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Physical Activity Trajectories and Multi-Level Factors among Adolescent Girls

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Abstract

Purpose—Although the decline of physical activity in adolescent girls is well-documented, there are girls whose physical activity does not follow this pattern. This study examined the relationships between physical activity trajectories and personal, psychosocial and environmental factors among adolescent girls.

Methods—Participants were from the University of Maryland field site of the Trial of Activity for Adolescent Girls. Of 730 girls measured in 8th grade, 589 were re-measured in 11th grade. Moderate to vigorous physical activity was assessed by accelerometers; participants were categorized as active maintainers (n=31), inactive maintainers (n=410), adopters (n=64), or relapsers (n=56). Height and weight were measured, personal and psychosocial information was collected from surveys, and distance from home to school and parks was assessed from Geographical Information Systems. Multivariable logistic regression was used for data analysis.

Results—Variables at individual, social, and environmental levels predicted active maintainers and inactive maintainers, while only individual-level variables predicted adoption. None predicted relapse. Higher (favorable) scores for physical self-concept, perceived body fat, friend and family physical activity support, frequency of physical activity with friends, and shorter distance from home to a park predicted active maintainers. Overweight/obese status, earlier age at menses, and lower scores for physical self-concept, perceived body fat, friend physical activity support, and frequency of physical activity with friends, and further distance from home to school predicted inactive maintainers. High physical self-concept and not being overweight/obese predicted adopters.

Conclusion—Multi-level factors appear to predict behavior maintenance rather than actual change.

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Implications and Contribution—Although physical activity declines among girls during adolescence, some maintain and others increase their physical activity. Our results identified factors across individual, social, and environmental levels that predicted physical activity maintenance over 3 years. These may guide future interventions to enhance adolescent girls' physical activity and combat the overall decline.

Regular physical activity promotes health, fitness, and quality of life for people of all ages, including youth [1]. The national physical activity guidelines recommend that children and adolescents participate in at least 60 minutes of moderate to vigorous physical activity (MVPA) every day to maintain good health [1]. About 75% of children aged 9 – 13 years reported participating in physical activity in the previous 7 days [2]. However, both boys and girls experience a general decrease in physical activity during the teenage years [3–5], and girls exhibit steeper declines than boys [3, 4, 6]. By high school, only 15% of students meet guidelines [3].

Although the decline of physical activity in girls during adolescence is well established, there are girls whose physical activity patterns do not decline. Longitudinal samples indicate low to moderate stability of physical activity, suggesting substantial variability in the behavior [5, 7]. However, relatively few studies have examined patterns of physical activity change [8]. Even fewer have examined potential determinant factors associated with these patterns [9]. It is particularly important to examine influences across individual, social, and environmental levels, as it is currently understood that physical activity has multi-level determinants [10].

This 3-year longitudinal study examined multi-level factors associated with physical activity trajectories among adolescent girls. We hypothesized that factors across all levels would be associated with physical activity maintenance, adoption, relapse, and maintenance of low activity. This study extends the scarce available literature by examining determinants of trajectories using accelerometers as the measure of physical activity.

Methods

This study used data from The Trial of Activity in Adolescent Girls 2 (TAAG2) study [11]. TAAG2 was a cross-sectional and longitudinal examination of physical activity in 8th and 11th grade girls who were originally recruited from the University of Maryland TAAG field site. Baseline data for TAAG were collected at 6 field sites and 36 middle schools (6 per field site) across the United States in 2002 (6th grade girls), 2005 (8th grade girls), and 2006 (8th grade girls) [12, 13]. The TAAG2 study collected follow-up data in 2009 on girls originally measured in 2006 from only the Washington, D.C./Baltimore area. At this measurement period, the girls were in 11th grade.

Participants

Eligibility requirements for TAAG were: girls had to speak and read English and be able to participate in physical education class and take a submaximal exercise test [12]. For TAAG2, eligible girls had to have accelerometer data in 2006. The research protocol was approved by the University of Maryland College Park Institutional Review Board. Written consent from parents and written assent from the girls were obtained prior to participation at both measurement periods.

For the 8th grade data collection, we visited the 6 middle schools participating in the University of Maryland TAAG site. At 11th grade, the girls had dispersed to 91 high schools. We visited 21 high schools, 67 homes, and mailed packages to 10 girls to obtain measurements. In addition to being instructed on accelerometer wear, participants completed

a survey of psychosocial and demographic information, and had their height and weight measured. Staff were trained and certified prior to data collection and recertified as necessary.

