



Active Video Games in Schools and Effects on Physical Activity and Health: A Systematic Review

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Objective To assess the quality of evidence for the effects of school active video game (AVG) use on physical activity and health outcomes.

Study design Online databases (ERIC, PsycINFO, PubMed, SPORTDiscus, and Web of Science) and gray literature were searched. Inclusion criteria were the use of AVGs in school settings as an intervention; assessment of at least 1 health or physical activity outcome; and comparison of outcomes with either a control group or comparison phase. Studies featuring AVGs within complex interventions were excluded. Study quality was assessed using the Effective Public Health Practice Project tool.

Results Twenty-two reports were identified: 11 assessed physical activity outcomes only, 5 assessed motor skill outcomes only, and 6 assessed both physical activity and health outcomes. Nine out of 14 studies found greater physical activity in AVG sessions compared with controls; mostly assessed by objective measures in school time only. Motor skills were found to improve with AVGs vs controls in all studies but not compared with other motor skill interventions. Effects of AVGs on body composition were mixed. Study quality was low in 16 studies and moderate in the remaining 6, with insufficient detail given on blinding, participation rates, and confounding variables.

Conclusions There is currently insufficient evidence to recommend AVGs as efficacious health interventions within schools. Higher quality AVG research utilizing randomized controlled trial designs, larger sample sizes, and validated activity measurements beyond the school day is needed. (*J Pediatr* 2016;172:40-6).

Children currently spend around 8.6 hours a day in sedentary behavior,¹ such as reading, watching television, using the computer, and playing video games in a seated or reclined position.^{2,3} Physically active time in children has been favorably associated with motor skills⁴ and cardiometabolic profiles,^{5,6} whereas sedentary behavior has been linked to reduced psychological well-being and academic achievement.^{7,8} Sedentary habits formed in childhood may continue into adulthood.⁹

Given the physical, social, and psychological benefits of physical activity,^{10,11} interventions have attempted to replace children's sedentary behavior with more active time.⁶ A meta-analysis of children's interventions found significant overall sedentary behavior reductions from baseline of 20.44 minutes a day and reduced body mass index (BMI) of -0.14 kg/m^2 .¹² Although screen-time is typically classified as sedentary behavior,⁸ research has also studied the use of screen-based technologies as an intervention for reducing children's sedentary lifestyles. Active video games (AVGs) are one such intervention, requiring physical movements to interact with screen-based games.¹³⁻¹⁵

AVGs typically elicit light to moderate intensity activity in children,^{16,17} as well as significantly increased acute energy expenditure,^{18,19} heart rate and oxygen consumption compared with sedentary behavior^{16,17,20} and unstructured outdoor play.²¹ However, the effects on AVGs on habitual improved activity are still unclear.²² In addition, there is evidence to suggest that children may compensate for active periods (such as AVGs) with increased sedentary behavior.²³⁻²⁶

Recent research has investigated the potential of AVGs as interventions within school settings: as an alternative to typical physical education (PE), recess, or classroom teaching.²⁷ As school time is under many conflicting demands,²⁸ it is important to assess the efficacy of school-based AVG interventions as a means to boost physical activity levels. The objective of this systematic review is to present current evidence on school-based AVGs and their relationship with health and physical activity outcomes including motor skills in children and youth aged 5 years and over.

Methods

The systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.²⁹

AVG	Active video game
BMI	Body mass index
MVPA	Moderate to vigorous physical activity
PE	Physical education

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To be included, studies needed to feature AVGs as an intervention exposure in school: within a lesson, during break-time, or before or after the school day. To enable assessment against typical school practice, a study design featuring either a control group or comparison phase was required. Studies also required a specific measure of at least 1 health or physical activity-related outcome including motor skills and physical fitness: whether direct (eg, accelerometer, body composition measurement) or indirect (eg, self- or teacher-report). Studies featuring pupils of any health or disability status were included.

Studies were excluded if they featured participants aged 18 years and over, passive video games only, nonschool settings, or if AVGs were included only as a control group or as part of a complex intervention. Study protocols and reviews were also excluded. Because of feasibility, non-English language papers were excluded.

A systematic search was carried out during April to May 2015 using ERIC, PsycINFO, PubMed, SPORTDiscus, and Web of Science electronic databases. Titles and abstracts were searched with 3 separate strings representing AVGs generally, specific AVG consoles and products, and school environment (Figure 1). Reference lists of included papers and gray literature^{30,31} were also searched.

A standardized data extraction form was used to record information about each study, including study design, sampling strategy, and AVG intervention details. Data extraction took place between April and June 2015 by 1 reviewer and checked by another for accuracy. Reported results were assessed in terms of their associations of school-based AVGs and health or physical activity outcomes. Studies were divided and presented according to the outcomes assessed. Effect sizes were reported as given in each study, commonly given as Cohen *d*, partial eta squared η^2 , or Glass Δ . If these were not provided, Cohen *d* was calculated with the means and SD of AVG intervention and control groups where provided, using the formula $d = M_i - M_c / s_{pooled}$.^{32,33} We chose to present the results of the review descriptively as heterogeneity of outcomes measured was too large to realistically undertake a meta-analysis.

The Effective Public Health Practice Project tool³⁴ was used to guide assessments of study quality. This intervention rating scale is composed of 6 components, assessing study design, selection bias, addressing of confounders, data collection methods (validity and reliability), and reporting of participant attrition and blinding. Strong, moderate, or weak scores were awarded in each category. An overall rating was then applied for each study, with a “strong” rating representing no weak ratings overall, a “moderate” rating representing 1 weak rating, and a “weak” rating representing 2 or more weak ratings.³⁴

Results

A total of 9020 articles were identified (Figure 2). The 22 included studies presented data from 18 different interventions (2 studies^{35,36} were from the same intervention, and 3 other studies³⁷⁻³⁹ were from another intervention). Twelve studies were performed in the US, 5 in the United Kingdom, 2 in Canada, 1 in Greece, 1 in The Netherlands, and 1 in Singapore.

Sample sizes ranged from $N = 4$ ^{35,36} to $N = 1112$,⁴⁰ with 4 studies having sample too small to permit significance testing.^{35,36,41,42} A total of $N = 3728$ were studied across all 22 studies. Across all studies, $N = 2332$ (62.6%) participants took part in AVG conditions and $N = 1997$ (53.5%) in control conditions; $N = 1299$ (34.8% overall sample) assessed health outcomes of BMI ($N = 1114$; 29% overall sample) and body composition ($N = 682$; 18.3% overall sample); and $N = 3371$ (90.4% overall sample) assessed physical activity outcomes and $N = 258$ (6.9% overall sample) assessed motor skills. Across the studies, participants ranged from 5-15 years old,⁴³ with 18 studies held in elementary schools, 1 in secondary schools,⁴⁴ and 3 studies held across elementary and secondary school ages.^{40,43,45} Overall, $N = 1723$ (46.2%) of participants were girls, and 3 studies featured students with balance disorders^{42,46} or autism⁴³ ($N = 146$; 3.9% overall sample).

Eight studies were forms of repeated measures designs, with all participants participating in AVG and control

Search strategy

1. Active video gam* or AVG* or video gam* or exergam* or dance simulation

OR

2. Nintendo* or Wii* or Xbox* or Kinect or Playstation* or EyeToy or DDR or Dance Revolution or interactive whiteboard* or PC

AND

3. school* or lesson* or class* or curricular* or physical education or PE or P.E* or physical* or activit* or exercise*

Figure 1. Search strategy.

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