The effectiveness of exercise in the management of post-natal depression: systematic review and meta-analysis

Amanda Daley, Kate Jolly and Christine MacArthur


**Background.** Post-natal depression (PND) is a serious mental health problem that may be reduced by exercise. National Institute for Health and Clinical Excellence in England have recommended that health professions should consider exercise as a treatment for PND.

**Objective.** To evaluate the effectiveness of exercise in the management of PND.

**Methods.** Systematic review and meta-analysis of randomized controlled trials (RCTs). Data sources involved in the study are Cochrane Library (CENTRAL), MEDLINE, EMBASE, PsycINFO, Science Citation Index and Social Science Citation Index, CINAHL and SPORTDiscus.

**Review methods.** Selection criteria are RCTs and quasi-RCTs that compared any type of exercise intervention with other treatments or no treatment in women with PND. Database searches and abstracts were reviewed independently by two authors. The Delphi criteria were used to assess the quality of included studies. Data were abstracted by two reviewers. Data synthesis is meta-analysis. Main outcome measure is post-natal depression.

**Results.** Five studies fulfilled our inclusion criteria. When compared with no exercise, exercise reduced symptoms of PND (SMD = –0.81 [95% confidence interval (CI): –1.53 to –0.10]). The overall WMD in Edinburgh Post-natal Depression Scale score was –4.00 points (95% CI: –7.64 to –0.35). However, significant heterogeneity was found. The effect size was reduced considerably (non-significant) when the trial that included exercise as a co-intervention with social support was excluded [SMD = –0.42 (95% CI: –0.90 to 0.05)] and heterogeneity was no longer present.

**Conclusions.** Due to heterogeneity, it is uncertain whether exercise reduces symptoms of PND. Caution is also required when interpreting findings from the main analysis as only five small trials were included and CIs were wide. Further research is evidently required.

**Keywords.** Behavioural sciences, depression, mental health, meta-analysis, systematic review, exercise.

**Introduction**

Post-natal depression (PND) is a serious problem across cultures and affects about 10–15% of women some time in the first year after giving birth.\(^1,^2\) This morbidity has health consequences not only for the mother but also for the child and family as a whole. Women who have PND are more likely to experience subsequent episodes of depression in later life\(^3\) and infant and child cognitive and emotional development and social behaviour have been shown to be adversely affected.\(^4\) PND can cause impaired maternal–infant interactions and negative perceptions of infant behaviour.\(^5\) Marital difficulties are not uncommon and the partner may also become depressed.\(^6\) Given that some women are reluctant to take antidepressant medication after giving birth,\(^7\) coupled with the limited availability of psychological therapies and the potential for prolonged effects of morbidity, the consideration of novel interventions for the treatment of PND would appear worthwhile and appropriate.

The Chief Medical Officer\(^8\) in the UK published recommendations regarding active living to achieve health benefits and concluded that participation
in physical activity was likely to have important mental health benefits, particularly for depression. Meta-analyses and reviews\cite{9-11} have concluded that exercise may be effective in reducing depression in general and depressed adult populations but have raised concerns regarding the methodological quality of trials. Additional trials that post-date these meta-analyses have also shown a reduction in depression in those randomized to exercise.\cite{12,13} On the basis of the available evidence in 2004, the National Institute for Health and Clinical Excellence in England (NICE)\cite{14} recommended that people with mild–moderate depression in primary and secondary care should be advised of the benefits of exercise. Based on increasing evidence of the positive effects of exercise on depression, it seems plausible that regular exercise may also be an effective intervention for the treatment of PND.

An earlier narrative review\cite{15} located two small randomized controlled trials (RCTs) of the effects of exercise (pram walking) on PND. Both RCTs involved women living in Australia and were conducted by the same research team. The review also identified several uncontrolled trials and observational studies that have investigated the association between the outcomes of interest. The review concluded that there was some limited evidence to support a relationship between participation in exercise and a reduction in PND and further research in the form of a substantive trial was required in order to examine this question more precisely. The review also highlighted that maternal body weight and post-partum weight may be negatively associated with psychological well-being following childbirth.\cite{16} And after giving birth, many mothers have excess weight and decreased fitness.\cite{17} In this regard, exercise may have scope to provide additional health benefits to post-partum women. In addition, observational studies\cite{18,19} have reported that post-natal women may be responsive to the suggestion from health professionals to exercise as part of treatment.

