ABSTRACT

Title of Thesis: Change in Physical Activity and Associated Factors among Adolescent Girls

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Objective: Examine relationships between changes in physical activity (PA) and personal, psychosocial and environmental factors among adolescent girls.

Methods: Longitudinal data were analyzed from two cohorts of adolescent girls. Participants were placed into four categories based on PA levels. Active Maintainer-AM, Inactive Maintainer-IM, Adopter-A, or Relapser-R. Anthropomorphic, personal, psychosocial and environmental data were collected. Multivariate logistic regression was used to estimate parameters.

Results: In early adolescence, Free/reduced price lunch and Self-Efficacy for PA were associated with AM; Race and Friend Support for PA with IM; and Friend Support for PA with R. In later adolescence, Distance to Nearest Park, PA Frequency with Friends, and Global Physical were associated with AM; BMI, Friend Support for PA, PA Frequency with Friends, and Age at Menses, with IM; BMI with A.

Conclusion: PA predictors were different across the categories and the predictors were different for early adolescence and later adolescence.

CHANGE IN PHYSICAL ACTIVITY AND ASSOICATED FACTORS AMONG ADOLESCENT GIRLS

By

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Chapter 1: Introduction

I. Background

Participation in regular physical activity (PA) promotes health, fitness and quality of life in people of all ages. While conditions such as diabetes, hypertension and heart disease typically don't manifest until adulthood, risk factors for these and other chronic diseases can develop in childhood and adolescence. The Physical Activity Guidelines, released by the U.S. Department of Health and Human Services in 2008 recommend that children and adolescents participate in at least 60 minutes of moderate to vigorous PA (MVPA) every day.[1] Results from the 2010 National Youth Physical Activity and Nutrition Study (YPANS), indicate that only 15.3% of students in grades 9-12 are meeting this recommended goal.[2]

Many adolescents are not participating in any regular PA. In a study of Turkish adolescents, Geckil and Dunder found that the most prevalent adolescent risk behavior was a lack of PA.[3] According to U.S. Centers for Disease Control and Prevention's Youth Risk Behavior Survey (YRBS) data from 2009, 23% of high school students reported that they did not participate in at least 60 minutes of PA on any day in the past 7 days.[4] When the data from both YPANS and YRBSS are broken down by sex, adolescent girls report significantly less PA participation than adolescent boys.[2,4]

A 2008 study by Kahn et al. found that PA levels increase with age as children move through early and middle childhood. At around age 13, however, there is a shift and PA levels for both boys and girls begin to decline.[5] This decline during the adolescent period has been well-documented by multiple studies.[2,5,6,7 8,9, 10] Both boys and girls experience a general decrease in PA throughout the teenage years, however, across

studies, boys have been found to have higher levels of PA than girls.[2–4,6,11,5,7,12,13, 14] Some findings have also suggested differences in PA change over time by sex. A systemic review by Craggs et al. found that gender was consistently associated with the change in PA during childhood and adolescence, with girls exhibiting greater declines than boys.[15]

II. Research Question

As previously noted, the decline of PA in girls during adolescence has been well established. Although these findings are used to describe the general trend of the population, there are girls whose PA patterns do not follow this decreased trajectory. Within longitudinal samples, there are subsets of participants that have maintained or even increased their level of PA over time. There are relatively few studies that have looked at these different directions of PA change.

The main research question for this study was: What factors are associated with changes in PA level during adolescence? In order to answer this question, this study defined PA level as "active" or inactive" and examined the three possible directions of change (maintenance, increase and decrease) in a population of adolescent girls. More specifically, four separate categories of PA level change were utilized: Active Maintainers, Inactive Maintainers (maintenance), Adopters (increase), and Relapsers (decrease). These categories are defined in more detail later in this thesis.

III. Specific Aims

This study had three specific aims:

1. Describe the four categories of PA level change in adolescent girls in early and later adolescence.

2. Identify the personal, psychosocial and environmental factors associated with these four categories of PA level change in early and late adolescence.

    Hypothesis 1: The predictors will be different across the four different categories of PA level change in early adolescence.

    Hypothesis 2: The predictors will be different across the four different categories of PA level change in late adolescence.

3. Examine if the predictors themselves change over time.

    Hypothesis 3: The predictors of PA level change identified in early adolescence will be different from the predictors of PA change identified in later adolescence.

Chapter 2: Literature Review

A review of the literature showed that many different personal, psychosocial and environmental factors have been examined for possible associations with the decline in PA during adolescence.

I. Measurement of Dependent variable: Change in PA Level

PA is measured in different ways depending on the study design and availability of data. Some studies assess PA in adolescents using self-report measures from national surveys such as YPANS and YRBSS.[2,4,7,16] Other studies use a 3-day physical activity recall (3DPAR) where participants self-report activity in half-hour blocks for a specified number of days.[9,17] Additional self-report measures include questions regarding participation in structured sports or other activities,[14,18–20] or some other survey instrument to assess an individual's PA.[5,6,8,10,13,18,21,22] In self-report measures, participants may be categorized into levels of activity (for example, high, medium and low) based on their responses or the activities are assigned metabolic values (METs) which reflect the activity's intensity and allow for a calculation of minutes of moderate or vigorous activity (MVPA) based on a predetermined MET cutoff. Although many self-reported measures have been shown to be reliable and valid, objective measures of PA are preferable because they reduces the chances of bias due to under or over reporting. Pedometers provide objective data on the number of steps an individual takes while the device is worn.[23,24] Pedometers can only detect movement, however, and cannot provide information about the intensity of the activity being performed. Accelerometers also provide an objective measure of PA.[25–29] They produce data regarding intensity, however they cannot provide information about the quality or context of any specific activity.

These devices typically cannot be submerged in water; therefore, any water-related PA during measurement may not be accounted for.

II. Independent Variables of Interest

A. Body Mass Index

Research suggesting an association between Body Mass Index (BMI—weight (kg)/height $(m)^2$) and PA has been inconsistent. Kahn et al. found a quadratic relationship between BMI and PA levels in adolescents, where PA levels were lower at both the high and low ranges of BMI than the intermediate range.[5] In their systematic review, Craggs et al. included fourteen studies that examined the relationship between change in PA and anthropometry in children and adolescents and found no consistent association.[15] Raudsepp and Viira, however, in their longitudinal study of 6^{th} grade girls, found that BMI was inversely related to both initial levels of PA and change in PA over time,[9] while findings by Rangul et al. suggest that girls who self-identified as overweight were more likely to decrease their PA over time compared with those who self-identified as average.[6] Lastly, Stevens et al. found that 6^{th} grade girls with 12.8 minutes of MVPA per day were 2.3 times more likely to be overweight than girls with 34.7 minutes of MVPA.[29]

B. Race/ethnicity

Associations between race/ethnicity and PA have also been inconsistent. Gordon-Larsen et al. found that non-Hispanic white girls were more likely to engage in MVPA and had higher levels of MVPA than minority females.[8] Craggs et al., however, found no consistent association with change in PA and ethnicity in their review of forty-six papers.[15] Similarly, Pate et al. found that African American girls had greater decreases in

PA in comparison to non-Hispanic white and Hispanic girls, but the differences were not statistically significant.[28]

C. Socioeconomic status

Associations between Socioeconomic status (SES) and PA have been more consistent across the literature. In a cross-sectional study of adolescents, Gordon-Larsen et al. found that inactivity was influenced by sociodemographic factors.[22] Singh et al. also found that the odds of physical inactivity were higher and the odds of PA lower for children with parents without a high school diploma compared with children of college-educated parents.[11] Another study by Schmitz et al. also found associations between sociodemographic variables and PA.[30] Drenowatz et al. found that children from lower SES tended to have lower PA levels and higher sedentary activity levels than children from higher SES. After controlling for BMI, the differences in PA levels were no longer significant, however the differences in sedentary behaviors remained.[31] Because studies in general have consistently shown an association between sociodemographic factors and PA or inactivity, they are typically measured and controlled for.[7,12,17,19–21,26,27,32–34]

D. Previous PA

Overall, findings suggest an association between previous PA levels and change in PA. In their systematic review, Craggs et al. found that among children ages 10 to 13, higher levels of previous PA resulted in a smaller declines of PA.[15] Research by Duncan et al. showed that higher levels of PA at age 12 were associated with a greater decline in PA from ages 12 to 17[7] and Rangul et al. found that non-participation in sports was a strong predictor of not becoming active in the future.[6]

E. Social support

Across studies, social support has been shown to be associated with PA. Duncan et al. found that, for girls, having physically active friends was a protective factor; girls who showed an increase in the number of physically active friends over time had a lesser decline in PA from ages 12 to 17.[7] Raudsepp and Viira found that friend social support was positively associated with both initial PA levels and the change in PA across a 1.75 year time period[9]. Vorhees et al. looked at social network factors and PA in adolescent girls and found that as reported activity with close friends increased, so did self-reported PA.[35] In their systematic review, Craggs et al. found that social support measures were also consistently associated with smaller declines in PA in adolescents age 14 and older.[15]

