Heart Rates of Elementary Physical Education Students During Dancing Classrooms Activities

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Abstract

This study examined how different types of dance activities, along with their duration, influenced heart rate responses among fifth grade physical education students (N = 96) who participated in the "Dancing Classrooms" program. Results indicate that the overall Dancing Classrooms program elicits a moderate cardiovascular heart rate response (M = 124.4 bpm), where 47 percent of class time was spent above a 60 percent maximal heart rate threshold. The "Swing" dance in particular (M = 143.4 bpm) stimulated heart rates at a much higher level than all other dances taught in the program with a mean heart rate change of 52.6 bpm. Girls (127.3 bpm) achieved marginally higher heart rates (p = .059) than the boys (121.1 bpm).

Key Words

Dance Education, Cardiovascular Response, Heart Rate Monitors

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Due to evidence of increasingly high levels of adult and childhood obesity in the United States, a renewed effort has been undertaken to identify the etiology of this epidemic. While poor nutrition has emerged as one contributing cause, the increasing prevalence of a sedentary lifestyle is also a major factor. Regular physical activity has been shown to reduce one's likelihood of becoming obese. Research has shown, however, that by the completion of elementary school 70 percent of children reported participating in health-enhancing physical activity on a regular basis, and by age 21, this activity level had fallen to 42 percent for men and 30 percent for women (Centers for Disease Control and Prevention, 1999). Thus, it is important to develop habitual physical activity in children. Physical education can play a critical role in helping children establish a foundation for an active lifestyle. Unfortunately, traditional practices of physical education have been called into question in regards to the amount of vigorous physical activity the class actually provides. Therefore, it is possible that traditional physical education curricula are deficient in providing the kinds of robust physical activity needed to combat these sedentary behavior related trends. In this light, researchers and professional organizations have called for innovative and well-designed physical education activities that can achieve a health-enhancing fitness (U.S. Department of Health & Human Services, 1996).

Many schools have risen to the challenge of incorporating new and innovative activities into their physical education curricula. In particular, Dancing Classrooms is one such program gaining in popularity and spreading rapidly into new cities and school districts across the nation. Featured in the award-winning 2005 documentary *Mad Hot Ballroom,* Dancing Classrooms was created in 1994 and introduced in the New York City public schools by ballroom dance champion Pierre Dulaine. Today, the program is offered at over 500 schools and includes over

52,000 children. The primary mission of the program is to address fundamental social development characteristics such as social awareness, mutual respect, teamwork, and diversity through dance. These objectives are constructed through group dance circles that utilize sequential rhythmical skills while working with a multitude of partners in “dance frame”. Participants of the program learn basic American Style Meringue, Foxtrot, Rumba, Tango, Swing, and Waltz. In addition, the students learn 2-4 “Fun dances” that do not require a partner such as the Stomp, Electric Slide, and Cha Cha Slide.

The Dancing Classrooms curriculum is made up of 20 uniform lessons that all fifth graders at the participating school receive twice per week via physical education class. The program is instructed by guest teaching artists who have been trained specifically in the “Dulaine Method”. Qualifications for teaching artists include stage presence, vocal command, and prior work experience with children. While previous dance training is preferred, it is not mandatory. For this study, the two cooperating guest teaching artists had more than five years of previous dance instruction. The highlight of the Dancing Classrooms program is a “Culminating Event”, in which all students collectively demonstrate the accomplishments of their ten-week journey while performing for parents, teachers, and administrators at their school. Additionally, schools may elect to send a team of 12 students to perform the dances and compete against other local elementary schools at a “Colors of the Rainbow Team Match”.

Although there is little research on Dancing Classrooms, one study reported a significant impact on students’ social development values such as (1) feeling better supported by teachers and administrators, (2) feeling more respected amongst peers, and (3) feeling more optimistic about life in school (Nelson, 2010). However, there has been no research examining the cardiovascular responses of participating in the Dancing Classrooms program. Where Dancing

Classrooms may benefit students in the area of social development, the program would also add value to the physical education curriculum if it could demonstrate a significant cardiovascular response with its participants. Therefore, the results of this study will demonstrate: (1) whether Dancing Classrooms is providing sufficient levels of moderate-vigorous physical activity that meet Healthy People 2000 guidelines; (2) a variation in heart rate intensity within the dancing classrooms activities; and (3) whether or not Dancing Classrooms is affecting girls' cardiovascular responses differently than the boys.

