

Original article

Sport Participation and Physical Activity in Adolescent Females across a Four-Year Period

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Manuscript received December 2, 2005; manuscript accepted March 15, 2006

Abstract

Purpose: To determine the odds of engaging in future moderate-to-vigorous physical activity (MVPA) and vigorous physical activity (VPA) in adolescent female sport participants. A secondary purpose was to compare activity levels of three groups of girls, those who played sports at three time points, those who dropped out, and those who did not participate in sports.

Methods: Data were collected at three time points, eighth, ninth, and 12th grades, in 429 adolescent girls across the state of South Carolina. Demographic, sport participation and physical activity (PA) data were collected using surveys. Odds ratios were calculated to determine the association between sport participation and future PA behavior. PA was also compared for three sport participation groups (nonparticipants, dropouts, or three-year participants) using analysis of variance.

Results: For MVPA, ninth grade participants were more likely to be active in 12th grade (OR = 1.74 [1.13, 2.67]), and eighth and ninth grade participants more likely to be active in 12th grade than nonparticipants (OR = 1.54 [confidence interval 1.01, 2.35]). For VPA, sport participants had higher odds of being active at all future time points. Three-year participants were significantly more vigorously active than nonparticipants and dropouts at all three time points ($p < .01$).

Conclusions: Adolescent girls who participate in sports in eighth, ninth, and 12th grades are more likely to be vigorously active in 12th grade. These findings are novel in providing evidence that sport participation contributes to overall vigorous physical activity during late adolescence, when overall physical activity is known to decline precipitously. © 2006 Society for Adolescent Medicine. All rights reserved.

Keywords:

Females; High school; Longitudinal; Physical activity; Sport participation

There is an emerging scientific consensus that physical activity is important for the health of children and youth [1]. However, as girls in the United States move through adolescence their participation in physical activity declines markedly [2,3]. In one population-based study, the median

level of leisure time physical activity among girls aged 9–18 years declined by about 80% [2]. The Youth Risk Behavior Surveillance System (YRBSS) survey of high school students in the United States estimated that the percentage of girls who participate in sufficient vigorous physical activity declines from 63.6% in ninth grade to 46.4% in 12th grade [4]. Similarly, the percentage of girls who report no vigorous or moderate physical activity increases from 9.7% in ninth grade to 17% in 12th grade. Those rates of change for girls are twice as great as for boys [4]. Low

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levels of physical activity during adolescence may contribute to increased incidence of obesity and type 2 diabetes [5,6], more symptoms of depression [7], and increased risk of sedentary adult behavior [8]. This public health burden makes it important to determine what contributes to physical activity behavior among girls during late adolescence.

Both cross-sectional and longitudinal studies have shown relationships between sport participation and overall physical activity among adolescents. In a cross-sectional study involving more than 50,000 ninth grade students, the odds of sport participants being more active than nonparticipants was 3.21 (2.96, 3.49) [9]. Katzmarzyk and Malina found that adolescent sport participants had higher overall and moderate-to-vigorous energy expenditure than nonparticipants [10]. Short-term longitudinal studies also have consistently reported positive associations between sport participation and physical activity [11–13]. However, long-term longitudinal data on U.S. children and adolescents are limited. Although studies have shown that sport participation comprises a large part of overall physical activity among girls, the association between sport participation and the decline in overall physical activity among girls during adolescence remains unclear.

The purpose of this study was to determine the odds of engaging in future moderate-to-vigorous physical activity (MVPA) and vigorous physical activity (VPA) in adolescent female sport participants. A secondary purpose was to compare activity levels of three groups of girls, those who played sports at all three time points, those who dropped out, and those who did not participate in sports at any time point.