F. Depression

Like social support, findings on the relationship between depression and PA have been relatively consistent. In their baseline analysis Rothon et al. suggest that there is evidence for an association between higher PA and reduced odds of depressive symptoms for girls. Their longitudinal analysis found the same direction of effect although the association was not significant.[21] Parfitt and Eston also found an inverse relationship between PA and both anxiety and depression[24] and a longitudinal study of girls age 11-15 by Jerstad et al. found that depression reduced the probability of later participation in PA.[10]

G. Self Esteem

Several studies have shown correlations between PA and self-esteem. A 12-week intervention study by DeBate et al. found that that after participating in a developmentally focused youth sport program, girls showed significant increases in global self-esteem.[16] This finding is further supported by a systematic review of

randomized controlled trials by Ekeland et al. that found that exercise can improve self-esteem in children.[36] Using data from the Adolescent Health Study, Kurt-Butler and Hagewen found that adolescents who participated in sports had a higher initial mean level of self-esteem than non-partipants[19] and in their cross-sectional study, Parfitt and Eston found a positive association between PA and global self-esteem. Findings from a longitudinal study by Raustorp et al. suggest a positive association between perceived physical self-esteem and being highly physically active in adolescent girls,[23] while Geckil and Dundar found that adolescents with lower self esteem had less PA.[3] Kranstover et al. found that lower psychological well-being at age 11 predicted lower enjoyment of PA which in turn predicted lower MVPA at age 13.[26] Not all studies have shown clear associations between PA and self-esteem however; Kahn et al. found positive associations between PA and social and athletic self-esteem, but not global or scholastic self esteem[5] and Russell and Cox found no relationship between exercise frequency and self esteem.[37]

H. Self-efficacy

Associations between PA and self-efficacy have been consistent across studies. Barr-Anderson et al. found a positive relationship between involvement in structured PA and self-efficacy in 6th grade girls[20] and Craggs et al. found self-efficacy measures were consistently associated with smaller declines in PA in adolescents age 10-13 and 14 and older.[15]

I. Employment

Because teens are eligible to enter the workforce starting around ages 14 to 16, it is theorized that there may be an association between employment and PA in

adolescence. A qualitative study by Slater and Tiggemann suggested that insufficient time due to competing commitments, such as homework and a job, was one reason adolescent girls gave for withdrawing from PA.[38] A cross-sectional study of 12th grade girls by Dowda et al. confirmed this finding, however the relationships were complex. While they found no differences by employment status for fitness or sports participation, they did find that employed girls self-reported higher overall PA than unemployed girls. When PA reported during work was eliminated, however, the non-employed girls actually had higher overall PA. The employed girls self-reported higher total METs and were more likely to participate in 2 or more blocks of MVPA per day than non-employed girls. Examining the data from a subset of girls who wore accelerometers, the authors found that girls who worked tended to accumulate more MVPA than those who did not work, but this finding was not statistically significant. Overall their results suggest that girls who work are more physically active and that work itself can be a source of PA in adolescent girls.[17]

J. Pubertal Development

Relatively few studies have looked at the relationship between PA and pubertal development. A longitudinal study by Krahnstoever et al. found associations between pubertal development and MVPA, with more advanced pubertal development at age 11 predicting fewer minutes of MVPA at age 13.[26] Using the same cohort, Baker et al. also found significant differences in both self-reported and accelerometer measures of PA at age 13 and pubertal development, with earlier maturing girls being overall less physically active.[27]

K. Sleep

Several studies have indicated that children and adolescents do not get enough sleep.[39,40] Inadequate sleep is often suggested to contribute to a variety of unhealthy behaviors, including decreased PA. Singh et al. found that inadequate sleep was associated with higher levels of physical inactivity and lower levels of PA in children ages 8 to 11.[11] Delisle et al. found similar results in a study of adolescents; higher VPA was associated with greater quantity of sleep.[41] In a study of European adolescents, Garaulet et al. found that adolescents who slept less than 8 hours a day were more sedentary those who slept more than 8 hours, but associations between sleep duration and PA measures were inconsistent.[42]

L. Boyfriend

No studies were found that examined the relationship between having a boyfriend or partner and PA.

M. Environmental Factors: Distance to School and Distance to Parks

In their study using Add-Health data, Boone-Heinonen et al. found that that green space coverage was positively associated with exercise and greater overall leisure MVPA and that shorter distance to parks was significantly related to reporting more bouts of MVPA per week and to participation in active sports.[12] In a study that looked at proximity to school, Cohen et al. found that the farther sixth grade girls lived from their school, the less MVPA minutes per week they accumulated.[32]

Many cross-sectional studies have looked at associations between PA levels in adolescents and anthropometric measures, personal and psychosocial factors or environmental factors; fewer studies have looked at adolescent PA longitudinally however, and there are even are even fewer that have looked at the directions of change.

Raudsepp and Viira conducted a study to examine the trajectory of PA using the 3DPAR in a population of 193 urban Estonian 6th grade girls.[9] Duncan et al. conducted a similar study in a U.S. population of 371 boys and girls to assess the trajectory of PA change from ages 12 to 17. PA was assessed using YRBSS PA questions and objectively with a pedometer. Their sample was predominantly white which restricted comparisons by race.[7] Rangul et al. also examined directional PA change over 4 years among adolescents in Norway using a self-reported measure of PA, similar to the YRBSS questions.[6] No studies to date could be found that have examined directions of PA change in adolescent girls in the U.S. using accelerometer data and multi-level determinants.

Chapter 3: Methods

I. Data Source

This study used data from The Trial of Activity in Adolescent Girls (TAAG) studies. TAAG and TAAG2 were cross-sectional and longitudinal examinations of PA in 6th, 8th and 11th grade girls. Baseline data for TAAG were collected in 6 different communities across the United States in the fall of 2002 when participants were in the 6th grade. Follow-up data were collected in the spring of 2005 when participants were in 8th grade (8a). Data were then collected on a new sample of 8th grade girls from the 6 communities in the spring of 2006 (8b). The TAAG2 study collected follow-up data on the 8b cohort from only the Washington, D.C./Baltimore area in the spring of 2009 when participants were in the 11th grade. This present study was longitudinal and utilized data from all 4 waves of data collection.

II. Participants

Participants for this study included 2 separate cohorts from the TAAG and TAAG2 studies. For the purpose of this study, the sample was restricted to those participants who had complete PA and height and weight data. The first cohort (A) included 984 girls with complete data and the second cohort (B) included 589 girls. Twenty-six girls from Cohort B had insufficient PA data and an additional two were missing height or weight data, bringing the sample to 561 participants.

III. Human Subjects

All procedures for the parent studies, TAAG and TAAG2, met the requirements of 45 CFR 46, Protection of Human Subjects. Each participating TAAG site obtained

local Institutional Review Board (IRB) approval. Written consent from parents and written assent from the girls were obtained prior to participation in the study. Data was protected by reasonable security procedures and de-identified for analysis to maintain participant confidentiality. The author of this study was added and approved as a student researcher to the current TAAG2 research protocol on file with the University of Maryland College Park IRB.

IV. Description of Dependent Variable

PA was measured objectively using Computer Sciences and Applications (CSA) accelerometers. Participants wore the accelerometers over their right hip for 6 days. The CSA was removed during periods of sleep, showering, bathing or swimming. Activity counts and intensity levels were collected over 30-second epochs for 6 days, converted to metabolic equivalents (METS) and averaged to produce a daily intensity weighted measure of MVPA. A sub study determined the CSA threshold of 1500 counts/30-second epoch, equivalent to 4.6 METS, as the minimum range for moderate intensity in middle-school girls. Current guidelines recommend that children between the ages of 5 and 17 participate in 60 minutes of MVPA every day.[1] The proportion of girls in the US who meet this recommendation is small (8.4%[2]), however, and the number of girls in the study sample who achieved the recommend 60 minutes was less than 2% (12 girls in cohort A; 5 girls in cohort B). In order to have enough data for meaningful analysis this study employed a cut-off of 30 minutes of MVPA as the threshold for "active". This is the amount recommended for adults ages 18-55.[1] In addition, other studies have also employed a threshold below the recommended guidelines.[6]

The outcome variable of PA level change was defined and categorized using the 2011 study by Rangul et al. as a guiding framework.[6] Participants were dichotomized at baseline and at follow-up based on their daily average MVPA at each measurement: "active" (≥30 minutes) and "inactive" (< 30 minutes). Participants were then categorized into one of four groups based on their status at both time points: 1) Active Maintainers (active at baseline and active at follow-up); 2) Inactive maintainers (inactive at baseline and inactive at follow-up); 3) Adopters (inactive at baseline, active at follow-up); and 4) Relapsers (active at baseline and inactive at follow-up).

V. Definitions of Independent Variables

A complete summary of the variables examined in this thesis is available in Table 1. Unless otherwise specified, the data analyzed were collected for both cohorts at baseline.

A. Race/ethnicity

Participants were asked to self-identify their ethnicity using a checklist that included: "White", "Black", "Hispanic", "Asian", "Native Hawaiian or other Pacific Islander", "American Indian or Native Alaskan" and "Other". Due to a low number of responses, respondents who selected a category other than "White", "Black" or "Hispanic" were classified as "Other".

