NIH Public Access
Author Manuscript
Med Sci Sports Exerc. Author manuscript; available in PMC 2009 October 29.

Published in final edited form as:
Med Sci Sports Exerc. 2008 November ; 40(11): 1916–1922. doi:10.1249/MSS.0b013e318180c390.

Tracking of physical activity and inactivity in middle school girls

Chris D. Baggett[1], **June Stevens**[2], **Robert G. McMurray**[3], **Kelly R. Evenson**[1], **David M. Murray**[4], **Diane J. Catellier**[5], and **Ka He**[2]

[1] Department of Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC

[2] Departments of Nutrition and Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, NC

[3] Department of Exercise and Sport Science, University of North Carolina at Chapel Hill, Chapel Hill, NC

[4] Division of Epidemiology, The Ohio State University, Columbus, OH

[5] Department of Biostatistics, University of North Carolina at Chapel Hill, Chapel Hill, NC

Abstract

Purpose—The purpose of this study was to describe and compare the levels of tracking of physical activity and inactivity as assessed by self-report and accelerometry in middle school girls over a 2-year period.

Methods—Participants (n=951) were from the Trial of Activity for Adolescent Girls (TAAG). At both 6th and 8th grades, inactivity and physical activity were measured using accelerometry (MTI Actigraph) and by self-report using the 3-day physical activity recall (3DPAR).

Results—Weighted kappa statistics ranged from 0.14–0.17 across inactivity, moderate-to-vigorous physical activity (MVPA), and vigorous physical activity (VPA) for self-report, from 0.13–0.20 for 3-day accelerometry, and from 0.22–0.29 for 6-day accelerometry. Intraclass correlations ranged from 0.17–0.22 for self-report, 0.06–0.23 for 3-day accelerometry, and 0.16–0.33 for 6-day accelerometry. In general, the estimates from 6-day accelerometry tended to be higher than those from self report, while few differences were observed between 3-day accelerometry and self-report. Odds ratios for being in the highest quintile at 8th grade for those in the highest quintile at 6th grade, compared to those in any other quintile at 6th grade were 3.26 (95% confidence interval=2.28, 4.67), 3.64 (2.55, 5.20), and 3.45 (2.42, 4.93) for 6-day accelerometry measured inactivity, MVPA, and VPA. Corresponding OR's from self-report were 2.44 (1.66, 3.58) for inactivity, 2.63 (1.83, 23.79) for MVPA, and 2.23 (1.54, 3.23) for VPA.

Conclusion—Tracking of inactivity and physical activity in middle school girls was fair-to-moderate. Our results suggest that physical activity and inactivity habits are dynamic for most girls during early adolescence. Population-based efforts should be made in this age group to promote physical activity and offer alternatives to inactivity for all girls.

Keywords

accelerometry; adolescent; longitudinal; self-report

Address for correspondence: Chris Baggett, Department of Epidemiology, CB 7435, University of North Carolina at Chapel Hill, Chapel Hill, NC, 27599, cbaggett@email.unc.edu, Phone: 919-962-3079, Fax: 919-962-3265.

No conflict of interest was reported by any author of this manuscript. The results of the present study do not constitute endorsement by ACSM.

INTRODUCTION

A number of studies have examined the stability, or tracking, of physical activity levels over time in children and youth. Tracking refers to the stability of relative rank or position within a group over time and is related to the ability to predict a measurement later in life knowing the value of the same variable earlier in life (8). Tracking of physical activity in children and youth is low-to-moderate at best; most tracking studies of children and youth have reported correlations of 0.30–0.60 depending on measurement method, age at baseline, and number of years between measurement (2,9,10,13,16,19,21,30). These findings indicate that there is considerable within-person variability in physical activity levels during childhood and adolescence and that the ability to predict an individual's current or future physical activity levels based on past physical activity levels is modest.

Several studies have assessed tracking in childhood (9,19,30) and late adolescence (2,8,21), however few have focused on early adolescence (11–14 years of age) (10). Given the dramatic physiologic and psychosocial changes associated with puberty that occur during this time, it is feasible that tracking during early adolescence may be different than during other points in the lifespan. This may be particularly true in girls who begin sexual maturation earlier and move through the stages of maturation at a greater rate than boys during this time (26). At least one study has found that early maturing girls have lower activity levels than later maturing girls of the same age (3). Studies focusing on physical activity habits during this dynamic time of a girl's life may help identify adverse health behaviors that can be successfully targeted for intervention.

