Using objective physical activity measures with youth: How many days of monitoring are needed?

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ABSTRACT

TROST, S. G., R. R. PATE, P. S. FREEDSON, J. F. SALLIS, and W. C. TAYLOR. Using objective physical activity measures with youth: How many days of monitoring are needed? *Med. Sci. Sports Exerc.*, Vol. 32, No. 2, pp. 426–431, 2000. **Purpose:** The purpose of this study was to establish the minimal number of days of monitoring required for accelerometers to assess usual physical activity in children. **Methods:** A total of 381 students (189 M, 192 F) wore a CSA 7164 uniaxial accelerometer for seven consecutive days. To examine age-related trends students were grouped as follows: Group I: grades 1–3 ($N = 92$); Group II: grades 4–6 ($N = 98$); Group III: grades 7–9 ($N = 97$); Group IV: grades 10–12 ($N = 94$). Average daily time spent in moderate-to-vigorous physical activity (MVPA) was calculated from minute-by-minute activity counts using the regression equation developed by Freedson et al. (1997). **Results:** Compared with adolescents in grades 7 to 12, children in grades 1 to 6 exhibited less day-to-day variability in MVPA behavior. Spearman-Brown analyses indicated that between 4 and 5 d of monitoring would be necessary to a achieve a reliability of 0.80 in children, and between 8 and 9 d of monitoring would be necessary to achieve a reliability of 0.80 in adolescents. Within all grade levels, the 7-d monitoring protocol produced acceptable estimates of daily participation in MVPA (R = 0.76 (0.71–0.81) to 0.87 (0.84–0.90)). Compared with weekdays, children exhibited significantly higher levels of MVPA on weekends, whereas adolescents exhibited significantly lower levels of MVPA on weekends. Principal components analysis revealed two distinct time components for MVPA during the day for children (early morning, rest of the day), and three distinct time components for MVPA during the day for adolescents (morning, afternoon, early evening). **Conclusions:** These results indicate that a 7-d monitoring protocol provides reliable estimates of usual physical activity behavior in children and adolescents and accounts for potentially important differences in weekend versus weekday activity behavior as well as differences in activity patterns within a given day. **Key Words:** CHILDREN, EXERCISE, ASSESSMENT, ACCELEROMETER

Developing accurate and reliable tools for quantifying physical activity behavior in children and adolescents continues to be a research priority (2,6,15). Precise measures of habitual physical activity are a necessity in studies designed to: 1) document the frequency and distribution of physical activity in defined population groups, 2) determine the amount or dose of physical activity required to influence specific health parameters, 3) identify the psychosocial and environmental factors that influence physical activity behavior in youth, and 4) evaluate the effectiveness of programs to increase habitual physical activity in youth (2,11,20).

A wide range of methods have been used to quantify youth physical activity behavior. These methods include subjective measures such as child and parent self-reports and objective measures such as direct observation, heart rate monitoring, motion sensors, and doubly-labeled water (2,11,17). Historically, because of their low cost and ease of administration, investigators conducting field-based research have used self-report methods to assess physical activity (19). However, because many children and adolescents have difficulty recalling their past activity behavior (3,17), objective measures such as heart rate monitors and motion sensors are being used with increasing regularity. Objective measures with real time data storage capabilities offer a distinct advantage over self-report methods in that they provide reliable information on patterns of physical activity within a given day or over several days.

Over the last decade or so, many investigations have evaluated the validity of objective monitoring devices in children and adolescents. Collectively, the results of these studies support the conclusion that objective measures such as heart rate monitors and accelerometers are useful tools for quantifying physical activity behavior in children and

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adolescents (8,11,17). However, some of the major methodological questions related to the use of objective monitoring devices in field-based research have not been adequately studied. These include: 1) How many days of monitoring are required to characterize an individual's usual physical activity behavior? 2) Should differences in weekday versus weekend physical activity be considered when assessing usual physical activity behavior in youth? 3) Are physical activity patterns during specific time periods representative of the entire day's physical activity pattern ? To fill this gap in the research literature, the current study addressed these important questions in a population-based sample of 381 public school students from Amherst, Massachusetts. Answers to these questions can guide the development of measurement protocols in field-based studies that are needed to investigate high priority issues related to youth physical activity (2,15,20).

METHODS

Subjects

Data for this study were collected as part of the Amherst Health and Activity Study, a cross-sectional observational study examining age and gender differences in objectively measured physical activity and the psychosocial and environmental determinants of physical activity. Subjects were recruited from seven elementary schools, one junior high, and one senior high school in Amherst, Massachusetts. All 3,648 students enrolled in physical education were provided with a packet containing study information, an informed consent document, and a parental questionnaire. Of this number, 1,379 or approximately 38%, returned a signed informed consent and a questionnaire completed by their parent or guardian. To ensure that only one parental questionnaire was completed per household, surveys completed for additional siblings were excluded from the analyses ($N = 269$). The final sample consisted of 1,110 students (51.4% female, 75.1% white).

