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Review Article

School-based physical activity interventions and physical activity enjoyment: A meta-analysis

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ABSTRACT

The purpose of this meta-analysis was to examine the effectiveness of school-based physical activity interventions on increasing students' physical activity enjoyment. An internet search with several databases using the keywords “Adolescents”, “Children”, “Enjoyment”, “Physical Activity”, and “Schools” was performed yielding over 200 published studies. Studies were eliminated based on the lack of experimental manipulation (i.e., non-intervention studies), no assessment of physical activity enjoyment as an outcome variable, a lack of a control or comparison group, and no reporting of the effect estimate's variability (i.e., standard deviation, standard error, etc.). This procedure resulted in 10 studies being examined in the meta-analysis. Data were analyzed in the state of Utah, USA in 2017. The Hartung-Knapp-Sidak-Jonkman method for a random effects meta-analysis was employed with studies being weighted by inverse variance. The pooled Standardized Mean Difference = 0.38 (95% C.I. [0.10–0.65], $p = 0.011$). Cochran's Q test showed statistical significance ($p < 0.001$) and the $I^2 = 76.6\%$, suggesting large heterogeneity across the 10 studies. Egger's regression model yielded an intercept coefficient that was statistically significant (bias = 3.28, 95% C.I. [0.21–6.36], $p = 0.039$), indicating the presence of small-study effects. This meta-analysis provides evidence that school-based physical activity interventions can be effective in increasing physical activity enjoyment in children and adolescents. However, the magnitude of the pooled effect was small-to-moderate and there was evidence for publication bias and large between-study heterogeneity.

1. Introduction

Physical activity enjoyment is a motivational construct that is a significant determinant of children's and adolescent's physical activity behaviors (Gao et al., 2012; Hagberg et al., 2009). Enjoyment is a psychological experience characterized by fun, liking, and pleasure and may be influenced by multiple factors, such as physical activity intensity, how a child or adolescent perceives success and failure, and the child or adolescent's emotional state prior to physical activity participation (Briggs, 1994; Gao et al., 2012; Smith and St. Pierre, 2009; Wankel, 1993). Past observational research has indicated that children and adolescents are more likely to participate in physical activity when they perceive it to be enjoyable (Gao et al., 2012, 2013; Wankel, 1993). Physical activity enjoyment has also been linked with sustained physical activity participation (Cairney et al., 2012; Gao et al., 2012, 2013; Prochaska et al., 2003). Importantly, a child's or adolescent's continuous participation in optimal levels of physical activity has been related to a plethora of beneficial health and performance outcomes such as improved body composition and cardio-respiratory endurance, decreases in cardio-metabolic risk factors, improved cognitive functioning, and increases in on-task classroom behavior (Boddy et al., 2014; Trudeau and Shephard, 2008).

Because most children and adolescents spend a majority of waking day hours in school, the school environment has increasingly become a target for physical activity interventions. Several successful school-based physical activity interventions have been implemented over the past couple of decades including (but not limited to): Sports, Play, and Recreation for Kids (SPARK) (Sallis et al., 1997), Middle School Physical Activity and Nutrition (M-SPAN) (McKenzie et al., 2004), Trial Activity for Adolescent Girls (TAAG) (Webber et al., 2008), the Comprehensive School Physical Activity Program (CSPAP) (Brusseau et al., 2016), and the NFL “Play 60” program (Bai et al., 2015). An issue that has manifested from some of these interventions is the sustainability of the effect of increasing physical activity and health-related fitness. The novelty and unique methodologies of these programs may initially elicit increases in physical activity behaviors. However, over time, physical activity behaviors may return to approximate baseline levels due to relative decreases in motivational constructs. Indeed, optimizing

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enjoyment in this context may play a critical role in maintaining physical activity involvement in children and adolescents. Although most school-based intervention studies target objective physical activity and health-related fitness as the primary outcomes (Bai et al., 2015; Brusseau et al., 2016; McKenzie et al., 2004; Sallis et al., 1997; Webber et al., 2008), physical activity enjoyment should also be included as a primary outcome because this construct may be an important determinant of the longitudinal efficacy of a respective intervention on sustaining elevated physical activity behaviors (Cairney et al., 2012; Prochaska et al., 2003).

Motivational constructs, such as physical activity enjoyment, have been extensively explored within observational research designs. These observational studies have explored enjoyment's relationship with objectively assessed physical activity and specific domains of health-related fitness (e.g., body composition and cardio-respiratory endurance) (Briggs, 1994; Gao et al., 2012, 2013; Jin et al., 2017), in addition to longitudinal enjoyment trends across age groups or grade levels (Cairney et al., 2012; Prochaska et al., 2003). However, the targeting of these motivational constructs, particularly enjoyment, as an intervention outcome or dependent variable has been surprisingly limited within the current literature. Additionally, to date, there has been no research that has examined the cumulative pooled effect of recently published school-based physical activity interventions on increasing physical activity enjoyment in the pediatric population. Therefore, the purpose of this study was to perform a meta-analysis on the effectiveness of school-based physical activity interventions to increase physical activity enjoyment in children and adolescents using intervention studies published within the past 15 years.