Self-reported physical activity is not usually precise, so it is plausible that the modest tracking of physical activity observed in studies that use self-reported measures was at least partly due to error inherent in the method. Objective measures of physical activity, such as accelerometry, may provide more accurate measures of physical activity habits than those obtained by self-report (23). To date, only a few studies have used an objective measure of physical activity to assess tracking of physical activity in youth (9,11,19,30), none of which have focused on the early pubescent years (10). Even fewer studies have assessed the tracking of inactivity using either objective or subjective methods (9–11) during childhood and adolescence. Additional studies utilizing objective measurements, such as accelerometry, are needed to improve our understanding of the development and stability of physical activity habits in adolescents, which may translate into the development of more successful interventions. Additionally, no study has compared tracking measures as assessed by accelerometry and self-report methods. A comparison of this kind would provide information on the ability of self-report to measure this phenomenon.

The purpose of this study was to investigate the tracking of physical activity and inactivity as assessed by 3-days of self-report and 3- and 6-days of accelerometry in a racially diverse group of middle school girls. We also compared tracking measures between self-report and accelerometry.

METHODS

Study Design

Data were collected as part of the Trial of Activity for Adolescent Girls (TAAG). TAAG is a multi-center group-randomized trial designed to test an intervention to reduce the usual decline in moderate to vigorous physical activity in middle-school girls (25). TAAG has six field centers (at the Universities of Arizona, Maryland, Minnesota, and South Carolina; San Diego State University; and Tulane University). The project was coordinated by the University of North Carolina, Chapel Hill and the project office at the National Heart Lung and Blood

Institute collaborated on the work. Girls were recruited from six middle schools within each field center for a total of 36 schools. The parent or guardian of each participant provided written informed consent and girls provided assent. The study was approved by each participating universities' Human Subjects Review Board.

Participants

The TAAG design included two cross-sectional samples of girls, one drawn from 6th graders at the beginning of the study in the spring of 2003, and a second drawn from 8th graders in the spring of 2005 following the implementation of the 2-year intervention. Additionally, we recruited all 8th grade girls who had been measured in 6th grade in 2003 and who attended a TAAG school in the spring of 2005 regardless of whether they were identified as part of the 8th grade cross-sectional random sample. A total of 951 girls who were measured at both 6th grade and at 8th grade were included in the current analyses.

Measurements

Objectively measured physical activity and inactivity were assessed using the MTI Actigraph accelerometer model 7164 (Manufacturing Technologies Inc., Fort Walton Beach, Florida). Six complete days of Actigraph data were collected. Girls were instructed to wear the accelerometer on a belt around their waist over their right hip and were asked not to remove the Actigraph except when sleeping, bathing or swimming. Activity counts were accumulated over 30-second epochs during the 6 days. Actigraph data were processed using methods described by Treuth et al. (27). Missing actigraph data were imputed using the Expectation Maximization (EM) algorithm (4). Previous work in the TAAG cohort determined that MET thresholds ranges of 0–2.09, 2.1–4.59, 4.6–6.49, and ≥ 6.5 METs best discriminated between activities classified as inactive, light, moderate and vigorous activity, respectively (27). These MET ranges corresponded to accelerometer count ranges of 0–50, 51–1499, 1500–2600, and > 2600 counts/30-seconds for inactivity, light, moderate, and vigorous activity, respectively (27).

Self-report of physical activity and inactivity was obtained using the 3DPAR (20). The 3DPAR is a modification of the Previous Day Physical Activity Recall, which has been validated in youth (29). Pate et al. (20) reported that 30-minute blocks of moderate-to-vigorous physical activity (MVPA) and vigorous physical activity (VPA) from the 3DPAR were significantly correlated with both 3 day (r=0.27–0.41) and 7 day (r=0.35–0.45) of Actigraph measurements. Girls recalled their past physical activity behavior for each of the three previous days. Each day was segmented into 36, 30-minute time blocks from 6 a.m. until midnight. A list of commonly performed activities was provided. Girls recorded the one activity that they performed for the longest period of time during each 30-minute time block. There was no lower limit set on the period of time that the activity identified was performed.

For non-sedentary activities, participants rated the intensity of the activity as light, moderate, hard, or very hard. Illustrations of individuals performing an activity at each of the four intensities were provided to help participants select the proper intensity. All activities classified as "inactivity" were assumed to only be performed at a single intensity. MET values were assigned to each block using standard published values (1). MET values used as cut points for classifying the activity in blocks as inactive, light, moderate or vigorous were the same shown above for accelerometry.

From the 3DPAR, the numbers of blocks classified in each intensity category each day were totaled, and daily averages were calculated for each girl. The 3-day average was used in the analyses of self-reported activity. For objectively measured activity, minutes spent in each intensity category were summed over the course of a day. Two averages were obtained: one using all 6 days measured and another limited to the same 3 days that were assessed using the 3DPAR in order to assess any differences between measurement methods that were a result of differing number of days and type of days (weekend versus weekdays).

