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Original article

Twelve weeks of dance exergaming in overweight and obese adolescent girls: Transfer effects on physical activity, screen time, and self-efficacy

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Abstract

Background: Given the low levels of physical activity (PA) among adolescent girls in the US, there is a need to identify tools to motivate increased PA. Although there is limited evidence that adolescents transfer PA from one context to another, exergames (i.e., video games that require gross motor activity) may act as a gateway to promote overall PA outside game play. The purpose of this study was to examine potential transfer effects (i.e., influences on external behaviors and psychological constructs) of a 12-week exergaming intervention on adolescent girls' PA, screen time, and self-efficacy toward PA, as well as the intrinsic motivation of exergaming.

Methods: Participants were 37 girls aged 14–18 years (65% African American, 35% white) who were overweight or obese (body mass index ≥ 85th percentile) and were recruited from the community via school, physicians, news media, and social media websites. Adolescents were randomly assigned to a 12-week group exergaming intervention (thirty-six 60 min sessions of group-based dance exergaming in a research laboratory using Kinect for Xbox 360 (Microsoft Corporation, Redmond, WA, USA)) or to a no-treatment control group. Outcome variables included objectively measured PA (total) and self-reported leisure-time PA (discretionary time only) 1 week before *vs.* 1 week after the intervention; selected type and intensity of PA when placed in a gym setting for 30 min ("cardio free choice"); screen time; self-efficacy toward PA; and intrinsic motivation toward exergaming.

Results: Attendance at the exergaming sessions was high (80%). Compared with the control group, the intervention group self-reported an increase in PA ($p = 0.035$) and fewer hours watching television or videos ($p = 0.01$) after the intervention, but there were no significant differences in sedentary, light, moderate, or vigorous PA measured by accelerometry. The intervention group significantly improved self-efficacy toward PA ($p = 0.028$). The intervention group highly rated intrinsic motivation toward exergaming.

Conclusion: Exergaming for 12 weeks was associated with positive impacts on adolescent girls' self-reported PA, television viewing, self-efficacy, and intrinsic motivation. Future research is warranted to leverage exergames as an enjoyable, motivating, and effective PA tool.

Keywords: Active video games; Leisure activity; Motivation; Screen time; Self-efficacy; Television

1. Introduction

The average American adolescent spends 62 h each week in front of a screen.[1] In contrast, only 8% of 12- to 15-year-olds meet National Physical Activity Guidelines of 1 h of daily moderate-to-vigorous physical activity (PA),[2] with adolescent girls having particularly low levels of PA.[3] Insufficient PA is a major contributor to obesity, which affects 18% of adolescent girls in the USA[3] and 61% of obese adolescents with at least 1 risk factor for cardiovascular disease.[4]

Leveraging adolescents' interest in video games is an innovative approach to combating pediatric obesity and physical inactivity, but motivation to be physically active remains a major barrier.[5] New-generation video games (i.e., exergames) require whole body movement, thereby yielding light to moderate levels of energy expenditure and elevated heart rate, which could potentially contribute to weight loss and cardiovascular health benefits.[6] Exergames, or active video games, are popular among youth: in a study of 1241 adolescents (age: 16.80 ± 0.05 years, mean ± SD), 24% reported playing exergames with an average play time of 50 min per session 2 days per week.[7] It is important that systematic reviews and meta-analyses indicate that exergaming can reach criteria of moderate- to vigorous-intensity activity.[8–10] Whole body movement while exergaming, such as during dance exergames, can reach levels of moderate

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intensity,[9,10] and exergaming that involves lower body movement produces higher energy expenditure than exergaming that uses just the arms.[8]

Despite the extensive evidence that exergaming can reach levels of moderate-intensity PA, it is not known whether being physically active by means of an exergame may influence an adolescent to become more physically active outside game play (i.e., "transfer effects"). There is limited evidence that adolescents transfer PA from one context to another. Prior data indicate that obese children aged 10–17 years experienced significantly increased self-reported PA and decreased screen time after a 12-week exercise trial involving 2 supervised and 1 home-based 45 to 60 min exercise sessions per week.[11] However, these exercises involved traditional gym equipment, including aerobic and resistance exercises. One randomized within-subjects trial in 26 male adolescents found higher levels of energy expenditure measured by indirect calorimetry during a 1 h exergaming session on the Kinect for Xbox 360 *vs.* a 1 h seated video game, yet there were no significant condition differences measured by accelerometry on boys' PA levels over 3 subsequent days.[12] The potential influence of a longer duration of exergaming on adolescents' activity choices, screen behaviors, or habitual PA is not known.