B. Socioeconomic status

Participants were asked if they received free or reduced price lunches at school and dichotomized as "Yes" or "Otherwise".

C. Body Mass Index (BMI)

Girls' height was measured using a portable stadiometer and weight was measured using a digital scale. BMI was calculated using weight (kg) divided by height squared (m^2) and age at time of measurement using CDC growth charts. Based on BMI calculations, participants were dichotomized as "$\geq 85^{th}$ percentile" (overweight/obese) and "$<85^{th}$ percentile" (normal).

D. Elevated Depressive Symptoms

Depression was measured using the Center for Epidemiological Depression Scale (CED-S), a 20-item questionnaire that characterizes the major symptoms of depression.[43] Participants were asked to indicate the presence of symptoms during the past week by responding to statements such as "I was bothered by things that usually don't bother me" using a 4-point Likert scale from "rarely or none of the time" (0) to "most or all of the time" (3). Responses for the 20 items were summed for a depressive symptoms score with a possible range of 0-60. The standard indicator for elevated depressive symptoms is a score 16 or higher. Based on the scores, participants were dichotomized as "$\geq$ 16" or "$<$ 16".

E. Self Concept: Self esteem/Body Fat and Global Physical

Self concept was measured using 3 subscales from the Physical Self Description Questionnaire (PSDQ): Global Self esteem (SE), Body Fat (BF) and Global Physical (GP).[44] The SE scale contains 8 items, and the BF and GP scales each contain 6 items. Respondents were asked to indicate how true or false a statement such as "My stomach is too big" was for them using a 6-point true false scale. Reversed items were coded appropriately. Responses for each subscale were summed with a range of 0-40 for SE,

and ranges of 0-30 for BF and GP. These measures were collected at follow-up for Cohort B only.

F. Social Support for PA

Social support for PA was measured using a modified parent and peer social support scale from the Amherst Health and Activity Study.[45] The questionnaire included three questions regarding peer support and five questions regarding parent or family support for PA. Participants were asked to indicate how often they received support for PA (encouragement, transportation, participation with them) during a typical week using a 5-point Likert scale from "none" (0) to "every day" (4). Responses for the 8 items were summed with a range of 0-12 for Friend Support for PA and 0-20 for Family Support for PA.

G. PA of Social Network

Participants were asked to list their three closest friends and then answer, for each friend, "Is this friend physically active?" Responses for all three friends were summed with a range of 0 to 3. Participants were then asked to indicate "How often are you physically active with this friend?" using an ordinal scale that ranged from "never" to "5 or more times per week". Responses for all three friends were summed with a range of 0 to 15. These measures were collected at follow-up for cohort B only.

H. PA Self-Efficacy

PA Self-efficacy was measured with a validated 8-item questionnaire.[43] 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" (1) to "agree a lot" (5). Responses for the 8 items were summed for a PA self-efficacy scale with a possible range of 8 to 40.

I. Previous Physical Activity

As part of their student questionnaire, students were given a list of 33 sports and activities and were asked to indicate which ones they participated in at school and/or outside of school during the past year. Students were dichotomized into "no sport participation" and "sport participation".

J. Pubertal Development-Age at Menses

Participants were asked to enter their age in years in response to the question "How old were you when you had your first menstrual period?" This measure was collected at follow-up for Cohort B only.

K. Boyfriend

Participants were asked a series of questions with appropriate skip patterns if they have ever had a serious boyfriend or partner. Based on their response, students were grouped into one of three categories: "never", "past" or "current". This variable was collected at follow-up for Cohort B only.

L. Sleep

Participants were asked to enter what time they usually go to bed and what time they usually wake up on school days and weekends and an estimated average hours of sleep per day was calculated. Participants were categorized into three groups according to the National Sleep Foundation's definitions of adequate sleep: optimal ($\geq$ 9 hours), borderline (8-9 hours), and insufficient ($<$ 8 hours).[46] This measure was collected at follow-up for Cohort B only.

M. Distance to School and Distance to Nearest Park

Using ArcGIS, participants' addresses were geocoded and the distance in miles from their residence to their school and the nearest park was calculated. Distance to school was collected at follow-up for Cohort A and at baseline for Cohort B. Distance to Nearest Park was collected at baseline for both cohorts.

VI. Data analysis

All data analyses were performed using SAS 9.2. First, descriptive analyses were done to present the distribution of the dependent and independent variables for both Cohort A and Cohort B. Next, Chi-square analyses (for categorical variables) 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 PA level change for both Cohort A and Cohort B. Fisher's exact test was used for those categorical variables where Chi-square was not appropriate. Univariate logistic regression models were run to calculate unadjusted odds ratios (OR) and 95% confidence intervals (CI) for each independent variable. Separate analyses were performed for each category of PA change. Lastly, multivariate logistic regression models were run for each of the four categories. The first model adjusted for Race and SES, two potential confounders identified by the literature. Prior to running the final models, correlation analyses were conducted to avoid multicollinearity in the primary analysis. Family Support for PA was correlated with Friend Support for PA and thus eliminated in the multivariate logistic regression models for Cohort A. Family Support for PA was correlated with Friend Support for PA, and Global Self Esteem and Body Fat were correlated with Global Physical and thus eliminated from the multivariate logistic

regression models for Cohort B. The final sets of variables were then selected via backward elimination technique (alpha=.2) for inclusion in the multivariate logistic regression models. All model results are reported as OR with two-sided p values and 95% CI.

Chapter 4: Results

I. Cohort A.

Figure 1. Cohort A: Distribution of Active and Inactive at Baseline and Follow-up, Early Adolescence (n=984).

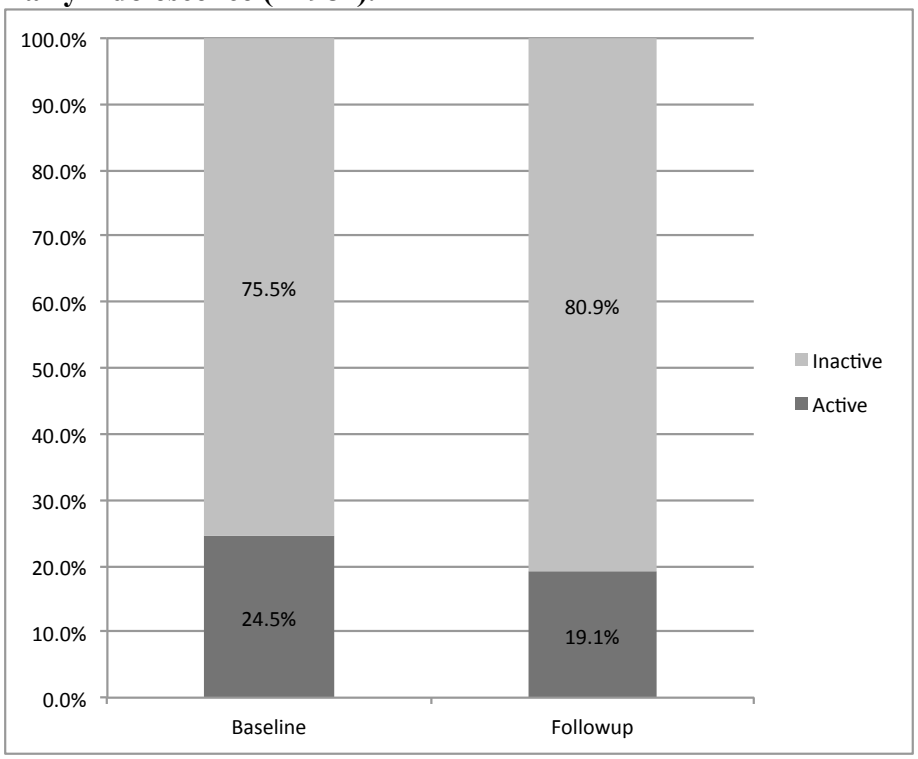


Table 2 shows the complete distribution of all characteristics for Cohort A; Table 3 shows the distribution by PA Change category. Nearly half of the girls identified themselves as white, about 20% self-identified as Black and 10% as Hispanic. Just over one-third of the sample reported receiving free or reduced lunch at school. Consistent with national prevalence rates for adolescent girls in the U.S.[47], one-third of the sample was overweight or obese with a measured BMI at or above the 85th percentile for age. About two-thirds of the participants were Inactive Maintainers (IM), with an average daily MVPA of less than 30 minutes at both measurement points. Another 15.5% were Relapsers (R)— active at baseline with greater than or equal to 30 minutes of daily

average MVPA, but inactive at follow-up. Ten percent were Adopters (A), inactive at baseline but active at follow-up and 9% were Active Maintainers (AM), active at both measurement points.

Logistic Regression models were run separately for each of the four categories of PA level change to provide a more detailed univariate analysis of each independent variable relative to each category; complete results of these analyses are found in Tables 4, 5, 6 and 7.

1. Active Maintainers (Table 4)

After fully adjusting for all other variables, participants who indicated receipt of free or reduced lunch (FRPL) had lower odds of AM compared to students who indicated otherwise. PA Self-Efficacy was also a predictor of AM; in the final model a higher PA Self-Efficacy score increased the likelihood of being AM.

