

Age-Related Changes in Types and Contexts of Physical Activity in Middle School Girls

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Background: Because girls are less physically active than boys, it is important to understand the types of activities preferred by girls, and changes in those preferences over time, in order to design effective physical activity interventions.

Purpose: To describe developmental trends in participation in specific forms of physical activity in 6th- and 8th-grade girls.

Methods: Data for this study are from the Trial of Activity for Adolescent Girls. Self-reported physical activity, anthropometric, and demographic data were collected from random cross sections of 6th-grade girls in 36 middle schools in six U.S. communities. The same data were collected 2 years later from random cross sections of 8th-grade girls, as well as in previously measured 6th-grade girls who remained in the schools. Analyses were conducted with SAS using mixed-model ANOVAs to determine differences between 6th- and 8th-grade girls. Data were collected in 2002–2003 and 2004–2005 and analyzed in 2008–2009.

Results: The top physical activities reported by 6th- and 8th-grade girls were similar. Of the top 13 activities reported by 6th- or 8th-grade girls, 8th-grade girls reported participating in more 30-minute blocks for ten of the activities and were more likely to report participating as part of an organized program.

Conclusions: The activities reported by 6th- and 8th-grade girls were similar, but the way they participated in them changed from 6th to 8th grade. Eighth-grade girls were more likely to participate in activities that are often part of school-based team sports, and the time of participation in these activities was greater. Interventions to increase physical activity in adolescent girls should be informed by the factors that influence their participation in organized school sports programs and community-based activities that promote physical activity.

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Introduction

The 2008 *Physical Activity Guidelines for Americans*¹ included a recommendation that children and youth engage in 60 or more minutes of moderate-to-vigorous physical activity each day. The Guidelines further recommended that youth should regularly engage in specific types of physical activity, including resistance exercise, bone-loading activities, and activity of vigorous intensity. Surveillance systems, including the Youth Risk Behavior Survey in the U.S., monitor participation in overall physical activity and intensities of activity. They typically do not, however, monitor participation in specific forms of activity and do not document the physical and social contexts for participation in specific activities.

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Physical activity patterns and preferences of youth vary by population subgroups, with the most obvious differences between girls and boys.^{2–5} Because girls are less physically active than boys, it is particularly important to understand the specific types of activities performed and preferred by girls. This information would help to increase the effectiveness of future interventions and public health programs designed to promote physical activity in young people.

The Trial of Activity in Adolescent Girls (TAAG) was a large-scale study of physical activity in middle school girls. Data on physical activity were obtained using a modified version of the 3-Day Physical Activity Recall (3DPAR), which captured context, type, and intensity of physical activity.^{6,7} The 3DPAR data provided information on the specific forms of physical activity performed by a large, diverse group of middle school girls. The data reported here identify the most common specific forms of physical activity that 6th- and 8th-grade girls engaged in during the 3 hours after school and describe the patterns and physical and social contexts of participation for the forms of activity reported most frequently. Developmental trends in physical activity participation were examined by comparing the 6th- and 8th-grade samples.

Methods

Study Design

The TAAG was a group RCT of a physical activity intervention in middle school girls recruited from six communities in the U.S.⁸ Six middle schools in each community were recruited for the study, for a total of 36 middle schools; three schools in each community were randomized to intervention and three to control. Schools were selected by convenience, but with ethnic diversity as a goal. Study coordination was provided by the University of North Carolina at Chapel Hill, and the Project Office was at the National Heart, Lung, and Blood Institute, NIH.

Two random cross-sectional samples were drawn, the first among 6th-graders at the beginning of the study and the second among 8th-graders at the end of the study, following the 2-year intervention. Sixth-grade girls who remained in a school at 8th grade also were re-measured, and formed an adventitious cohort.

The study was approved by the participating universities' IRBs. Each participant's parent or guardian provided written informed consent, and all participants assented to participation. Consent for measurement was obtained for at least 80% of the random sample. The cross-sectional analysis included 1636 girls in 6th grade and 3398 girls in 8th grade from the 36 schools. Data were collected in 2002–2003 and 2004–2005 and analyzed in 2008–2009.