Methods

Design

Data were collected longitudinally over a four-year period, beginning when girls were in eighth grade, as part of the Lifestyle Education for Activity Program (LEAP) [14]. Each girl was recruited and measured at three time points: eighth grade (baseline), ninth grade (first follow-up), and 12th grade (second follow-up). Girls from 31 middle schools were invited to participate in baseline measures. Girls from one middle school (that included ninth grade) and 23 high schools were invited to participate in the first follow-up, and 12th grade girls from 22 high schools were invited to participate in the second follow-up. Between the first and second follow-ups two schools merged, causing the loss of one school. At each time point, all girls in the targeted grade level were invited to participate, even if they had not participated in a prior measurement. All participants were volunteers, and no one was excluded from participating in the study. If girls could not read English, had a mental limitation, or were pregnant, they were allowed to participate, but their data were excluded at the time of analysis.

Subjects

In eighth grade a total of 2382 girls were measured, followed by 2240 girls in the ninth grade and 1556 girls in the 12th grade. A total of 510 girls were measured across all three of the time points (i.e., measured at eighth, ninth, and 12th grades). After deletions for missing physical activity data ($n = 81$), 429 girls were included in this study. Demographic data (race and parent education) were obtained via brief questionnaire. Of the 429 girls, 56% were African-American, and 61% had at least one parent who was educated beyond high school. All phases of this study were approved by the University of South Carolina's Institutional Review Board. A parent or guardian of each girl provided informed consent at each time point (with the exception of the 12th grade assessment for some girls who were 18 years old); girls provided their own informed consent at each time point.

Physical Activity Recall

The 3-Day Physical Activity Recall (3DPAR) was used to measure participation in physical activity. All data from the 3DPAR instrument are converted into MET scores, which are multiples of resting metabolism (one MET is the amount of energy required to maintain the body's activity at rest). Scores from the 3DPAR have been validated by concurrent comparison with accelerometer-derived count variables for total METs, moderate to vigorous physical activity (MVPA), and vigorous physical activity (VPA). Correlations for both three days of accelerometer counts and seven days of accelerometer counts were significant for all 3DPAR variables in a sample of 70 eighth and ninth grade girls (54.3% white, 37.1% African-American) [15].

The 3DPAR was administered to the subjects in the spring of their eighth, ninth, and 12th grade years. The instrument was always administered on a Wednesday, with girls recalling activities from the immediately preceding Tuesday, Monday, and Sunday. Each day is segmented (using a grid format) into 30-minute time blocks (7:00 am to 12:00 midnight), which, in turn, are grouped into morning, afternoon and evening time periods. Subjects were asked to report the predominant activity in each of the 30-minute blocks. A list of 55 activities, grouped into the categories of eating, work, after school/spare time/hobbies, transportation, sleep/bathing, school, and physical activities and sports was provided, along with a space to write in "other." Four more activities were added to the list at 12th grade due to frequency of write-in at eighth and ninth grades.

The 3DPAR uses definitions and graphic figures to explain the intensity of common activities. Light activities are described as requiring little or no movement with slow breathing, moderate activities as requiring some movement and normal breathing, hard activities as requiring moderate movement and increased breathing, and very hard activities as requiring quick movements and hard breathing. Each

30-minute block of each day was assigned a MET intensity from the Compendium [16]. The number of blocks was then summed for activities that were assigned an intensity of three METs or greater (MVPA) and for activities that were assigned an intensity of six METS or greater (VPA). The girls were then categorized as active if they had two or more blocks of MVPA per day or one or more blocks of VPA per day averaged across the three days. Girls not meeting those criteria were categorized as inactive.

Sport Team Participation

On a separate questionnaire, two items adapted from the Youth Risk Behavior Surveillance System survey [17] asked about sport team participation during the past year: “During the past 12 months, how many sports teams run by your school did you play on? (DO NOT include PE classes)” and “During the past 12 months, how many sports teams run by organizations outside your school did you play on?” Scores for each item ranged from zero to three. Three categories of sport team participation were created, as described in the statistical analyses section.

Body Mass Index

Height was measured to the nearest 1.0 cm with a portable stadiometer, and weight was measured to the nearest .1 kg with a calibrated digital scale (BeFour, Inc. Model PS6600; Saukville, WI). Body mass index (BMI) was calculated by dividing weight in kilograms by height in meters squared ($\text{kg} \cdot \text{m}^{-2}$).