2. Inactive Maintainers (Table 5)

Race was significant in the final model. Girls categorized as "Other" were more likely to be IM than Whites. FRPL approached significance suggesting that those who reported receipt of FRPL were more likely to be IM than those who reported otherwise. Friend Support for PA was significant; a lower Friend Support for PA score had a higher likelihood of IM.

3. Adopters (Table 6)

There were no variables found to be associated with A in the final model.

4. Relapsers (Table 7)

In the fully adjusted model, Friend Support for PA was the only variable associated with R; a higher Friend Support for PA score increased the likelihood of R.

BMI approached significance, suggesting that overweight or obese participants were less likely to be R compared with those of normal weight.

II. Cohort B.

Figure 2. Cohort B: Distribution of Active and Inactive at Baseline and Follow-up (n=561).

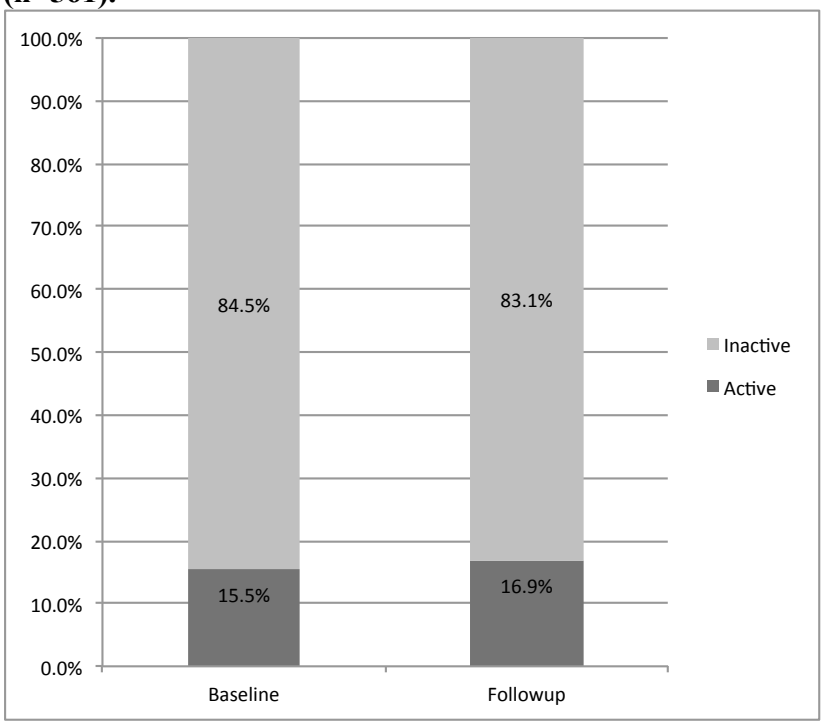


Table 2 shows the complete distribution of all characteristics for Cohort B; Table 3 shows the distribution by PA Change category. The majority of the girls identified themselves as white (47.8%); 20.9% self-identified as Black and 13.2% as Hispanic; the remaining 18.2% was categorized as "Other". About one quarter of the sample reported receiving free or reduced lunch at school. Like with Cohort A, one-third of the sample was overweight or obese with a measured BMI at or above the 85th percentile for age. Most of the participants, 73.1%, were categorized as IM. Another 10% were R, 11% were A and only 5.5% of the girls were categorized as AM. Nearly half of the sample reported receiving less than 8 hours of sleep per day while fewer than 20% received recommended

9+ hours per day. Nearly 40% indicated they had a job for which they earned money. Over 75% of the participants reported that they have currently or have had in the past a serious boyfriend or partner. On average, girls reported age at menses at 12.3 years.

Logistic regression models were run separately for each of the four categories of PA level change to provide a more detailed univariate analysis of each independent variable relative to each category; results of these analyses are found in Tables 8, 9, 10 and 11.

1. Active Maintainers (Table 8)

In the final model, Friend Support for PA approached significance. Living a greater distance from the nearest park lowered the likelihood for AM. A higher Frequency of PA with Friends score resulted in greater likelihood of AM. Global Physical scores were positively associated with increased odds of AM.

2. Inactive Maintainers (Table 9)

BMI was found to be a significant predictor for IM. After adjusting for other variables, participants who measured overweight/obese were more likely to be IM than those who measured normal weight. Friend Support for PA and Frequency of PA with Friends were also consistent predictors with a lower score predicting a higher likelihood for IM. Age at Menses also showed a negative association with a younger age predicting higher odds for IM.

3. Adopters (Table 10)

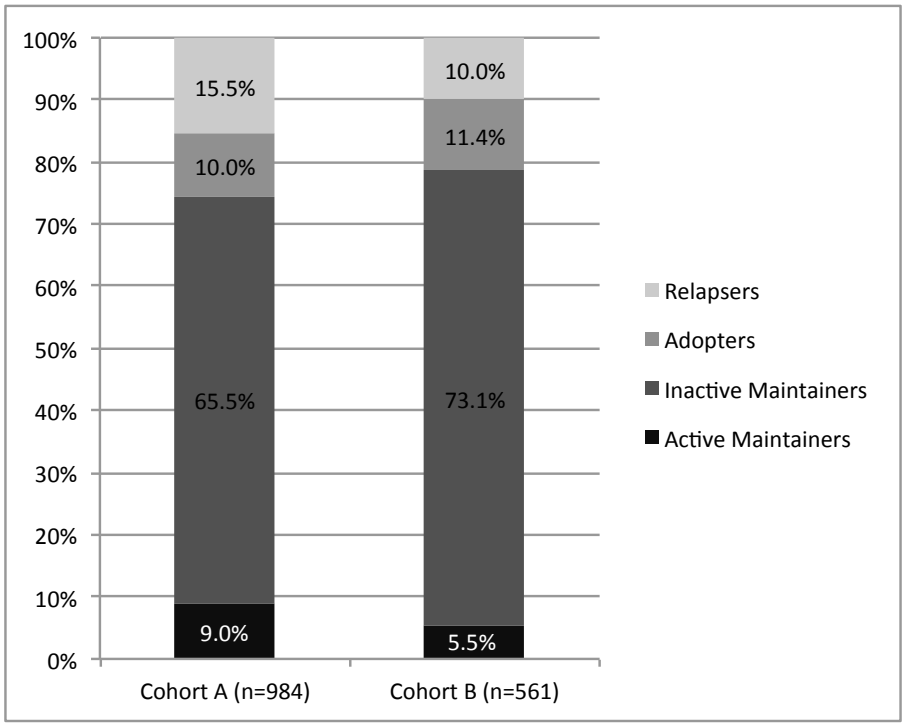
After adjusting for all variables, BMI was the only variable associated with A in later adolescence. Participants who measured normal weight were more likely to be A compared to those who measured overweight/obese.

4. Relapsers (Table 11)

No variables demonstrated a significant association with R.

Chapter 5: Discussion

Figure 3. Comparison of the Distribution of Physical Activity Categories, Cohort A and Cohort B.



This study found that there were differences in: 1) The predictors across the four categories of PA change in early adolescence; 2) The predictors across the categories in later adolescence; and 3) The predictors themselves between early and later adolescence. In early adolescence, predictors were: AM) FRPL and PA Self-Efficacy; IM) race, FRPL (approached) and Friend Support for PA; A) none; R) Friend Support for PA. In later adolescence, predictors were: AM) Friend Support for PA (approached), Distance to Nearest Park, PA Frequency with Friends and Global Physical; IM) BMI, Friend Support for PA, PA Frequency with Friends and Age at Menses; A) BMI; R) none.

Many of these findings are consistent with existing research. An association was noted for race, but only for IM in early adolescence. Previous research has also found inconsistent relationships between race and PA.[8,15,28] SES has often been cited as a

predictor for PA and inactivity[11,22,30,31]; this study found a consistent association or trending association between receipt of FRPL and decreased odds of AM and increased odds of IM in early adolescence, but no association in later adolescence.

This study found an inverse association between BMI and PA, but it was significant only for IM and A in later adolescence. There were associations noted for BMI for other categories in the unadjusted models, but after controlling for other variables these associations were no longer evident. Furthermore, BMI trended significant for R in early adolescence, but in the opposite direction one would expect to see—overweight/obese participants had lower odds of being R compared to those of normal weight. Across other studies, the relationship between BMI and PA has also been inconsistent.[5,6,9,15,29]

This study found no association between PA and Elevated Depressive Symptoms in either cohort, which is contrary to other findings on PA and depression.[10,21,24] Previous PA and participation in sports has been shown by others to be associated with future PA,[6,7,15] but the present research found no significant association for either cohort. In their systematic review, Craggs et al. also found that there was insufficient evidence to suggest an association in age groups older than 10-13.[15] The lack of association may also have been due to the small number of participants who stated they did not participate in any sports or activities during the previous year (11% in Cohort A; 4% in Cohort B). While it's promising that over 90% of girls reported participating such activities, another measure of Previous PA may be more appropriate for future research.

Like other studies, this research found positive associations between social support and PA,[7,9,15,35] but it was not evident in all groups. A higher Friend Support for PA score increased the likelihood of being R in early adolescence. This may be explained by the fact that this measurement was done at baseline when, by definition, Relapsers were classified as active.