Measures

Physical activity trajectories—Physical activity was assessed using Actigraph accelerometers (MTI model 7164, Fort Walton Beach, FL). Accelerometers were initialized the day prior to their distribution and set to start recording at 5 a.m. the next day. Participants wore the accelerometers over their right hip for 7 days, thus providing 6 complete days for analysis. Staff provided verbal and written instructions on monitor placement. Participants were instructed to wear the monitor at all times except during sleep, showering, bathing, or swimming. Accelerometers were returned to staff and downloaded to the same computer used to initialize them. Activity counts and intensity levels were collected over 30-second intervals, converted to metabolic equivalents (METs), and averaged to produce a daily intensity weighted measure of moderate to vigorous physical activity (MVPA) [14]. Based on our previous accelerometry validation work, activity counts of at least 1500 counts per 30 seconds (4.6 METs) was considered MVPA [14].

Current guidelines recommend that youth between the ages of 5 and 17 participate in 60 minutes of MVPA daily [1]. Accelerometry is a fairly recent innovation in physical activity surveillance and consensus has not been reached on how to define meeting guidelines using accelerometers [15]. For example, only 8.4% of girls in the US meet the guidelines when MVPA is assessed with accelerometers [3] and only 5 girls in this study achieved the guidelines. We previously reported variation ranging from 0.6% to 100% of 6th grade TAAG girls meeting guidelines using accelerometers to assess physical activity and 6 different definitions for operationalizing meeting guidelines [15]. We chose a cut-off of 30 minutes of daily MVPA to define “physically active,” which indicated 16.1% of 6th grade girls met guidelines [15], a prevalence that we found plausible. The 30-minute guideline is the standard recommended for adults [1] and other studies in youth have used a lower threshold [9].

Physical activity change was categorized using the study by Rangul et al. as a framework [9]. Participants were dichotomized at baseline and follow-up based on their daily MVPA: “active” (greater or equal to 30 minutes each day) and “inactive” (less than 30 minutes each day). They were then categorized: 1) Active Maintainers (active at baseline and follow-up); 2) Inactive Maintainers (inactive at baseline and follow-up); 3) Adopters (inactive at baseline, active at follow-up); and 4) Relapsers (active at baseline, inactive at follow-up).

Potential factors across individual, social, and environmental levels were identified based on a recent review of determinants of youth physical activity change [6]. If a variable was available in our dataset and was either reported to be associated with physical activity change or was equivocal, we included it in our models. Unless otherwise specified, the variables were collected at 8th grade.

Individual level variables

Race/ethnicity: Participants self-identified their race/ethnicity. Respondents reporting an identity other than “White”, “African American” or “Hispanic” were classified as “Other.”

Socioeconomic status: As in other school-based studies [16–19], we operationalized socioeconomic status as participation in the free or reduced price school meals program. Girls responses were dichotomized as yes or no (no included those who did not respond).

Employment status: Because teens are eligible to enter the workforce, we theorized that there may be an association between employment and physical activity change. At the 11th grade only, we asked if the girls had a job for which they earned money. They were dichotomized into employed or not employed status.

Body mass index: Girls' height was measured to the nearest mm using a Schorr measuring board and weight was measured to the nearest 0.1 kg using a digital scale that was calibrated prior to each data collection visit. Height and weight were assessed twice; if the difference between measures was greater than 0.1 cm or 0.1 kg, respectively, a third measure was taken. Every 20th participant was selected for a quality assessment measure and staff were retrained if assessments differed. Values were averaged and body mass index (BMI) was calculated using weight (kg) divided by height squared (m²). The Centers for Disease Control and Prevention growth charts were used to dichotomize participants as normal weight (less than the 85th percentile based on age) or overweight/obese (greater or equal to the 85th percentile).

Pubertal development: We were not able to assess maturation at 8th grade, but included a crude measure at 11th grade: "How old were you when you had your first menstrual period?"

Sleep: We asked participants what time they usually went to bed and what time they usually woke up, separately, on school days and weekends. An estimated average hours of sleep per day was calculated. Girls were categorized into three groups according to the National Sleep Foundation's definitions of adequate sleep: Greater or equal to 9 hours (optimal), 8–9 hours (borderline), and less than 8 hours (insufficient) [20]. Sleep was assessed only at the 11th grade.