At the completion of the 6-day Actigraph monitoring period, participants completed the 3DPAR. This protocol resulted in having data from both self-report and Actigraph on three corresponding days. The 3DPAR was most frequently completed on a Wednesday (33%) or a Tuesday (28%) and was never completed on a Saturday or Sunday. Therefore, weekend days were over-represented in the 3-day sample with 47% weekdays and 53% weekend days assessed, as opposed to the 71% weekdays and 29% weekend days that would be expected had the sampling of days been uniform. The 6-day accelerometry data were less skewed with 67% of the data from weekdays and 33% of the data from weekend days. Previous work from TAAG has shown that physical activity levels differ by day of week (18).

Body mass was measured while wearing light clothing by use of an electronic scale (Seca, Model 770, Hamburg, Germany). Height was assessed without shoes using a portable stadiometer (Shorr Height Measuring Board, Olney, MD). Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Percent body fat was estimated from anthropometric measures using an equation that was developed by TAAG investigators for use in middle school girls (12).

Race/ethnicity was indicated via self-report on a six-item checklist which included (1) Caucasian (White, non-Hispanic), (2) African-American, (3) Hispanic, (4) Asian/Pacific Islander, (5) American Indian, and (6) Other. A proxy measure of socio-economic status (SES) was assessed at the school level by obtaining the proportion of students who received free or reduced cost lunch during the 2002–2003 school year.

Exclusions

In the 6th grade sample of girls, consent was obtained from 1721 girls. Of these girls, 118 had incomplete accelerometry data, 54 had fewer than three days of physical activity recall, 19 had incomplete body composition measures, seven were missing age, and one was missing race/ethnicity. Of the 1522 girls with complete measures in the 6th grade, 1243 were also assessed in the 8th grade sample. Among these girls 290 had incomplete or missing accelerometry data and two had fewer than three days of physical activity recall. Thus, 951 girls provided data for the current analyses. Body composition and MVPA did not differ between those girls measured at both 6th and 8th grade compared to those measured only at 6th grade.

Statistical analysis

Statistical analyses were conducted using SAS version 8.02 (SAS Institute, Cary, NC). There were only trivial differences in the tracking measures in the girls assigned to intervention and control schools, and therefore the data were combined for all analyses. Weighted kappa statistics (6) were calculated to assess the agreement in inactivity and different intensities of activity between baseline and follow-up (tracking). In order to calculate the kappa statistics, data were categorized into quintiles. The kappa statistics were interpreted according to the recommendations of Munoz and Bangdiwala (17), whereby a Kappa-value of <0.00 equates to poor strength of agreement, 0.00–0.20 is fair agreement, 0.21–0.45 is moderate agreement, 0.46–0.75 is substantial agreement, and 0.76–1.0 is almost perfect agreement. Differences in the kappa statistics were assessed using the method described by McKenzie (15) to compare kappas drawn from the same sample.

Intraclass correlations (ICC) between 6th grade and 8th grade were calculated using PROC MIXED and methods described by Fleiss and Shrout (22). Differences between the ICCs were assessed using the method described by Donner and Zou (7) to compare correlations drawn from dependent samples. The odds of being in a specific quintile of MVPA, VPA, and inactivity at 8th grade given assignment in the same quintile at 6th grade, relative to those in any other quintile at 6th grade, were assessed using a logistic mixed model. For the ICC and logistic models field center and school within field center were included as random effects in all models. Covariates tested included race/ethnicity, BMI, percent body fat, SES, age, and intervention assignment (treatment or control). Inclusion of these variables in the models did not improve the fit ($p<0.05$), and none of the estimates changed by more than 8% when the variables were included. Therefore, these potential covariates were not included in the analyses shown here.

RESULTS

Table 1 shows descriptive characteristics of the girls measured in the 6th and 8th grades. The sample was racially diverse (48.2% non-white). The mean time between measurements was 2 years (SD=0.14). On average, body weight, BMI, and percent body fat were higher in 8th than in 6th grade. There was an increase in accelerometer-measured inactivity, while self-reported inactivity was relatively stable. MVPA and VPA tended to decline from 6th to 8th grade for both accelerometer-measured and self-reported activity.

Table 2 presents the sample sizes and ranges of values across quintiles of inactivity, MVPA, and VPA for 6-day accelerometry and self-report. For objectively-measured physical activity the sample sizes within the quintiles were almost identical. The ranges of the measured minutes were much larger in the extreme quintiles (quintiles 1 and 5) than in quintiles 2, 3, or 4. For example, in 6th grade the spans were 124 and 178 minutes respectively in the first and fifth quintiles, whereas the span was only 32 minutes in the middle quintile. The same trends were found in the 3-day means from accelerometry (data not shown).