Statistical Analyses

All analyses were performed using SAS statistical software (Version 8.2, SAS Institute, Cary, NC). Crude and adjusted odds ratios (OR) and 95% confidence intervals (CIs) were calculated to determine the association between sport participation and physical activity. All data are reported with non-sport-participants as the referent group for each grade, and adjusted analyses controlled for baseline age, BMI, parent education, and race.

To directly compare physical activity based on categories of sport participation, participants were also divided into three groups (nonparticipants, dropouts, and three-year participants) and analyzed using analysis of variance (ANOVA). Dropouts participated in eighth grade only, ninth grade only, or eighth and ninth but not 12th grade. Data were not examined in this analysis for girls who participated in sports during eighth and 12th grades only ($n = 20$), ninth and 12th grades only ($n = 28$), or 12th grade only ($n = 31$). We did not control for any variables in this analysis because the crude and adjusted odds ratios were similar in the previous analyses.

Results

Participant characteristics are shown in Table 1. Mean age at baseline was 13.6 years, and mean BMI of all three years was 24.0 (data are reported as one value for three years because BMI did not change significantly over the four-year time period). Girls spent similar percentages of time engaging in physical activity (both MVPA and VPA) in eighth and ninth grades, and values were lower in 12th grade. Similarly, the proportion of girls who played on any sport team was similar from eighth to ninth grade, but was lower in 12th grade. Forty-eight percent of the participants played sports at all three time points.

Table 2 shows all odds ratio data for MVPA. Crude and adjusted odds ratios were similar; adjusted values are reported in the following text. Eighth grade sport participants were more likely to engage in MVPA in ninth (OR = 1.68; 95% CI 1.08, 2.61) but not 12th grade (OR = 1.15; 95% CI .74, 1.77). Ninth grade sport participants were more likely to engage in MVPA in 12th grade (OR = 1.74; 95% CI 1.13, 2.67). Girls who played sports in both eighth and ninth grade were more likely to engage in MVPA in ninth (OR = 2.30; 95% CI 1.47, 3.60) and 12th grades (OR = 1.54; 95% CI 1.01, 2.35), but girls who played sports in all three years were not more likely to participate in MVPA in 12th grade (OR = 1.41; 95% CI .90, 2.21).

Table 3 shows all odds ratio data for VPA. Eighth grade sport participants were more likely to engage in VPA in ninth (OR = 1.80; 95% CI 1.19, 2.71) and 12th grades (OR = 1.88; 95% CI 1.21, 2.93). Ninth grade sport participants were more likely to engage in VPA in 12th grade (OR = 1.89; 95% CI 1.21, 2.94). Girls who played sports in both eighth and ninth grade were more likely to engage in VPA in ninth (OR = 2.06; 95% CI 1.39, 3.06) and 12th grades (OR = 2.03; 95% CI 1.34, 3.08), and girls who played sports in all three years were more than twice as likely to participate in VPA in 12th grade (OR = 2.23; 95% CI 1.47, 3.41).

Results from ANOVA revealed significant physical activity differences among sport participation categories (Table 4). For number of blocks of MVPA there was a significant difference between nonparticipants and three-year participants, and between dropouts and three-year participants, at eighth and ninth but not 12th grade ($p < .01$). For number of blocks of VPA there was a significant difference between nonparticipants and three-year participants, and between dropouts and three-year participants, at all three time points ($p < .01$).

Discussion

To our knowledge, this is the first study of a large cohort of U.S. girls to demonstrate that sport participation contributes to overall participation in vigorous physical activity during late adolescence, when physical activity is known to

Table 1
Characteristics of 429 girls measured at three time points (8th, 9th, 12th grades)