Methods

Participants

Participants of the study were 172 fifth graders from two suburban north Texas elementary public schools. Both schools were generally situated in the middle of the socio-economic scale and have a diverse student population of Caucasians (39%), African Americans (23%), Hispanics (21%), Asians (14%), and Middle Eastern/Indians (3%). Roughly half the participants (46.7%) recorded BMI scores in the "healthy" range, and the other half (52.2%) recorded "overweight" or "obese" BMI scores (based on the Centers for Disease Control and Prevention's growth charts for typical 5th graders). Protocols for the study were approved by an internal review board for research as well as the participating school district's administration.

Study Design

Because heart rate during aerobic exercise has been directly associated with an increase in oxygen uptake by the body, the percentage of maximal heart rate workload is oftentimes used as a surrogate for estimating the percentage of maximal oxygen uptake (American College of Sports Medicine, 1998). Thus, cardiovascular workload for the Dancing Classrooms program was measured using Polar E-600 heart rate monitors. These monitors have been recognized as

one of the most accurate tools for heart rate monitoring and registering in the field (Kingsley, Lewis, & Marson, 2005; Achten & Jeukendrup, 2003; Laukkanen & Virtanen, 1998; Treiber, Musante, Hartdagan, Davis, Levy, & Strong, 1989).

Exercise intensity classifications for the Dancing Classrooms program were based on Healthy People 2000 objectives which suggest students spend at least 50 percent of class time actively engaged in moderate-vigorous physical activity (Centers for Disease Control and Prevention, 1999). In addition, this report noted:

> Vigorous physical activities are rhythmic, repetitive physical activities that use large muscle groups at 60 percent or more of maximum heart rate for age. An exercise rate of 60 percent of maximum heart rate for age is about 50 percent of maximal cardio-respiratory capacity and is sufficient for cardio-respiratory conditioning. (p. 39)

Therefore, using Tanaka, Monahan, and Seal's (2001) regression equation (208 - 0.7 x age) for maximum heart rate prediction, an average maximum heart rate of 200 was calculated for the participants (using the average and mode age of 11 years old). Therefore, if students had a heart rate of 120 bpm (60 percent of maximal heart rate) or higher for more than 50 percent of class activity time, the Dancing Classrooms program was considered to be successful at meeting exercise guidelines.

Data Collection

The two elementary schools participating in this study were selected largely because the cooperating physical education teachers and students themselves have had experience using the Polar E600 heart rate monitors, which reduced instruction and preparation time during the data collection process. Lessons 17 and 18 (out of 20) were chosen for data collection because they were the only "review-based" lessons that incorporated all of the dance activities in the Dancing

Classrooms program. The heart rate monitors were set to collect data every five seconds. Upon entering the gymnasium, students were given an information sheet to fill out along with heart rate monitoring equipment and instructions on proper usage. After receiving assistance with the monitors, participants were instructed to find some personal space, lie down and relax, and identify and record their lowest heart rate reading (i.e., resting heart rate). Information sheets were collected from the participants and timers for all heart rate monitors were synchronized and started on cue. In order to code lesson activities with individual heart rate data responses, an audio recorded file of each lesson was synchronized to match the heart rate monitor timers. At the end of each class, the monitors were collected from the children and the datum was downloaded into a Polar data management software program. From here, the heart rate data was exported into an Excel spreadsheet and macros were written to translate the data into a usable SPSS format.

Initially, datum was collected on 172 participating students. However, due to absenteeism, human error (e.g., putting the monitors on improperly), random breaks in electrode connectivity, and timing inconsistencies, a total of 96 student files (46 boys and 50 girls) were deemed absolute for final analyses. To determine if this 44 percent attrition rate was indeed random, the incomplete sets of data were error corrected and/or estimated, and compiled into a new set of data for comparison. The mean differences between the useable data and the incomplete dataset were found to be insignificant and had no effect on the overall results.