Previous organized physical activity: Participants were given a list of 33 sports, classes, and lessons (e.g., soccer, dance, tennis) and asked to indicate which ones they participated in at school and/or outside of school during the past year [21, 22]. Those who indicated they had not participated in any of these activities were classified as "no previous participation." The remainder was categorized as "participants."

Physical activity self-efficacy: We assessed physical activity self-efficacy with a validated 8-item questionnaire [23–25]. Test-retest reliability was 0.84[26]. Participants were asked to indicate their agreement with statements such as "I can be physically active during my free time on most days" using a 5-point Likert scale from "disagree a lot" to "agree a lot." Responses were summed to create a scale with a range of 8 to 40.

Depressive symptoms: Depressive symptoms was assessed using the Center for Epidemiological Depression Scale, a 20-item questionnaire [27, 28]. Responses were summed for scores with a range of 0–60. The standard indicator for elevated depressive symptoms is a score 16 or higher; girls were thus categorized as elevated depressive symptoms "yes" or "no."

Self-esteem: We assessed self-esteem from the Physical Self-Description Questionnaire, a multidimensional physical self-concept instrument. We used 3 subscales: global self-esteem (i.e., overall positive feelings about oneself), perceived body fat (i.e., perceiving to not be overweight or too fat), and general physical self-concept (i.e., feeling positive about one's physical self) [29]. The global self-esteem scale contains 8 items; the other 2 each contain 6 items. Responses were summed with a range of 0–40 for the global self-esteem scale, and ranges of 0–30 for the body fat and self-concept scales. A higher score indicates greater positive perception of one's self. These measures were collected only at 11th grade.

Social level variables

Physical activity social support: We assessed physical activity social support using a modified parent and peer social support scale of 8 items [30] with demonstrated factorial validity [25]. Participants were asked to indicate how often they received support for physical activity (e.g., encouragement, transportation, participation with them) during a typical week using a 5-point Likert scale. Responses were summed with a range of 0–12 for friend support and 0–20 for family support.

Boyfriend status: We thought romantic relationships may influence girls' physical activity change. They were asked questions about whether they had a serious boyfriend or partner. Based on their response, students were grouped into one of three categories: "never", "past" or "current." This item was assessed at 11th grade.

Physical activity with friends: We administered a social network-type instrument in 11th grade in which participants were asked to list their three closest friends and then answer, for each friend, "Is this friend physically active?" and "How often are you physically active with this friend?" using an ordinal scale that ranged from "never" to "5 or more times per week" [31]. Responses were summed to create a score for each question, ranging from 0 to 15.

Environmental level variables

Distance to school and distance to parks: Using ArcGIS and each girl's primary residence as a geo-reference, we determined the distance in miles from home to their school and to the nearest park. Residences and schools and parks were geocoded onto separate layers and spatially joined onto one layer. Distance was measured using the Euclidean distance feature of ArcGIS, which measures straight-line distance between points. Distance was determined in linear feet and converted to miles.

Analysis

Descriptive analyses were completed to present the distribution of the dependent and independent variables. Chi-square analyses, Fisher's exact test, and multi-categorical logistic regression (for continuous variables) were performed to examine the differences in the proportions/means of the independent variables among the four groups of physical activity change. Except when only collected in 11th grade, independent variables were assessed at 8th grade. Multivariable logistic regression models were run for each of the four categories, adjusting for race and socioeconomic status, to calculate odds ratios (OR) and 95% confidence intervals (CI) for each independent variable. Analyses were performed using SAS 9.2.

Results

There were 730 girls who were measured at the University of Maryland field site in 2006. Of these, we recruited and measured 589 (81%) in 2009 when the girls were in 11th grade [32]. Twenty-six girls had insufficient physical activity data and an additional two were missing height or weight data, bringing the sample to 561 participants. As indicated in Figure 1, prevalence of active and inactive categories was similar between 8th and 11th grade.

Table 1 displays the distribution of all characteristics for the cohort at 8th grade (and 11th grade for those variables only assessed at that time point). The majority of the girls were white, 21% were African American, 13% Hispanic, and the remaining 18% were "Other." About one quarter of the sample reported receiving free or reduced-price meals. One-third

were categorized as overweight or obese. Fewer than 20% received the recommended 9 or more hours of nightly sleep. Nearly 40% indicated they were employed at 11th grade. Over 75% of the participants reported that they currently or previously had a serious boyfriend or partner.