To examine potential age-related differences, participants were categorized into four age groups. Group I consisted of students in grades 1–3 ($N = 261$), Group II consisted of students in grades 4–6 ($N = 291$), Group III consisted of students in grades 7–9 ($N = 332$), and group IV consisted of students in grades 10–12 ($N = 226$). Participation rates within each age group ranged from 36.6% to 40.3%.

Participants for the activity monitoring portion of the study were identified by randomly selecting 100 students from each of the age groups listed above. For each student selected, a telephone call was made to his or her primary guardian to obtain consent to participate in the monitoring study. If consent was not given, an additional student was randomly selected from the appropriate age group category as a replacement. Only four students were not given permission to participate in the monitoring study. Following deletions for monitor failure ($N = 14$), monitor loss ($N = 1$), or incomplete monitoring data ($N = 4$), the final sample consisted of 381 students. The descriptive characteristics of the questionnaire sample and the activity monitoring sample are shown in Table 1.

CSA Instrumentation

Objective assessments of physical activity behavior over seven consecutive days were obtained using the Computer Science and Applications Inc. (CSA) 7164 activity monitor (Shalimar, FL) (5). Briefly, the CSA 7164 is a uniaxial accelerometer designed to detect vertical acceleration ranging in magnitude from 0.05 to 2.00 G with frequency response of 0.25 to 2.50 Hz. These parameters allow for the detection of normal human motion and will reject high frequency vibrations encountered in activities such as operation of a lawn mower. The filtered acceleration signal is digitized and the magnitude is summed over a user-specified time interval. At the end of each interval, the summed value or activity "count" is stored in memory and the integrator is reset. For the current study, a 1-min time interval was used. Trost et al. (23) recently assessed the validity and inter-instrument reliability of the CSA 7164 activity monitor in children aged 10–14. Consistent with the results of studies evaluating earlier CSA models (13), activity counts were strongly correlated with energy expenditure during treadmill walking and running (Pearson $r = 0.86$). The intraclass correlation for two CSA 7164 monitors worn simultaneously was 0.87, indicating a strong degree of inter-instrument reliability.

Procedure

Timeline. The activity monitoring portion of the study was performed in two waves. The first wave of monitoring ($N = 273$) took place during the fall of 1996, beginning in late October and ending in mid-December. The second wave ($N = 108$) took place during the spring of 1997 (April). One-way analysis of variance revealed no significant differences between the two waves with respect to either weekday ($F_{1,379} = 0.54$, $P = 0.46$) or weekend ($F_{1,379} = 0.12$,

TABLE 1. Demographic characteristics of the questionnaire sample and the monitoring subsample.

Variable	Total Sample ($N = 1110$)	Monitoring Sample ($N = 381$)
Group I (grades 1–3)		
N	261	92
% female	49.8	52.2
% white	70.2	63.0
Mean age	7.1 ± 0.9 yr	7.2 ± 1.4 yr
Group II (grades 4–6)		
N	291	98
% female	47.6	46.9
% white	73.9	68.3
Mean age	10.1 ± 0.9 yr	10.4 ± 1.0 yr
Group III (grades 7–9)		
N	332	97
% female	50.9	49.5
% white	81.5	84.5
Mean age	12.9 ± 0.9 yr	12.9 ± 0.9 yr
Group IV (grades 10–12)		
N	226	94
% female	59.1	53.2
% white	73.0	72.3
Mean age	15.6 ± 0.9 yr	15.8 ± 1.1 yr

$P = 0.72$) moderate-to-vigorous physical activity. Thus, data from the two waves were pooled. Within each measurement wave, activity monitors were distributed evenly across age and gender groups.

Protocol. Before monitoring, families were contacted by phone to confirm the date and time the activity monitor would be distributed at school. For students attending elementary school (Groups I and II), activity monitors were attached either at the beginning of the school day or during lunch. Junior and senior high school students (Groups III and IV) received their monitors at the beginning of their physical education class. Students were instructed to wear the CSA during the waking hours for seven consecutive days. Consistent with previous studies, monitors were attached to adjustable elastic belts and worn over the right hip. At the time of distribution, students were given a 7-d log sheet to record the time the monitor was worn and to provide information about any physical activity performed while the monitor was not worn (e.g., swimming). One to two days before monitor collection, the participants' families were contacted by phone to remind them of the date and time the monitor would be collected. After collection, stored activity counts were downloaded and saved to a IBM compatible computer for subsequent data reduction and analysis.

