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## CHILDREN'S PHYSICAL ACTIVITY LEVELS AND PSYCHOLOGICAL CORRELATES IN INTERACTIVE DANCE VERSUS AEROBIC DANCE

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Original article

# Children’s physical activity levels and psychological correlates in interactive dance versus aerobic dance

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## Abstract

**Purpose:** The purpose of this study was to compare children’s physical activity (PA) levels, self-efficacy, and enjoyment when experiencing dance-exergaming (Dance Dance Revolution, DDR) and aerobic dance in physical education.

**Methods:** A total of 53 urban fourth grade children were divided into two groups, with one group playing DDR and the other group engaged in aerobic dance. After 15 min, the groups switched activities and continued their respective activities for another 15 min. Participants wore NL-1000 pedometers in four consecutive sessions, and responded to a questionnaire measuring their self-efficacy and enjoyment toward two dance activities at the end of the first session.

**Results:** Children spent more moderate-to-vigorous PA (MVPA) time ( $p < 0.01$ ,  $\eta^2 = 0.49$ ) in aerobic dance than DDR. Additionally, children reported significantly higher self-efficacy ( $p < 0.001$ ,  $\eta^2 = 0.28$ ) and enjoyment ( $p < 0.01$ ,  $\eta^2 = 0.18$ ) in DDR than in aerobic dance.

**Conclusion:** Health care professionals and educators may not replace the traditional PAs and sports with interactive video games, but may use exergaming as an excellent addition to promote PA.

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**Keywords:** Dance Dance Revolution; Enjoyment; Moderate-to-vigorous physical activity; Self-efficacy

## 1. Introduction

The prevalence of childhood obesity has increased dramatically in the U.S. partially due to physical inactivity in the past decades,<sup>1,2</sup> which raises serious concerns to the nation’s public health<sup>3</sup> as obesity is the underlying factor of many chronic diseases such as type 2 diabetes. Participation in regular physical activity (PA) plays a key role in promoting

children’s health and well-being.<sup>4,5</sup> Although school physical education (PE) programs can be an ideal vehicle to contribute significant amount of PA to children’s daily total PA,<sup>6,7</sup> researchers suggested that PE, unfortunately, have not provided sufficient PA for children.<sup>8,9</sup> Thus, exploring innovative approaches to promote and maximize children’s PA in PE becomes very critical to health care professionals and educators.

Research evidence has shown that PE content has different effects upon children’s motivation<sup>10–12</sup> and PA levels.<sup>11,12</sup> For example, children’s self-efficacy, intrinsic motivation, and PA levels varied as a function of learning content.<sup>11,12</sup> However, most empirical studies in this area of inquiry have focused on the traditional PAs. The inclusion of active video games (exergaming), which require PA in playing the games,<sup>13</sup> in PE has been overlooked. Therefore, empirical studies examining the effects of exergaming and its corresponding traditional activity are warranted.

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According to Dishman and colleagues,<sup>14,15</sup> adolescent girls tended to engage in PAs with which they felt competent and enjoyed. In other words, children's self-efficacy and enjoyment are two often identified correlates of their PA participation. Specifically, self-efficacy refers to the perception of one's ability to successfully perform a particular task.<sup>16</sup> It is deemed as a major positive predictor for children's in-class PA levels in PE.<sup>16,17</sup> Enjoyment is defined as a positive state of emotion that reflects generalized feelings such as pleasure, liking, and fun. The level of enjoyment is a critical determinant for children's PA choices.<sup>15</sup> In fact, Dishman et al.<sup>15</sup> indicated children's most frequently reported reason for PA participation was their enjoyment. These psychosocial factors recently have been examined in the exergaming field to explore participants' psychosocial correlates of PA.<sup>18,19</sup> For instance, Gao and colleagues<sup>18</sup> suggested that a 9-month Dance Dance Revolution (DDR) program had a positive effect on elementary school children's self-efficacy and social support.<sup>18</sup> Gao et al.<sup>19</sup> also indicated that children's intrinsic motivation toward DDR was a positive predictor for PA enjoyment and PA behaviors. Hence, self-efficacy and enjoyment, as motivators for PA behaviors, were used as the psychosocial correlates of PA in the present study.