Self-efficacy is often cited as a significant factor for PA,[15,20] but the present research found that PA Self-Efficacy was a predictor for AM in early adolescence, only.

Similar to studies that have suggested an association between PA and the built-environment[12,32], in later adolescence this study found greater distance to the nearest park decreased the likelihood of being AM.

Other studies suggested evidence for a positive relationship between sleep and PA,[11,41,42] but the present study found no association. Research has suggested that competing commitments for time, such as employment, may contribute to adolescent withdrawal from PA,[38] or that employment may actually be a source of PA for adolescents.[17] This study, however, found no association between employment or having a boyfriend/partner and PA in later adolescence.

Like previous research on social network factors and PA,[35] this study found that in later adolescence a higher PA Frequency with Friends score predicted greater odds of AM and a lower score predicted higher odds of IM. The number of friends reported to be physically active was not significant. This suggests that simply having physically active friends is not enough to predict PA and participating in PA with friends may be an important factor for adolescent PA. Further research on PA and social networks is needed

to better understand how peer networks may play a role in increasing PA among adolescents.

This study found some similar relationships to other findings on pubertal development and PA[26,27]; reporting menarche at a later age resulted in a lower likelihood of being IM in later adolescence.

The present research included several measures of perceived self-concept in later adolescence—Body Fat, Global Physical and Global Self Esteem; only Global Physical was selected for inclusion in the final model. Many studies have looked at other measures of self concept and PA and most have found positive associations, [3,16,19,23–25,36] however this study found an association with AM only.

Overall, these findings show that: 1) There are differences in what factors predict whether a girl maintains, increases or decreases her level of PA and 2) Those factors differ between early and later adolescence. In addition, the present research further highlights the complexity of the relationship between PA and its determinants and the importance of examining multi-level predictors.

A. Study Strengths and Limitations

Few studies to date have looked at different directions of change in PA in adolescent girls using an objective measure of PA; none were found that used accelerometers. In addition, this study used longitudinal data to look at change during two different periods of adolescence and examined multi-level predictors. This study did have its limitations. Two different cohorts were used and Cohort A was national while cohort B consisted of girls from the Washington DC/Baltimore area only which limits generalizability. In addition, some of the variables examined in this study were available

only for cohort B, limiting the comparisons between the two cohorts. No school level variables or policy level variables were included for either cohort. The majority of variables selected were measured at baseline, however it is possible that follow-up variables or the change in the variables between baseline and follow-up may be better predictors than the baseline measure.

B. Public Health Significance

This study adds to the current body of literature addressing PA and related determinants in adolescent girls. Examining predictors for each level of change may help to inform the implementation of programs to not only reduce the overall decline of PA, but may also help guide strategies to help girls maintain or even increase their level of PA during adolescence. In addition, this research provides further evidence that to adequately address the decline in PA, interventions need to occur at all social-ecological levels. Finally, it should be noted that some of the OR values may be seen as modest or relatively weak. On an individual level, it is true that the likelihoods are only minimally elevated or decreased. However, it is important to remember that on a population level, a slight shift in the distribution one way or the other can have a significant impact on the health and well-being of the population.

Table 1: Variable List Summary

Variable	Type	Cohort	Measurement
Dependent Variable			
PA level	Categorical (4)	A & B	Active Maintainers=*Active at baseline and followup) Inactive Maintainers= **Inactive at baseline and follow-up Adopters=Inactive at baseline, Active at followup) Relapsers=Active at baseline, inactive at followup) *Active= $\geq$ 30 minutes of average daily MVPA **Inactive=< 30 minutes
Independent Variables			
Race/Ethnicity	Categorical (4)	A & B	W=White B=Black H=Hispanic O=Other
Free/reduced Price Lunch (proxy for SES)	Dichotomous	A & B	*Do you receive free/reduced lunch at school?* Yes Otherwise
Body Mass Index (BMI)	Dichotomous	A & B	Measured Weight (kg)/height $(m)^2$ > 85^{th} percentile = overweight/obese all else=normal weight
Elevated Depressive Symptoms	Dichotomous	A & B	CED-S; possible range 0-60 $\geq$ 16=elevated depressive symptoms. < 16= none
Self Concept			
Self Esteem	Continuous	B only	PSDQ; range 0-40
Body Fat	Continuous	B only	PSDQ; range 0-30
Global Physical	Continuous	B only	PSDQ; range 0-30
Social Network			
Physically Active Friends	Continuous	B only	*Is this friend physically active?* Range 0-3
PA Frequency with Friends	Continuous	B only	*How often are you physically active with this friend?* Range 0-15
Social Support for PA			
Friend Social Support for PA	Continuous	A & B	Range 0-12
Family Social Support for PA	Continuous	A & B	Range 0-20

PA Self-efficacy	Continuous	A & B	Range 8-40
Previous Sports Participation	Dichotomous	A & B	Participation in sports teams and/or activity classes at baseline during the past year Yes No
Age at Menses-Pubertal Development	Continuous	B only	Age at first menstruation (in years)
Boyfriend	Categorical (3)	B only	*Have you ever had a serious boyfriend/partner?* Never Current Past
Sleep	Categorical (3)	B only	Average hours of daily sleep Optimal=≥ 9 hours Borderline = 8-9 hours Insufficient = < 8 hours
Employment	Dichotomous	B only	*Do you have a job for which you earn money?* Yes No
Distance to nearest park	Continuous	A & B	Shortest street network distance, in miles
Distance to school	Continuous	A & B	Shortest street network distance, in miles

Table 2. Descriptive Characteristics for Cohort A and Cohort B.

	Cohort A		Cohort B	
	n	%	n	%
	984		561	
Variable				
Race**				
White	491	49.4	268	47.8
Black	191	19.4	117	20.9
Hispanic	102	10.4	74	13.2
Other	200	20.3	102	18.2
Free/reduced price lunch	984		561	
Yes	358	36.4	146	26.0
Otherwise	626	63.6	415	74.0
Elevated depressive symptom	984		561	
Yes	374	38.0	235	41.9
No	610	62.0	328	58.5
Previous sports participation	984		561	
Yes	876	89.0	537	95.7
No	108	11.0	24	4.3
BMI	984		561	
Normal	655	66.6	376	67.0
Overweight/Obese	329	33.4	185	33.0
	Mean	**SD**	**Mean**	**SD**
Friend Support for PA	9.23	2.82	8.48	3.02
Family Support for PA	17.11	4.48	15.15	4.97
Self-Efficacy for PA	29.79	6.26	28.53	6.43
Distance to Neareset Park[a]	0.67	0.88	1.22	1.38
Distance to Own School**	2.62	1.91	2.13	2.10
Self-Esteem*			40.15	6.45
Body Fat*			26.76	8.77
Global Physical*			25.40	7.36
Age at menses*			12.29	1.48
Are your friends active*			1.97	0.93
PA Frequency with Friends*			3.84	2.16
			n	**%**
Sleep*			555	
optimal (> or equal 9 hours)			102	18.4
borderline (8-9 hours)			177	31.9
Insufficient (< 8 hours)			276	49.7
Have you had a boyfriend?*			561	
Never			127	22.6
Past, but not now			213	38.0
Current			221	39.4
Do you currently have a job?*			561	
Yes			221	39.4
No			340	60.6

[a] 47 observations missing
*measured at follow-up cohort B
** measured at follow-up cohort A

Table 3. Descriptive Characteristics for Cohort A (n=984) and Cohort B (n=561), by PA Change Category