2. Methods

2.1. Search procedures and inclusion criteria

An internet search with several databases using the keywords “Adolescents”, “Children”, “Enjoyment”, “Physical Activity”, and “Schools” was performed yielding over 200 studies published within the past 15 years. The internet databases included MEDLINE (PubMed), Scopus, EMBASE, and SportDiscus. Studies were then selected from this initial pool in three steps. The first selection step extracted intervention studies targeting physical activity enjoyment as an outcome variable from observational studies or from studies only using physical activity enjoyment as a covariate or as a moderating variable. The majority of the originally identified studies were excluded after this first selection step. The second step further discriminated the studies based on whether a control or comparison group was utilized within the research design from studies that utilized a pre-test/post-test design with no control group. It is acknowledged that studies utilizing pre-test/post-test designs without a control group can still provide valid information, however it was determined that studies lacking a control or comparison group may increase heterogeneity in the meta-analysis. Therefore, studies that did not have a control or comparison group, utilizing a single-group pre-test/post-test design, were excluded. The third and final selection step involved eliminating studies if insufficient information was provided within the published manuscript that was needed to calculate the standardized mean differences (see Calculation of Effect Size). This three-step selection procedure yielded 10 studies used in the subsequent meta-analysis.

2.2. Study characteristics

Study characteristics related to methodology are communicated in Table 1. A total of 2617 children and adolescents were included across the 10 selected studies. Mean age of the samples ranged from 6.40 to 15.04 years. Intervention durations lasted anywhere from 6 weeks to 20 months and employed a variety of methodologies during various school segments, such as during physical education (n = 7), lunchtime (n = 1), and after school (n = 1). One study employed a multi-component intervention approach (n = 1). Intervention programs focused on student-centered methodologies and emphasized health-related fitness and physical activity enjoyment. These programs included the Sports, Play, and Recreation for Kids (SPARK) (Fu et al., 2016, 2013), the Sports Education teaching model (Spittle and Byrne, 2009; Wallhead and Ntoumanis, 2004), and other tailored programs such as “GoGirlGo!” for girls and active video gaming in a sample of Chinese children (Huberty et al., 2014; Lau et al., 2016). The intervention programs were either contrasted to the Traditional physical education teaching model (comparison group) or to a group where there was no program implementation (control group). Studies were located in Australia (n = 2), China (n = 1), England (n = 2), Norway (n = 1), and the United States (n = 4). Given the statements provided, various ethical review boards approved the protocols used in each of the respective studies.

2.3. Physical activity enjoyment assessment

A variety of physical activity enjoyment assessment instruments were employed across the 10 studies, all of which displayed test-retest reliability and construct validity evidence given the information provided in each of the manuscripts (Brustad, 1993; Cuddihy et al., 2002; Hyndman et al., 2013; Kendierski and DeCarlo, 1991; Liang et al., 2014; Motl et al., 2001; Ryan, 1982; Scanlan et al., 1993). The Intrinsic Motivation Inventory (IMI) was used in three of the studies (Fairclough et al., 2016; Spittle and Byrne, 2009; Wallhead and Ntoumanis, 2004), the Sport Enjoyment Scale was used in two of the studies (Fu et al., 2016, 2013), the Physical Activity Enjoyment Scale (PACES) was also used in two studies (Huberty et al., 2014; Schneider and Cooper, 2011), and other validated instruments were employed on the remaining studies' samples (Bergh et al., 2012; Hyndman et al., 2013; Jin et al., 2017; Lau et al., 2016). The assessment instruments were usually administered during school hours, specifically during physical education or health education class.

2.4. Calculation of effect size

For each selected study, three pieces of information were used to calculate the effect sizes or standardized mean differences (SMDs). These pieces of information included: 1.) the intervention and control group's sample sizes, 2.) the intervention and control group's mean differences on physical activity enjoyment, and 3.) the standard deviation of the intervention and control group's mean differences on physical activity enjoyment. SMDs rather than absolute mean differences were used because of the discordance in physical activity enjoyment assessment instruments employed across the 10 studies. Studies that did not sufficiently communicate the aforementioned information were excluded from the meta-analysis.

2.5. Statistical analysis

The following meta-analysis tested the null hypothesis that the overall effect (pooled SMD) of physical activity interventions on increasing physical activity enjoyment across studies was 0. Initially, using STATA's “metan” command, the DerSimonian and Laird random effects model was employed with the estimates of heterogeneity taken from the inverse-variance fixed-effect model. Studies were weighted by inverse variance, which included both within-study and between-study variance (i.e., heterogeneity). Individual study effects and the overall summary effect (i.e., pooled SMD) were reported within a Forest Plot with corresponding 95% Confidence Intervals. Results from the DerSimonian and Laird method were then converted to results using the Hartung-Knapp-Sidak-Jonkman method via the procedures outlined in IntHout et al. (2014). This post hoc conversion was employed because the Hartung-Knapp-Sidak-Jonkman method yields more adequate error