The distribution of self-reported blocks of inactivity also showed larger spans in the extremes and relatively even numbers of participants within the 5 quintiles. However, for MVPA and VPA ties resulted in an uneven number of girls within quintiles. This was most evident for VPA in 8th grade as 421 girls (44% of the sample) reported no blocks. For this reason, self-reported VPA was analyzed in four, rather than five categories.

Weighted kappa statistics and intraclass correlations for self-report and 3- and 6-day accelerometry are presented in Table 3. For self-report and 3-day accelerometry measures the kappa statistics suggested fair agreement between 6th and 8th grade, while the kappa statistic from 6 days of accelerometry indicated moderate agreement. Kappas ranged from 0.14–0.17 across inactivity, MVPA, and VPA for both self-report and 3-day accelerometry, and from 0.22–0.29 for 6-day accelerometry. Significant differences ($p<0.05$) were observed between kappa statistics produced from self-report and 6-day accelerometry, with the kappas from 6-day accelerometry being higher for inactivity and MVPA. No differences were observed between kappas from self-report and 3-day accelerometry.

For self-report as well as 3- and 6-day accelerometry the highest ICCs were for MVPA (ICC = 0.22, 0.23, and 0.33, respectively), while the lowest ICCs were for inactivity (ICC = 0.17, 0.06, 0.16 respectively). The ICC of inactivity for 3-day accelerometry was significantly lower ($p<0.05$) then that from self-report. ICCs for MVPA and VPA were significantly higher ($p<0.05$) from 6-day accelerometry compared to self-report for MVPA and VPA.

To calculate the odds ratios shown in Table 4, dichotomous variables were created to indicate whether or not a girl's inactivity or activity was in a given category in 6th and 8th grades. These analyses showed that for accelerometry-measured activity and inactivity, the odds of being in the same quintile in both 6th and 8th grade were greatest for those in the extreme quintiles, while the odds of remaining in the middle three quintiles were smaller and generally not significantly different. For example, the odds of being in the highest quintile of inactivity (the most inactive) at 8th grade was greatest for those in quintile 5 at 6th grade (OR [95% CI]=3.26 [2.28, 4.67]) compared to those in any other quintile at 6th grade (quintiles 1–4), while the odds of being in the third quintile of inactivity at 8th grade was no different for those in the third quintile at 6th grade (OR [95% CI]=1.32 [0.90, 1.93]) compared to those in any other quintile at 6th grade (quintiles 1, 2, 4, 5).

The odds ratio for being in a given quintile of self-reported inactivity, MVPA, and VPA in 8th grade given assignment in the same quintile at 6th grade are also presented in table 4. In general these odds ratios were smaller than those from accelerometry, but displayed a similar trend. The odds of remaining in the same quintile in both 6th and 8th grade were greatest for those in the extreme quintiles, while the odds of remaining in any of the middle three quintiles was not significantly different from those in any other quintile at 6th grade.

DISCUSSION

This study showed that over a 2-year period tracking of physical activity and inactivity in middle school girls was fair to moderate depending on the assessment method and the days measured. Six days of accelerometry tended to provide higher tracking measures than three days. When the 3 days measured were matched, tracking assessments were similar whether measured by self-report or accelerometry.

To our knowledge this is the first study to assess the tracking of physical activity and inactivity in middle school girls using accelerometry. Accelerometry generally provides a more accurate and reliable measure of physical activity than self-report (12,24). Earlier results from the TAAG study suggested that the reliability and validity of the 3DPAR decreased with each day of recall compared to accelerometry (27). It might be expected that the greater precision and repeatability associated with accelerometry would lead to higher tracking measures compared to self-report. Nevertheless, our results suggested little difference between tracking measures of MVPA or VPA compared to those from self-report when the measurement days used were matched. Only when physical activity was measured over 6-days did accelerometry produce higher tracking measures than 3DPAR.

The discrepancies in the comparison of 3DPAR to accelerometry from 3-days versus 6-days may be due to the percentage of days measured that were weekend days. It is known that there is greater variability (lower ICCs) in physical activity measurement on weekends versus on weekdays(14,27,28) when assessed by accelerometry. Thus the over-representation of weekend days in our 3-day matched analysis may have resulted in lower tracking. It was interesting that the measured tracking was so similar between self-report and accelerometry in the 3-day matched analysis. This does not mean that self-report and accelerometry quantify physical activity and inactivity levels equally well, but that that the two assessment methods may have similar abilities to evaluate changes in physical activity and inactivity over time. Self-report may provide a good measure of tracking that requires less monetary resources and subject burden compared to accelerometry. Additional work is needed comparing tracking measures of physical activity and inactivity from self-report to accelerometry with varying number of days.

