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Physical Activity Levels of Adolescent Girls During Dance Classes

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Background: The aims of this study were to describe the physical activity levels of girls during dance classes and to identify factors associated with moderate-to-vigorous physical activity (MVPA) in those classes. ***Methods:*** Participants were 137 girls (11 to 18 years-old) enrolled in ballet, jazz, or tap dance classes from 11 dance studios. Participants wore an accelerometer during the selected dance class on 2 separate days. Factors hypothesized to be associated with MVPA were dance style, instructional level, instructor's experience, percent of class time spent in choreography, and participants' age, race/ethnicity, BMI-for-age percentile, and years of dance training. Data were analyzed using generalized linear mixed models. ***Results:*** Girls engaged in 9.8 minutes of MVPA, 6.0 minutes of moderate, 3.8 minutes of vigorous, 39.3 minutes of light, and 10.9 minutes of sedentary behavior per hour of dance class participation. Jazz/tap classes provided more MVPA than ballet classes, and intermediate level classes provided more MVPA than advanced level classes. Girls with more dance training obtained more MVPA than girls with less dance training. ***Conclusion:*** Dance classes provide valuable opportunities for adolescent girls to be physically active.

Keywords: accelerometry, teaching, youth

The 2008 Physical Activity Guidelines for Americans recommend that youth obtain at least 60 minutes of daily moderate- to vigorous-intensity physical activity, including vigorous-intensity physical activity on at least 3 days per week.[1] Youth should also engage in muscle-strengthening and bone-strengthening activities on at least 3 days per week.[1] Despite the importance of regular physical activity, many American children and adolescents do not obtain the recommended amount of physical activity.[2] For example, less than 25% of high school students (24.8% of boys and 11.4% of girls) engaged in 60 minutes of moderate-to-vigorous physical activity (MVPA) on all 7 days of the week.[3] Furthermore, physical activity measured objectively in the National Health and Nutrition Examination Survey (NHANES) found that 42% of 6- to 11-year-old children met the current physical activity guidelines, whereas only 8% of 12- to 19-year-old adolescents met the guidelines.[2]

Participation in structured physical activity programs, such as physical education classes, organized sports, and activity classes or lessons, is a recommended strategy for youth to meet the physical activity guidelines.[1] To date, there is limited knowledge about the amount of physical activity in structured physical activity programs and about the contribution of such programs to the overall physical activity levels of children and adolescents. In recent years, accelerometers have been increasingly used to objectively and validly measure physical activity levels of children and adolescents, as they provide activity intensity and duration, unlike pedometers, and are not affected by the cognitive and recall limitations of self-report questionnaires.[4,5] A limited number of physical activity programs have been studied previously using accelerometry; these include physical education classes,[6] organized sports,[6,7] and after-school programs.[8–11]

Dance is a well-liked[12–14] and prevalent form of physical activity among girls.[15–17] A common venue for dance participation is the structured environment of dance classes.[18,19] During adolescence, physical activity levels decline,[20–22] and there is a steeper decline among girls than boys.[20,23] Thus, it is important to gather information on dance classes to add to the growing body of knowledge on structured settings, of which dance is one. However, the amount of physical activity adolescent girls obtain during structured dance classes is unknown. Accordingly, the aims of this study were 1) to describe the physical activity levels of adolescent girls during structured dance classes using objective measurement of physical activity and 2) to identify factors associated with the amount of MVPA in structured dance classes.

Methods

Study Design

This study employed a cross-sectional design in measuring physical activity in girls attending structured dance

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classes. Data were collected in a sample of dance studios in Columbia, South Carolina. To be eligible, a dance studio was required to offer at least 1 ballet, jazz, or tap class per week to students ages 11 years and older. In each participating dance studio, 1 to 4 classes were selected for physical activity measurement; classes were chosen to represent various instructional levels (eg, intermediate, advanced) and dance styles (eg, ballet, jazz, tap). This protocol was designed to obtain 2 measurements from each participant during the selected dance course (eg, ballet on Tuesdays from 4 PM to 5 PM) over a 2-week period. Although dance students may participate in more than 1 dance course per week, for this study, each participant contributed 1 dance course (ie, the same dance style for both measurements). Direct observation was used to obtain an accurate assessment of the time during which the 2 measurements (ie, classes) of the dance course occurred, as well as the time during which class components occurred (warm-up, progressions, and choreography). To identify factors potentially associated with level of MVPA in the dance classes, the following variables were measured: dance style, level of instruction, instructor's teaching experience, participant's age, race/ethnicity, BMI-for-age percentile, years of dance training, and percent of class time spent in choreography.