	ActiveMaintain		Adopter		InactiveMaintain		Relapser		p value	ActiveMaintain		Adopter		InactiveMaintain		Relapser		p value
	n	%	n	%	n	%	n	%		n	%	n	%	n	%	n	%	
	89	9.0	99	10.1	644	65.4	152	15.5		31	5.5	64	11.4	410	73.1	56	10.0	
Variable																		
Race**									0.0738									0.1970
White	54	6.1	58	58.6	297	46.1	82	53.9		22	71.0	29	45.3	193	47.1	24	42.9	
Black	12	13.5	13	13.1	139	21.6	27	17.8		3	9.7	14	21.9	83	20.2	17	30.4	
Hispanic	9	10.1	12	12.1	64	9.0	17	11.2		1	3.2	8	12.5	60	14.6	5	8.9	
Other	14	15.7	16	16.2	144	22.4	26	17.1		5	16.1	13	20.3	74	18.0	10	17.9	
Free/reduced price lunch									0.0074									0.2089
Yes	19	21.3	34	34.3	254	39.4	51	33.6		4	12.9	14	21.9	110	26.8	18	3.2	
Otherwise	70	28.7	65	65.7	390	60.6	101	66.4		27	87.1	50	78.1	300	73.2	38	6.8	
Elevated depressive symptoms									0.7163									0.5642
Yes	30	33.7	35	35.4	248	38.5	61	40.1		10	32.3	30	46.9	170	41.5	25	44.6	
No	59	66.3	64	64.7	396	61.5	91	59.9		21	67.7	35	54.7	241	58.8	31	55.4	
Previous sports participation									0.1472									
Yes	83	93.3	89	89.9	563	87.4	141	92.8		30	96.8	62	96.9	391	95.4	54	96.4	0.9753
No	6	6.7	10	10.1	81	12.6	11	7.2		1	3.2	2	3.1	19	4.6	2	3.6	
BMI									0.0755									0.0038
Normal	66	74.2	65	65.7	413	64.1	111	73.0		26	83.9	54	84.4	256	62.4	40	71.4	
Overweight/Obese	23	25.8	34	34.3	231	35.9	41	27.0		5	16.1	10	15.6	154	37.6	16	28.6	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Friend Support for PA	9.75	2.56	9.44	3.24	9.00	2.82	9.92	2.55	0.0004	9.94	3.21	8.88	3.13	8.25	2.98	8.90	2.86	0.0097
Family Support for PA	17.65	4.29	16.74	4.74	16.87	4.57	18.09	3.86	0.0097	17.87	5.33	16.61	4.30	15.26	4.94	14.79	5.31	0.0074
Self-Efficacy for PA	31.64	6.13	30.41	6.37	29.40	6.31	29.91	5.87	0.0076	30.46	6.75	28.52	7.13	28.23	6.38	29.64	5.59	0.152
Distance to Neareset Park[a]	0.76	0.93	0.60	0.72	0.67	0.91	0.63	0.80	0.6166	0.78	0.93	1.17	2.24	1.24	1.28	1.36	1.03	0.224
Distance to Own School**	2.40	1.55	2.68	1.96	2.68	2.02	2.47	1.54	0.3919	2.33	1.94	2.29	2.04	2.15	2.18	1.68	1.49	0.3684
Self-Esteem*										40.45	7.53	40.09	7.30	40.15	6.13	40.07	7.21	0.994
Body Fat*										29.61	9.12	28.14	8.15	26.15	8.76	28.04	8.97	0.0489
Global Physical*										29.23	7.36	26.27	7.64	24.82	7.19	26.57	7.59	0.0053
Age at menses*										12.77	1.56	12.47	1.48	12.19	1.45	12.55	1.57	0.0452
Are your friends active*										2.23	0.80	2.07	0.90	1.94	0.94	1.96	0.99	0.301
PA Frequency with Friends*										5.19	2.56	4.20	2.11	3.67	2.11	3.95	2.14	0.0013
										n	%	n	%	n	%	n	%	
Sleep*										30		64		405		56		0.6807
optimal (> or equal 9 hours)										5	16.7	8	12.5	78	19.3	11	19.6	
borderline (8-9 hours)										10	33.3	22	34.4	132	32.6	13	23.2	
Insufficient (< 8 hours)										15	50.0	34	53.1	195	48.1	32	57.1	
Have you had a boyfriend?*																		0.4422
Never										9	29.0	11	17.2	97	23.7	10	17.9	
Past, but not now										8	25.8	28	43.8	158	38.5	19	33.9	
Current										14	45.2	25	39.1	155	37.8	27	48.2	
Do you currently have a job?*																		0.8324
Yes										11	35.5	25	39.1	160	39.0	25	44.6	
No										20	64.5	39	60.9	250	61.0	31	55.4	

[a] 47 observations missing
*measured at follow-up cohort B
** measured at follow-up cohort A

Table 4. Parameter Estimates for Cohort A, Active Maintainers (n=89)

Variable	Unadjusted OR	Unadjusted 95% CI	Unadjusted p-value	Adjusted 1[a] OR	Adjusted 1[a] 95% CI	Adjusted 1[a] p-value	Adjusted 2[b] OR	Adjusted 2[b] 95% CI	Adjusted 2[b] p-value
Race*			0.1737			0.5865			0.7907
W	1.000			1.000			1.000		
B	0.543	0.283, 1.038		0.769	0.384, 1.540		0.847	0.411, 1.748	
S	0.783	0.374, 1.642		1.120	0.511, 2.457		1.220	0.547, 2.718	
O	0.783	0.330, 1.124		0.700	0.377, 1.303		0.812	0.432, 1.525	
Free/reduced lunch			0.0025			0.0106			0.0161
Otherwise	1.000			1.000			1.000		
Yes	0.445	0.263, 0.752		0.470	0.263, 0.839		0.482	0.266, 0.873	
BMI			0.1133			0.2508			
Normal Weight	1.000			1.000					
Overweight	0.671	0.409, 1.100		0.744	0.448, 1.233				
Elevated Depressive Symptoms			0.3815			0.6369			
No	1.000			1.000					
Yes	0.814	0.514, 1.290		0.894	0.561, 1.424				
Previous Sports Participation			0.1859						
Yes	1.000			1.000		0.2600			
No	0.562	0.239, 1.320		0.610	0.258, 1.442				
Friend Support for PA	1.075	0.994, 1.163	0.0708	1.079	0.996, 1.169	0.0632			
Family Support for PA	1.030	0.98, 1.083	0.2389	1.022	0.972, 1.075	0.3931			
PA Self-Efficacy	1.060	1.019, 1.102	0.0036	1.055	1.014, 1.097	0.0035	1.063	1.020, 1.108	0.0036
Distance to Neareset Park[c]	1.123	0.901, 1.400	0.4223	1.088	0.869, 1.362	0.4618			
Distance to Own School[d]*	0.925	0.810, 1.057	0.2523	0.918	0.803, 1.049	0.2098	0.918	0.801, 1.051	0.2148

[a] Includes Race and SES

[b] Includes Race, SES and those variables selected at a<.2 by backward elimination

[c] 47 observations missing

* Measured at follow-up

Table 5. Parameter Estimates for Cohort A, Inactive Maintainers (n=644)

	Unadjusted			Adjusted 1[a]			Adjusted 2[b]		
Variable	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Race*			0.0031			0.0225			0.0381
W	1.000			1.000			1.000		
B	1.746	1.210, 2.518		1.158	1.020, 2.258		1.463	0.962, 2.225	
S	1.100	0.708, 1.709		0.953	0.597, 1.532		0.869	0.534, 1.417	
O	1.680	1.174, 2.402		1.582	1.099, 2.276		1.547	1.060, 2.257	
Free/reduced lunch			0.0062			0.0762			0.0666
Otherwise	1.000			1.000			1.000		
Yes	1.478	1.117, 1.955		1.329	0.971, 1.820		1.356	0.979, 1.878	
BMI			0.0262			0.0873			0.1024
Normal Weight	1.000			1.000			1.000		
Overweight	1.381	1.039, 1.836		1.291	0.963, 1.731		1.288	0.951, 1.746	
Elevated Depressive Symptoms			0.6566			0.9543			
No	1.000			1.000					
Yes	1.063	0.811, 1.395		0.992	0.752, 1.308				
Previous Sports Participation			0.0283						
Yes	1.000			1.000		0.0504			
No	1.667	1.056, 2.633		1.586	0.999	2.5190			
Friend Support for PA	0.906	0.864, 0.951	<.0001	0.903	0.860, 0.948	p<.0001	0.906	0.862, 0.953	0.0001
Family Support for PA	0.964	0.936, 0.994	0.0176	0.969	0.940, 0.999	0.0413			
PA Self-Efficacy	0.971	0.951, 0.993	0.0086	0.975	0.954, 0.997	0.0243			
Distance to Neareset Park[c]	1.024	0.878, 1.194	0.7603	1.056	0.903, 1.235	0.4922			
Distance to Own School[d]*	1.051	0.976, 1.131	0.1896	1.057	0.980, 1.139	0.1498	1.059	0.980, 1.144	0.1149

[a] Includes Race and SES

[b] Includes Race, SES and only those variables selected at a<.2 by backward elimination

[c] 47 observations missing

* Measured at follow-up

Table 6: Parameter Estimates for Cohort A, Adopters (n=99)

Variable	Unadjusted OR	Unadjusted 95% CI	Unadjusted p-value	Adjusted 1[a] OR	Adjusted 1[a] 95% CI	Adjusted 1[a] p-value	Adjusted 2[b] OR	Adjusted 2[b] 95% CI	Adjusted 2[b] p-value
Race			0.1669			0.1723			0.1723
W	1.000			1.000			1.000		
B	0.545	0.291, 1.020		0.526	0.268, 1.032		0.526	0.268, 1.032	
S	0.995	0.514, 1.929		0.960	0.473, 1.948		0.960	0.473, 1.948	
O	0.649	0.346, 1.159		0.639	0.354, 1.153		0.639	0.354, 1.153	
Free/reduced lunch			0.6567			0.7762			0.9763
Otherwise	1.000			1.000			1.000		
Yes	0.906	0.585, 1.402		1.074	0.657, 1.756		1.074	0.657, 1.756	
BMI			0.8399			0.6287			
Normal Weight	1.000			1.000					
Overweight	1.046	0.675, 1.621		1.117	0.712, 1.753				
Elevated Depressive Symptoms			0.5663			0.7316			
No	1.000			1.000					
Yes	0.881	0.571, 1.359		0.926	0.597, 1.436				
Previous Sports Participation			0.7692						
Yes	1.000			1.000		0.8747			
No	0.902	0.454, 1.793		0.946	0.473, 1.890				
Friend Support for PA	1.030	0.956, 1.109	0.4395	1.031	0.956, 1.111	0.4268			
Family Support for PA	0.980	0.936, 1.026	0.3855	0.975	0.931, 1.022	0.2949			
PA Self-Efficacy	1.018	0.984, 1.054	0.2957	1.015	0.980, 1.051	0.3976			
Distance to Neareset Park[c]	0.899	0.685, 1.180	0.4434	0.871	0.662, 1.148	0.1995			
Distance to Own School*	1.016	0.912, 1.133	0.7707	1.015	0.908, 1.134	0.7945			

