of life and depression for older people also. [20] Hypothesized mechanisms for the beneficial effects of exercise on mental health include biological explanations, self-esteem and mastery and the distraction

hypothesis.[21] Increasing physical activity in the population is important for older people given the established health benefits of a more active lifestyle. Physical exercise is an achievable means by which the progression of mobility limitation and further disability may be slowed or even prevented, both within the general population and specifically for older adults with or without chronic conditions. Further, first episode depression after the age of 60 has a 70% risk of recurrence within two years of remission [22] and exercise promotion may therefore be a sustainable method for continued treatment in the long term.

It is already known that specifically, exercise has benefits for clinically depressed people in primary care.[23] Research has suggested the potential psychological benefits of exercise training for older, non-depressed adults and these include improvements in cognitive function, mood and wellbeing. [24–26] There are fewer reports of research on participatory exercise interventions as treatment for depressed older adults. Although a previous review has identified a short-term effect of physical exercise in reducing clinical depression and depressive symptoms in studies published prior to April 2005,[27] a current review of the quality of the available evidence and effects of such interventions in both the short and long term is required. Thus the present paper aims to assess the efficacy of physical exercise interventions for alleviating depressive symptoms in depressed older people (aged > 60 years).

## Method

### Identification of relevant studies

*Electronic databases*

Studies in any language and any type, including journal articles, book chapters, dissertations and conference abstracts, were searched and identified in the following electronic databases: MEDLINE (1966–May 2008); EMBASE (1980–May 2008); Cumulative Index to Nursing & Allied Health Literature (CINAHL; 1982–May 2008); PsycINFO (1966–May 2008), The Cochrane Library (Issue 2, 2008) and National Research Register (NRR; Issue 2, 2008).

*Key search terms*

A broad search strategy was developed under the following key terms: 'physical activity', 'older people', and 'depressive symptoms'. To maximize the search in the databases, various synonyms and combinations of the search terms were used. Search terms for 'physical activity' included 'physical activity' and 'exercise'. Search terms for 'older people' included 'older people', 'older adults', 'elderly', 'aging', 'ageing', and 'gerontology'. Search terms for 'depressive symptoms' included 'depression', 'depressed', 'depressive', and 'mood' (see Appendix for an example of search strategy).

Reference lists of articles identified through the database searches were examined in order to identify further relevant studies. Bibliographies of systematic and non-systematic review articles were also examined for further relevant studies.

*Criteria for inclusion*

Studies were included for the review if they fulfilled the following criteria. First, the study described a randomized controlled trial or quasi-experimental study design in which participants had been assigned to either an intervention group or a control group. Second, the intervention described had an exercise component, which was

delivered by someone with explicitly stated training. Third, the study was explicitly on older adults where over 80% of participants were recorded as being 60 years of age or more. A previous systematic review of treatments for depression in older age focused on participants aged 60 and over and so this was adopted as the age cut-off point in this review. Fourth, participants were diagnosed on recruitment with depressive symptoms (including major depression, a depressive disorder, or dysthymia) via a psychiatric interview, standardized mood measures or a treating clinician. Fifth, participants were screened to exclude individuals with dementia in order to avoid the confounding effects of the condition, which may have resulted in difficulty adhering to the exercise intervention. Studies were excluded where participants were not depressed at recruitment, or the sole purpose of the intervention was to provide information or education, or occupational therapy unless there was a clearly defined exercise intervention component.

There were no restrictions on the basis of age, gender or other participant individual characteristic. There was no restriction on the eligibility of studies on the basis of sample size, duration of follow-up or publication status. Studies including mixed patient populations were not excluded from review as long as they all had a diagnosis of depressive symptoms at recruitment.

*Excluded studies*

Excluded studies and the reasons for their exclusion are presented in Table 1.[28–46] The primary reasons for exclusion were that participants were
not from an older population or were not depressed
at baseline, the exercise intervention was not structured,
or there were no appropriate outcome

measures.

*Review process*

The reviewers independently extracted, crosschecked and reported data using standardized data extraction forms recommended by the Scottish Intercollegiate Guidelines Network (SIGN) (available at http://www.sign.ac.uk/). Disagreements were resolved by discussion. Data regarding the participants' characteristics, research design, intervention and effect size were collected. The methodological quality of the studies was then assessed using the Critical Appraisal Skills Programme (CASP) tool (available at http:// www.phru.nhs.uk/Pages/PHD/resources.htm) for randomized controlled trials and the guidelines set by the SIGN.

