A systematic review and meta-analysis of interventions designed to increase moderate-to-vigorous physical activity in school physical education lessons

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CRD summary
The authors concluded that interventions can increase the proportion of time students spend in moderate-to-vigorous physical activity during physical education lessons and could lead to substantial public health benefits. This was generally a well-conducted review but limited study quality and differences between the included studies mean that the authors' conclusions may not be reliable.

Authors' objectives
To evaluate the effectiveness of interventions aimed at increasing the proportion of physical education lesson time that students spend in moderate-to-vigorous physical activity (MVPA).

Searching
Scopus, SPORTDiscus, PubMed and PsycINFO were searched from inception to March 2012 for peer-reviewed articles in English. Search terms were reported. Reference lists of relevant review articles and included primary source articles were handsearched.

Study selection
Experimental and quasi-experimental studies of interventions designed to increase the proportion of physical education lesson time spent in MPVA among primary/elementary or secondary/high school students were eligible for inclusion. Included studies had to use an objective measure (such as accelerometer) or systematic direct observation by an independent rater to measure the proportion of time spent in MPVA. Studies with cross-sectional or cohort designs and studies that evaluated conditions (such as different types of physical education activity) rather than an intervention were excluded.

The included studies were published between 1991 and 2008. Studies were conducted in USA, Belgium, Australia and the UK (two studies). Just over half of the interventions were performed in primary/elementary schools (grades 3 to 5); the rest were in grades 6 to 8 or grade 9 (secondary/high school). Most of the interventions altered teaching strategies; a small proportion utilised fitness infusion methods and one study did not report the methods used. All control conditions received usual practice teaching. Fewer than half of the studies reported using a theoretical basis for the intervention. The outcome of interest was often measured using systematic direct observation, a heart rate monitor or an accelerometer. The minimum criterion for MPVA in most studies was walking.

Two reviewers independently selected studies for inclusion; any disagreements were resolved by discussion.

Assessment of study quality
Risk of bias was assessed independently by two reviewers using adapted criteria from a published source with criteria for comparability of groups at baseline, randomisation, accounting for baseline values in analyses, statistical power calculations, reliability and validity of MPVA measures, drop-outs, comparability of measurement times between groups and blinding of outcome assessors. High risk of bias was indicated by total scores of 0 to 2, moderate risk of bias by scores of 3 to 5 and low risk of bias by scores of 6 to 8.

Data extraction
Data on the outcome were extracted independently by two reviewers to calculate mean differences between study groups for each study. Where possible, missing data were estimated using calculations and/or assumptions evident from the information provided in the report. Discrepancies in data extraction were resolved by discussion.

Methods of synthesis
Mean differences from individual studies were pooled to provide absolute differences and standardised mean differences (SMD) with 95% confidence intervals (CI) (meta-analytical methods not reported).
Between-study heterogeneity was assessed using the $I^2$ statistic with thresholds to indicate low (25%), moderate (50%) and high consistency (75%) across the studies.

Subgroup analyses were performed according to type of intervention, age and gender of participants, and intervention duration. A funnel plot was constructed to assess publication bias.

**Results of the review**

Fourteen studies were included in the review: 11 cluster randomised controlled trials (RCTs) (approximately 3,164 participants), one crossover RCT (45 participants), one quasi-experimental study (approximately 117 participants) and a parallel group RCT (40 participants). Five studies were rated as having high risk of bias, eight as having moderate risk of bias and one as having a low risk of bias. Follow-up ranged from one to 156 weeks (with most occurring after 35 weeks) in the 10 studies that measured baseline MPVA levels.

All of the included studies reported a higher proportion of active learning time in the intervention group compared with the control group; most of these differences were reported as being statistically significant. The meta-analysis (13 studies) revealed an absolute difference of 10.37% (95% CI 6.33 to 14.41) of lesson time spent in MPVA in favour of the intervention over controls. The 10.37% difference related to 24% more active learning time in the intervention groups than in the control groups (SMD 0.62, 95% CI 0.39 to 0.84). Substantial heterogeneity was shown between the studies ($I^2=88\%$).

Results from subgroup analyses according to intervention type showed the same direction of effect (reported in paper). None of the factors in the other subgroup analyses (such as age and gender) appeared to moderate the intervention effects (data not shown). No evidence of publication bias was reportedly found but some outlier studies were shown on the funnel plot.

**Authors' conclusions**

Interventions can increase the proportion of time students spend in MPVA during physical education lessons and could lead to substantial public health benefits.

**CRD commentary**

The review question and inclusion criteria were clearly reported. Relevant databases were searched. The restriction to peer-reviewed articles published in English means that some relevant studies may have been missed. Efforts were made throughout the review process to minimise reviewer error or bias. The quality assessment criteria and scoring system seemed suitable; results showed that nearly all of the studies had a high or moderate risk of bias.

Study details were presented and revealed some differences across the studies. These differences mean that it may not have been appropriate to pool the studies in a meta-analysis, especially given that heterogeneity remained high in the subgroup analyses reported. The authors acknowledged that this heterogeneity (between-study differences) means that their findings should be interpreted with caution.

This was generally a well-conducted review but limited study quality and diversity between the studies mean that the authors' conclusions may not be reliable.

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

Practice: The authors stated that increasing active learning time in physical education should be considered a public health priority and that high levels of active learning time should be balanced with opportunities for instruction, feedback and reflection.

Research: The authors stated that researchers aiming to increase active learning time in physical education should consider motivational theories that have been proven useful in explaining student behaviour, cognition and affect in physical education. Other recommendations included: additional, adequately powered and higher quality cluster RCTs to determine the effectiveness of strategies and theoretical frameworks for increasing MVPA in physical education; investigation into the effects of interventions on psychosocial mediators; more transparent reporting of intervention strategies; and consistency in physical activity assessment.

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