Despite the negative impact of sedentary video games on obesity, exergaming has potential to help promote PA in youth.<sup>19–22</sup> Currently, exergaming has been increasingly used at schools as an innovative and fun approach to promoting PA.<sup>11,23–25</sup> For example, DDR combines real physical dancing requiring fast-foot movement with energetic music and visuals, which serves as an important bridge to capture children's interest and promote a health-enhancing level of PA.<sup>23–26</sup> Researchers have recently investigated the benefits of exergaming as a means for increasing PA. Empirical studies suggested that exergaming enables light-to-moderate PA, and is effective in promoting children's PA level<sup>24,27,28</sup> and psychosocial benefits.<sup>18,29</sup> However, investigations have primarily been conducted in the laboratory or extracurricular settings with small samples of Non-Hispanic White individuals. Empirical evidence tended to compare children's PA between exergaming and other traditional exercise or sedentary video games. The comparisons between the effects of dance-exergaming and the corresponding aerobic dance activities on PA levels measured by pedometers and PA psychosocial correlates (e.g., self-efficacy and enjoyment) remain unanswered. Emerging evidence also suggests that a single-dimension approach (e.g., effects of DDR on energy expenditure) to studying exergaming may overlook the effects of exergaming on multiple aspects of a child's physical and psychosocial domains.

In summary, it is evident that exergaming has the potential to exert positive effects on children's PA and psychosocial beliefs. Yet comparisons between such effects and the effects from traditional aerobic dance exercise remain largely unexplored. Therefore, the purpose of this study was to determine the differences in children's PA levels and psychosocial correlates of PA (self-efficacy and enjoyment) in DDR and aerobic dance in PE. Based on previous studies,<sup>23–28</sup> we

hypothesized that children would have similar PA levels in DDR and aerobic dance. Second, we hypothesized that children would display higher self-efficacy and enjoyment toward DDR than they would toward aerobic dance in PE.

## 2. Methods

### 2.1. Participants

Participants were 53 urban fourth grade children (24 boys, 29 girls; mean age = 10.3 years) from an urban public elementary school in the U.S. Approximately 73% of children were from low socioeconomic status families. The inclusion criteria for this study were: a) children aged 10–11 years; b) children attended all the sessions during data collection; and c) children turned in parental informed consent forms and assent forms. All children provided parental permission and assent to participate in this study. Children who had genetic diseases, injuries, or illnesses that limited their participation were excluded. The inclusion criteria were verified through a self-report questionnaire and classroom teacher reports. Exclusion criteria were verified via information provided in parental consent forms.

### 2.2. Research design

A repeated measures design was used in this study. All children participated in a 9-month DDR-based program that was integrated in regular PE (three 30-min sessions per week). The class size was about 26. In addition to DDR and aerobic dance, PE classes included other sports and fitness activities, such as jumping rope, volleyball, soccer, *etc.* Prior to data collection began, the children had 3 weeks' experience with the DDR and aerobic dance (i.e., 9 lessons) respectively. All children wore pedometers under the supervision of the research assistants during that period. Thus the reactive effects to the pedometer and the researchers were minimized.

In the data collection period, participants were divided into two groups during each 30-min PE session, with one group playing DDR and the other group was engaged in aerobic dance for 15 min. The groups then switched dance activities in the second 15 min. Participants wore pedometers in four consecutive sessions; and sequences for playing (DDR or aerobic dance) were count-ordered. They also responded to a questionnaire measuring their self-efficacy and enjoyment toward DDR and aerobic dance at the end of the first PE session. Informed parental consent and child assent were obtained in accordance with University Institutional Review Board and school district requirements prior to the data collection.

The DDR program was offered and monitored by the researcher and research assistants. Detailed information with regard to how to play DDR is presented elsewhere.<sup>11</sup> In the present study, children played DDR in the Game Mode. Eight DDR stations were set up next to the walls of the gym with each DDR station accommodating two children. Generally, the classroom teachers supervised the class behaviors for the DDR

program. For the aerobic dance, a well-trained research assistant led the children to dance in the center of the gym. All children had 3 weeks of experiencing DDR and aerobic dance in the same environment before the data collection began, thus the confounding effect of participating the two activities in the same gymnasium was minimized.