## Results

### Included studies

Based on the literature search, 4385 abstracts were identified and irrelevant citations were discarded on the basis of title and abstract. Twenty-nine articles were relevant to the study aims and full texts of these were retrieved for further examination. Throughout the screening process, contacts were made to authors for further details of the characteristics of participants. Ten studies met the inclusion criteria and were included for the review. One additional study was identified through the reference lists of the selected articles. All of the identified articles were in English. Details of the study selection process are presented in Figure 1.

## Participant characteristics

*Sample characteristics*

The sample size of the studies varied considerably from 14 to 138. The mean age of participants ranged from 65 to 82.4 years. The male to female ratio ranged from 1:4.4[47] to 1:1.[48] One study did not provide any information regarding gender of the participants.[49] The full characteristics of the participants are presented in Table 2.

*Depression diagnosis*

Participants were either diagnosed as fulfilling the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) criteria for depression or dysthymia, or were screened for depressive symptoms using standardized measurements such as the Diagnostic Interview Schedule, Hamilton Rating Scale for Depression (HRS), Center for Epidemiological Studies Depression Scale (CES-D), Geriatric Depression Scale (GDS) and Beck Depression Inventory (BDI). In eight studies where information about participant's use of medical treatment was available, six studies stated that participants were not receiving pharmacologic medication prior to the study.[49–54] In one study, participants were receiving pharmacological treatment for at least six weeks prior to the study but with no evidence of a sustained response and they continued to receive pharmacological treatment throughout the study.[55] In another study, participants were on medication but had no change of medication or its dosage prior to the study.[56]

*Study characteristics*

All of the included studies described randomized controlled trials. The characteristics of the selected studies are presented in Table 2.

*Mode of intervention*

The mode of physical activity intervention described included walking,[49] aerobics,[47],[50] Tai Chi,[48] Qigong (a formulated set of practice involving the coordination of body movement and breathing techniques),[56] and weight-bearing or progressive resistance training.[47],[50–55]

*Intensity and duration*

The training intensities in the studies varied greatly; however in most studies, participants engaged in the designated physical activity three times per week. The duration of the intervention session varied from 20 to 60 minutes, and the duration of the intervention period varied considerably from 6 to 19 weeks. Seven studies reported follow-up assessment varying from 4 weeks to 26 months.[47],[50],[52–53],[55–57]

*Setting*

Participants were outpatients recruited from primary care, psychiatric services, local nursing or care homes, religious organizations, volunteer databases or media advertisements.

*Outcome measures*

The primary outcome focused on the proportion of patients who were no longer diagnosed as depressed according to diagnostic criteria as applied by the study authors at follow-up or depressive symptoms as measured on standardized validated scales including the Hamilton Rating Scale for Depression,[58] Geriatric Depression

Scale,[59] Beck Depression Inventory,[60] Center for Epidemiological Studies Depression Scale [61] and the mental health scale of the Medical Outcome Study SF-36 Scale.[62] Outcomes included immediate post treatment, medium term (3–12 months) and long term (412 months).

*Quality assessment*

Although all included studies were randomized controlled trials, only five studies reported the allocation concealment method.[50],[52],[53],[55],[57] Blinding of investigator was not mentioned in four studies, however in the remaining seven studies,[47],[48],[51],[54–57] the investigator was kept blinded about participants' treatment condition. Four studies reported differences in some of the participants' baseline measures,[51],[55–57] with two studies reporting greater proportion of participants with dysthymia [57] or depression[56] in the intervention group, and the other two reporting greater proportion of female participants in the intervention group.[51],[55] Three studies reported no drop-outs,[49],[52],[55], and one study did not provide information about drop-out rates.[50] In the remaining seven studies, the attrition rate ranged from 5% to 23.5%. The use of intention-to-treat analysis was described in five studies.[47],[48],[51],[57],[53] The full results of the quality assessment are presented in Table 3.

*Effect of exercise on depressive symptoms*

*Immediately post intervention*

Findings of the studies are presented in Table 2. Out of the 11 studies reviewed, findings on the immediate post-intervention effect of exercise intervention were available in seven studies. Five yielded significant positive results for exercise

intervention in improving depression or depressive symptoms. These studies showed that participants who were in the exercise intervention group showed significant reductions in depression or depressive measures [48],[49],[52],[56] at the end of the intervention compared with participants in the no treatment control group. One study showed that participants who were assigned to a higher intensity of progressive resistance training showed significantly higher levels of improvement in depression compared with those in a low-intensity progressive resistance training condition, or a control group.[54] On the other hand, one study found that although participants in the exercise conditions showed declines in clinician-rated depression severity compared with the control group and results were comparable with those who received medication, no significant differences were found in self-reported depression measures.[50] Another study of older people who were on antidepressant treatment but were not responsive to it found that although there was significantly higher proportion of the participants in the intervention group who experienced a greater than 30% decline in depression as measured by the Hamilton Rating Scale for Depression at post intervention, both groups showed significant improvement in depression as measured by the Geriatric Depression Scale.[55]