In 2006, NICE\cite{20} recommended in their guidance on the management of antenatal and post-natal mental health that exercise should be considered as a treatment for women who develop mild or moderate depression during the post-natal period. However, no published systematic review or meta-analysis has evaluated the effectiveness of exercise as a treatment specifically for PND and we aim here to address this gap in the literature. A secondary aim of this review was to identify key areas for future research.

Methods

Search strategy for identification of studies

Searches of the following electronic bibliographic databases were performed to identify RCTs and quasi-RCTs: Cochrane Library (CENTRAL), MEDLINE, EMBASE, PsycINFO, Science Citation Index and Social Science Citation Index, CINAHL and SPORTDiscus. Searches were based on text words or MESH terms when available, which encompassed PND, post-partum depression, exercise, physical activity, physical training, pram pushing and walking. Information about ongoing and completed research trials was obtained by searching the National Research Register, Current Controlled Trials and ClinicalTrials.gov. Searches were carried out between 20 and 24 March 2008 and not restricted by date or language. We searched the bibliographies of studies identified by electronic searches to identify additional studies. Relevant review articles were searched for information on additional trials. We contacted authors for information on any ongoing trials that may not have been located by our search strategy.

Study selection

This review included published and unpublished RCTs and quasi-RCTs (i.e. quasi-randomized approaches, such as alternating sequences were accepted) that compared any type of exercise intervention with other treatments or no treatment. Exercise was defined as any planned, structured and repetitive bodily movement. Trials involving exercise with additional interventions (co-interventions) were eligible. We excluded trials that compared different types of exercise interventions as well as uncontrolled before and after trials. Trials needed to include exercise interventions of at least 6 weeks duration and assess depression as an outcome using a validated instrument. To be eligible for inclusion trials needed to recruit women who were between 4 weeks and 18 months post-partum. Trials were included if participants had been diagnosed using a clinical interview, screened for probable depression using a recognized tool [e.g. Edinburgh Post-natal Depression Scale (EPDS)\cite{21} or the Beck Depression Inventory] or diagnosed according to the clinical judgement of a health professional (e.g. GP, health visitor or psychiatrist). No language restrictions were applied to searches.

Assessment of study quality

Two reviewers (AD and KJ) independently assessed the methodological quality of studies. The scoring system was modified from the Delphi list criteria,\cite{22} a set of nine criteria for quality assessment of RCTs (Table 2). In the current review, seven of the nine Delphi list quality criteria were evaluated. The criteria relating to the use of blinding procedures were not rated (i.e. blinding of the care providers and blinding of the patients) because it is unlikely, if not impossible, to conduct exercise intervention trials where patients and care providers are blinded. Blinding of the outcome assessor was included as one of the quality criteria. Inter-reviewer discrepancies concerning the quality of
a particular report were resolved by consensus with a third reviewer (CM).

**Data extraction**

One reviewer (AD) searched for studies by using the keywords search strategy and screened the title and abstracts identified. Full articles of any possibly relevant reports were retrieved for more detailed evaluation and two authors (AD and KJ) independently performed a final selection of trials to be included in the review using a standardized eligibility form. If the study fulfilled the inclusion criteria, data concerning type of publication, participant characteristics, study design, number of cases, recruitment procedures, nature and length of the intervention, type of comparator group, outcome assessments, intervention adherence, potential sources of bias and relevant confounders were extracted by two reviewers (AD and KJ) using a standard extraction form. Reviewers were not blinded to names of authors, institutions or journal of publication. Study authors were contacted if additional information was required to adequately complete the data extraction form.

**Data synthesis**

We carried out meta-analysis for PND, using a random effect model if heterogeneity was present. Where studies reported multiple follow-up times, we used data from the final assessment point. To use as much of the data as possible, we pooled all the studies, regardless of the type of exercise intervention. STATA software was used to perform meta-analysis. We used sensitivity analysis to assess the robustness of the results to the exclusion of trials where exercise was included as a co-intervention or part of a multi-intervention. We investigated the presence of publication bias using a funnel plot.

**Results**

**Trial flow and characteristics of included studies**

Figure 1 shows details of exclusion and inclusion of studies. After reviewing the full articles, we identified 27 reports that were potentially suitable for inclusion. Of these, five trials were included in the review. Table 1 shows the characteristics of the included trials. Four trials were published as full reports and one recently completed trial (identifier NCT00384943) was only available as conference abstracts.