Data Analyses

A mixed model repeated measures design was used to analyze data for this study. In order to account for some of the variance in heart rates for each dance of the program, a three factor ANCOVA (gender x dance x time) was applied in order to increase the ratio of variance

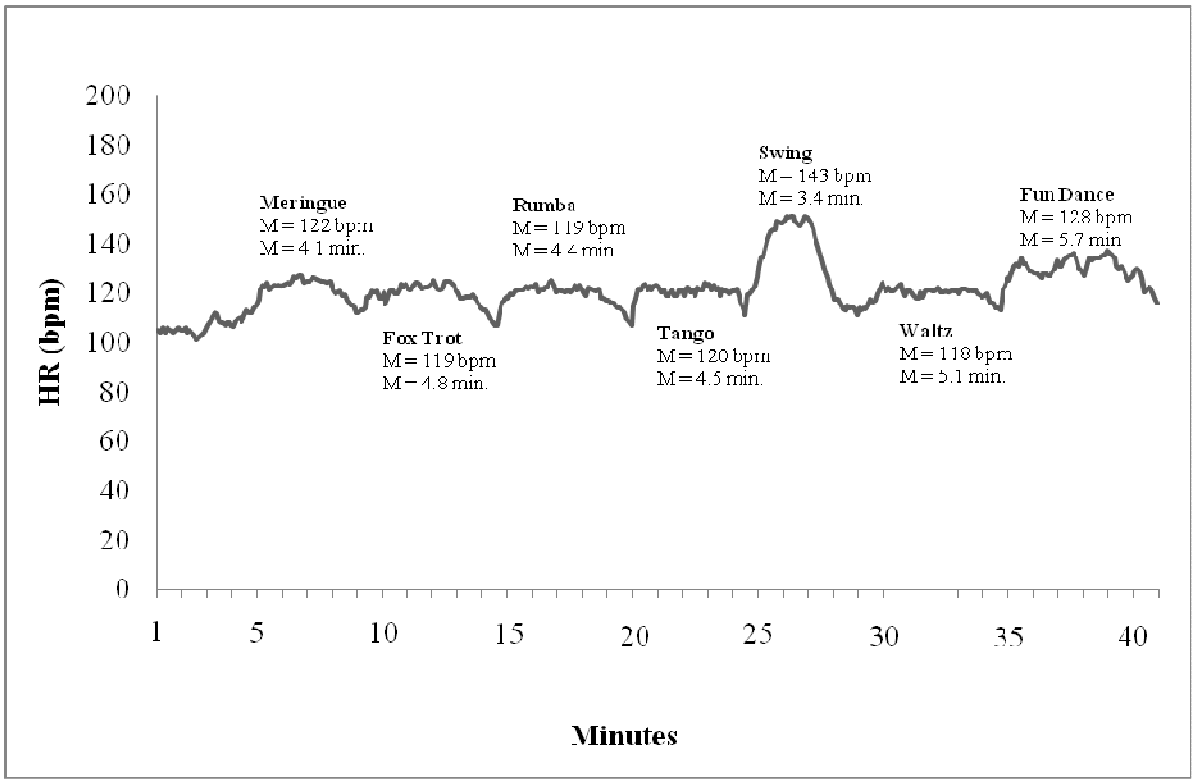
explained by the other independent factors used in the model. The between-subject factors included gender, and the within-subject factors included: (1) the seven specific dances that make up the program; and (2) a time factor (or change in heart rates variables) for each of the dances. Covariates used in the model were baseline and highest heart rate measurements for each dance. Since we know children recover from exercise very quickly (Turley, 1997), baseline heart rate measurements were established by looking at the resting periods between each dance in the lesson (e.g., the lowest heart rate recovery value for "Subject X" following the Meringue dance was 75 bpm which was the same consistently lowest value "Subject X" recorded after Fox Trot, Tango, etc.). For 71% of the participants, there was a consistent drop in heart rate recordings between all dance activities. For those who did not exhibit a consistent leveling off drop in heart rate recordings (i.e., the other 29%), initial resting heart rate values were used as their baseline measurement. Highest heart rate measurements were established by finding the highest mode heart rate recordings across the last full minute of each dance activity. Mode was minimally defined here as having at least three of the same heart rate values in a row (i.e., 15 seconds worth). A significance level of $p < .05$ was used to verify all differences in variability.

Results

A general heart rate intensity of the Dancing Classrooms program is outlined in Figure 1. The average time that children were physically active during the Dancing Classrooms lessons was 37 minutes (which includes transition time between dance activities). Of this total physical activity time, 47 percent (or an average of 17.39 minutes) was spent above the 60 percent maximal heart rate threshold for age. Heart rate recordings ranged from 73-185 bpm, and the mean heart rate for the total lesson was 124.4 bpm. Each of the seven dances exhibited a

significant increase in heart rate intensity ($F(6) = 1312.5$, $p < .001$) with an overall mean difference of 33.8 bpm (Table 1).