*Medium term (3–12 months)*

Findings on the medium-term effect of exercise intervention were available in six studies. Ciechanowski et al.[57] reported that participants in the intervention group showed significant improvement in depression at six months and 12 months follow-up. They were also more likely to have at least a 50% reduction in depressive symptoms, and to achieve complete remission from depression at 12 months. Singh et al.[53] found that participants in the exercise group showed significant reduction in

depression at 20 weeks follow-up compared with controls. On the other hand, in one study among participants who were not responsive to antidepressant treatment, there were no difference between the intervention and control groups at 24 months follow-up.[55] One study with Qigong intervention showed that while there were significant improvements in depression midway through the intervention and at the end of exercise intervention, this was not maintained at the four-week and eight-week follow-up.[56] Another study comparing the effects of aerobic and resistance exercise found that a significant reduction in depression score was showed in only aerobic exercise but not the resistance exercise condition at three and nine months follow-up.[47] Sims et al.[51] also reported no significant difference in depression score between intervention and control groups at 10 weeks and six months follow-up. In summary, there is limited or conflicting evidence of benefit of exercise in the medium term.

*Long term (412 months)*

Findings on the long-term effect of exercise intervention were available in only two studies with mixed results. Singh et al.[53] found that depression score significantly reduced in the intervention group at 26 months follow-up compared with controls. On the other hand, Penninx et al.[47] reported significant reduction in depression score in the aerobic exercise group but not in the resistance exercise group at 18 months follow-up.[47]

**Discussion**

Most of the studies had significant positive findings in terms of reductions in depression or depressive symptoms, or increased remission from depression

immediately after exercise intervention, when compared with controls. The few remaining studies identified non-significant trends towards positive outcomes or positive outcomes over the study period for both intervention and control groups. More than half the studies which measured medium-term outcomes demonstrated a positive effect of exercise on depression outcomes. Other studies found no medium-term effect or that positive effects varied according to exercise mode of intervention (e.g. aerobic/resistance). Most studies did not measure the long-term outcomes of intervention yet those that did showed positive outcomes, although longer term effects were found for aerobic exercise but not maintained for resistance exercise modalities. We therefore conclude that exercise intervention exerts a clinically relevant effect on depressive symptoms in older people.

Direct comparison between studies is difficult since studies varied greatly in sample characteristics, nature of control comparison group (e.g. group attendance versus usual care), mode of intervention, intensity and duration of exercise, outcome measures used and length of follow-up. Although evidence from well-designed research studies is clearly limited, the findings do suggest that both aerobic exercise and resistance training programmes may be beneficial in improving mood in older people with depression.

There are several limitations of the present review that should be noted. Comparable with most systematic reviews, there remains a possibility that some articles may have been overlooked, particularly for studies examining exercise interventions without explicitly addressing older adults with depression or depressive symptoms in their abstract or title. Nevertheless, a range of databases have been searched and articles that did not explicitly mention older adults with depression or depressive symptoms in their title or abstracts were retained in the first screening and their full text was

reviewed before a decision was made. In addition, there remains a risk of publication bias, as negative or insignificant results might be less likely to be published. In addition, as most of the studies engaged participants with exercise in a group format, no conclusion could be made as to whether the benefits were due to social or group effect, or physical exercise per se. Therefore, these findings must be interpreted with caution. Finally, it was hoped that a meta-analysis would be feasible, although this was not undertaken firstly due to constraints of time and funding, and secondly it was decided that the trials included were too heterogeneous for a statistical pooling to be meaningful. Evidence of cost-effectiveness of exercise interventions for the treatment of depressive symptoms would be of benefit for decision-making regarding service use and delivery. However, most of the studies included did not investigate the cost-effectiveness of exercise as a treatment modality for depressive symptoms. More well-designed research studies are needed to clarify the effectiveness of different intervention modalities for older people and to further investigate the medium- and long-term impact of exercise programmes in this group.

Exercise is currently under-used as a treatment for depression although exercise therapies are becoming increasingly available through organized referral schemes in primary care. However, these are not well-utilized and general practitioners (GPs) report low usage of the services with only 15% of GPs who know about the services frequently referring their depressed patients.[63] Exercise may be as effective as medication yet has many additional health benefits including reduced risk of heart disease, stroke, high blood pressure, some cancers, type 2 diabetes, osteoporosis and obesity.[22] This makes exercise appropriate for patients with a combination of physical and mental health problems without the stigma sometimes associated with antidepressant medication and the ‘talking therapies’.