Most participants (n=410; 73%) were categorized as inactive maintainers. Another 10% were relapsers, 11% were adopters, and only 6% of the girls were categorized as active maintainers. As displayed in Table 1, there were differences across physical activity change categories for the individual level variables of BMI category, physical self-concept and body fat scales, and age at menses. For the social level variables, friend support for physical activity, family support for physical activity, and physical activity of friends differed.

Active maintainers

Results indicated predictors of physical activity maintenance across individual, social, and environmental levels. Participants with higher physical self-concept and body fat scores were more likely to be active maintainers (OR: 1.11, 95% CI: 1.05, 1.19 and OR: 1.05, 95% CI: 1.00, 1.11, respectively). At the social level, those with higher social support from friends (OR: 1.19, 95% CI: 1.04, 1.35), social support from family (OR: 1.11, 95% CI: 1.02, 1.20), and frequency of physical activity with friends scores (OR: 1.34, 95% CI: 1.13, 1.59) had greater odds of being active maintainers. (Table 2) The odds of distance from home to the nearest park was 0.63 (95% CI: 0.42, 0.95), indicating participants with a shorter distance to a park were more likely to be active maintainers compared with the other groups.

Adopters

As displayed in Table 2, BMI and the physical self-concept score were the only variables associated with adopting physical activity. Participants who were overweight/obese had lower odds of being an adopter (OR: 0.34, 95% CI: 0.17, 0.70) than their normal weight counterparts. Those with higher self-concept scores were more likely to be adopters (OR: 1.11, 95% CI: 1.05, 1.19).

Inactive maintainers

Overweight/obese participants had 2.30 (95% CI: 1.47, 3.60) times the odds of being inactive maintainers compared to their normal weight peers (Table 2). Earlier age at menses was also a predictor (OR: 0.84, 95% CI: 0.73, 0.96). Girls with lower physical self-concept scores (OR: 0.96, 95% CI: 0.93, 0.98) and lower body fat scores (OR: 0.97, 95% CI: 0.95, 0.99) were more likely to be inactive maintainers. Friend support for physical activity and frequency of physical activity with friends were also predictors, with lower scores predicting higher odds for inactive maintainers (OR: 0.91, 95% CI: 0.85, 0.97 and OR: 0.87, 95% CI: 0.80, 0.95, respectively). Greater distance from home to one's middle school had greater odds (OR: 1.10, 95% CI: 1.01, 1.20) for being inactive maintainers.

Relapsers

No variables were associated with relapse. (Table 2)

Discussion

Results of this study highlight the complexity of physical activity change trajectories for adolescent girls. While variables at individual, social, and environmental levels were predictors of active maintainers and inactive maintainers, only individual-level variables predicted adoption. None predicted relapse. Thus, multi-level factors appear to predict behavior maintenance rather than actual change between 8th and 11th grade.

It is notable that, for the most part, the variables predictive of active maintainers and inactive maintainers were the same, although in the opposite direction. Girls with higher scores for self-concept, friend support for physical activity, and frequency of physical activity with friends were more likely to be active maintainers, whereas those with lower scores were more likely to be inactive maintainers. In addition, favorable perceived body fat and family support for physical activity scores predicted active maintainers, while lower scores approached significance for predicting inactive maintainers. Higher BMI predicted inactive maintainers and lower BMI had a trend to predict active maintainers. Finally, those living closer to school were more likely to be active maintainers and those living further from parks were more likely to be inactive maintainers. Only age at menses was a unique predictor for inactive maintainers. These results may indicate that successful interventions focusing on these variables may need to occur before 8th grade, since they appear to predict stability rather than change.

We found an inverse association between BMI and physical activity, but it was significant only for inactive maintainers and adopters. Across other studies, the relationship between BMI and physical activity change has also been inconsistent [6, 7, 9, 33].

Previous physical activity is often found to be associated with future physical activity [5, 9]. However, Craggs et al. concluded there was insufficient evidence to suggest an association in age groups older than 10–13 [6], which is consistent with the ages we studied (14, 17 years old). Conversely, at 8th grade virtually all of the girls (96%) were participants in sports, physical activity classes, or lessons, suggesting that our measure did not discriminate well. Another assessment of previous physical activity may be more appropriate for future research.