Figure 1. General heart rate curve of the Dancing Classrooms program.



Note. Data from this heart rate curve were taken from aggregate mean heart rate plots for each of the 5-second interval heart rate data recordings. Mean time reporting (M = Mean) for each dance does not include the six transition times (or instructional/resting time) between the dances.

Table 1. Heart rates of Dancing Classrooms activities (bpm).

	Overall Heart Rates		Covariate Heart Rate Measures				
	M	*SD*	*M* *Baseline HR*	*SD*	*M* *Highest HR*	*SD*	*M* *Difference*
Meringue	122.1	14.5	99.2	10.1	131.4	11.4	32.3*
Fox Trot	118.6	12.7	100.5	9.7	128.2	10.8	27.7*
Rumba	119.2	13.1	101.4	10.5	130.4	12.0	29.0*
Tango	119.9	13.1	101.7	10.6	131.4	10.8	29.7*
Swing	143.4	17.8	100.6	9.9	153.2	12.9	52.6*
Waltz	118.2	11.7	100.3	9.9	126.4	10.1	26.1*
Fun Dance	128.3	18.4	101.6	10.6	140.7	16.0	39.1*
Total	124.4	17.0	100.8	10.2	134.5	12.0	33.8*

Note. *M* = Mean. *HR* = Heart Rate. *SD* = Standard Deviation.
*Significant difference at the $p < .01$ level

The second aspect of this study focused on whether significant heart rate changes occurred between the specific dances of the Dancing Classrooms program. Results showed a significant difference between the dance activities ($F(6) = 74.8$, $p < .001$), in which post hoc tests (Tukey's HSD) showed Swing dance (measuring a change of 52.6 bpm or 26 percent increase in heart rate response) and Fun Dance (measuring a change of 39.1 bpm or 20 percent increase in heart rate response) stimulated higher and much different heart rate profiles than all other dances in the program (Table 2). Dances that did not show a significant difference in heart rate responses included Meringue and Fox Trot ($p = .053$), Meringue and Rumba ($p = .202$), Fox Trot and Waltz ($p = .170$), and Rumba and Tango ($p = .139$).

The third aspect of this study focused on whether or not Dancing Classrooms affected girls' cardiovascular responses differently than the boys. Findings showed females (127.3 bpm) achieved higher mean heart rates than their male counterparts (121.1 bpm), averaging 6.3 bpm more per Dancing Classrooms lesson ($F(1) = 3.709$, $p = .059$). For the girls, this is approximately 12 percent more of class time spent above the 60 percent maximal heart rate threshold.

Table 2. Interactions of heart rates between the Dancing Classrooms activities.

Dance	Meringue	Fox Trot	Rumba	Tango	Swing	Waltz
Meringue						
Fox Trot						
Rumba		*				
Tango	*	*				
Swing	*	*	*	*		
Waltz	*		*	*	*	
Fun Dance	*	*	*	*	*	*

* Significant difference at the $p < .05$ level

Discussion

The Cardiovascular Response of Dancing Classrooms and its Relationship to Other Physical Education Activities

The primary purpose of this study was to profile the cardiovascular fitness response of the Dancing Classrooms program. It would appear as though Dancing Classrooms is a physical education activity that is eliciting a moderate cardiovascular response amongst fifth grade participants as defined by Healthy People 2000 and the Centers for Disease Control and Prevention (1999). The current study showed participants exercising at or above the 60 percent maximal heart rate level for an average of 17.4 minutes, indicating that the majority of physical activity time (53%) was spent slightly below the specified moderate-to-vigorous physical activity threshold. That said, it is important to point out here that the findings in this study are not so different from what others have reported in the literature regarding the cardiovascular responses of a variety of physical education activities. For example, Strand and Reeder (1993) found students exercised intensely enough to reach their target heart rate zone at some point during

their physical education class, but did not reach a desirable heart rate level for at least 15 minutes or more. Strand and Reeder (1993) further reported that 60 percent or more of class time was spent exercising below their target heart rate zone. Stratton (1996) reviewed heart rates of 44 different physical education activities in which only 16 activities (36%) showed students spending > 50 percent of class time at a moderate-to-vigorous physical activity level. Most of these top 16 activities were high intensity team sports such as soccer and basketball. Results of the current study would position Dancing Classrooms just below these top 16 activities reported by Stratton (1996), generally situated around the 63rd percentile of all the physical education activities reported.