### 2.3. Instruments

#### 2.3.1. PA levels

Participants' PA levels were measured using NL-1000 piezoelectric pedometers (New Lifestyles Inc., Lee's Summit, MO, USA). The NL-1000 is an accurate pedometer to measure children's PA levels in the field settings.<sup>30</sup> This pedometer has an accurate moderate-to-vigorous PA (MVPA) timer. That is, in addition to accurately counting steps, the NL-1000 also detects the intensity of each step displaying intensity as MVPA time accumulation.<sup>30</sup> Prior to the study, Vincent and Sidman's<sup>31</sup> recommended procedures were followed to validate the pedometers. In particular, the pedometer was shaken vertically 100 times and the error between shaken and recorded steps was examined for each pedometer. Deviation from the 100 shakes for all pedometers was less than 5%. The validation demonstrated that the pedometers could provide accurate step counts and estimated time in MVPA. In this study, children were instructed to reset the pedometers to zero before performing DDR/aerobic dance. Research assistants recorded the steps and MVPA time at the end of the 15-min session. Then children again reset the pedometers to zero before moving to the next 15-min session (i.e., aerobic dance/DDR). Their steps and MVPA time also were recorded at the end of the session. In the present study, children's MVPA times were retrieved directly from the recorded outputs and were used as the outcome variable.

#### 2.3.2. Self-efficacy

To measure children's self-efficacy, three items were adopted from Gao et al.<sup>16</sup> Specifically, participants responded to the items using a 5-point Likert-type scale (1 = strongly disagree, 5 = strongly agree), with the item "With regard to DDR/aerobic dance, I have confidence in...". The answers were: (a) my ability to do well in DDR/aerobic dance; (b) my ability to learn skills well in DDR/aerobic dance; and (c) my performance in DDR/aerobic dance. The means of these items were used as a measure of children's self-efficacy toward DDR or aerobic dance in PE, respectively.

#### 2.3.3. Enjoyment

The measure of enjoyment was from an assessment instrument used by Ommundsen et al.<sup>32</sup> Five items were used to assess children's enjoyment in DDR/aerobic dance with children responding on a 5-point Likert scale as that of self-efficacy. The five items were: (a) I have more fun playing DDR/aerobic dance than doing other things; (b) Playing DDR/aerobic dance is the thing I like to do best; (c) I wish I could play more DDR/aerobic dance than I get chance to; (d) I usually prefer to watch rather than play DDR/aerobic dance; and (e) I

really like playing DDR/aerobic dance at school. The means of these items were used as a measure of children perceived enjoyment toward DDR or aerobic dance in PE, respectively.

### 2.4. Data analyses

All the data (i.e., MVPA, self-efficacy, and enjoyment) were entered manually into SPSS 15.0 (SPSS, Inc., Chicago, IL, USA). Data were analyzed in four steps. First, Cronbach's  $\alpha$  coefficients were utilized to examine the internal consistency of the self-report measures used in this study. Descriptive statistics (e.g., means of MVPA time and self-efficacy) were performed. Second, analysis of variance (ANOVA) was used to examine the sequence differences on all the study variables. Additionally, a one-way ANOVA with repeated measures for children's MVPA was conducted for children's PA levels with dance condition as the independent variable. Finally, multivariate analysis of variance (MANOVA) with repeated measures for children's PA correlates (i.e., self-efficacy and enjoyment) was performed. The within-subject factor was time (i.e., two times; one for DDR and one for aerobic dance). The  $\alpha$  level of 0.05 was used for all statistical analyses.

## 3. Results

Cronbach's  $\alpha$  coefficients for self-efficacy and enjoyment are 0.82 and 0.79 for DDR, and 0.80 and 0.78 for aerobic dance, respectively. The coefficients exceeded the minimum recommended value of 0.70, which indicated the self-reported instruments had acceptable internal consistency in the target population. Table 1 shows the descriptive statistics for the whole sample across different dance conditions. In general, children displayed relatively high self-efficacy and enjoyment toward DDR, as the mean scores of these variables were above the midpoint of the measures (i.e., 3). They also had moderate levels of self-efficacy and enjoyment toward aerobic dance. Additionally, children spent approximately 21% of time in MVPA time in DDR and 31% of time in MVPA time in aerobic dance. The ANOVA for the sequence differences indicated that there was no significant difference between the sequences for taking DDR/aerobic dance,  $F(1, 52) = 1.32$ ,  $p > 0.05$ .