Characteristic	Percent or Mean (SD)				
Race					
African American	55.7%				
White	39.6%				
Other	4.7%				
Age (8th grade), years	13.6 (.6)				
BMI, mean of all years available	24.0 (5.4)				
Parent education					
HS or less	38.5%				
More than HS	60.8%				
Missing	0.1%				
Sport participant					
	School	Other	Both	None	Either
8th grade	44.8%	47.1%	28.0%	36.1%	63.9%
9th grade	50.6%	47.1%	31.2%	33.6%	63.2%
12th grade	46.9%	30.3%	19.6%	42.4%	57.6%
1 or more blocks of VPA					
8th grade	44.1%				
9th grade	44.3%				
12th grade	35.0%				
2 or more blocks of MVPA					
8th grade	72.7%				
9th grade	72.7%				
12th grade	69.7%				
Non-sport participant	20.3%				
Drop-out	31.7%				
Sport participant in 8th, 9th and 12th grade	48.0%				

MVPA = moderate-to-vigorous physical activity; VPA = vigorous physical activity.

decline precipitously. Overall, sport participants were more likely to be physically active than nonparticipants over time. A higher number of years of sport participation was associated with more physical activity, particularly in the case of vigorous activity. Relationships between sport participation and physical activity were stronger for vigorous physical activity than for moderate-to-vigorous physical activity. The findings of the current investigation suggest that adolescent girls who participate in sports in eighth, ninth, and 12th grades are more likely to be vigorously active in 12th grade.

The results of this study are similar to previous longitudinal research in other populations. The study most similar to the current investigation involved participants aged 15–18 years in New Zealand [12]. The findings of that study showed that youth who were sport participants at age 15 were 1.8 times more likely to participate in more than four hours of physical activity per week at age 18. Similarly, a Finnish study showed a weak but statistically significant relationship between sport participation and future physical activity in a study involving children/youth aged 9, 12, 15, and 18 years [18]. An investigation involving early adoles-

Table 2
Crude and adjusted odds ratios for meeting at least two blocks of moderate-to-vigorous physical activity per day (1 = yes) for sport participation (1 = yes)

Sport participation (n = 429)	Meeting	MVPA (≥ 2 blk) Sport (%)		Crude OR (95% CI)	Adjusted ^a OR (95% CI)
		No	Yes		
8th grade only n = 36 (8.4%)	9th grade	73.8	61.1	.56 (.28, 1.13)	.57 (.28, 1.17)
	12th grade	71.0	55.6	.51 (.26, 1.02)	.53 (.26, 1.06)
8th grade n = 274 (63.9%)	9th grade	65.8	76.6	1.71 (1.10, 2.63)	1.68 (1.08, 2.61)
	12th grade	67.7	70.8	1.15 (.75, 1.77)	1.15 (.74, 1.77)
9th grade only n = 25 (5.8%)	12th grade	70.3	60.0	.63 (.28, 1.45)	.63 (.27, 1.48)
9th grade n = 271 (63.2%)	12th grade	62.0	74.2	1.76 (1.15, 2.68)	1.74 (1.13, 2.67)
8th and 9th grade n = 218 (50.8%)	9th grade	64.5	80.7	2.31 (1.49, 3.58)	2.30 (1.47, 3.60)
	12th grade	64.9	74.3	1.56 (1.03, 2.37)	1.54 (1.01, 2.35)
8th, 9th and 12th n = 168 (39.2%)	12th grade	66.7	74.4	1.45 (.94, 2.24)	1.41 (.90, 2.21)

^a Adjusted for baseline age, BMI, parent education, and race.

Table 3

Crude and adjusted odds ratios for meeting at least one block of vigorous physical activity per day (1 = yes) for sport participation (1 = yes)

Sport participation (n = 429)	Meeting	VPA (≥ 1 blk Sport (%))		Crude OR (95% CI)	Adjusted ^a OR (95% CI)
		No	Yes		
8th grade only n = 36 (8.4%)	9th grade	27.8	45.8	.47 (.22, 1.00)	.47 (.22, 1.00)
	12th grade	25.0	35.9	.60 (.27, 1.30)	.63 (.28, 1.39)
8th grade n = 274 (63.9%)	9th grade	34.8	9.6	1.84 (1.23, 2.77)	1.80 (1.19, 2.71)
	12th grade	25.2	40.5	2.03 (1.31, 3.13)	1.88 (1.21, 2.93)
9th grade only n = 25 (5.8%)	12th grade	24.0	35.6	.57 (.22, 1.46)	.65 (.25, 1.71)
9th grade n = 271 (63.2%)	12th grade	25.3	40.6	2.02 (1.31, 3.11)	1.89 (1.21, 2.94)
	9th grade	35.1	53.2	2.11 (1.43, 3.10)	2.06 (1.39, 3.06)
8th and 9th grade n = 218 (50.8%)	12th grade	26.1	43.6	2.19 (1.46, 3.29)	2.03 (1.34, 3.08)
	12th grade	26.8	47.6	2.48 (1.65, 3.73)	2.23 (1.47, 3.41)