Participants

Participants were girls (ages 11 to 18 years) enrolled in the selected dance classes at dance studios in Columbia, South Carolina. Forty-three dance studios, defined as commercial facilities whose primary business is to provide dance instruction, were identified using local published and electronic telephone books. The director of each dance studio was contacted by telephone to determine the studio's eligibility status. Twenty-three dance studios were eligible and were invited to participate. Of the 23 eligible dance studios, 11 directors agreed to participate, and those directors provided the schedules and the instructional levels of the ballet, jazz, and/or tap classes that were offered to students ages 11 years and older. Within the 11 dance studios, 213 students were eligible to participate in the study. Of these students, 150 (70.4%) agreed to participate. Written informed consent was provided by each student's parent or guardian and informed assent was given by each student (if < 18 years) before collection of data. The study was approved by the University of South Carolina Institutional Review Board.

Measurement of Physical Activity

Physical activity was assessed objectively with accelerometry. ActiGraph accelerometers (Model 7164, Pensacola, FL) were used to measure time spent in sedentary, light, moderate, vigorous, and MVPA. The ActiGraph is a reliable[24] and valid method for assessing children's and adolescent's physical activity, both in laboratory and field settings.[25–28] The cut-points established by Treuth and colleagues were used to determine physical activity intensity levels.[29] These cut-points were developed for use in adolescent girls aged 13 to 14 years, using both laboratory and field activities.[29] Accelerometers were initialized to save data in 30-second intervals, in accordance with the procedures of Treuth et al.[29]

Measurement Protocol

Data collection occurred during 3- to 4-week periods at each dance studio. A research assistant placed accelerometers on participants approximately 10 minutes before the beginning of the dance class. Accelerometers were attached to an adjustable elastic belt and worn over the right hip. Participants wore the accelerometers during the entire class and during the same dance class the following week. If a participant was absent the second week, she wore the accelerometer during the third week, and if a participant was absent during both subsequent visits, data for a second measurement was not collected. With this data collection method, most participants completed 2 measurements of structured dance class participation (n = 104). Reasons for completing only 1 measurement included absences (n = 30) and accelerometer malfunctions (n = 3). The accelerometers were removed by the research assistant at the end of the class, and activity counts were downloaded and saved for data reduction and analysis.

Start and stop times of each dance class were recorded by an observer. In addition, start and stop times for warm-up, progressions, and choreography components were recorded by the observer. These were defined as 1) warm-up: preparatory activities for more intensive dancing; 2) progressions: execution of dance steps; and 3) choreography: learning and rehearsing a dance routine. The times were obtained from a palm pilot that was synchronized with the accelerometers.

Data Reduction

Intensities of physical activity were operationally defined as: sedentary (<50 counts/30 seconds), light (51–1499 counts/30 seconds), moderate (1500–2600 counts/30 seconds), and vigorous physical activity (>2600 counts/30 seconds).[29] MVPA was determined by calculating the total number of minutes above the moderate cut-point (≥1500 counts/30 seconds).[29] Accelerometer counts collected during the observed class and each class component were segmented from the raw accelerometer data file, and the amounts of time (min) spent in sedentary, light, moderate, vigorous, and MVPA were calculated for each class.

Anthropometric Measures

Height and mass measurements were conducted in a private setting. Height and mass were assessed objectively using a portable stadiometer (measured to the nearest 0.1 cm) and an electronic scale (measured to the nearest 0.1 kg), respectively. The average of 2 measurements

was used. Body mass index (BMI) was calculated and expressed as mass in kilograms divided by height in meters squared, and BMI was converted to BMI percentiles using the CDC Growth Charts.[30]

Additional Variables

Factors hypothesized to be associated with MVPA were dance style, level of instruction (eg, intermediate, advanced), instructor's teaching experience, participants' age, race/ethnicity, BMI-for-age percentile, years of dance training, and percent of class time spent in choreography. For dance style, tap and jazz classes were combined due to the small number of tap classes and because they had similar physical activity profiles. The dance studio directors provided the instructors' teaching experience at that particular dance studio. Participants' date of birth and race/ethnicity were reported by parents on the consent form, and participants reported their age when they began dance training.