Figure 2 shows how the mean heart rates of the Dancing Classrooms program generally measured up to a range of other physical activities reported by Laurson, Brown, Cullen, and Dennis (2008). If the Dancing Classrooms datum was further translated to a 50 percent of maximal heart rate threshold (in order to make direct comparisons with activities in Laurson's study), we find that Dancing Classrooms then recorded 89.7 percent of total activity time at or above the 50% maximal heart rate threshold for age (Figure 3). Although not absolute when it comes to a relative intensity heart rate comparison, this generally equated Dancing Classrooms to Cross-Country running (90.6%). It is important to note here that Cross-Country running was the second highest (out of 16) in-zone time activities reported.

Figure 2. Mean heart rates and standard deviations of the Dancing Classrooms program compared to activities reported by Laurson, Brown, Cullen, & Dennis (2008).

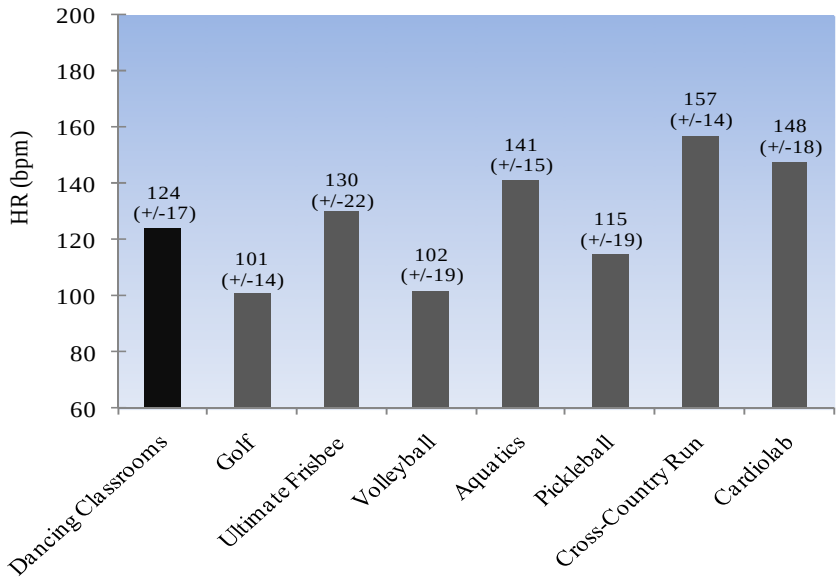
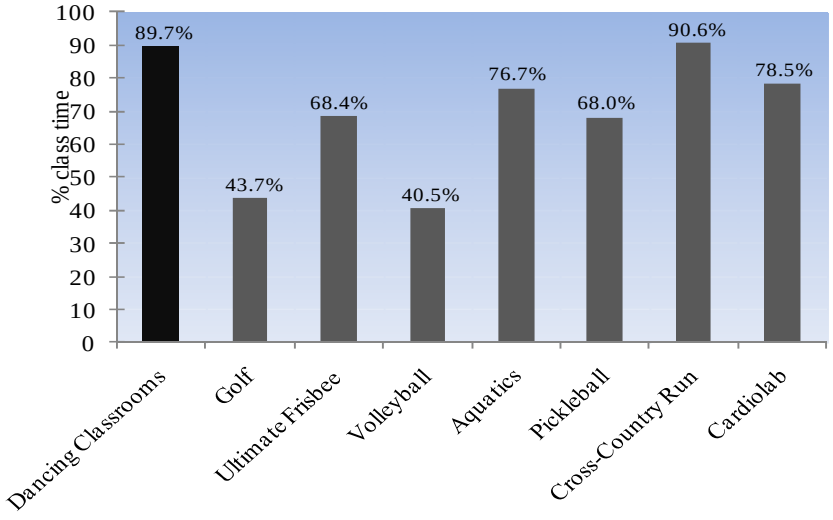


Figure 3. Percentage of class time Dancing Classrooms spent above a 50% of maximal heart rate threshold compared with activities reported by Laurson, Brown, Cullen, & Dennis (2008).