The five trials included in the meta-analysis incorporated 221 participants (n = 114 interventions, n = 107 comparators) and were published between 2003 and 2008 (Table 1). Five reports of four RCTs and one quasi-randomized trial were identified. Trials were conducted in Australia, Canada, England and Taiwan, respectively. Four trials screened participants using the EPDS prior to trial entry and one trial used a combination of screening using the EPDS and health professional clinical judgement. Two trials evaluated community-based group pram walking, one involved whole stretching classes run at a hospital plus phone calls to encourage exercise compliance, one offered individual exercise consultations that promoted participation in regular exercise plus phone calls to encourage exercise and one offered an individualized home-based exercise programme administered by an exercise physiologist with follow-up support sessions. One trial compared exercise plus social support (multi-intervention) with usual care and in one trial exercise was compared with social support. Four trials compared exercise with no exercise usual care comparison groups. All trials evaluated interventions of 12-weeks duration and included an assessment of PND using the EPDS, but not necessarily as a primary outcome. One trial included the EPDS as well as the Hamilton Rating for Depression as outcomes. In four trials, participants were able to receive concurrent antidepressant medication and/or psychological therapies, one trial excluded participants if they were currently using antidepressants or had received psychotherapy in the previous year and one trial did not provide this information.
<table>
<thead>
<tr>
<th>Study, design and location</th>
<th>Inclusion criteria</th>
<th>N</th>
<th>Recruitment procedures</th>
<th>Intervention and duration</th>
<th>Control or comparison group</th>
<th>Outcome and assessments</th>
<th>Intervention adherence or attendance</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armstrong and Edwards²³</td>
<td>Child aged between 6 weeks and 12 months and EPDS score of &gt;12 at screening phase</td>
<td>n = 20</td>
<td>Recommendation from health professionals or self-referral from community adverts about the study</td>
<td>Group pram-walking sessions plus social support three times per week for 12 weeks for 30–40 minutes at moderate intensity. Social support session took place once per week</td>
<td>Control group. At Week 6, participants received support call to minimize dropout</td>
<td>EPDS score 12 weeks from baseline (immediately post-intervention)</td>
<td>Mean number of sessions attended was 24 (36 were offered)</td>
<td>Not clear how the outcome questionnaires were administered. About 50% of the sample was taking medication at baseline and some were receiving counselling.</td>
</tr>
<tr>
<td>Armstrong and Edwards²⁴</td>
<td>English speaking, child between 6 weeks and 18 months, EPDS score of &gt;12 at both screening and study entry</td>
<td>n = 24 (n = 19 completed follow-up)</td>
<td>Recommendation from health professionals or self-referral from community adverts about the study</td>
<td>Twice weekly pram-walking group over 12 weeks for 40 minutes at moderate intensity. Participants encouraged to do third pram-walking session in their own time each week</td>
<td>Social support intervention once per week over 12 weeks. Children were invited to attend to create a playgroup environment</td>
<td>EPDS score 6, 12 (immediately post-intervention) and 24 weeks from baseline</td>
<td>Overall adherence rate was 75% for the exercise group and 73% for the social support group</td>
<td>Not clear how outcome questionnaires were administered. 50–60% of sample receiving counselling or taking medication. An additional follow-up at 24 weeks was included but no data given. The HAM-D administered by telephone by a trained clinical interviewer at baseline and all follow-ups. EPDS administered by post. The data for depression are currently only available as conference abstracts.</td>
</tr>
<tr>
<td>Da Costa et al.²⁷,²⁸</td>
<td>Inactive, 4–38 weeks post-partum, no history of chronic depression, not using antidepressants, no psychotherapy in past year, EPDS score &gt;10</td>
<td>n = 88 (n = 63 completed final follow-up)</td>
<td>Women recruited via adverts and at obstetrician and gynaecologists offices</td>
<td>Individualized home-based exercise programme for 12 weeks. Met with exercise physiologist four times during intervention for exercise prescription and guidance</td>
<td>Standard care control group</td>
<td>EPDS and HAM-D score 12 weeks (immediately post-intervention) and 6 months from baseline</td>
<td>Participants achieved 124 minutes of exercise per week and completed 3.1 sessions per week</td>
<td></td>
</tr>
<tr>
<td>Study, design and location</td>
<td>Inclusion criteria</td>
<td>N</td>
<td>Recruitment procedures</td>
<td>Intervention and duration</td>
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<td>Notes</td>
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<tr>
<td>Daley et al.²⁵, RCT and England</td>
<td>Inactive, aged &gt;16 years with child aged &lt;12 months. Needed to be deemed at risk of PND by health professional, diagnosed with PND or screen &gt;12 on EPDS</td>
<td>( n = 38 ) (( n = 31 ) completed follow-up)</td>
<td>Patient lists at mother and baby hospital psychiatric unit, GP records, health professionals clinical judgement or self-referral</td>
<td>Participants offered two exercise consultations that promoted regular exercise/pram walking. Follow-up phone calls that encouraged regular exercise were given. Intervention lasted 12 weeks</td>
<td>Usual care</td>
<td>EPDS score 12 weeks from baseline (immediately post-intervention)</td>
<td>On average participants engaged in 174 minutes of exercise per week (i.e. 25 minutes per day)</td>
<td>Most women were taking medication. Questionnaires administered by post. This study was a pilot feasibility RCT and was not powered to detect a significant difference in EPDS scores between the groups</td>
</tr>
<tr>
<td>Heh et al.²⁶ b, quasi-randomized and Taiwan</td>
<td>Married, first time mothers 20–35 years. Had normal delivery with a single full-term baby, birth weight &gt;2500 g. APGAR score &gt;7 and score &gt;10 on EPDS</td>
<td>Of 400 women screened, 80 consented, with ( n = 68 ) eventually taking part (( n = 63 ) completed follow-up)</td>
<td>Women were screened in the fourth week after childbirth and those scoring &gt;10 on the EPDS invited to participate, first by telephone and then by letter at 6 weeks post-partum</td>
<td>45 minutes group: whole body gentle stretching exercise at a hospital once per week and two sessions at home for 12 weeks. Participants given exercise CD, booklet on PND and weekly calls that encouraged compliance</td>
<td>Standard care</td>
<td>EPDS score 5 months post-partum (i.e. within 1 month post-intervention)</td>
<td>Most women reported an increase in physical activity level (( n = 27/33 ))</td>
<td>Women with a psychiatric history and obstetric complications were excluded. No information reported on the number of women taking medication or receiving psychological therapies</td>
</tr>
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</table>