Statistical Analyses

Physical activity data were reduced for analysis using 3 different expressions: minutes per class, minutes per hour of class participation, and percentage of class time for sedentary, light, moderate, vigorous, and MVPA. To control for differences between studios and to account for repeated measurements, data were analyzed using generalized linear mixed models (PROC MIXED). These analyses were conducted for the total sample of dance classes, and then separately for the 2 dance styles (ballet and jazz/tap). For the purpose of comparing physical activity across dance styles, least squares means were used. To identify factors that associate with the amount of MVPA (minutes per hour of class participation) in dance classes, univariate correlations were first conducted. The significant factors in the univariate analyses were entered into a multivariate generalized linear mixed model predicting MVPA (minutes per hour of class participation). SAS software (version 9.2; SAS Institute, Cary, NC) was used for all statistical analyses. Statistical significance was set at an alpha level of .05.

Results

A total of 150 girls provided informed consent to participate in the study. Three girls were excluded due to absences during the observed dance classes, 9 were excluded due to accelerometer malfunctions, and 1 was excluded for incomplete data. This left a final study sample of 137 girls. The descriptive characteristics of the sample are presented in Table 1. Most of the participants were Caucasian (80.3%), and 9.5% were African American. The average BMI was 20.2 ± 3.5 $kg \cdot m^{-2}$. The average amount of dance training was 10.2 ± 3.1 years, and 80.3% of the girls participated in competitive or company dance.

The 137 participants were observed during a total of 241 dance classes during which accelerometer data were collected. One hundred and 4 girls (75.9%) completed 2 measurements and 33 girls (24.1%) completed 1 measurement. The intraclass correlation coefficient (ICC) for MVPA for those with 2 measurements was 0.66. The mean difference in percent of class time in MVPA

Table 1 Descriptive Characteristics of Girls Participating in Structured Dance Classes

Characteristic	n	Mean (SD) or %
Age (years)	137	14.6 ± 2.0
Race/ethnicity, %		
Caucasian	110	80.3
African American	13	9.5
Other	14	10.2
Height (cm)	137	159.5 ± 7.2
Mass (kg)	137	51.8 ± 10.5
BMI (kg/m^2)	137	20.2 ± 3.5
BMI percentile	137	51.6 ± 26.9
Age when began dance training (years)	137	4.4 ± 2.7
Duration of dance training (years)	137	10.2 ± 3.1
Number of dance styles studied	137	5.9 ± 1.9
Number of dance classes taken per week	137	6.2 ± 2.6
Amount of rehearsal per week (hours)	136	6.2 ± 5.3
Participation in company or competitive dance, %	137	80.3%

Abbreviations: SD, standard deviation; BMI, body mass index.

Table 2 Means (95% CI) for Physical Activity Variables Among Girls During Dance Classes (N = 137)

	Physical activity (min/class)				
	Sedentary	**Light**	**Moderate**	**Vigorous**	**MVPA**
All classes	13.2 ± 1.0 (11.2, 15.2)	42.6 ± 1.1 (40.4, 44.9)	6.2 ± 0.3 (5.7, 6.8)	4.2 ± 0.3 (3.6, 4.7)	10.4 ± 0.5 (9.4, 11.4)
Style					
Ballet	11.6 ± 1.5 (8.7, 14.5)	49.4 ± 1.5 (46.5, 52.4) *	4.8 ± 0.4 (4.0, 5.6) *	3.8 ± 0.4 (3.0, 4.6)	8.6 ± 0.7 (7.3, 10.0) *
Jazz/tap	14.5 ± 1.4 (11.8, 17.2)	36.7 ± 1.4 (34.0, 39.5)	7.5 ± 0.4 (6.8, 8.2)	4.4 ± 0.4 (3.7, 5.2)	11.9 ± 0.6 (10.7, 13.2)

	Physical activity (min/hour)				
	Sedentary	**Light**	**Moderate**	**Vigorous**	**MVPA**
All classes	10.9 ± 0.5 (9.8, 12.0)	39.3 ± 0.5 (38.3, 40.4)	6.0 ± 0.3 (5.5, 6.5)	3.8 ± 0.2 (3.4, 4.2)	9.8 ± 0.4 (9.0, 10.6)
Style					
Ballet	9.6 ± 0.8 (8.0, 11.1) *	42.9 ± 0.7 (41.6, 44.2) *	4.3 ± 0.3 (3.7, 5.0) *	3.2 ± 0.3 (2.6, 3.8) *	7.5 ± 0.5 (6.4, 8.6) *
Jazz/tap	12.0 ± 0.7 (10.6, 13.4)	36.3 ± 0.6 (35.1, 37.5)	7.4 ± 0.3 (6.8, 8.0)	4.3 ± 0.3 (3.8, 4.9)	11.8 ± 0.5 (10.8, 12.7)