Data Reduction

Minute-by-minute activity counts were uploaded to a QBASIC data reduction program written by the primary author for determination of time spent in moderate (3–5.9 MET), vigorous (6–8.9 MET), and very vigorous physical activity (≥9 MET) during each 60-min segment of the 7-d monitoring period. The age-specific count ranges corresponding to the intensity levels were derived from the energy expenditure prediction equation developed by Freedson et al. (9). This equation accounted for 90% of the variance in observed MET levels and predicted energy expenditure during treadmill running and walking within ± 1.1 MET. Daily totals for the physical activity variables were calculated by summing the values from the 24, 60-min time blocks comprising each day. Daily time spent in MVPA (≥3 MET) was calculated by summing the minutes of moderate, vigorous, and very vigorous minutes for each day. The assumptions underlying these calculations were: 1) that students wore the activity monitors during the entire waking period, and 2) that the "0's" recorded by the CSA during the nonmonitored period (nonwaking hours) were indicative of sleeping. Means ± SD for the number of hours the CSA monitors were worn each day are shown in Table 2. Consistent with the expected sleeping habits of children and adolescents, the average monitoring time increased with age and did not differ between males and females. Monitoring time ranged from 12.3 ± 1.0 h in group I females to 14.6 ± 1.0 h in group IV males.

TABLE 2. Descriptive statistics (Mean ± SD) for the number of hours the CSA monitor was worn each day by age group and gender.

Age Group	Overall	Male	Female
Group I (grades 1–3)	12.4 ± 1.1	12.6 ± 1.2	12.3 ± 1.0
Group II (grades 4–6)	13.3 ± 1.1	13.4 ± 0.9	13.2 ± 1.2
Group III (grades 7–9)	13.4 ± 1.4	13.4 ± 1.0	13.3 ± 1.9
Group IV (grades 10–12)	14.3 ± 1.4	14.6 ± 1.0	13.9 ± 1.7

TABLE 3. Intraclass reliability coefficients and 95% CI based on 7 d of activity monitoring.

	Intraclass Reliability Coefficients and 95% CI			Days of Monitoring Required to Achieve Reliabilities of		
	1 Day	4 Days	7 Days	0.70	0.80	0.90
Group I	0.46 (0.34, 0.57)	0.77 (0.73, 0.82)	0.86 (0.82, 0.89)	2.7	4.7	10.6
Group II	0.49 (0.39, 0.59)	0.79 (0.75, 0.83)	0.87 (0.84, 0.90)	2.4	4.2	9.4
Group III	0.33 (0.19, 0.46)	0.66 (0.59, 0.73)	0.77 (0.72, 0.82)	4.8	8.3	18.6
Group IV	0.31 (0.17, 0.45)	0.64 (0.57, 0.72)	0.76 (0.71, 0.81)	5.1	8.8	19.8

Statistical Analyses

Between-day intraclass reliability coefficients (R) and 95% confidence intervals (CI) were calculated using repeated measures analysis of variance (ANOVA) (4). The required days of monitoring needed to achieve reliabilities of 0.70, 0.80, and 0.90, respectively, were calculated using the Spearman-Brown prophecy formula (22). Hypothesized differences between weekday and weekend MVPA across age and gender groups were tested using a three-way (age group × gender × time) repeated measures ANOVA. To determine whether specific time periods during the day were representative of the entire day's physical activity pattern, MVPA totals from each 60-min time block between 7:00 a.m. and 9:00 p.m. were subjected to a principal components analysis with varimax (orthogonal) rotation. For these analyses, monitoring data collected on a Wednesday and Saturday served as indicators of weekday and weekend physical activity. To ensure sufficient sample size for the principal component analysis ($N > 100$) (12), subjects were classified as either children (Groups I and II) or adolescents (Groups III and IV). For all analyses, statistical significance was set at an alpha level of $P \leq 0.05$.

RESULTS

Reliability Coefficients

Intraclass reliability coefficients and 95% CI for mean daily MVPA scores derived from 1, 4, and 7 d of monitoring are shown in Table 3. The reliability coefficients exhibited a clear age-related trend, with higher reliability coefficients observed among students in groups I and II than students in groups III and IV. Overall, the reliability of MVPA scores derived from a single day of monitoring was low, ranging from 0.31 among group IV students to 0.49 among group II students. In contrast, the reliability of daily MVPA scores derived from 7 d of monitoring was acceptable (≥0.70) (16), ranging from 0.76 among group IV students to 0.87 among group II students. The Spearman-Brown analysis indicated that for children (grades 1 to 6), between 2 and 3 d of monitoring are required to achieve a reliability of 0.70