[a] Includes Race and SES

[b] Includes Race, SES and those variables selected at a<.2 by backward elimination

[c] 47 observations missing

* Measured at follow-up

Table 7: Parameter Estimates for Cohort A, Relapsers (n=152)

	Unadjusted			Adjusted 1[a]			Adjusted 2[b]		
Variable	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Race*			0.6004			0.6736			0.5969
W	1.000			1.000			1.000		
B	0.821	0.513, 1.315		0.869	0.520, 1.450		0.937	0.555, 1.580	
S	0.998	0.563, 1.768		1.056	0.575, 1.940		1.211	0.653, 2.246	
O	0.745	0.463, 1.199		0.764	0.471, 1.238		0.776	0.476, 1.262	
Free/reduced lunch			0.4307			0.5901			0.5948
Otherwise	1.000			1.000			1.000		
Yes	0.864	0.599, 1.244		0.893	0.593, 1.347		0.894	0.591, 1.351	
BMI			0.0674			0.0847			0.0899
Normal Weight	1.000			1.000			1.000		
Overweight	0.698	0.475, 1.026		0.707	0.476, 1.049		0.709	0.477, 1.055	
Elevated Depressive Symptoms			0.5576			0.4597			
No	1.000			1.000					
Yes	1.112	0.781, 1.583		1.144	0.800, 1.636				
Previous Sports Participation			0.1124						
Yes	1.000			1.000		0.1236			
No	0.591	0.309, 1.131		0.599	0.312, 1.150				
Friend Support for PA	1.110	1.042, 1.183	0.0012	1.113	1.044, 1.185	0.0010	1.112	1.044, 1.185	0.0011
Family Support for PA	1.062	1.020, 1.107	0.0037	1.062	1.019, 1.107	0.0044			
PA Self-Efficacy	1.004	0.976, 1.032	0.7843	1.002	0.975, 1.031	0.8781			
Distance to Neareset Park[d]	0.939	0.760, 1.161	0.5611	0.929	0.750, 1.151	0.5006			
Distance to Own School*	0.947	0.856, 1.047	0.2859	0.945	0.853, 1.046	0.2736			

[a] Includes Race and SES

[b] Includes Race, SES and those variables selected at a<.2 by backward elimination

[c] 47 observations missing

* Measured at follow-up

Table 8: Parameter Estimates for Cohort B, Active Maintainers (n=31)

	Unadjusted			Adjusted 1[a]			Adjusted 2[b]		
Variable	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Race			0.0704			0.1516			0.2723
W	1.000			1.000			1.000		
B	0.294	0.086, 1.003		0.342	0.097, 1.208		0.351	0.091, 1.361	
S	0.153	0.020, 1.156		0.176	0.023, 1.354		0.212	0.027, 1.694	
O	0.576	0.212, 1.565		0.620	0.226, 1.700		0.733	0.250, 2.147	
Free/reduced lunch			0.0969			0.3653			0.4576
Otherwise	1.000			1.000			1.000		
Yes	0.405	0.139, 1.177		0.598	0.197, 1.819		0.631	0.187, 2.126	
BMI			0.0478			0.0868			
Normal Weight	1.000			1.000					
Overweight	0.374	0.141, 0.990		0.423	0.158, 1.132				
Elevated Depressive Symptoms			0.2667			0.2906			
No	1.000			1.000					
Yes	0.646	0.298, 1.398		0.657	0.301, 1.432				
Previous Sports Participation			0.7671						
Yes	1.000			1.000		0.8667			
No	0.735	0.096, 5.627		0.839	0.108, 6.541				
Friend Support for PA	1.191	1.050, 1.351	0.0065	1.185	1.043, 1.347	0.0093	1.132	0.987, 1.297	0.0756
Family Support for PA	1.114	1.029, 1.205	0.0074	1.109	1.022, 1.203	0.0126			
PA Self-Efficacy	1.055	0.992, 1.122	0.0868	1.041	0.978, 1.108	0.2029			
Distance to Neareset Park	0.661	0.438, 1.000	0.0498	0.630	0.418, 0.950	0.0274	0.665	0.441, 1.003	0.0515
Distance to Own School	1.043	0.893, 1.219	0.5910	1.015	0.864, 1,193	0.8571			
Sleep[c]*			0.9648			0.9416			
Optimal	1.000			1.000					
Borderline	1.162	0.386, 3.498		1.147	0.378, 3.418				
Insufficient	1.115	0.395, 3.150		1.204	0.421, 3.448				
Boyfriend*			0.3514			0.4531			
Never	1.000			1.000					
Current	0.887	0.372, 2.111		1.094	0.453, 2.644				
Past	0.512	0.192, 1.362		0.624	0.231, 1.681				
Employment*			0.6471			0.4808			
No	1.000			1.000					
Yes	0.838	0.394, 1.785		0.758	0.351, 1.638				
Active Friends*	1.396	0.915, 2.130	0.1221	1.218	0.784, 1.893	0.3806			
Frequency of PA w/ Friends*	1.354	1.142, 1.606	0.0005	1.339	1.125, 1.593	0.0010	1.239	1.023, 1.500	0.0280
Age at Menses*	1.288	0.994, 1.668	0.0553	1.242	0.947, 1.629	0.1174	1.228	0.913, 1.652	0.1754
Self Esteem*	1.008	0.951, 1.068	0.7910	1.015	0.958, 1.076	0.6136			
Global Physical*	1.095	1.030, 1.163	0.0036	1.114	1.045, 1.186	0.0008	1.077	1.006, 1.152	0.0318
Body Fat*	1.047	0.997, 1.099	0.0664	1.052	1.001, 1.105	0.0443			

[a] Includes Race and SES

[b] Includes Race, SES and those variables selected at a<.2 by backward elimination

[c] 6 observations missing

* Measured at follow-up

Table 9: Parameter Estimates for Cohort B, Inactive Maintainers (n=410)

	Unadjusted			Adjusted 1[a]			Adjusted 2[b]		
Variable	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Race			0.4232			0.4522			0.6790
W	1.000			1.000			1.000		
B	0.949	0.587, 1.533		0.909	0.550, 1.503		0.802	0.462, 1.391	
S	1.665	0.878, 3.158		1.601	0.832, 3.081		1.260	0.638, 2.489	
O	1.027	0.617, 1.711		1.006	0.601, 1.684		0.948	0.549, 1.635	
Free/reduced lunch			0.4746			0.5822			0.5649
Otherwise	1.000			1.000			1.000		
Yes	1.171	0.759, 1.807		1.138	0.718, 1.803		1.156	0.706, 1.891	
BMI			0.0002			0.0003			0.0093
Normal Weight	1.000			1.000			1.000		
Overweight	2.329	1.496, 3.625		2.302	1.470, 3.603		1.919	1.175, 3.136	
Elevated Depressive Symptoms			0.7361			0.6474			0.1542
No	1.000			1.000			1.000		
Yes	0.937	0.643, 1.367		0.915	0.626, 1.338		0.746	0.499, 1.116	
Previous Sports Participation			0.4945						
Yes	1.000			1.000		0.5479			
No	1.419	0.520, 3.869		1.362	0.497, 3.730				
Friend Support for PA	0.909	0.854, 0.969	0.0033	0.908	0.851, 0.968	0.0030	0.925	0.864, 0.990	0.0238
Family Support for PA	0.963	0.927, 1.000	0.0500	0.965	0.928, 1.002	0.0655			
PA Self-Efficacy	0.973	0.944, 1.003	0.0728	0.975	0.946, 1.006	0.1113			
Distance to Neareset Park	1.047	0.907, 1.209	0.5310	1.061	0.914, 1.231	0.4364			
Distance to Own School	1.019	0.930, 1.116	0.6918	1.098	1.009, 1.195	0.0303			
Sleep[c]*			0.4464			0.4723			0.2259
Optimal	1.000			1.000			1.000		
Borderline	0.903	0.511, 1.594		0.907	0.513, 1.604		0.876	0.485, 1.582	
Insufficient	0.741	0.438, 1.253		0.747	0.440, 1.268		0.653	0.377, 1.133	
Boyfriend*			0.4062			0.3118			
Never	1.000			1.000					
Current	0.726	0.440, 1.198		0.689	0.415, 1.145				
Past	0.888	0.533, 1.482		1.601	0.514, 1.451				
Employment*			0.7679			0.7903			
No	1.000			1.000					
Yes	0.944	0.645, 1.382		0.949	0.644, 1.397				
Active Friends*	0.860	0.701, 1.054	0.1456	0.870	0.704, 1.074	0.1955			
Frequency of PA w/ Friends*	0.872	0.799, 0.952	0.0021	0.870	0.796, 0.950	0.0019	0.899	0.819, 0.987	0.0257
Age at Menses*	0.833	0.728, 0.953	0.0078	0.837	0.731, 0.959	0.0103	0.870	0.753, 1.005	0.0581
Self Esteem*	1.000	0.971, 1.029	0.9900	1.000	0.972, 1.030	0.9745			
Global Physical*	0.959	0.933, 0.985	0.0021	0.957	0.931, 0.984	0.0018	0.980	0.949, 1.011	0.2016
Body Fat*	0.969	0.948, 0.992	0.0073	0.969	0.947, 0.992	0.0698			

