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Review

A systematic review and meta-analysis of moderate-to-vigorous physical activity levels in elementary school physical education lessons

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ABSTRACT

Objective. To examine elementary school students' moderate-to-vigorous physical activity (MVPA) levels during physical education (PE) lessons.

Methods. A systematic search of nine electronic databases was conducted (PROSPERO2014: CRD42014009649). Studies were eligible if they were in English; published between 2005–April 2014; assessed MVPA levels in PE lessons of elementary school children (aged four–12 years); and used an objective MVPA measure. Two reviewers retrieved articles, assessed risk of bias, and performed data extraction. The findings were synthesised using a meta-analysis.

Results. The search yielded 5132 articles. Thirteen studies from nine countries met the inclusion criteria. Eight studies measured MVPA through observational measures, five used accelerometry and one used heart rate monitoring. The percentage of PE lesson time spent in MVPA ranged between 11.4–88.5%. Meta-analysis of seven studies (4 direct observations; 4 accelerometers) found that children spent a mean (95% CI) 44.8 (28.2–61.4)% of PE lesson time in MVPA. When measured using direct observation and accelerometers, children spent 57.6 (47.3–68.2) and 32.6 (5.9–59.3)% of PE lesson time in MVPA, respectively. The review has limitations; the search strategy was restricted to studies in English; theses, dissertations and conference abstracts were excluded; and six studies that provided insufficient data were excluded from the meta-analysis.

Conclusion. MVPA levels during elementary school PE lessons do not meet the United States Centre for Disease Control and Prevention and the United Kingdom's Association of Physical Education recommendation (50% of lesson time), but is higher than estimated in the previous review (34.2%). Interventions to increase MVPA in PE lessons are needed.

Contents

Abbreviations: Accel, accelerometer; afPE, Association of Physical Education; ASD, autistic spectrum disorders; BEACHES, Behaviour of Eating and Activity for Children's Health: Evaluation System; BMI, Body Mass Index; CDC, Centre for Disease Control; CDOM, continuous direct observation method; FI, fitness infusion; FMS, fundamental movement skills; HR, heart rate; min, minutes; MVPA, moderate-to-vigorous physical activity; NR, not reported; NSW, New South Wales; PE, physical education; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCT's, Randomised Controlled Trials; SAM, Simple Activity Measurement; SD, standard deviation; SE, standard error; SES, Socioeconomic Status; UK, United Kingdom; US, United States; WHO, World Health Organisation; SOFIT, System for Observing Fitness Instruction Time; 95% CI, 95% Confidence Intervals.

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Introduction

Engaging children in physical activity during childhood is important as physical inactivity has been associated with cardiovascular risk factors and obesity in children (Andersen et al., 2006; Froberg and Andersen, 2005; Ekelund et al., 2012). International guidelines by the World Health Organisation (WHO) recommend that 5–17 year old children engage in 60 min of moderate-to-vigorous physical activity (MVPA) each day (World Health Organisation, 2014). However national data from the United States (US) (Troiano et al., 2008) collected using accelerometers, and self-report survey data from Australia (Australian Bureau of Statistics, 2013), have reported that less than half of children meet this recommendation.

Schools are a valuable setting to promote and engage children in physical activity (Pate et al., 2006). In particular, physical education (PE) lessons provide an opportunity for children to engage in MVPA and develop the fundamental movement skills (FMS), knowledge and attitudes required for a lifetime of physical activity (Hills et al., 2015). The US Centre for Disease Control (CDC) and Prevention (U.S. Department of Health and Human Services et al., 2010) and the United Kingdoms (UK) Association of Physical Education (afPE) (2008) have recommended that both elementary and secondary school children engage in MVPA for at least 50% of PE lesson time.

Despite the potential for PE lessons to play a role in promoting physical activity in children from a young age, only one review has examined MVPA during elementary school PE lessons (Fairclough and Stratton, 2006). The narrative review was based on 44 studies published until 2005, and included cross sectional, longitudinal and intervention studies (baseline and follow-up data of all control and intervention groups) (Fairclough and Stratton, 2006). The majority of studies used observational methods to measure MVPA (n = 26), whilst 15 studies used heart rate monitoring and nine used monitor sensors (accelerometers and pedometers) (Fairclough and Stratton, 2006). Six studies used a combination of physical activity measurements methods (Fairclough and Stratton, 2006). The mean lesson length was 33.7 min (Fairclough and Stratton, 2006). The review found that when data from PE lessons under both intervention and non-intervention conditions were combined (n = 44), students participated in MVPA for 37.4% of PE lesson time, with a mean of 34.2% based on non-intervention condition studies only (n = 15) (Fairclough and Stratton, 2006). Sub-group analyses showed that activity tended to increase with school grade, particularly between grades three and five. MVPA differed according to measurement type, with heart rate monitors reporting the highest percentage MVPA (40.4%), followed by motion sensors such as accelerometers and pedometers (36.8%), and observation methods (32.5%) (Fairclough and Stratton, 2006). The review did not undertake an assessment of risk of bias to aid the interpretation of findings.

Given the absence of a subsequent updated review, the primary aim of this systematic review was to examine elementary school students' MVPA levels during PE lessons in studies published between 2005 and 2014. The secondary aims were to evaluate student participation in MVPA during PE lessons by: i) measurement type (accelerometer, heart rate monitoring, pedometry or observational measure); ii) PE activities; and iii) student (e.g. sex, socioeconomic status (SES)), teacher (e.g. training) and environmental factors (e.g. country).

Methods

For the purpose of this review, the term 'elementary school' (i.e. catering for children aged 4–12 years) will be used throughout. The systematic review protocol was registered with Prospero on the 7/5/2014 (PROSPERO2014: CRD42014009649): http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42014009649. The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement (Moher et al., 2009).

A two-step search strategy was used. First, a systematic search of nine electronic scientific databases was performed in May 2014: Medline, Sport Discus, CINAHL, The Central Cochrane database, ERIC, Proquest, EMBASE, Scopus, and PsycINFO. Key search terms and their synonyms were searched using four filters identifying the: i) setting (e.g. physical education), ii) target population (e.g. child), iii) measurement (e.g. MVPA), and iv) study design (e.g. prospective studies). Search terms within each filter were combined using the Boolean operator 'or', and all four filters were combined to form one search using the Boolean operator 'and'. See Appendix A for the full list of search terms and a record of the search strategy. Secondly, the reference lists of all included studies were manually searched for additional papers not already identified.

Inclusion and exclusion criteria

The title and abstracts of the studies identified during the search were retrieved and examined by two reviewers (J.H., A.W.) to determine if the study met the inclusion criteria. The full texts of potentially eligible studies were retrieved and independently assessed by the two reviewers to determine eligibility. If there was disagreement on whether a study should be included in the review and a consensus could not be reached through discussion, a third independent reviewer was consulted (R.S.).