	Physical activity (% class time)				
	Sedentary	**Light**	**Moderate**	**Vigorous**	**MVPA**
All classes	18.2% ± 0.9 (16.4%, 20.0%)	65.5% ± 0.9 (63.8%, 67.3%)	10.0% ± 0.4 (9.1%, 10.9%)	6.3% ± 0.4 (5.6%, 7.1%)	16.3% ± 0.7 (15.0%, 17.6%)
Style					
Ballet	16.0% ± 1.3* (13.4%, 18.6%)	71.5% ± 1.1* (69.3%, 73.7%)	7.2% ± 0.6* (6.1%, 8.3%)	5.3% ± 0.5* (4.3%, 6.3%)	12.5% ± 0.9* (10.7%, 14.3%)
Jazz/tap	20.0% ± 1.2 (17.6%, 22.4%)	60.4% ± 1.0 (58.4%, 62.5%)	12.4% ± 0.5 (11.3%, 13.4%)	7.2% ± 0.5 (6.3%, 8.2%)	19.6% ± 0.8 (18.0%, 21.2%)

Abbreviations: SE, standard error; min, minutes; MVPA, moderate-to-vigorous physical activity.

* Ballet significantly different from Jazz/Tap, $P < .05$.

Table 3 Factors Associated With MVPA (min/hour) Among Girls During Dance Classes (N = 137)

Variable	β	SE	*P*
Age	–0.06	0.21	.77
BMI percentile	–0.00	0.02	.82
Race/ethnicity[a]			
African American	–1.25	1.43	.38
Other race	–0.87	1.35	.52
Style[b]	–4.24	0.74	<.001
Level[c]	2.32	0.84	<.01
Dance training	0.27	0.13	.04
Teacher experience	0.10	0.05	.06
Choreography[d]	–2.47	1.57	.12
Multivariate model			
Style[b]	–4.05	0.70	<.001
Level[c]	2.70	0.77	<.001
Dance training	0.37	0.12	<.01

Abbreviations: MVPA, moderate-to-vigorous physical activity; min, minutes; SE, standard error; BMI, body mass index.

[a] Reference Group: White.

[b] Reference Group: Jazz/Tap.

[c] Reference Group: Advanced.

[d] Percent of class time spent in choreography.

between the 1st and 2nd measurement was 0.42%. Of the 241 dance classes, 108 (44.8%) were ballet, and 133 (55.2%) were jazz/tap. The average dance class length (ie, wear time) was 66.5 ± 22.6 minutes.

The means for the physical activity variables are presented in Table 2. Girls obtained an average of 10.4 minutes of MVPA, 6.2 minutes of moderate, 4.2 minutes of vigorous, 42.6 minutes of light, and 13.2 minutes of sedentary behavior per dance class. Jazz/tap classes had significantly more MVPA and significantly less light physical activity than ballet classes.

In univariate analyses, style, level of instruction, and years of dance training were significantly associated with minutes of MVPA per hour of class participation ($P < .05$). Girls' age, race/ethnicity, and BMI-for-age percentile, as well as percent of class time in choreography and teacher's experience were not associated with minutes of MVPA per hour of class participation. In multivariate analyses, style, level of instruction, and years of dance training predicted minutes per hour of MVPA ($P < .05$). Jazz/tap classes provided more MVPA than ballet classes, and intermediate level classes provided more MVPA than advanced level classes. Girls with more years of dance training obtained more MVPA than girls with fewer years of dance training. These results are summarized in Table 3.

Discussion

This was the first study to objectively quantify physical activity levels of adolescent girls during their participation in structured dance classes. The results indicate that girls obtained approximately 10 minutes of MVPA per hour of dance class participation. Considering that the Physical Activity Guidelines for Americans call for youth to obtain 60 minutes of daily MVPA,[1] dance classes provided a substantial yet modest proportion of the recommended amount of MVPA. This finding is important because dance is a highly prevalent type of physical activity among girls,[15–17] and increasing the amount of MVPA provided through structured dance classes has the potential to make an impact on the physical activity levels of many adolescent girls.

Although structured physical activity programs are recommended settings for adolescents to be physically active,[1,31] and accelerometry is a state-of-the-art measure of physical activity,[25–29] accelerometry has been used infrequently to quantify physical activity in structured physical activity programs.[6,8,11] These include after-school programs,[8,11] organized sports,[6,7] and physical education classes.[6] In the current study, dance classes (eg, ballet, jazz, tap) provided 9.8 minutes of MVPA per hour of participation; jazz and tap classes offered 11.8 minutes of MVPA per hour of participation. This is comparable to after-school programs which provided children with approximately 7 minutes[11] to 13 minutes[8] of MVPA per hour of participation. In contrast, dance classes provided girls with fewer minutes of MVPA per hour compared with organized sports and physical education classes; each setting provided boys with 24 minutes of MVPA per hour.[6]