In addition to limited evidence of behavioral transfer from exergaming, there is also limited evidence of psychological transfer of exergaming to improve adolescents' psychosocial health. Specifically, both self-efficacy[13] and intrinsic motivation[14] have been identified as targeted mediators to promote adolescent girls' PA. Exergaming, particularly in a group setting, may increase self-efficacy related to PA[15] and exergaming,[16] as well as intrinsic motivation.[17] According to social cognitive theory,[18] behavioral change results from links among behaviors (e.g., exergame play), the environment (e.g., social interaction), and psychosocial variables (e.g., self-efficacy). Group cohesion in digital game play[6] may appeal to obese youth, who are less likely to engage in traditional sports owing to weight criticism.[19] Group exergame play may, therefore, improve the poor psychosocial health often experienced by overweight youth and thereby facilitate increased total PA levels.[6]

The aim of this study was to examine potential transfer effects, that is, influences of exergaming on external behaviors (PA levels, screen time) and psychological constructs (self-efficacy), of a 12-week exergaming intervention, as well as adolescents' intrinsic motivation related to exergaming.

2. Methods

2.1. Participants

Forty-two overweight or obese adolescent girls participated in an exergaming intervention or were placed in a no-treatment care control group. Participants were recruited from the greater Baton Rouge, LA, area via schools, health clinics, community events, e-mail listservs, news media, and social media websites. Participants were female, between 14 and 18 years of age, and postmenarcheal; had a body mass index percentile ≥ 85; and were free of serious medical conditions that contraindicated exercise or video game play. Thirty-seven participants had complete data for the accelerometry and were included in the present analysis.

2.2. Procedures

These data were collected as secondary outcomes in a trial designed to examine the effects of exergaming on body composition and cardiovascular risk factors; a complete description of the intervention and study methods is published elsewhere.[20] Study procedures were approved by the Pennington Biomedical Research Center Institutional Review Board. Parents and adolescents provided written consent and assent, respectively. Participants completed a baseline clinic visit. At the end of the clinic visit, participants were randomly assigned to the intervention or a no-treatment control group.

In the intervention condition, participants attended 60 min group exergaming sessions 3 times per week for 12 weeks, whereas the control group was instructed to maintain current level of activity for 12 weeks. The intervention occurred outside school time in a dance studio at Pennington Biomedical, where 3 to 4 exergaming stations were available, each equipped with the Kinect for Xbox 360 gaming console (Microsoft Corporation, Redmond, WA, USA), a television, and the following exergames: Just Dance (Just Dance 3, Just Dance 4, Just Dance 2014, and Just Dance Greatest Hits; Ubisoft, Rennes, France) and Dance Central (Dance Central 2 and Dance Central 3; Microsoft Game Studios, Redmond, WA, USA). Exergames focused on dancing were selected to encourage whole body movement and moderate-intensity energy expenditure.[9,10] Three "gaming coaches" were present to supervise the sessions, and 2–12 participants were present at any given time. Participants self-selected the games, songs, dance mode, intensity level, and dance partner. All participants completed final measurements in Week 13, which was 1 week after the intervention ended.

2.3. Measures

2.3.1. Anthropometry

Height and weight were measured using standardized clinic procedures.

2.3.2. PA

Intervention participants wore Omron GoSmart pedometers (Omron Healthcare Inc., Bannockburn, IL, USA) during exergaming and recorded steps at the end of each session. Accelerometry (ActiGraph GT3X+; ActiGraph Inc., Fort Walton Beach, FL, USA) was used to assess habitual PA at baseline and follow-up. Participants were instructed to wear the accelerometer on a belt around their waist during all waking hours for 7 full days. Accelerometers were worn 1 week prior to the intervention and 1 week after the end of intervention (therefore after exergaming sessions had ended). Whereas the accelerometer captured total daily PA, the Godin-Shephard Leisure-Time Physical Activity Questionnaire[21] was used to specifically capture PA during leisure time (i.e., discretionary time). This self-report instrument has been validated against the Caltrac accelerometer (Muscle Dynamics, Torrance, CA, USA) ($r = 0.45$; $p < 0.01$) and other self-report surveys (e.g., $r = 0.61$ with the Baecke Physical Activity Questionnaire).[22]