Self-Reported Physical Activity

The 3DPAR assesses self-reported PA behavior in the previous 3 days, beginning with the most recent day, using a script and graphic figures to explain the intensity of common activities.⁶ Participants recorded their physical activity using a grid divided into 30-minute time blocks, beginning at 6:00AM and ending at 12MN. Girls entered

their predominant activity in each 30-minute block and selected an intensity code for each non-sedentary activity. A list of 71 activities grouped in categories by type of activity was provided. MET values were obtained from the Compendium of Physical Activities.⁹ For the current study, only activity from the 3 hours after school was considered.

Girls also reported where and with whom non-sedentary activities took place. The five choices for “where” were school, home/neighborhood, community facility, other outdoor public area, and other. For the present study, other outdoor public area and other were combined with community facility. The four choices for “with whom” were by yourself; with one other person; with several people; and with an organized program, class, or team.

Other Measures

Girls answered two questions about race/ethnicity and self-reported free/reduced lunch status. Parents reported girls' date of birth on the consent form. Height and weight were measured by trained assessors using standardized procedures. BMI was calculated by dividing weight in kilograms by height in meters squared. Weight status categories (<85th percentile and ≥85th percentile BMI-for-age) were created based on the CDC Growth Charts.¹⁰

Statistical Methods

Descriptive statistics were calculated for girls included in the cross-sectional samples. The top ten activities that were equal to or above 3 METs were determined for each sample of girls using 3 days of recall. A girl was considered a participant in an activity if she reported the activity at least once during the 3-day recall period. Comparison by group (control versus intervention) revealed no significant differences,⁸ so the groups were combined in the analyses. All analyses were conducted with SAS, version 9.1.3.

Mixed-model ANOVAs were used to determine if there were differences in year (6th versus 8th grade) for percentage of girls reporting each activity (using Proc Mixed and Glimmix with logit link and binomial distribution); mean number of blocks reported for the activity (using Proc Mixed and Glimmix with log link and Poisson distribution); and the intensity of the activity (mixed-model ANOVA). Models included time as a fixed effect, with field center and school within field center as random effects for each sample. Significance levels were assessed based on the mixed models, taking into account the positive intraclass correlation expected in these data.¹¹ Models were also tested with race, weight status, and both race and weight status as fixed effects. These models were then repeated with the cohort of girls that was measured in both 6th and 8th grades.

Unadjusted frequencies for “where” and “with whom” were calculated for reported 30-minute blocks of each activity. Logistic analyses for each of the activities were performed to test if there was a grade difference.

Results

Approximately 20% of the girls in each cross-sectional sample were African American, 22% were Hispanic, >45% were white, and 11% were other races; >37% reported free/reduced-price lunch (Table 1). Girls in the 6th-grade sample were of mean age 12.0 years (SD=0.5)

Table 1. Descriptive characteristics of participants

Variable	M (SD) or %
SIXTH GRADE	
Age (years)	12.0 (0.5)
BMI	20.8 (4.8)
>85th percentile	33.2
Race	
White	47.1
Black	20.2
Hispanic	22.0
Other	10.8
Free/reduced-price lunch	
Yes	40.8
No	46.3
Don't know	12.9
EIGHTH GRADE	
Age (years)	14.0 (0.5)
BMI	22.8 (5.3)
>85th percentile	34.8
Race	
White	46.3
Black	21.0
Hispanic	21.3
Other	11.5
Free/reduced-price lunch	
Yes	37.6
No	55.1
Don't know	7.3

Note: 85th percentile based on BMI growth charts

and their BMI was 20.8 (SD=4.8). Girls in the 8th-grade sample had a higher mean BMI (22.8±5.3).

The ten physical activities most frequently reported by girls in 6th and 8th grades are shown in Table 2. Travel by walking and household chores were the activities most frequently reported by both 6th- and 8th-grade girls. Dance, basketball, playing with younger children, walking for exercise, and running/jogging were in the top ten for both age groups. Activities in the top ten for only 8th-grade girls included softball/baseball, volleyball, and track and field, whereas bicycling, playground games, and gymnastics/tumbling were in the top ten for only 6th-grade girls.