The one-way ANOVA with repeated measures for MVPA time yielded a significant main effect for dance condition, Hotelling's Trace = 0.966,  $F(1, 52) = 50.26$ ,  $p < 0.01$ ,

Table 1  
Descriptive statistics in DDR and aerobic dance groups (mean  $\pm$  SD).

	DDR	Aerobic dance
MVPA (min)	3.16 $\pm$ 1.55	4.66 $\pm$ 1.93*
Enjoyment	3.42 $\pm$ 0.70	2.96 $\pm$ 0.93*
Self-efficacy	4.22 $\pm$ 0.64	3.53 $\pm$ 1.12*

Abbreviations: DDR = Dance Dance Revolution, MVPA = moderate-to-vigorous physical activity (15 min total).

\* $p < 0.01$ , compared with DDR group.

$\eta^2 = 0.49$ . That is, children demonstrated significantly higher MVPA time in aerobic dance than they did in DDR (Table 2). Similarly, the MANOVA with repeated measures yielded a significant main effect for dance condition, Hotelling's Trace = 0.416,  $F(2, 48) = 9.97$ ,  $p < 0.01$ ,  $\eta^2 = 0.29$ . Follow-up univariate tests indicated that children reported significantly higher self-efficacy,  $F(1, 49) = 18.81$ ,  $p < 0.01$ ,  $\eta^2 = 0.28$ , and higher enjoyment,  $F(1, 49) = 10.57$ ,  $p < 0.01$ ,  $\eta^2 = 0.18$ , in DDR compared to aerobic dance (Table 3).

#### 4. Discussion

The purpose of the present study was to investigate whether children's PA levels and PA correlates (self-efficacy and enjoyment) differed as a function of different aerobic activities (DDR vs. aerobic dance). This study found that fourth grade children exhibited more estimated MVPA time in aerobic dance than they did in DDR. It does not support our first hypothesis, as we anticipated the effect of DDR on children's PA levels was similar to that of traditional aerobic activity. A number of laboratory-based studies indicated exergaming was an effective approach that may facilitate mild-to-moderate intensity PA promotion, and that the effect sizes (0.17–0.28) of playing exergaming on individuals' heart rate, energy expenditure, and maximum oxygen consumption were equivalent to traditional PAs.<sup>21,33</sup> As known, DDR has a Workout Mode (i.e., Workout Mode, Game Mode, and Tutorial Mode) that allows players to track how many calories they burn as they play, and therefore it is considered a good aerobic exercise. However, our finding does not favor exergaming in this regard as compared to aerobic dance in this study. We speculate that, not like Workout Mode which allows fluent flow during playing, Game Mode of DDR used in this study was intermittent in nature because children had to stop and make choices from time to time in this mode. Therefore the PA patterns were not uniform across the DDR session. Second, children focused primarily on feet movement when playing DDR. The activity intensity varies greatly across different games and gaming systems. For example, MVPA is significantly greater for games that involve the whole body movement (i.e., Wii DDR requiring four limbs movement) as compared with lower body. But DDR requires only lower body movement during game playing.

Interestingly, our finding in the present study is in line with several recent exergaming studies using accelerometers as instruments to measure PA in PE.<sup>11,29,34</sup> For example, Gao and colleagues<sup>11</sup> suggested that junior high school students were

Table 2  
ANOVA parameters for physical activity.

Source	d.f.	Sum of squares	Mean squares	F	Significance	Partial eta squared
Time	1	59.34	59.34	50.26	0.000*	0.49
Error	52	61.40	1.18			
Total	53					

\* $p < 0.01$ , between DDR and aerobic groups.

Table 3  
MANOVA parameters for self-efficacy and enjoyment.