We know of only three studies that have used accelerometry to assess tracking of physical activity in youth. In the Iowa Bone Development Study (9), accelerometers were used to assess tracking of physical activity over a 3-year period in a group of elementary-school aged boys and girls. Spearman rank-order correlation coefficients between baseline and follow-up MPA and VPA were modest (r = 0.32–0.40). Wilkin et al.(30) assessed tracking of physical activity using accelerometry in elementary school aged children over a one-year period. Correlations for daily activity between years were moderate (*r*=0.49 total, *r*=0.36 girls, *r*=0.55 boys, all *P*<0.001). Kelly et al. (11) observed Spearman rank correlations of 0.35–0.37 for total PA, inactivity, and MVPA in a small group of young children (mean age at baseline 3.8 years) over a 2-year period. Raw kappa statistics were 0.17, 0.013, and 0.21 for total PA, sedentary behavior, and MVPA, respectively. All of these studies used the same accelerometer model we used, the data were reduced using alternate methods, and the length of time the monitors were worn varied; however, the conclusions from these studies are similar to ours in that fair-to-moderate tracking of accelerometer measured physical activity and inactivity was found.

Tracking in girls similar in age to those studied here has been examined using self-report measures. Janz and colleagues (10) assessed tracking of vigorous activity and television viewing/video game playing over a five year period in a small group of early adolescent girls (n=62, mean age at baseline=10.3 years). Vigorous activity was assessed using the 3-day Sweat Recall and television viewing/video game playing using an interviewer administered previous day recall. They found strong tracking of vigorous activity with Spearman correlations between year 5 and each of the 4 preceding years ranging from 0.43–0.65. Low tracking was found in TV/video game recall except between years 5 and 4 (Spearman correlation=0.59); Spearman correlations between year 5 and years 1–3 ranged from 0.16–0.26. Thus, similar to our study, Janz et al. found tracking in self-reported activity and inactivity in adolescent girls. Discrepancies in the estimated level of tracking may have been influenced by differences in the measurement intervals and the recall methods used.

Intuitively tracking should increase as the time interval between measures decreases. The 2-year interval examined here is relatively brief. However, early adolescence is a stage in life of particularly great biological, as well as psychosocial changes, which may result in substantial changes in physical activity and inactivity levels. Indeed, Baker et al. (3) have demonstrated that 11-year-old girls who experienced puberty early relative to their peers had lower objectively measured physical activity at age 13 than later maturing girls, even after controlling for differences in physical activity and body composition at age 11. Although we do not have a measure of pubertal status our mean age at baseline was 11.9 years and at follow-up was 13.9 years. Nationally representative data from NHANES III indicated that at age 11.7 approximately 25% of girls had experienced first menstruation, while 2 years later 90% of girls had achieved menarche (5). Differences in the timing and tempo of sexual maturation throughout our 2-year measurement period and changes in activity associated with maturation may have reduced tracking. Additional research is needed focusing on the physiologic, as well as psychosocial and environmental determinants of tracking of physical activity habits in this age group.

The odds of remaining in the same quintile of accelerometry assessed inactivity, MVPA, and VPA over 2 years were higher than being in a different quintile, and this effect was larger and statistically significant at the extremes of the distribution. This effect in the extreme quintiles may be due to the large range of the measured variables in the extreme quintiles compared to the range in the middle three quintiles. On average, a much greater change in minutes or blocks would be needed in order to move from either the lowest or highest quintile at 6^{th} grade into another quintile at 8^{th} grade, while moving from one of the middle quintiles would require a smaller change. Although the size of the odds ratios from self-report tended to be smaller than those from 6-day accelerometry, the trends were similar. The highest odds were seen for those in the extreme quintiles at 6^{th} grade.

Our study had several limitations. The 3DPAR has been validated for the measurement of total physical activity, MVPA, and VPA, but not for inactivity. It should be noted that our use of a 3-day accelerometry measure is not consistent with the current recommended guidelines for accelerometry use in adolescents of 4–9 days in order to obtain a reliable measure of physical activity (28). Another limitation of this study is that comparisons of the 3- and 6-day accelerometry measures were complicated by the mixture of weekdays versus weekend days assessed.

The primary strength of this study was the use of both accelerometry and self-report to quantify the tracking of physical activity and inactivity. Additionally, we used population specific intensity cut points to determine time spent in inactivity, MVPA, and VPA. We used three different statistical methods to quantify tracking, and this allowed us to better understand complexities of the issue. Kappa statistics and ICCs provided global measures of agreement and described agreement over the entire distribution, while the odds ratios allowed us to look within specific portions of the distribution to identify where agreement occurred. The ICC analyzed the activity and inactivity data as continuous variables, whereas the kappas and odds ratios examined data in categories. The ICC and odds ratio analyses tested for influences of demographic characteristics of the participants on tracking. Finally, this study included a larger, more ethnically diverse sample than has been previously reported in the literature for accelerometry measured tracking of physical activity and inactivity.

