Effectiveness of intervention on physical activity of children: systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird 54)

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CRD summary
This review concluded that there was strong evidence that physical interventions had only a small effect on children's overall activity levels. This was generally a well-conducted review and the conclusions are likely to be reliable, but their generalisability to the entire paediatric population is unclear.

Authors' objectives
To determine whether, and to what extent, physical activity interventions affect overall activity levels in children.

Searching
The following databases were searched for articles from January 1990 to March 2012: EMBASE, MEDLINE, PsycINFO and SPORTDiscus. No language restrictions were used and the search terms were reported. References from included studies and relevant review articles were scanned. Only peer-reviewed publications were considered for inclusion.

Study selection
Cluster and individual randomised controlled trials (RCTs) or controlled clinical studies, that included a component designed to increase the physical activity levels of children or adolescents were eligible for inclusion. Interventions had to be at least four weeks long and studies had to report physical activity for the whole day or a clearly defined proportion of the day, measured using accelerometers before the end of or immediately after the intervention period.

The included studies were published between May 2003 and December 2011. Most studies were school based or conducted in the family home. Most of the interventions provided activity or exercise sessions. Some studies included only boys or girls; in mixed populations, the percentage of girls ranged from 27 to 64. Mean age at baseline varied from 1.8 to 13.1 years, and eight studies exclusively included children who were overweight or obese. Most studies used uniaxial accelerometers; one used a biaxial, and three used triaxial. Data that were collected more than one month after the end of the intervention were not included.

Studies were assessed for inclusion by two independent reviewers and discrepancies were resolved by discussion.

Assessment of study quality
One reviewer assessed the quality of randomisation, reporting of the proportion lost to follow-up, and intention-to-treat analysis, for each study, and a second reviewer checked this information. Studies were judged to be of high quality if they were positive for all three quality criteria.

Data extraction
Study-level covariates (listed in the paper) and results were extracted by one reviewer and checked by a second, for total physical activity, moderate to vigorous activity, or both. Where data for only one outcome were reported, authors were contacted for the missing data. The standardised mean difference (Hedges' g) and 95% confidence interval were calculated for each outcome.

Where a trial reported within-group means at baseline and follow-up separately, or comparisons that were dependent on each other, a correlation of 0.5 was assumed between the measures. Where studies reported the results for multiple subgroups or time points, the standardised mean difference was calculated for each one separately. Where a study did not report the combined effect and variance, the reviewers reported the weighted mean of multiple effects.

Methods of synthesis
A random-effects meta-analysis, weighted by inverse variance, was used to produce pooled effect sizes and 95% confidence intervals. An overall standardised mean difference of 0.2 was considered to be small, 0.5 was moderate, and
0.8 was large. The cluster design was accounted for in the analysis (details provided in the paper). Heterogeneity was assessed by visual inspection of forest plots and using $I^2$.

A weighted random-effects meta-regression and a multivariate regression, using a backward elimination method, were used to explore the impact of gender; age; body mass index; activity level; study size, duration and quality; timing of follow-up; and type of intervention. Sensitivity analyses were conducted to investigate the impact of varying the correlation between baseline and follow-up activity and study quality. Funnel plots were used to assess publication bias.

**Results of the review**

Thirty studies were included, with 14,326 participants (range 18 to 2,840); a subgroup of 6,153 children (range 18 to 1,138) was assessed using accelerometers across these studies. Twenty-seven studies were RCTs and the other three were controlled clinical trials. Sixteen studies (3,883 children) were judged to be of high quality. Twelve of the other 14 studies (2,270 children) scored positively on two of the quality criteria, and two scored positively on one criterion. Loss to follow-up ranged from none to 46% and 20 studies reported less than 20% attrition. All but three of the studies carried out intention-to-treat analysis.

The pooled analysis across all 30 studies showed a statistically significant effect in favour of the intervention group for both total physical activity (SMD 0.12, 95% CI 0.04 to 0.20) and moderate or vigorous physical activity (SMD 0.16, 95% CI 0.08 to 0.24). These differences were judged to be small and of limited clinical significance. $I^2$ heterogeneity was 38% for total activity and 51% for moderate or vigorous activity.

The investigations into the study-level covariates and the sensitivity analyses showed that the results of the main analyses were robust. The funnel plots suggested the presence of a small-study effect, but this was unlikely to change the findings.

**Authors’ conclusions**

There was strong evidence that physical activity interventions had only a small effect on children's activity levels. This might help to explain why such interventions had limited success in reducing children's body fat or body mass index.

**CRD commentary**

This review addressed a clear question with appropriate inclusion and exclusion criteria. The searches were relatively broad, without language restrictions, but the outcome measure terms might have omitted relevant studies. Only including peer-reviewed research could have introduced publication bias. The reviewers acknowledged this, but suggested it would not have changed the main finding, which is likely to be true. The review processes were described and seem likely to have reduced the impact of error or bias.

The included studies were quality assessed, but there were few criteria, which did not fully assess the potential for bias. The results of the quality assessment were not reported in full, making it impossible to know which studies were subject to which bias. A few studies carried a lot of weight in the analyses; three out of four were non-randomised trials and favoured the intervention.

The synthesis seems to have been appropriate, and potential sources of heterogeneity were investigated. Some of the analyses showed a statistically significant impact for the intervention, but the overall effect size was small and the question over the clinical relevance of these results, raised by the authors, seems appropriate. The authors did not evaluate the impact of physical exercise on changes in body mass, so the conclusion that the lack of effectiveness of exercise interventions might partially explain why they do not reduce obesity, seems sensible, but was not directly assessed. The review was based on a subgroup of children who had their outcomes assessed using accelerometers. It was not clear whether these children who used accelerometers were representative of the entire trial population.

Overall, this was a well-conducted review, and the conclusions are likely to be reliable, but the degree to which they are generalisable to the entire paediatric population is unclear.

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

**Practice:** The authors stated that organised physical activity could have benefits, such as improved coordination, greater self-confidence, team participation, and social inclusion.
Research: The authors stated that future research could explore why physical activity interventions fail to increase activity sufficiently. Within-study risk group analyses could examine whether the intervention is effective for children who could benefit the most. Further research could assess whole-day activity and activity for specific intervention periods.

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