^a Adjusted for baseline age, BMI, parent education, and race

cents showed that participation in community sports was a significant predictor of moderate-to-vigorous physical activity for boys and girls [11], whereas other studies have shown a relationship between sport participation at younger ages and physical activity during adulthood [19,20]. The current investigation highlights the contribution of sport participation specifically to vigorous physical activity in a prospective cohort of adolescent girls. It is unknown exactly why the relationship between activity and sport was stronger for vigorous activity than for moderate-to-vigorous activity; however, most sports involve an activity level that girls would perceive and report as vigorous. In light of the available evidence that prevalence of meeting vigorous physical activity guidelines in girls was approximately 64% in ninth grade and 46% in 12th grade in the 2003 YRBSS [4], it may be particularly important for future studies to explore the role sport participation can play in keeping adolescent girls active.

Along with examining the role sports can play in keeping girls active, it is important to consider the effects of drop-

Table 4

Comparison of MVPA and VPA for nonparticipants, dropouts, and three-year participants

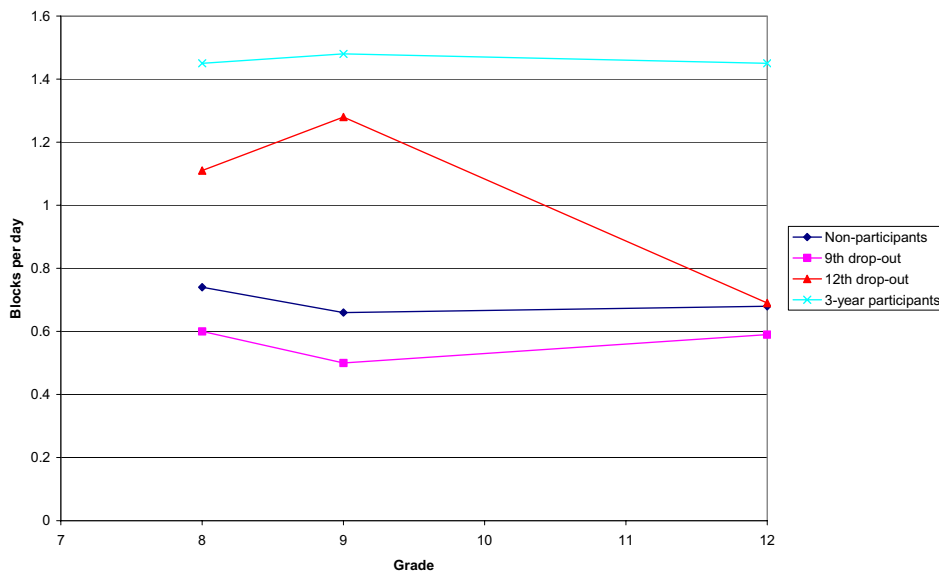
		Nonparticipants (n = 71; M \pm SD)	Dropouts (n = 111; M \pm SD)	All Three Years (n = 168; M \pm SD)
8th	MVPA	2.79 \pm 2.23 ^a	3.50 \pm 2.70 ^a	4.36 \pm 2.74
	VPA	.74 \pm 1.03 ^b	0.90 \pm 1.13 ^b	1.45 \pm 2.16
9th	MVPA	2.60 \pm 1.97 ^b	3.21 \pm 2.31 ^b	4.38 \pm 2.65
	VPA	.66 \pm 1.28 ^b	0.94 \pm 1.18 ^b	1.48 \pm 1.59
12th	MVPA	3.77 \pm 3.48	4.43 \pm 4.11	4.91 \pm 3.82
	VPA	.68 \pm 1.56 ^a	0.69 \pm 1.38 ^a	1.45 \pm 2.16

MVPA = moderate-to-vigorous physical activity; VPA = vigorous physical activity; MVPA and VPA = number of 30-minute blocks per day reported on the 3DPAR.