Our results suggest that physical activity and inactivity habits are dynamic for most girls during early adolescence. Efforts should be made in this age group to promote physical activity and offer alternatives to inactivity to all girls, not just those presently inactive, in order to maintain or increase activity levels in those already active as well as increase activity in those currently inactive. Intervention may be necessary to achieve recommended levels of activity in the most inactive and least active girls, who have a propensity to maintain these health behaviors during early adolescence.

Acknowledgments

We thank the faculty and staff of the 36 schools which participated in the trial. We thank all the investigators and support staff at the various study sites for their tireless efforts in conducting this trial. Finally, we thank all of the girls who participated in the intervention and measurements.

TAAG was funded by grants from the NIH/NHLBI (#U01HL-066845, HL-66852, HL-066853, HL-066855, HL-066856, HL-066857, and HL-066858).

References

1. Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. Med Sci Sports Exerc 2000;32(9 Suppl):S498–504. [PubMed: 10993420]
2. Andersen LB, Haraldsdottir J. Tracking of cardiovascular disease risk factors including maximal oxygen uptake and physical activity from late teenage to adulthood. An 8-year follow-up study. J Intern Med 1993;234(3):309–315. [PubMed: 8354982]
3. Baker BL, Birch LL, Trost SG, Davison KK. Advanced pubertal status at age 11 and lower physical activity in adolescent girls. J Pediatr 2007;151(5):488–493. [PubMed: 17961691]
4. Catellier DJ, Hannan PJ, Murray DM, et al. Imputation of missing data when measuring physical activity by accelerometry. Med Sci Sports Exerc 2005;37(11 Suppl):S555–562. [PubMed: 16294118]
5. Chumlea WC, Schubert CM, Roche AF, et al. Age at menarche and racial comparisons in US girls. Pediatrics 2003;111(1):110–113. [PubMed: 12509562]
6. Cohen J. A coefficient of agreement for nominal scales. Educational and Psychological Measurement 1960;20(1):37–46.
7. Donner A, Zou G. Testing the equality of dependent intraclass correlation coefficents. The Statistician 2002;51(3):367–379.
8. Fortier MD, Katzmarzyk PT, Malina RM, Bouchard C. Seven-year stability of physical activity and musculoskeletal fitness in the Canadian population. Med Sci Sports Exerc 2001;33(11):1905–1911. [PubMed: 11689742]