Differences between Activities in the Dancing Classrooms Program

The Swing dance (143.4 bpm) clearly elicited the strongest cardiovascular response with fifth graders during the Dancing Classrooms program. This is due to the fact that "Swing" is danced to vigorous music with an upbeat tempo which can elevate heart rates accordingly. When comparing the Swing dance heart rates to activities reported in Laurson et al. (2008) study (Figure 2), we find that the Swing dance independently (143 bpm) would be situated between Aquatics activities (141 bpm) and Cardiolab activities (148 bpm). Unfortunately, the Swing

dance was instructed the least amount of time in the program averaging only 3.4 minutes per lesson.

The dance that exhibited the second greatest cardiovascular response with the Dancing Classrooms participants was the Fun Dance (128 bpm), also situated comfortably above the 60% maximal heart rate threshold level. Fun Dance is not like the other dances in the program, however, in that it does not focus directly on working with a partner. This may also explain why standard deviation heart rate responses were highest within the Fun Dance (+/- 18.4 bpm). If compared to other physical activities reported in Table 2, we find that Fun Dance is most like Ultimate Frisbee in cardiovascular response. Furthermore, Fun Dance was the longest dance activity instructed during lessons 17 and 18 (averaging 5.7 minutes per lesson).

The other five dances in the program (i.e., Meringue, Fox Trot, Rumba, Tango, and Waltz) exhibited very similar heart rate curve patterns. These dances shared many characteristics (e.g., partner dancing in dance frame, large circular group formations, and similar tempos of music) which may help explain the similarity in cardiovascular response. These dances are most closely related to activities such as Pickleball shown in Figure 2.

Does Dancing Classrooms Affect Girls Differently than Boys

Differences in cardiovascular response to dynamic exercise between boys and girls have been reported in the literature. Although these findings have been mixed, Turley (1997) suggested that boys recorded lower heart rates and higher stroke volumes than girls when activities of a similar cardiovascular workload are compared (i.e., treadmill and stationary bike programs). This is largely attributed to the fact that boys have larger hearts than girls. However, studies that have focused more on “physical education” kinds of activities, reported boys’ cardiovascular responses are typically higher than girls. For example, Fairclough and Stratton

(2005) reported boys' averaged 39.4 percent of physical education time engaged in moderate-to-vigorous physical activity, where girls averaged only 29.1 percent. Stratton (1997) looked at the heart rates of children during 66 different kinds of physical education activities and concluded that boys had significantly higher heart rates than girls. This suggests that the kinds of physical education activities being taught may influence how boys and girls are responding to exercise. In fact, some of the research has suggested that "activity type" in physical education is the better indicator of cardiovascular responses between boys and girls. For example, Nelson (2005) reported that boys spend 24 percent more time than girls in school-related physical activities (e.g., team-sports). Similarly, Laurson et al. (2008) reported boys attained significantly higher heart rates during team activities (+21 bpm); while females achieved higher heart rates during individual types of activities (+54 bpm). Furthermore, Kulinna, Martin, Lai, and Kliber (2003) measured heart rate responses of male and female students and found that boys spent less time in their target heart rate zones during individual activities than in team activities (32.9% vs. 58.3% respectively).

For the current study, why girls responded to the Dancing Classrooms program differently than boys in their exercise intensity may be partly explained by the psychosocial and cultural factors associated with dance that influence young girls. Research has also indicated that girls tend to do better when instructional activities are interactive and cooperative in nature (Ginsburg-Block, Rohrbeck, & Fantuzzo, 2006; Lou, Abriami, Spence, Chambers, & d'Apollonia, 1996). Therefore, Dancing Classrooms may have a significant value to teachers and administrators looking for new units of physical education curricula that motivate girls to exercise at higher intensity levels. Certainly, Dancing Classrooms could play an important role in

those physical education programs that traditionally favor a greater cardiovascular response with the boys (e.g., team-sports).

These findings may also have important implications for addressing sedentary behavior trends that show children (especially girls) declining rapidly in their participation in moderate-vigorous physical activities into adulthood (Centers for Disease Control and Prevention, 1999). Here, it is important to note that the Dancing Classrooms program has expanded into the middle (eighth grade) and high school (eleventh grade) physical education curricula, thus providing ongoing dance opportunities for participants throughout their entire public school experience. If the girls (and maybe some of the boys) are aware that they will be getting more exposure to Dancing Classrooms instruction during their secondary education, it might increase the probability they will continue practicing the dances well after the 5th grade. Certainly, this kind of repeated exposure could cultivate an appreciation of dance as a form of lifetime physical activity and fitness.