APGAR, appearance, pulse, grimace, activity, respiration; HAM-D, Hamilton Rating for Depression.

²Additional information regarding this trial was provided by the authors.
³Women were allocated alternatively to trial groups. The woman with the earliest date of childbirth was assigned to exercise and the next to the control group and so forth.
Four trials reported EPDS scores as continuous data, and one trial reported EPDS scores as both continuous and dichotomous data. The percentage point difference between the groups in the proportion of women scoring above and below 10 on the EPDS at follow-up. Follow-up times in three trials was 12 weeks (immediately post-intervention). In one trial, follow-up took place approximately 16 weeks from baseline (5 months post-partum) and in another, the final assessment of outcomes took place 6 months from baseline. Three trials showed a significant difference in EPDS score between trial groups at final follow-up and two did not.

Methodological quality of included studies

Included trials obtained a quality score of either four, five or six points from a possible score of seven (Table 2). Some reports were not clear in reporting the trial methods, particularly regarding the steps taken to ensure allocation concealment. Only one trial clearly stated that outcome assessors were blinded to participants’ group allocation.

Meta-analysis

All the included trials used the EPDS to assess PND and therefore we used this data in the meta-analysis. (For the Daley trial, unadjusted mean scores were used in the meta-analysis; therefore, data differ from the trial report which used adjusted scores. The unadjusted mean scores were provided by the trial author. Participant numbers refer to those completing follow-up unless imputation methods were used.) When compared with no exercise, exercise reduced symptoms of PND [standardized mean difference in effect size –0.81 [95% confidence interval (CI): –1.53 to –0.10]] when using a random effects model (Fig. 2). The overall weighted mean difference (random effects) in EPDS score was –4.00 points (95% CI: –7.64 to –0.35) (Fig. 3). Significant heterogeneity between studies was found (Figs. 2 and 3). The Egger test for publication bias was non-significant (coefficient –4.74, P > 0.14).

When the trial that included exercise as a co-intervention with social support was excluded from the meta-analysis, the standardized mean difference in size of effect was reduced to –0.42 (–0.90 to 0.05) and the weighted mean difference in size of effect in EPDS score was –2.03 (–4.34 to 0.29) (Fig. 3). Significant heterogeneity between studies was not found.