NIH-PA Author Manuscript
NIH-PA Author Manuscript

9. Janz KF, Burns TL, Levy SM. Tracking of activity and sedentary behaviors in childhood: the Iowa Bone Development Study. Am J Prev Med 2005;29(3):171–178. [PubMed: 16168865]
10. Janz KF, Dawson JD, Mahoney LT. Tracking physical fitness and physical activity from childhood to adolescence: the muscatine study. Med Sci Sports Exerc 2000;32(7):1250–1257. [PubMed: 10912890]
11. Kelly LA, Reilly JJ, Jackson DM, Montgomery C, Grant S, Paton JY. Tracking physical activity and sedentary behavior in young children. Pediatr Exerc Sci 2007;19(1):51–60. [PubMed: 17554157]
12. Loftin M, Nichols J, Going S, et al. Comparison of the validity of anthropometric and bioelectric impedance equations to assess body composition in adolescent girls. Int J Body Compos Res 2007;5 (1):1–8. [PubMed: 18163160]
13. Malina RM. Tracking of physical activity and physical fitness across the lifespan. Res Q Exerc Sport 1996;67(3 Suppl):S48–57. [PubMed: 8902908]
14. Mattocks C, Leary S, Ness A, et al. Intraindividual variation of objectively measured physical activity in children. Med Sci Sports Exerc 2007;39(4):622–629. [PubMed: 17414799]
15. McKenzie DP, Mackinnon AJ, Peladeau N, et al. Comparing correlated kappas by resampling: is one level of agreement significantly different from another? J Psychiatr Res 1996;30(6):483–492. [PubMed: 9023792]
16. McMurray RG, Harrell JS, Bangdiwala SI, Hu J. Tracking of physical activity and aerobic power from childhood through adolescence. Med Sci Sports Exerc 2003;35(11):1914–1922. [PubMed: 14600559]
17. Munoz S, Bangdiwala S. Interpretation of Kappa, and B-statistics measures of agreement. J Appl Stat 1997;24(1):105–111.
18. Murray DM, Stevens J, Hannan PJ, et al. School-level intraclass correlation for physical activity in sixth grade girls. Med Sci Sports Exerc 2006;38(5):926–936. [PubMed: 16672847]
19. Pate RR, Baranowski T, Dowda M, Trost SG. Tracking of physical activity in young children. Med Sci Sports Exerc 1996;28(1):92–96. [PubMed: 8775360]
20. Pate RR, Ross R, Dowda M, Trost SG, Sirard JR. Validation of a 3-day physical activity recall instrument in female youth. Pediatr Exerc Sci 2003;15(3):257–265.
21. Raitakari OT, Porkka KV, Taimela S, Telama R, Rasanen L, Viikari JS. Effects of persistent physical activity and inactivity on coronary risk factors in children and young adults. The Cardiovascular Risk in Young Finns Study. Am J Epidemiol 1994;140(3):195–205. [PubMed: 8030623]
22. Shrout PE, Fleiss JL. Intraclass Correlations: Uses in Assessing Rater Reliability. Psychological Bulletin 1979;86(2):420–428. [PubMed: 18839484]
23. Sirard JR, Pate RR. Physical activity assessment in children and adolescents. Sports Med 2001;31 (6):439–454. [PubMed: 11394563]
24. Sirard JR, Riner WF Jr, McIver KL, Pate RR. Physical activity and active commuting to elementary school. Med Sci Sports Exerc 2005;37(12):2062–2069. [PubMed: 16331130]
25. Stevens J, Murray DM, Catellier DJ, et al. Design of the Trial of Activity in Adolescent Girls (TAAG). Contemp Clin Trials 2005;26(2):223–233. [PubMed: 15837442]
26. Sun SS, Schubert CM, Chumlea WC, et al. National estimates of the timing of sexual maturation and racial differences among US children. Pediatrics 2002;110(5):911–919. [PubMed: 12415029]
27. Treuth MS, Schmitz K, Catellier DJ, et al. Defining accelerometer thresholds for activity intensities in adolescent girls. Med Sci Sports Exerc 2004;36(7):1259–1266. [PubMed: 15235335]
28. Trost SG, McIver KL, Pate RR. Conducting accelerometer-based activity assessments in field-based research. Med Sci Sports Exerc 2005;37(11 Suppl):S531–543. [PubMed: 16294116]
29. Weston AT, Petosa R, Pate RR. Validation of an instrument for measurement of physical activity in youth. Med Sci Sports Exerc 1997;29(1):138–143. [PubMed: 9000167]
30. Wilkin TJ, Mallam KM, Metcalf BS, Jeffery AN, Voss LD. Variation in physical activity lies with the child, not his environment: evidence for an ‘activitystat’ in young children (EarlyBird 16). Int J Obes (Lond) 2006;30(7):1050–1055. [PubMed: 16801942]

Table 1

Descriptive characteristics [mean (SD) or percent] of girls measured at 6th and 8th grade in the TAAG study (n=951).

	6th grade mean (SD) or %	8th grade mean (SD) or %
Age (yrs)	11.9 (0.4)	13.9 (0.4)
Weight (kg)	48.4 (13.8)	58.1 (15.0)
BMI (kg/m^2)	20.7 (4.7)	22.5 (5.2)
% Body Fat	27.8 (9.2)	31.2 (8.3)
Accelerometer (minutes/day)		
Inactivity	460.6 (67.3)	513.2 (62.5)
MVPA	23.4 (11.6)	21.8 (10.7)
VPA	5.6 (4.7)	5.1 (4.0)
Self-report (30-minute blocks/day)		
Inactivity	28.7 (3.4)	28.9 (3.1)
MVPA	1.9 (2.1)	1.5 (1.9)
VPA	1.3 (1.6)	1.0 (1.4)
Race/ethnicity (%)		
White	51.8	-
African-American	19.2	-
Hispanic	19.1	-
Asian/Pacific Islander	4.5	-
Other	5.3	-

Table 2

Range (n) of measured values within each quintile of inactivity, MVPA and VPA for 6-day accelerometry and self-report.