[a] Includes Race and SES

[b] Includes all variables

[c] 6 observations missing

* Measured at follow-up

Table 10: Parameter Estimates for Cohort B, Adopters (n=64)

	Unadjusted			Adjusted 1[a]			Adjusted 2[b]		
Variable	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Race			0.9536			0.8999			0.7919
W	1.000			1.000			1.000		
B	1.120	0.568, 2.208		1.238	0.611, 2.510		1.422	0.687, 2.946	
S	0.999	0.436, 2.288		1.097	0.469, 2.564		1.271	0.535, 3.018	
O	1.204	0.599, 2.419		1.264	0.625, 2.557		1.255	0.613, 2.572	
Free/reduced lunch			0.4226			0.3466			0.4699
Otherwise	1.000			1.000			1.000		
Yes	0.774	.414, 1.447		0.729	0.378, 1.408		0.779	0.396, 1.533	
BMI			0.0026			0.0030			0.0025
Normal Weight	1.000			1.000			1.000		
Overweight	0.341	0.169, 0.686		0.343	0.170, 0.695		0.333	0.164, 0.679	
Elevated Depressive Symptoms			0.3911			0.3366			0.1708
No	1.000			1.000			1.000		
Yes	1.257	0.745, 2.119		1.294	0.765, 2.188		1.454	0.851, 2.483	
Previous Sports Participation			0.6306						
Yes	1.000			1.000		0.6475			
No	0.697	0.160, 0.035		0.709	0.162, 3.098				
Friend Support for PA	1.051	0.964, 1.147	0.2569	1.058	0.969, 1.155	0.2058			
Family Support for PA	1.053	0.997, 1.111	0.0617	1.053	0.998, 1.112	0.0588			
PA Self-Efficacy	1.000	0.960, 1.041	0.9871	1.000	0.960, 1.042	0.9923			
Distance to Neareset Park	0.970	0.794, 1.185	0.7648	0.981	.803, 1.199	0.8516			
Distance to Own School	1.038	0.926, 1.165	0.5198	1.031	0.918, 1.158	0.6035			
Sleep[c]*			0.4410			0.4417			
Optimal	1.000			1.000					
Borderline	1.668	0.714, 3.897		1.675	0.716, 3.916				
Insufficient	1.651	0.737, 3.697		1.647	0.732, 3.702				
Boyfriend*			0.4561			0.4631			
Never	1.000			1.000					
Current	1.345	0.638, 2.834		1.383	0.651, 3.937				
Past	1.596	0.765, 3.329		1.601	0.761, 3.367				
Employment*			0.9541			0.9293			
No	1.000			1.000					
Yes	0.984	0.577, 1.678		1.025	0.597, 1.760				
Active Friends*	1.152	0.865, 1.534	0.3327	1.180	0.877, 1.588	0.2734			
Frequency of PA w/ Friends*	1.090	0.967, 1.228	0.1601	1.095	0.971, 1.236	0.1379	1.092	0.968, 1.233	0.1536
Age at Menses*	1.102	0.918, 1.322	0.2987	1.104	0.918, 1.327	0.2940			
Self Esteem*	0.998	0.959, 1.039	0.9371	0.998	0.958, 1.040	0.9394			
Global Physical*	1.019	0.982, 1.057	0.3192	1.114	1.045, 1.186	0.0008			
Body Fat*	1.022	0.990, 1.055	0.1813	1.023	0.991, 1.056	0.1674			

[a] Includes Race and SES

[b] Includes Race, SES and only those variables selected at a<.2 by backward elimination

[c] 6 observations missing

* Measured at follow-up

Table 11: Parameter Estimates for Cohort B, Relapsers (n=56)

	Unadjusted			Adjusted 1[a]			Adjusted 2[b]		
Variable	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**	**OR**	**95% CI**	**p-value**
Race			0.2870			0.3729			0.4329
W	1.000			1.000			1.000		
B	1.728	0.890, 3.356		1.578	0.782, 3.182		1.624	0.800, 3.298	
S	0.737	0.271, 2.002		0.675	0.242, 1.881		0.772	0.275, 2.167	
O	1.105	0.509, 2.400		1.055	0.481, 2.313		1.127	0.509, 2.494	
Free/reduced lunch			0.2728			0.4159			0.4804
Otherwise	1.000			1.000			1.000		
Yes	1.395	0.769, 2.531		1.303	0.689, 2.464		1.257	0.666, 2.375	
BMI			0.4607			0.3796			
Normal Weight	1.000			1.000					
Overweight	0.795	0.433, 1.462		0.758	0.408, 1.407				
Elevated Depressive Symptoms			0.6600			0.6452			
No	1.000			1.000					
Yes	1.133	0.650, 1.975		1.141	0.651, 1.998				
Previous Sports Participation			0.7834						
Yes	1.000			1.000		0.7898			
No	0.813	0.186, 3.553		0.818	0.186, 3.597				
Friend Support for PA	1.052	0.959, 1.153	0.2827	1.052	0.958, 1.155	0.2895			
Family Support for PA	0.968	0.916, 1.023	0.2490	0.967	0.914, 1.022	0.2366			
PA Self-Efficacy	1.032	0.986, 1.079	0.1734	1.034	0.987, 1.084	0.1558	1.033	0.986, 1.082	0.1682
Distance to Neareset Park	1.070	0.901, 1.272	0.4406	1.064	0.888, 1.274	0.5006			
Distance to Own School	0.854	0.709, 1.028	0.0961	0.864	0.717, 1.041	0.1248	0.862	0.714, 1.041	0.1240
Sleep[c]*			0.3364			0.4005			
Optimal	1.000			1.000					
Borderline	0.656	0.282, 1.523		0.651	0.279, 1.518				
Insufficient	1.085	0.525, 2.243		1.029	0.495, 2.140				
Boyfriend*			0.3497			0.3765			
Never	1.000			1.000					
Current	1.628	0.761, 3.485		1.563	0.723, 3.380				
Past	1.146	0.515, 2.548		1.081	0.481, 2.429				
Employment*			0.3976			0.3988			
No	1.000			1.000					
Yes	1.271	0.729, 2.218		1.276	0.724, 2.249				
Active Friends*	0.991	0.738, 1.331	0.9515	1.017	0.751, 1.377	0.9151			
Frequency of PA w/ Friends*	1.024	0.902, 1.163	0.7113	1.033	0.909, 1.173	0.6205			
Age at Menses*	1.152	0.948, 1.401	0.1550	1.164	0.956, 1.418	0.1296			
Self Esteem*	0.998	0.956, 1.041	0.9197	0.991	0.950, 1.035	0.6937			
Global Physical*	1.025	0.986, 1.066	0.2112	1.018	0.978, 1.060	0.3837			
Body Fat*	1.020	0.986, 1.054	0.2512	1.016	0.982, 1.051	0.3535			

[a] Includes Race and SES

[b] Includes Race, SES and only those variables selected at a<.2 by backward elimination

[c] 6 observations missing

* Measured at follow-up

Table 12. Comparison of Significant Predictors of Physical Activity Change for Cohort A and Cohort B with Parameter Estimates; OR (95% CI)

Active Maintainers-Early Adolescence			
OR > 1.0		**OR<1.0**	
Self-Efficacy	1.063 (1.020, 1.108)	FRPL	0.482 (0.266, 0.873)

Active Maintainers-Late Adolescence			
OR > 1.0		**OR<1.0**	
PA Freq w/ Friends	1.239 (1.023, 1.500)	Distance to Park	0.665 (0.441, 1.003)
Global Physical	1.077 (1.006, 1.152)		

Inactive Maintainers-Early Adolescence			
OR > 1.0		**OR<1.0**	
Race-Black	1.463 (0.962, 2.225)	Friend Support for PA	0.906 (0.862, 0.953)
Race-Other	1.547 (1.060, 2.257)	Race-Hispanic	0.869 (0.534, 1.417)

Inactive Maintainers-Late Adolescence			
OR > 1.0		**OR<1.0**	
BMI	1.919 (1.175, 3.136)	PA Freq w/ Friends	0.899 (0.819, 0.987)
		Age At Menses	0.870 (0.753, 1.005)
		Friend Support for PA	0.925 (0.864, 0.990)

Adopters-Early Adolescence			
OR > 1.0		**OR<1.0**	
None		None	

Adopters-Late Adolescence			
OR > 1.0		**OR<1.0**	
None		BMI	0.333 (0.164, 0.679)

Relapsers-Early Adolescence			
OR > 1.0		**OR<1.0**	
Friend Support	1.112 (1.044, 1.185)	None	

Relapsers-Late Adolescence			
OR > 1.0		**OR<1.0**	
None		None	

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