Table 3 presents unadjusted data for differences in prevalence of the 13 activities that were included in the

Table 2. Most prevalent physical activities in 6th- and 8th-grade girls

Activity	6th grade	8th grade
1	Travel by walking	Travel by walking
2	Doing household chores	Doing household chores
3	Basketball	Dance
4	Dance	Basketball
5	Playing with younger children	Walking for exercise
6	Walking for exercise	Running/jogging
7	Running/jogging	Playing with younger children
8	Bicycling	Softball/baseball
9	Playground games	Volleyball
10	Gymnastics/tumbling	Track and field

Note: 6th grade, n=1636; 8th grade, n=3398

top ten for either 6th- or 8th-grade girls or both. Sixth-grade girls were significantly more likely than 8th-grade girls to report basketball, playing with younger children, running/jogging, bicycling, playground games, and gymnastics. Eighth-grade girls were significantly more likely to report travel by walking, softball/baseball, track and field, and volleyball. After adjusting for race, weight status, and race and weight status, there were no changes in direction or significance of the differences from 6th to 8th grade except for gymnastics/tumbling, for which the difference was not significant when adjusting for race or race and weight status.

Table 3 also includes grade-level comparisons for the unadjusted mean number of 30-minute blocks and the reported intensity of each activity over the 3-day period. Ten of the 13 activities differed in the mean number of blocks reported by 6th- and 8th-grade girls. After adjusting for race, weight status, and race and weight status, the direction and significance of the differences between 6th and 8th grade remained the same, except for playground games. After adjusting for race and race and weight status, the reported number of blocks of playground games declined significantly from 6th to 8th grade. No differences by grade were found for playing with younger children and bicycling. For the activities that did differ, 8th-grade girls reported a higher number of blocks for ten of them. Sixth-grade girls reported a higher number of blocks for only one, playground games. Only two activities differed in reported intensity. Sixth-grade girls reported higher intensity than 8th-grade girls for basketball (6.5 and 6.2 METS, respectively) and walking for exercise (4.1 and 3.9 METS, respectively). There were no changes

Table 3. Prevalence, frequency, and intensity of middle school girls' participation in common forms of physical activity across all days

Activity	Percentage of girls reporting		M (SE) blocks		M (SE) intensity	
	6th grade (n=1482)	8th grade (n=2969)	6th grade	8th grade	6th grade	8th grade
Travel by walking	16.0	18.4**	1.9 (0.09)	2.2*** (0.07)	3.7 (0.05)	3.7 (0.05)
Doing household chores	13.4	14.6	2.0 (0.10)	2.2** (0.07)	3.1 (0.03)	3.1 (0.02)
Basketball	8.9	6.2****	2.7 (0.24)	3.3*** (0.22)	6.5 (0.10)	6.2** (0.09)
Dance	6.1	5.7	2.1 (0.18)	2.6** (0.13)	4.5 (0.00)	4.5 (0.00)
Playing with younger children	5.1	2.7****	2.2 (0.14)	2.1 (0.12)	4.0 (0.00)	4.0 (0.00)
Walking for exercise	4.6	5.4	1.8 (0.16)	2.2** (0.11)	4.1 (0.06)	3.9** (0.03)
Running/jogging	4.2	3.1**	1.6 (0.13)	2.0** (0.11)	9.5 (0.19)	9.4 (0.15)
Bicycling, mountain biking	2.7	1.1****	2.1 (0.21)	2.1 (0.22)	6.3 (0.32)	6.3 (0.32)
Playground games	2.6	0.1****	2.3 (0.25)	1.6 (0.30)	5.0 (0.00)	5.0 (0.00)
Gymnastics/tumbling	1.3	0.9*	2.4 (0.54)	3.7*** (0.50)	4.6 (0.12)	4.7 (0.11)
Softball/baseball	1.0	1.9***	2.3 (0.55)	4.1*** (0.35)	5.0 (0.00)	5.0 (0.00)
Track and field	0.7	1.4***	2.8 (0.86)	4.7** (0.56)	7.7 (0.63)	6.6 (0.46)
Volleyball	0.5	1.8****	1.6 (0.84)	3.8*** (0.55)	5.1 (0.26)	5.5 (0.15)

Note: Years were compared using mixed-model ANOVA with school and site as random variables and controlling for race.

* $p=0.05$, ** $p<0.05$, *** $p<0.01$, **** $p<0.001$

after adjustment for race, weight status, or race and weight status.

The analyses for Table 3 were repeated in the cohort of girls for which both 6th- and 8th-grade data were available ($n=1336$; 52.5% white, 18.6% African American, 19.5% Hispanic; mean (SD) age = 11.9 (0.4) years; mean BMI = 20.7 (4.8); 34.8% free/reduced-price lunch at baseline). For percentage of girls reporting and mean blocks of activity, all means (SE) were in the same direction, although travel by walking, running/jogging, and gymnastics/tumbling did not reach significance ($p>0.05$). For intensity, basketball and walking for exercise were in the same direction as in the cross-sectional analyses, but they did not reach significance ($p>0.05$).