	Quintile 1	2	3	4	5
Accelerometry (minutes/day)					
Inactivity					
6th Grade	282.5–406.6 (191)	406.7–441.2 (190)	441.3–473.4 (190)	473.6–517.7 (190)	518.6–696.8 (190)
8th Grade	309.9–460.0 (191)	461.0–493.7 (190)	493.8–525.0 (190)	525.2–562.9 (190)	563.0–752.1 (190)
MVPA					
6th Grade	2.6–13.9 (191)	13.9–18.8 (190)	18.8–24.2 (190)	24.3–31.6 (190)	31.6–87.8 (190)
8th Grade	2.0–13.2 (191)	13.2–17.4 (190)	17.5–22.2 (190)	22.2–29.4 (190)	29.4–76.3 (190)
VPA					
6th Grade	0.2–2.4 (191)	2.4–3.6 (190)	3.6–5.1 (190)	5.2–8.0 (190)	8.0–49.6 (190)
8th Grade	0.3–2.3 (191)	2.3–3.4 (190)	3.4–4.6 (190)	4.6–7.3 (190)	7.3–31.0 (190)
Self-report (30-min. blocks/day)					
Inactivity					
6th Grade	12.7–26.0 (201)	26.3–28.3 (207)	28.7–30.0 (192)	30.3–31.3 (161)	31.7–36.0 (190)
8th Grade	16.3–26.3 (198)	26.7–28.3 (183)	28.7–30.0 (210)	30.3–31.7 (205)	32.0–36.0 (155)
MVPA					
6th Grade	0.0–0.0 (201)	0.3–0.7 (187)	1.0–1.7 (204)	2.0–3.0 (174)	3.3–15.0 (185)
8th Grade	0.0–0.0 (317)	0.3–0.7 (152)	1.0–1.3 (126)	1.7–2.7 (176)	3.0–15.3 (180)
VPA					
6th Grade	0.0–0.0 (284)	0.3–0.7 (233)	1.0–1.0 (69)	1.3–2.0 (184)	2.3–12.3 (181)
8th Grade*	0.0–0.0* (421)		0.3–0.7 (183)	1.0–1.7 (168)	2.0–12.3 (179)

*Quintiles 1 and 2 combined due to 44% of girls reporting zero blocks of VPA at 8th grade

Table 3

Assessment of tracking of physical activity and inactivity over 2-years comparing the same measure at 6th and 8th grade using weighted kappa statistics and intraclass-correlations (ICC) (95% CI) for self-report and accelerometry.

	Self-Report		Accelerometery			
	Weighted Kappa 3-day	**ICC 3-day**	**Weighted Kappa 3-day**	**ICC 3-day**	**Weighted Kappa 6-day**	**ICC 6-day**
Inactivity	0.14 (0.10, 0.18)	0.17 (0.17, 0.17)	0.13 (0.08, 0.17)	0.06* (0.06, 0.07)	0.26* (0.21, 0.30)	0.16 (0.15, 0.16)
MVPA	0.17 (0.13, 0.22)	0.22 (0.21, 0.22)	0.20 (0.16, 0.24)	0.23 (0.20, 0.25)	0.29* (0.24, 0.33)	0.33* (0.32, 0.33)
VPA	0.17 (0.12, 0.22)	0.17 (0.16, 0.17)	0.17 (0.13, 0.22)	0.19 (0.17, 0.20)	0.22 (0.18, 0.27)	0.25* (0.24, 0.25)

*Different from corresponding self-report statistic ($p < 0.05$).

Table 4

Odds of being in a given quintile* of inactivity, MVPA, and VPA in 8th grade for those in the same quintile at 6th grade, relative to those in any other quintile at 6th grade.

	Odds ratio (95% CI) for 8th grade quintile				
	1	**2**	**3**	**4**	**5**
Accelerometry					
Inactivity	2.86 (2.01, 4.08)	1.89 (1.32, 2.72)	1.32 (0.90, 1.93)	1.58 (1.09, 2.30)	3.26 (2.28, 4.67)
MVPA	3.38 (2.37, 4.83)	1.47 (1.01, 2.14)	1.37 (0.94, 1.99)	1.38 (0.94, 2.01)	3.64 (2.55, 5.20)
VPA	3.59 (2.53, 5.10)	1.22 (0.83, 1.79)	1.39 (0.96, 2.03)	1.22 (0.83, 1.79)	3.45 (2.42, 4.93)
Self-report					
Inactivity	1.84 (1.29, 2.63)	1.01 (0.68, 1.49)	1.12 (0.78, 1.63)	1.56 (1.07, 2.29)	2.44 (1.66, 3.58)
MVPA	1.80 (1.30, 2.47)	1.39 (0.92, 2.09)	1.36 (0.88, 2.09)	1.27 (0.84, 1.89)	2.63 (1.83, 3.79)
VPA	1.74** (1.31, 2.31)		0.90 (0.47, 1.72)	1.33 (0.89, 1.99)	2.23 (1.54, 3.23)

*Logistic mixed models: logit [8th grade quintile] = 6th grade quintile+ (Site + School within Site included as random effects).

**Quintiles 1 and 2 combined due to 44% of girls reporting zero blocks of VPA at 8th grade