Similar to other work [5–7], we found positive associations between social support and physical activity change. We extended prior results by having examined social network factors and change in physical activity. The number of friends that were physically active was not a significant predictor for change trajectories, although participating in physical activity with friends was a predictor and, thus, may be an important factor for adolescent physical activity. Further research on physical activity and social networks is needed to better understand how peer networks may play a role in increasing physical activity among adolescent girls.

Associations between physical activity and the built environment in adolescent populations have largely been limited to cross-sectional associations [34, 35]. Hence, our results indicating that closer distance from home to school was associated with activity maintenance and further distance to parks predicted inactive maintenance over a 3-year period is an important finding. Even more remarkable is that during this time girls transitioned from their middle schools to high schools, which are typically further away from many neighborhoods than elementary and middle schools. The distance to school or park variables may be markers for neighborhoods with more physical activity-related resources.

Others have found that early pubertal development may result in physical activity decline [36]. Davison et al. found that depression, low global self-worth, and maturity fears may explain this relationship [37]. While we found that early maturation and low physical self-concept predicted inactive maintainers, depressive symptoms did not. None of these variables predicted relapsers (i.e., those who were active at baseline but inactive at follow-up). Future studies should continue to explore the mechanisms by which early puberty may influence physical activity among girls.

There are a number of strengths of this study. Few, if any, studies to date have examined different physical activity trajectories among adolescent girls using accelerometers. We had a wide array of variables available, which allowed us to examine multi-level predictors. The sample had racial/ethnic diversity, which has been lacking in previous work [7, 38, 39].

This study also had limitations. Girls were from the Washington DC/Baltimore area only, which limits generalizability. Few girls remained physically active at both time points. Some of the variables we included were available only at 11th grade. If we had used change from baseline or 11th grade dependent variables, our results may have differed. Our instrument for classifying girls as participants in organized sports, lessons, or classes indicated that virtually all the girls in 8th grade were participants; a variable with greater discriminatory ability may have altered the results. A number of variables that were included were collected from self-report, a data collection method with potential for misclassification.

This study adds to the current body of literature addressing physical activity change in adolescent girls. Examining predictors across trajectories may help to inform the implementation of programs to not only reduce the overall decline of physical activity, but may also help guide strategies to help girls maintain or even increase their level of physical activity during adolescence. Given that our results showed that multi-level factors predicted behavior maintenance (active, inactive) between 8th and 11th grade, this study merits replication across different stages of adolescence.

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Figure 1.
Comparison of the distribution of physical activity categories by grade.

Table 1

Descriptive characteristics for the cohort, overall and by physical activity trajectory.

	Total	Active Maintainer	Adopter	Inactive Maintainer	Relapser	P value ^a
N, (%)	561 (100)	31 (6)	64 (11)	410 (73)	56 (10)	
Individual level variables:						
Race/ethnicity, n (%)						.20
White	268 (48)	22 (71)	29 (45)	193 (47)	24 (43)	
African American	117 (21)	3 (10)	14 (22)	83 (20)	17 (30)	
Hispanic	74 (13)	1 (3)	8 (13)	60 (15)	5 (9)	
Other	102 (18)	5 (16)	13 (20)	74 (18)	10 (18)	
Free/reduced price meal program participation, n (%)	146 (26)	4 (13)	14 (22)	110 (27)	18 (32)	.21
Employed, ^b n (%)	221 (39)	11 (36)	25 (39)	160 (39)	25 (45)	.83
BMI, mean (SD)	22.4 (5.1)	20.3 (3.5)	21.0 (4.8)	22.8 (5.1)	22.8 (6.5)	.009
BMI category, n (%)						.004
Normal	376 (67)	26 (84)	54 (84)	256 (62)	40 (71)	
Overweight ^c	90 (16)	2 (7)	6 (9)	77 (19)	5 (9)	
Obese ^c	95 (17)	3 (10)	4 (6)	77 (19)	11 (20)	
Age at menses, ^b years, mean (SD)	12.29 (1.48)	12.77 (1.56)	12.47 (1.48)	12.19 (1.45)	12.55 (1.57)	.04
Sleep duration, ^b n (%)						.72
Greater or equal to 9 hours	102 (18)	5 (16)	8 (13)	78 (19)	11 (20)	
8–9 hours	177 (32)	10 (32)	22 (34)	132 (32)	13 (23)	
Less than 8 hours	282 (50)	16 (52)	34 (53)	200 (49)	32 (57)	
Previous physical activity, n (%)	537 (96)	30 (97)	62 (97)	319 (95)	54 (96)	.98
Physical activity self-efficacy score, mean (SD)	28.53 (6.43)	30.46 (6.75)	28.52 (7.13)	28.23 (6.38)	29.64 (5.59)	.15
Elevated depressive symptoms, n (%)	328 (59)	21 (68)	35 (55)	241 (59)	31 (55)	.56
Global self-esteem score, ^b	40.15 (6.45)	40.45 (7.530)	40.09 (7.30)	40.15 (6.13)	40.07 (7.21)	.99
Perceived body fat score, ^b	26.76 (8.77)	29.61 (9.12)	28.14 (8.15)	26.15 (8.76)	28.04 (8.97)	.05
General physical self-concept score, ^b mean (SD)	25.40 (7.36)	29.23 (7.36)	26.27 (7.64)	24.82 (7.19)	26.57 (7.59)	.005
Social level variables:						
Friend support for physical activity score, mean (SD)	8.48 (3.02)	9.94 (3.21)	8.88 (3.13)	8.25 (2.98)	8.90 (2.86)	.01