Figures 1 and 2 show the locations where girls reported performing the 13 activities. Sixth-grade girls were more likely to report participating in basketball and volleyball at home or in their community, whereas 8th-grade girls were more likely to report participating in these activities at school or in the community. Girls were most likely to participate in softball/baseball in the community as sixth-graders and at school as eighth-graders. Sixth-grade girls reported participating in track and field at home, school, and community locations, whereas the majority of 8th-grade girls reported participating in it at school.

Responses to the "with whom" question are shown in Figures 3 and 4. The most significant difference between

6th- and 8th-grade girls was observed in the sports activities. Eighth-grade girls were more likely than 6th-grade girls to report participating in basketball, dance, running, gymnastics, softball, track, and volleyball as part of an organized program. More 6th-grade girls reported walking for exercise alone and biking with one other person, whereas more 8th-grade girls reported walking with one other person and biking with several people.

Discussion

Many previous studies have reported declines in participation in moderate-to-vigorous physical activity as youth move through adolescence.^{12–16} However, the specific physical activity behaviors underlying that change have not been studied extensively. The major finding of the present study was that specific forms of physical activity reported most frequently were similar in 6th- and 8th-grade girls, but the manner in which girls engaged in some of those activities changed in ways that are potentially important. Notably, there was an apparent trend toward greater participation in team sports among eighth-graders. For 8th-grade girls, more-frequent participation was observed in the forms of physical activity that young people typically engage in as school-based competitive team sports (i.e., softball, track and field, and volleyball). Further, the time of participation for these

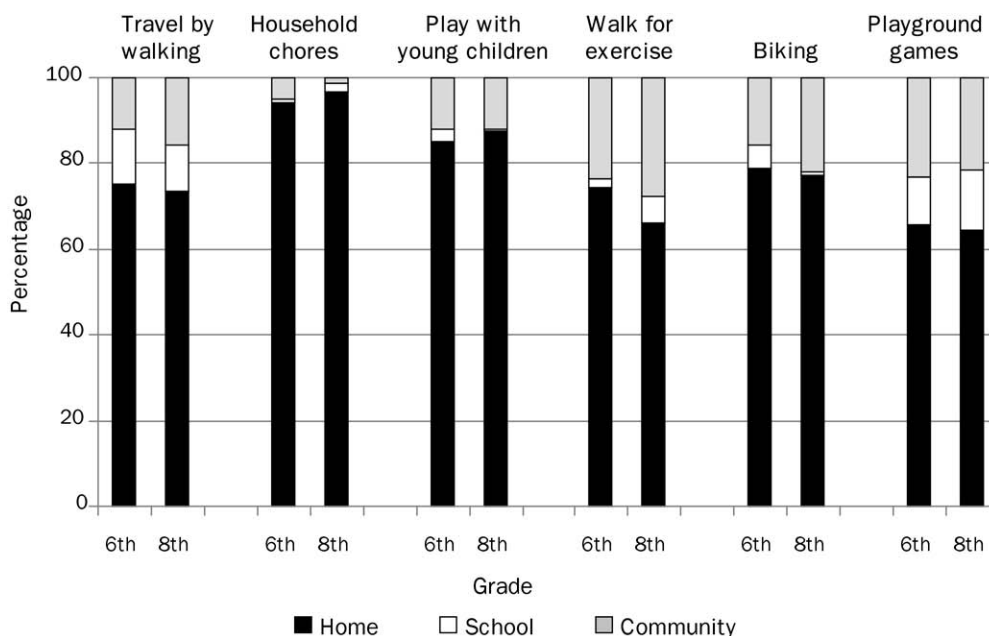


Figure 1. Location where girls reported engaging, on any days of recall, in unorganized physical activity for which intensity ≥ 3 METs, by grade
 *Difference by grade $p < 0.05$

forms of physical activities was greater among eighth-graders than sixth-graders, a pattern that is consistent with structured team sport practice sessions.