^a significantly different from three-year participants ($p < .01$).^b significantly different from three-year participants ($p < .001$).

ping out of sports. For the analyses in the current investigation, the dropout category included both girls who participated in sports in eighth grade only (not ninth or 12th; n = 36) and those who participated in eighth and ninth grades only (but not 12th; n = 50). However, dropping out of sport after eighth grade may be significantly different from dropping out after ninth grade. As a post hoc analysis, we compared vigorous physical activity for nonparticipants, participants who dropped out after eighth grade, participants who dropped out after ninth grade, and three-year participants, using ANOVA. Results from the analysis (not shown) were similar to those presented in Table 4, with each group significantly different from three-year participants ($p < .001$). Although the participants who dropped out after eighth grade were not significantly different from the participants who dropped out after ninth grade ($p = .07$), the data showed a dramatic decline in vigorous physical activity for girls who dropped out after ninth grade (Figure 1). It is likely that there was not enough statistical power to detect a difference between the two types of dropouts (n = 36 and n = 50, respectively). For those girls who drop out after they make the transition to high school sports, it appears that sport is an important source of physical activity. In contrast, girls who drop out after eighth grade are more similar to nonparticipants in their activity patterns. It is likely that the girls who dropped out of sport after eighth grade were not as committed to sport as those who dropped out after ninth grade, indicating that those girls who are more seriously involved in sport and drop out suffer greater declines in overall physical activity than girls who are less seriously involved or nonparticipants.

This study had several strengths and a few limitations. Although the evidence is not causal in nature, the use of longitudinal data is a strength and provides a clear, positive link between sport participation and physical activity across four years. Another strength is that the study population included a representative sample of African-American and white girls from all areas of South Carolina, allowing for a



NOTE: 9th grade drop-out refers to participants who played sports in 8th grade; 12th grade drop-out refers to participants who played sports in 8th and 9th grade.

Figure 1. Vigorous physical activity (VPA) across four years; 9th grade dropout refers to participants who played sports in 8th grade; 12th grade dropouts refers to participants who played sports in 8th and 9th grade.

diverse subject population. Our results showed no difference in crude versus adjusted odds ratios controlling for race, suggesting that race does not play a significant role in the relationship between sport participation and physical activity. These findings are in contrast to a previous investigation [21], which found that sport participation was a predictor of physical activity in African-American but not white girls. However, the previous study was cross-sectional and showed that sport participation accounted for less than 10% of the variance in a linear regression analysis, whereas this investigation addressed sport participation over time. One limitation of this study is that specific information regarding participation in formal physical activity programs or lessons was not collected. This information could have provided more insight into the associations between the types or settings of sport participation and physical activity. Another limitation is that the physical activity results could have been affected by recall bias, because it is not known if sport participants or nonparticipants recall activities differently; however, the 3DPAR has been validated in previous studies [15,22].

In conclusion, girls who played sports for a higher number of years were more active than nonparticipants, suggesting that adolescent girls who participate in sports in eighth, ninth, and 12th grades have higher odds of being vigorously active in 12th grade. Also, three-year sport participants maintain consistent activity patterns over time. Although the results were not as strong for moderate-to-vigorous activity, girls who were sport participants in both eighth and ninth grades were more likely to engage in moderate-to-vigorous physical activity in 12th grade. More research

regarding both the contribution of sport participation to physical activity behavior and the effects of discontinuing sport participation on physical activity behavior in adolescent girls is necessary.

Acknowledgments

This work was supported by HL-057775 from the National Institutes of Health. The authors thank Gaye Groover Christmus for editing the manuscript, LaVerne Shuler and Janna Borden for coordinating the project, and all of the schools, participants, and data collection staff who contributed to the project.

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