	Total	Active Maintainer	Adopter	Inactive Maintainer	Relapser	P value ^d
Family support for physical activity score, mean (SD)	15.15 (4.97)	17.87 (5.33)	16.61 (4.30)	15.26 (4.94)	14.79 (5.31)	.007
Boyfriend status, ^b n (%)						.44
Never	127 (23)	9 (29)	11 (17)	97(24)	10 (18)	
Past, but not now	213 (38)	8 (26)	28 (44)	158 (39)	19 (34)	
Current	221 (39)	14 (45)	25 (39)	155 (38)	27 (48)	
Friends who are active score, ^b mean (SD)	1.97 (0.93)	2.23 (0.8)	2.07 (0.90)	1.94 (0.94)	1.96 (0.99)	.30
Frequency of physical activity with friends score, ^b mean (SD)	3.84 (2.16)	5.19 (2.5)	4.2 (2.11)	3.67 (2.11)	3.95 (2.14)	.001
Environmental level variables:						
Distance to nearest park, mile, mean (SD)	1.22 (1.38)	0.78 (0.93)	1.17 (2.24)	1.24 (1.28)	1.36 (1.030)	.22
Distance to own school, mile, mean (SD)	2.13 (2.10)	2.33 (1.94)	2.29 (2.04)	2.15 (2.18)	1.68 (1.49)	.37

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared)

^dP values determined from chi-square or Fisher exact test for differences in categorical distributions; multi-categorical logistic regression for continuous variables

^bAssessed only in 11th grade (2009)

^cOverweight and obesity defined as 85th and 95th age and sex based percentiles, respectively.

Table 2

Parameter estimates for physical activity trajectories.