We observed changes in the location of some activities (“where”) between sixth- and eighth-graders. In all cases, 8th-grade girls were less likely than 6th-grade girls to report doing these activities at home and more likely to report doing them at school or in a community setting. It is not

clear if the change in locations reflects changes in girls’ activity preferences or differences in the types of activities that are available to them; organized activities at school and in the community may be more available and accessible to older girls. Some TAAG schools provided interscholastic sports for 7th- and 8th-grade students but not for 6th-graders. In order to promote activity in girls, it may be useful for middle schools to open sports participation to students in all

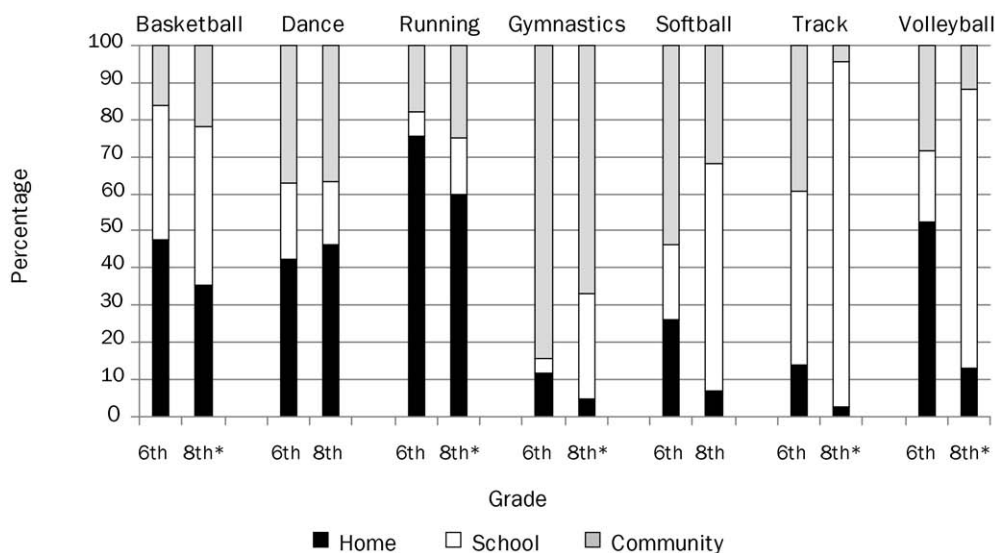


Figure 2. Location where girls reported engaging, on any days of recall, in organized physical activity for which intensity ≥ 3 METs, by grade
 *Difference by grade $p < 0.05$

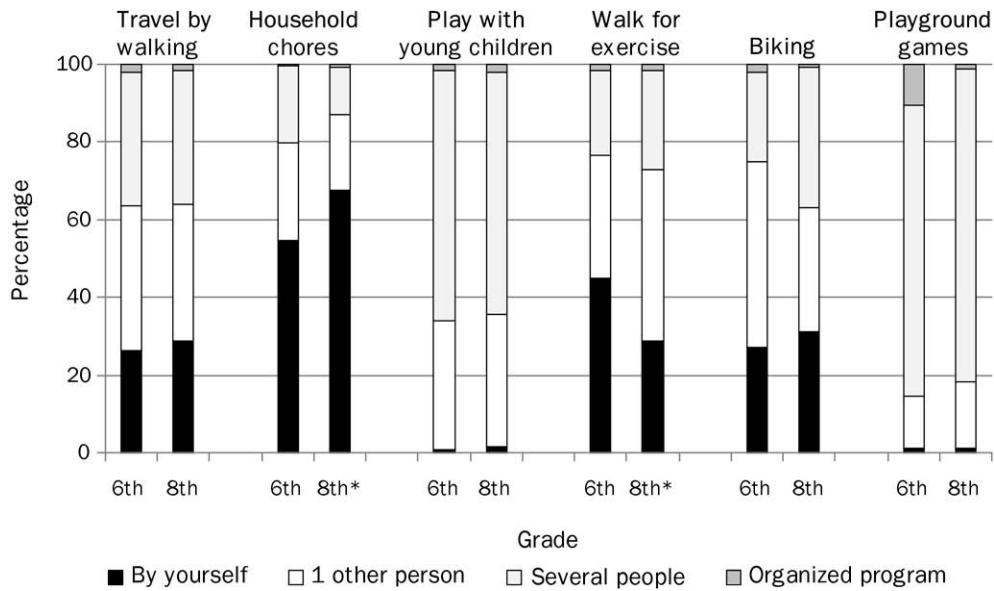


Figure 3. People or group with whom girls reported engaging in unorganized physical activity
*Difference by grade $p < 0.05$

grades and for community programs to offer a variety of activities that appeal to both younger and older middle school girls.