Compliance

Attendance at exercise classes or adherence to exercise intervention guidelines was reported to be very good in all the included trials. One trial reported that on average, women adhered to about 24/36 sessions (67%). In the trial that compared exercise with social support, overall attendance was 75% for the pram-walking group and 73% for the social support group. Using data from diaries, Daley reported that participants were able to achieve on average 174 minutes (SD = 73.6) of moderate intensity exercise per week (equivalent of 25 minutes per day). Heh reported that most women (n = 27/33 (82%)) reported an increase in their physical activity levels as a result of the intervention. In the trial by Da Costa, adherence to the aerobic exercise component of the programme was 76.1% (based on 60 minutes/week), with an average of 124.1 minutes/week (SD = 96.3). Thirty-five out of the 46 (76.1%) women in the exercise group adhered to the intervention.

Ongoing trials

Searches of ClinicalTrial.gov identified one ongoing trial (identifier: NCT00361478) which is evaluating the

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**Table 2** Assessment of methodological quality of included studies

<table>
<thead>
<tr>
<th>Quality characteristics</th>
<th>Armstrong and Edwards&lt;sup&gt;23&lt;/sup&gt;</th>
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<th>Da Costa et al.&lt;sup&gt;27,28&lt;/sup&gt;</th>
<th>Daley et al.&lt;sup&gt;25&lt;/sup&gt;</th>
<th>Heh et al.&lt;sup&gt;26&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was randomization performed?</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>2. Were the groups similar at baseline regarding important prognostic indicators?</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>–</td>
</tr>
<tr>
<td>3. Were the eligibility criteria specified?</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>4. Was the outcome assessor blinded?</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>5. Was allocation concealment adequate?&lt;sup&gt;a&lt;/sup&gt;</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>6. Were point estimates and measures of variability presented for the primary outcome measures?</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>7. Did the analysis include an intention-to-treat analysis?</td>
<td>–</td>
<td>×</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Total score (out of 7)</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

<sup>a</sup>As used in previous systematic reviews for concealment allocation, we distinguished between trials that were adequately concealed (i.e., central randomization at remote site from the study, computerized allocation in which records are in locked unreadable file that can be accessed only after entering patients details, drawing on sealed and opaque sequentially numbered envelopes), inadequately concealed (i.e., open list or tables of random numbers, open computer systems and drawing of non-opaque envelopes) and unclear (i.e., no information in report and the authors did not respond to requests for information or were unable to provide the information).
effects of an 8-week mother and baby programme on psychological health outcomes of new mothers aged 18–45 years who do not have a history of PND and this trial may be eligible for inclusion in a future review.

Discussion

This systematic review and meta-analysis provides some support for the role of exercise in the management of PND. While the magnitude of the statistically significant large effect might appear initially encouraging, we should be mindful that the CIs were wide. Caution should also be taken when interpreting this review because all the trials were small and with only 221 participants included in the primary meta-analysis, the estimates may be imprecise. It is also noteworthy that the largest trial to date did not show a significant difference in EPDS score between trial groups at follow-up. Trials were heterogeneous and therefore the use of a quantitative summary statistic in this report could be questioned. Only five trials were eligible for inclusion which does limit the meta-analysis.

The effect size was reduced considerably when the trial that included exercise as a co-intervention with social support was excluded from the meta-analysis [standardized mean difference reduced from −0.81 (95% CI: −1.53 to −0.10) to −0.42 (95% CI: −0.90 to 0.05)] and heterogeneity was no longer present. These findings may suggest that the overall estimate effects are unstable. In addition, these results might point towards exercise being offered as part of a multi-component intervention that includes social support, although in another very small trial, exercise was found to be more effective than social support alone. As these trials were indeed very small, it is difficult to unpick this issue here, but it is one that future research needs to address.

Given the recent guidance from NICE that health professionals should consider exercise as treatment for PND, it is rather surprising that so few published trials exist. Moreover, when this guidance was issued by NICE in 2006, only two very small (total n = 39) of the five trials included in this review had been completed and they had limited follow-up and included samples of volunteers. It appears that the guidance from NICE may have been somewhat premature, although findings from this review do give a little more support to this.