	Active Maintainers		Adopters		Inactive Maintainers		Relapsers	
	OR (95% CI) ^a		OR (95% CI) ^a		OR (95% CI) ^a		OR (95% CI) ^a	
Individual level variables:								
Race/ethnicity								
White	1.0 (reference)		1.0 (reference)		1.0 (reference)		1.0 (reference)	
African American	0.34 (0.10, 1.21)		1.24 (0.61, 2.51)		0.91 (0.55, 1.50)		1.58 (0.78, 3.18)	
Hispanic	0.18 (0.02, 1.35)		1.10 (0.47, 2.56)		1.60 (0.83, 3.08)		0.68 (0.24, 1.88)	
Other	0.62 (0.23, 1.70)		1.26 (0.63, 2.56)		1.01 (0.60, 1.68)		1.06 (0.48, 2.31)	
Free/reduced price meal program participation								
No	1.0 (reference)		1.0 (reference)		1.0 (reference)		1.0 (reference)	
Yes	0.60 (0.20, 1.82)		0.73 (0.38, 1.41)		1.14 (0.72, 1.80)		1.30 (0.69, 2.46)	
Employment status ^b								
No	1.0 (reference)		1.0 (reference)		1.0 (reference)		1.0 (reference)	
Yes	0.76 (0.35, 1.64)		1.03 (0.60, 1.76)		0.95 (0.64, 1.40)		1.28 (0.72, 2.25)	
BMI								
Normal weight	1.0 (reference)		1.0 (reference)		1.0 (reference)		1.0 (reference)	
Overweight/obese ^c	0.42 (0.16, 1.13)		0.34 (0.17, 0.70)		2.30 (1.47, 3.60)		0.76 (0.41, 1.41)	
Age at menses ^b	1.24 (0.95, 1.63)		1.10 (0.92, 1.32)		0.84 (0.73, 0.96)		1.16 (0.96, 1.42)	
Sleep duration ^b								
Greater or equal to 9 hours	1.0 (reference)		1.0 (reference)		1.0 (reference)		1.0 (reference)	
8–9 hours	1.15 (0.38, 3.42)		1.68 (0.72, 3.92)		0.91 (0.51, 1.60)		0.65 (0.28, 1.52)	
Less than 9 hours	1.20 (0.42, 3.45)		1.65 (0.73, 3.70)		0.75 (0.44, 1.27)		1.03 (0.50, 2.14)	
Previous organized physical activity								
Yes	1.0 (reference)		1.0 (reference)		1.0 (reference)		1.0 (reference)	
No	0.84 (0.11, 6.54)		0.71 (0.16, 3.10)		1.36 (0.50, 3.73)		0.82 (0.19, 3.60)	
Physical activity self-efficacy	1.04 (0.98, 1.11)		1.00 (0.96, 1.04)		0.99 (0.95, 1.01)		1.03 (0.99, 1.08)	
Elevated depressive symptoms								
No	1.0 (reference)		1.0 (reference)		1.0 (reference)		1.0 (reference)	

	Active Maintainers		Adopters		Inactive Maintainers		Relapsers	
	OR (95% CI) ^a		OR (95% CI) ^a		OR (95% CI) ^a		OR (95% CI) ^a	
Yes	0.66 (0.30, 1.43)		1.29 (0.77, 2.19)		0.92 (0.63, 1.34)		1.14 (0.65, 2.00)	
Global self-esteem score ^b	1.02 (0.96, 1.08)		1.00 (0.96, 1.04)		1.00 (0.97, 1.03)		0.99 (0.95, 1.04)	
Perceived body fat score ^b	1.05 (1.00, 1.11)		1.02 (0.99, 1.06)		0.97 (0.95, 0.99)		1.02 (0.98, 1.05)	
General physical self-concept score ^b	1.11 (1.05, 1.19)		1.11 (1.05, 1.19)		0.96 (0.93, 0.98)		1.02 (0.98, 1.06)	
Social level variables:								
Friend support for physical activity score	1.19 (1.04, 1.35)		1.06 (0.97, 1.16)		0.91 (0.85, 0.97)		1.05 (0.97, 1.16)	
Family support for physical activity score	1.11 (1.02, 1.20)		1.05 (1.0, 1.11)		0.97 (0.93, 1.00)		0.97 (0.91, 1.02)	
Boyfriend status ^b								
Never	1.0 (reference)		1.0 (reference)		1.0 (reference)		1.0 (reference)	
Current	1.09 (0.45, 2.64)		1.38 (0.65, 3.94)		0.69 (0.42, 1.15)		1.56 (0.72, 3.38)	
Past	0.62 (0.23, 1.68)		1.60 (0.76, 3.37)		1.60 (0.51, 1.45)		1.08 (0.48, 2.43)	
Friends who are active score ^b	1.22 (0.78, 1.89)		1.18 (0.88, 1.59)		0.87 (0.70, 1.07)		1.02 (0.75, 1.38)	
Frequency of physical activity with friends score ^b	1.34 (1.13, 1.59)		1.10 (0.97, 1.24)		0.87 (0.80, 0.95)		1.03 (0.91, 1.17)	
Environmental level variables:								
Distance to nearest park	0.63 (0.42, 0.95)		0.98 (0.80, 1.20)		1.06 (0.91, 1.23)		1.06 (0.89, 1.27)	
Distance to own school	1.02 (0.86, 1.19)		1.03 (0.92, 1.16)		1.10 (1.01, 1.20)		0.86 (0.72, 1.04)	

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); OR, odds ratio; CI: confidence interval

^aModel adjusted for race/ethnicity and SES.

^bAssessed only in 11th grade (2009)

^cOverweight and obesity defined as 85th and 95th age and sex based percentiles, respectively.