Middle school may be a time to leverage girls' growing awareness of and interest in sports for the purpose of increasing their overall physical activity levels. Efforts to attract girls to sports programs could support their involvement in sporting activities through increased offerings, involvement of family, and reinforcement by influential adults (teachers and coaches). Also, physical education could play an important role.¹⁷ In addition to

including sports popular with girls in the curriculum, physical education teachers should advocate for sports participation outside of their class, linking girls to opportunities for participation in the community.

In the present study, the most common place for physical activity was home/neighborhood, suggesting that most activities were not organized. Unstructured physical activities, such as walking for exercise, walking for transportation, and biking took place most often in this setting. This finding suggests that neighborhoods need to be designed with transportation in-

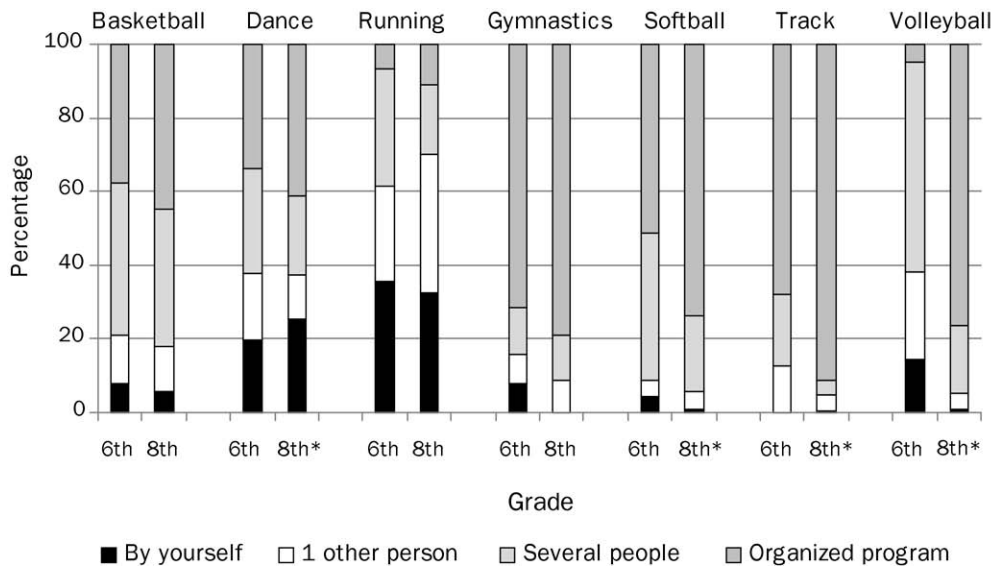


Figure 4. People or group with whom girls reported engaging in organized physical activity
*Difference by grade $p < 0.05$

frastructure (sidewalks, bike lanes) to support walking and biking, and park and recreation facilities to support other common activities.¹⁸ Efforts to promote these activities may be particularly important for girls who are not interested in or do not have access to sport activities. From the 6th to 8th grades, school became a more important location for organized activities. This shift could result from a combination of community programs becoming more competitive and exclusive and middle schools providing more opportunities for older students.

The large and diverse samples of girls from six different regions of the U.S. are a strength of the current study. Although the data cannot be considered to be nationally representative, it is likely that the physical activity patterns observed in the present study are reflective of those in 6th- and 8th-grade girls across the country. Future studies in nationally representative samples would be desirable. Replication of the cross-sectional analyses in a sizeable adventitious cohort is another strength of the study. It is also important that contextual information related to social and physical settings for physical activity was available, in addition to information on the specific forms of physical activity in which girls participated. A major limitation of the study is that data were available for girls in 6th and 8th grades only; it will be important for future studies to apply similar methods across wider age ranges. In addition, the assessments of the key variables examined in the present study were based on self-report and, therefore, recall limitations may have influenced the findings.

In summary, the current study observed participation in specific forms of physical activity in diverse samples of 6th- and 8th-grade girls. Changes were consistent with increased participation in structured school sports programs and suggest that effective promotion of physical activity in adolescent girls may depend, in part, on girls' access to and preparation for attractive school sports programs.

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