Furthermore, exercise habits can become part of a healthy lifestyle pattern which not only has obvious physical and mental health benefits but can provide individuals with a sense of control over their own recovery, which is important since depression is often associated with hopelessness.[63]

Exercise for older people with depression can be structured or unstructured, with participation initiated by individuals, social and volunteer groups or primary care referral. Although there are issues with attrition from exercise programmes which require some level of commitment from participants, exercise has long been identified as a popular treatment for depression by patients [64],[65] and treatment completion rates in exercise referral schemes are often higher than those for medication.[63]

From a resource perspective, exercise therapy involves referring patients to other health professionals. This could potentially share out the burden of patient care which may be attractive to practitioners.

**Clinical messages**

- Exercise may reduce depression or depressive symptoms in older people, with immediate and clinically relevant effects.
- Longer term outcome, mode, duration and intensity of intervention needs further investigation.
- Exercise may be useful as a supplementary treatment for depression in older people.

**Competing interests**

None declared.

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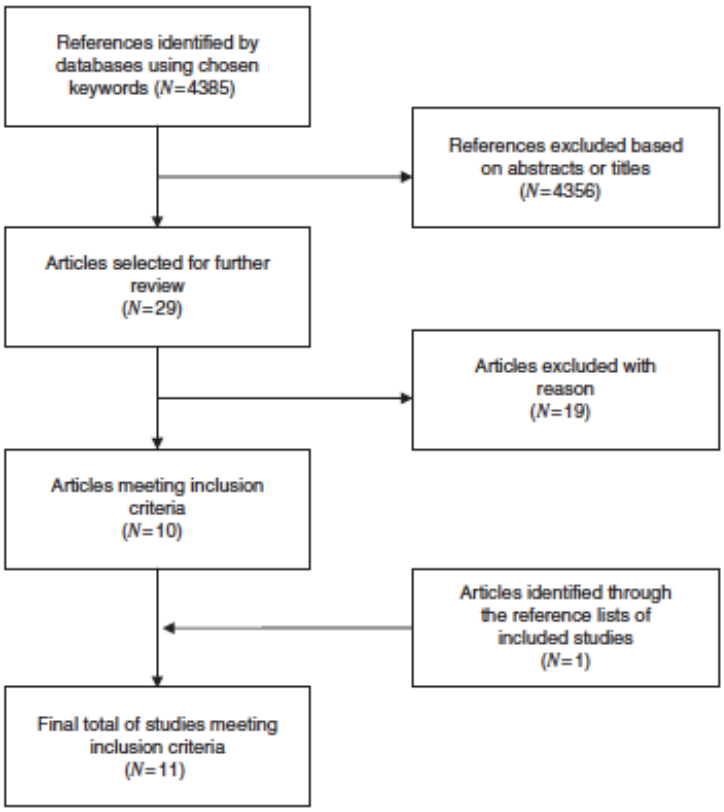


**Figure 1** QUORUM flowchart of study selection process.

**Table 1** Articles excluded and reason for exclusion

| | Study | Reason for exclusion |
|---|---|---|
| 1) | Babyak *et al.*, 2000 | Less than 80% of participants over 60 |
| 2) | Bartholomew *et al.*, 2005 | Participants not elder population |
| 3) | Blumenthal *et al.*, 1999 | Less than 80% of participants over 60 |
| 4) | Hembree, 2001 | Participants not depressed at baseline |
| 5) | Hume, 2001 | Commentary of an exercise intervention study |
| 6) | Knubben *et al.*, 2007 | Participants not elder population |
| 7) | Kovach-Anta, 1998 | Participants not depressed at baseline |
| 8) | Legrand *et al.*, 2007 | Participants not elder population |
| 9) | Llewellyn-Jones *et al.*, 1999 | Intervention not structured |
| 10) | McMurdo, 2001 | No outcome data reported |
| 11) | Miser, 2000 | Less than 80% of participants over 60 |
| 12) | Motl *et al.*, 2005 | Participants not depressed at baseline |
| 13) | Parkinson, 2006 | Participants not depressed at baseline |
| 14) | Price, 2006 | Commentary of an exercise intervention study |
| 15) | Raj, 2004 | Commentary of an exercise intervention study |
| 16) | Shin, 1999 | Participants not depressed at baseline |
| 17) | Veale, 1992 | Not elder population |
| 18) | Williams *et al.*, 1997 | Participants not depressed at baseline |
| 19) | Zou, 2005 | No exercise component |