Limitations

Inherent to this study are a few limitations. School location, teacher motivation, class size, non-randomness of the sample, and time spent previously practicing the activity all may have caused variation in heart rate responses. There may also have been marked variation in the maximal heart rates of participants. This would suggest that the standard estimation of maximal heart rates would possibly under-estimate intensity for some and over-estimate intensity for others. Furthermore, the prediction of actual energy expenditure and/or cardio-respiratory fitness may have been more accurately measured if heart rate reserve (e.g., Karvonen formula) was used for each subject in the prediction equation instead of a generalized heart rate maximum. Because heart rate reserve was not used in the prediction equation for this study, it is possible that the

results may have overestimated the cardio-respiratory responses of Dancing Classrooms participants. Finally, this study was limited by the fact that data were collected at the very end of the Dancing Classrooms program (lessons 17 and 18 out of 20), in which participants were much more familiar with the dances and likely to be more confident in their ability to perform the dances correctly. This too may have overestimated the actual heart rate response of the overall Dancing Classrooms program.

Recommendations for Practice and Future Research

Based on the findings of this study, if Dancing Classrooms instructors were to simply double the time spent facilitating the Swing dance (or substituting Waltz or Fox Trot with a Swing-like dance), we would see a significant increase in the percentage of class time spent above the 60 percent maximal heart rate threshold from 47 percent to approximately 65 percent. This one simple curricular adjustment would put Dancing Classrooms amongst the top physical education activities that meet Healthy People 2000 guidelines of at least 50 percent of class time spent at a moderate-to-vigorous intensity. Therefore, it is recommended by the authors of this study that the Swing dance (or similar dance with an upbeat tempo) receive more time and attention during the Dancing Classrooms program for health enhancing physical education.

Recommendations for future research on Dancing Classrooms may include applying the same research design onto a different school population in order to assess the reliability of this study's findings. Also of interest would be a reordering of the dances in lessons 17 and 18 (i.e., Swing first, Rumba second, Meringue third, etc.) in order to see if each dance's cardiovascular response showed consistency despite the order in which it was instructed in the lesson sequence. Another recommendation would be further examination of heart rate responses at the other levels in which the Dancing Classrooms program is offered (i.e., eighth and eleventh grade). This

would allow investigators to determine if, and to what levels, Dancing Classrooms is physiologically benefiting the older kids participating in the program. Here, a trend analysis may further predict whether or not Dancing Classrooms has the potential to help close the gap with the physical activity level declination taking place between the girls and boys as they move through adolescence and into adulthood. Also of interest would be an intensity study comparing those schools electing to participate in the Colors of the Rainbow Team Match with those schools that did not choose to participate. This would yield information as to if, and to what degree, the competitive influence of adults (e.g., guest teaching artists, physical education teachers, administrators, and parents) affect the time and intensity of the activities practiced in the program. Beyond Dancing Classrooms, other research directions may include using this study as a physical education fitness research model that aides in profiling and comparing the cardiovascular responses of existing physical education activities, alternative activities in which physical education credit is given (e.g., band, cheerleading, ROTC), and new and/or innovative programs that have not yet been introduced into the curriculum. Whichever the case, it is recommended that the investigators include heart rate data on a control group/curriculum in order to strengthen the methodology and benefit from having a comparison group (dance or otherwise).

Conclusion

In summary, the results of this study showed that the Dancing Classrooms program is a physical education activity that elicits a moderate cardiovascular response with its fifth grade participants. Most of the dance activities in the program (i.e. Fox Trot, Rumba, Tango, and Waltz) elicited similar cardiovascular responses just below the 60% of maximal heart rate threshold. Meringue elicited a slightly higher heart rate response just above the specified

threshold level, whereas Fun Dance and Swing clearly raised heart rate responses into a more vigorously defined heart rate range. Females demonstrated moderately higher heart rate responses than the males, thus making Dancing Classrooms one of the few coed and group-oriented physical education activities in which girls exhibited a greater cardiovascular response than the boys.

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