The style of dance, the level of instruction (eg, intermediate, advanced), and the number of years of previous dance training were significant predictors of

MVPA in dance classes. Jazz and tap classes provided approximately 4.5 more minutes of MVPA per hour of dance class participation than ballet classes. Ballet classes are traditionally structured to begin with exercises at the *barre*, which prepare dancers for more intensive movements. This considerable portion of ballet classes involved primarily light physical activity, which reduced the amount of class time available for MVPA compared with jazz and tap classes. However, it should be acknowledged that exercises at the *barre* require muscular strength and endurance, and participation in ballet classes can help girls meet the muscle-strengthening recommendation.[1] Intermediate level classes provided more MVPA than advanced level classes; intermediate level classes may allow more opportunities for girls to practice their skills compared with the advanced level classes. In addition, girls with more years of dance training obtained more MVPA than girls with fewer years of dance training. This finding suggests that continued participation in dance classes is important, since girls' physical activity levels decrease dramatically during adolescence.[23]

Dance classes provided girls with a substantial yet modest amount of MVPA. At the lower end of the physical activity continuum, dance classes involved very little sedentary behavior (an average of 10.9 minutes per hour) compared with other structured physical activity programs. For example, dance classes had fewer minutes of sedentary behavior per hour of participation compared with after-school programs, which ranged from approximately 27 minutes[8] to 39 minutes[11] of sedentary behavior per hour of participation. The sedentary behavior in dance classes is similar to the amount of sedentary behavior of boys in physical education classes (12 minutes per hour of participation).[6] The majority of dance class time (65.5%) was spent in light activity, which indicates that the girls were moving, albeit at a relatively low intensity. This light activity contributes to total energy expenditure, and its associated health benefits.[32] Currently, youth are encouraged to reduce sedentary behaviors,[1] and these findings support that dance classes are an excellent option because of their low levels of sedentary behavior.

There are opportunities to increase the amount of MVPA in structured dance classes. Class management strategies that have been effective in increasing the amount of MVPA in physical education classes[33,34] could be employed to increase MVPA in dance classes. For example, one strategy is to limit the amount of time students wait before their turn to perform a combination. This can be achieved by having dancers perform combinations in small groups consisting of 3 to 5 dancers, instead of 1 or 2 dancers at a time, and by prompting and encouraging dancers to be ready when the previous group is close to the end of the combination. Dance instructors could also encourage their students to consistently put forth maximal effort when practicing routines, which would likely increase MVPA levels during dance classes. In addition, if dance instructors are aware that a particular component of the class is active, they could extend that component to increase the time spent in MVPA. More research is needed to determine the most effective ways to increase the amount of MVPA in dance classes, because doing so has the potential to move girls closer to achieving the physical activity guidelines.

This study has strengths and limitations that should be noted. An important strength of this study was its utilization of objective measurement of physical activity with accelerometry. A second strength was the placement of accelerometers on participants just before dance classes ensuring accurate placement, which is important for valid data collection. A third strength was the observation of the start and stop times of the classes, which provided accurate assessments of the duration of and exact times time during which the classes occurred. This was important because the accelerometer data were associated with specific time intervals, and this procedure ensured the accelerometer counts used in the analyses were those that corresponded to the exact times the classes occurred. This removed the possibility of misclassification, which may be a limitation when youth self-report the start and stop times of structured activities,[6] because activities may not occur exactly during the scheduled times. Fourth, this study included a variety of dance styles from 11 dance studios. A limitation was that the accelerometer count cut-points were developed in laboratory and field settings, but not specifically for dancing. In addition, accelerometers do not measure upper-body movement, which is expected during dance, and its associated energy expenditure. Finally, because data were collected in 1 metropolitan area, they may not be generalizable to other populations. Despite these limitations, these findings make a unique contribution to the scientific literature on dance as a form of health-promoting physical activity in girls.

In summary, girls engaged in approximately 10 minutes of MVPA per hour of dance class participation. This was a substantial but modest proportion of the recommended amount of at least 60 minutes of daily MVPA.[1] Thus, parents cannot expect dance classes, alone, to provide all of the needed physical activity. Dance classes involved very limited amounts of sedentary behavior, providing evidence that dancing is an activity that promotes continuous movement and associated energy expenditure. With the high prevalence of dance as a type of physical activity among girls,[15–17] increasing the amount of MVPA in structured dance classes can play a vital role in increasing the physical activity levels of adolescent girls at the population level. These unique findings support that structured dance classes provide valuable opportunities for adolescent girls to be physically active.

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