Three of the five trials reported that many participants were receiving other standard treatments, such as medication and/or counselling, one excluded such patients and the other did not specify this information; therefore, if exercise is to be recommended to

![FIGURE 2 Standardized mean differences in size of effect of exercise relative to comparators for PND](https://academic.oup.com/fampra/article-abstract/26/2/154/2367218/17/March/2019)
women with PND, it should be as an adjunctive treatment. We found no evidence to support the effectiveness of exercise as replacement for standard treatment. The effectiveness of any health promotion intervention in improving health outcomes is reliant on participants initiating the target behaviour and then sustaining this behaviour change. With this in mind, the high level of attendance and adherence to the different types of exercise interventions and classes offered in the trials was very encouraging and may suggest that women with PND are keen to be physically active after childbirth, when given the opportunity to do so. However, it might also be the case that rates were high because volunteer samples of motivated women were recruited into the trials.

A range of types of exercise intervention, including gentle stretching, were used in trials and this makes it difficult to know which approach might be most effective in reducing PND. Pram walking was the predominant activity in three trials, this type of aerobic exercise might be more accessible to new mothers than more organized activities. Clinicians and health practitioners may also feel more confident in promoting walking-based activities with their patients. One trial used class-based whole body stretching, although the effect was relatively modest in comparison to trials where aerobic exercise-based interventions were used or encouraged. Nevertheless, it might be that non-aerobic activities can also be effective in reducing levels of PND. Future trials might consider including an intervention that promotes a combination of aerobic and non-aerobic-based activities.

While trials were generally small, quality scores ranged from between four and six points (out of seven). As is often the case in exercise trials, only one study included blinded assessment of PND scores, although two trials asked participants to self-complete questionnaires at follow-up and to return by post. Follow-up was short and limited to between 3 and 4 months after baseline in three trials and 6 months in only one trial. Only three trials used intention-to-treat analysis and this may have contributed to an inflation of treatment effects.

Follow-up was acceptable (>80%) in only two trials, although two other trials obtained follow-up in 79% of their samples which approached our acceptability score of >80%. As only one trial reported data from follow-up beyond the completion of the intervention, we have very limited information about the longer term effect of exercise on PND. This should be a prerequisite of the design of any future trials. In the two largest trials, an EPDS scores of

![Figure 3](https://academic.oup.com/fampra/article-abstract/26/2/154/2367218)

**Figure 3** Weighted mean differences in size of effect of exercise relative to comparators for EPDS score

<table>
<thead>
<tr>
<th>Study</th>
<th>WMD (95% CI)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armstrong (2003)</td>
<td>-10.10 (-13.17, -7.03)</td>
<td>20.50</td>
</tr>
<tr>
<td>Armstrong (2004)</td>
<td>-7.00 (-12.35, -1.65)</td>
<td>15.82</td>
</tr>
<tr>
<td>Da Costa (2005/2006)</td>
<td>0.20 (-1.85, 2.25)</td>
<td>22.31</td>
</tr>
<tr>
<td>Daley (2008)</td>
<td>-1.60 (-5.52, 2.32)</td>
<td>18.79</td>
</tr>
<tr>
<td>Hey 2008</td>
<td>-2.50 (-4.36, -0.64)</td>
<td>22.59</td>
</tr>
<tr>
<td>Overall (I-squared =87.8%, p = 0.000)</td>
<td>-4.00 (-7.64, -0.35)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

**NOTE:** Weights are from random effects analysis

To trials where aerobic exercise-based interventions were used or encouraged. Nevertheless, it might be that non-aerobic activities can also be effective in reducing levels of PND. Future trials might consider including an intervention that promotes a combination of aerobic and non-aerobic-based activities.

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\[10\] was used to classify women ‘at risk’ of PND (and potentially eligible to enter the trials), although it is more usual for a cut-off score of 12/13 to be adopted. The use of a lower EPDS score in these particular trials may have increased the number of false-positive cases recruited and consequently their contribution to the meta-analysis should be interpreted with this in mind. One trial\(^{24}\) included women who were up to 18 months post-partum but it is more conventional to consider the post-partum period to be within 12 months of childbirth. A particular shortcoming of trials is their failure to report information confirming treatment or intervention fidelity.

In conclusion, we found some support to suggest that exercise can reduce PND but this finding is contingent on the inclusion of one trial that included exercise as a co-intervention. We also remain cognizant that trials have been small, CIs were wide, had limited follow-up and included samples of volunteers. A large trial that compares exercise with standard treatments and which includes long-term follow-up is now essential given the recommendation from NICE that health professionals should consider exercise as treatment for PND.

Declaration

Funding: None.

Ethical approval: None.

Conflicts of interest: Two authors of this report were authors of one of the trials included in the meta-analysis.

References