Source	Variable	d.f.	Sum of squares	Mean squares	F	Significance	Partial eta squared
Time	Self-efficacy	1	11.79	11.79	18.81	0.000*	0.28
	Enjoyment	1	5.29	5.29	10.57	0.002*	0.18
Error	Self-efficacy	49	30.71	0.63			
	Enjoyment	49	24.53	0.50			
Total		50					

\* $p < 0.01$ , between DDR and aerobic groups.

not physically active in DDR unit in PE. Similarly, Sun<sup>34</sup> found that fourth grade children displayed significant lower in-class PA levels in exergaming unit than they did in a fitness unit. It is plausible that children played exergaming intermittently in PE setting but consecutively in laboratory settings. In general, a typical PE class is composed of warm-up, instructions, skill practice or drills, game play, and cool down in which a large percentage of PE class time (approximately 30%–40%) is spent in class management and instruction. As such, children's PAs are intermittent in nature in PE. On the other hand, the studies conducted in laboratory settings are devoted specifically in target activities or performance tests, which minimize the non-activity time. Further explanation for this difference deserves in-depth investigation.

We found that children demonstrated higher self-efficacy and enjoyment toward DDR than they did toward aerobic dance. The findings provide robust support for the second hypothesis. Children's high self-efficacy in exergaming can be explained by the sources of self-efficacy:<sup>35</sup> mastery experiences (i.e., children learned how to play DDR gradually in PE), vicarious experiences (i.e., children mimicked the dance movements of the dance figures in the screen), and verbal persuasion (i.e., children received simultaneous feedback from the exergaming system and timely comments from their peers and teachers feedback). In addition, children were encouraged to play DDR at their individual expertise levels, which would prevent the decrease in self-efficacy in face of difficulty.<sup>17</sup> In aerobic dance, children only had the movement demonstration and occasional performance feedback from the instructor. Therefore, it is not surprising that children reported higher self-efficacy toward DDR.

In general, the empirical studies and literature reviews consistently reported that participants reported enjoyment/situational interest/intrinsic motivation/liking of and enthusiasm for exergaming.<sup>19,21,29,34</sup> For instance, Gao<sup>29</sup> suggested that children were intrinsically motivated toward DDR in PE. Sun<sup>34</sup> reported that elementary children had higher situational interest in exergaming than in fitness. Even after intervention, children reported enjoying exergaming and indicated they would continue to play if possible.<sup>36</sup> Apparently, exergaming can capture children's enjoyment and attract them to engage in the activities.

Considering the fact that aerobic dance is a very physically active exercise as compared to some non-invasion PE contents such as baseball and volleyball, we speculate that the dance-exergaming may be appropriate for PE although it

accumulated less MVPA time than aerobic dance. Exergaming also fostered higher self-efficacy and enjoyment among children than aerobic dance. In addition, research indicated positive effects of exergaming on individuals' motor skills such as gross/fine motor skills.<sup>37</sup> Taken together, exergaming has potential to help children accomplish several important goals in PE as stated by National Association for Sport and Physical Education (e.g., participate in PA regularly; value PA for enjoyment; and improve motor skills and movement patterns), and it may serve as a good alternative activity in PE. That is, this study provides empirical support for the use of exergaming in PE, as exergaming is promising to intrinsically motivate children to be physically active and provide moderate levels of PA. However, it should be noticed that exergaming can only be used as a component of an effective PE program but not replace the PE curriculum. That is, exergaming, by itself, is not the sole solution to promote PA. It is not a replacement for traditional PA in the real settings. Rather, exergaming may augment our current PAs in PE to promoting PA participation by serving as a fun PA option.

The study findings, while encouraging, have a few limitations. First, there are many other dance activities available for use with children, such as line dance, Wii just Dance, and Xbox 360 Kinect Dance Central. Additional research is warranted to further examine the different effects of those dance activities on children's PA levels and PA correlates, particularly those effects from different gaming systems (i.e., Wii vs. Kinect). Second, dance is traditionally viewed as a female dominant activity. We only investigated dance in the present study although a large variety of sports/activities are available in exergaming including football and soccer (i.e., Kinect Ultimate Sports). It is important to investigate the effects of different gender appropriate exergaming activities (i.e., male dominant activity like football, female dominant activity like yoga, and gender neutral activity like running) on children's PA levels and PA correlates across different genders. Despite these limitations of this exploratory study, the findings are promising in terms of application of exergaming in PE. In summary, educators should not replace the traditional PAs and sports with exergaming in PE. Meanwhile, exergaming can be an excellent addition to promote PA.

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