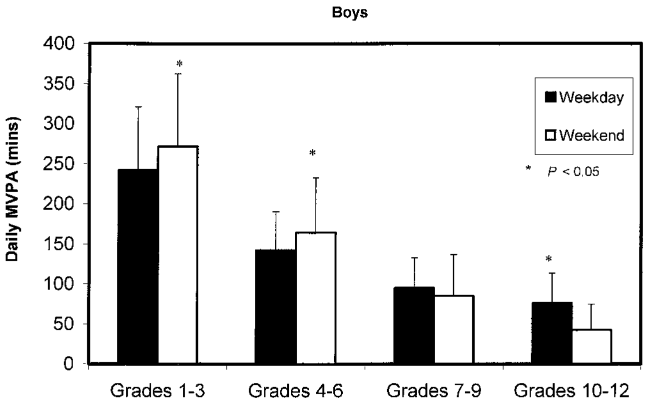

Figure 1—Weekend versus weekday moderate-to-vigorous physical activity in boys.

and between 4 and 5 d of monitoring are required to achieve a reliability of 0.80. Between 9 and 11 d of monitoring are required to achieve a reliability of 0.90. Among adolescents (grades 7 to 12), between 4 and 5 d of monitoring are required to achieve a reliability of 0.70 and between 8 and 9 d of monitoring are required to achieve a reliability of 0.80. Between 18 and 20 d of monitoring are required to achieve a reliability of 0.90.

Weekday Versus Weekend MVPA

Participation in MVPA averaged over Monday to Friday (Weekday) and Saturday and Sunday (Weekend) are shown in Figures 1 and 2 for boys and girls, respectively. Compared with weekdays, girls in group I exhibited significantly greater MVPA scores on the weekend, while girls in group II exhibited similar amounts of MVPA on weekends relative to weekdays. Girls in groups III and IV exhibited significantly lower amounts of MVPA on weekends relative to weekdays. Compared with weekdays, boys in groups I and II exhibited significantly greater MVPA on the weekend, whereas boys in group IV exhibited significantly less MVPA on the weekends. Boys in group III reported similar amounts of MVPA on weekends and weekdays.

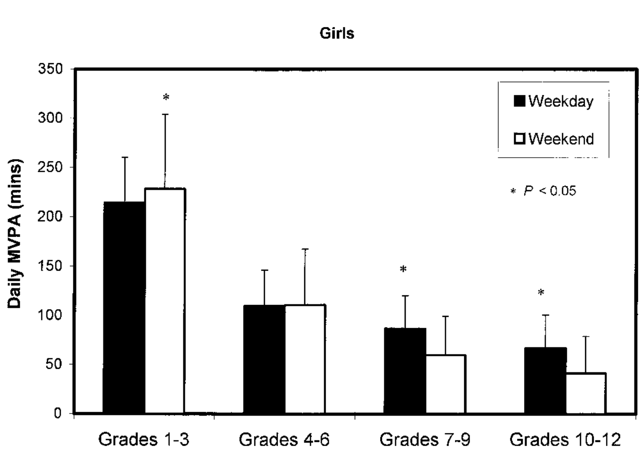

Figure 2—Weekend versus weekday moderate-to-vigorous physical activity in girls.

TABLE 4. Weekday hourly MVPA scores (mean ± SD) and principal components analysis for Group I and II students.

Time Periods	Mean ± SD (min)	Factor 1	Factor 2
7:00–7:59 a.m.	10.2 ± 12.5	−0.14	0.78
8:00–8:59	13.6 ± 10.9	0.08	0.82
9:00–9:59	9.8 ± 12.2	−0.07	0.82
10:00–10:59	9.0 ± 9.0	0.23	0.42
11:00–11:59	10.8 ± 10.0	0.45	0.23
12:00–12:59 p.m.	12.2 ± 12.5	0.67	0.21
1:00–1:59	11.4 ± 11.0	0.78	0.06
2:00–2:59	11.3 ± 14.3	0.79	0.03
3:00–3:59	10.2 ± 12.9	0.78	−0.03
4:00–4:59	12.2 ± 15.3	0.83	−0.02
5:00–5:59	9.2 ± 11.9	0.83	0.05
6:00–6:59	10.3 ± 12.7	0.80	0.06
7:00–7:59	9.7 ± 12.0	0.77	0.08
8:00–8:59	6.0 ± 8.8	0.56	−0.03

Principal Components Analyses

The results of the principal components analyses are displayed in Tables 4 through 7. On both weekdays and weekends, children's participation in MVPA exhibited two distinct components during the day. On weekdays these components were 11:00 a.m. to 8:59 p.m. (component 1) and 7:00 a.m. to 10:59 a.m. (component 2) (Table 4), while on weekends the components were 10:00 a.m. to 8:59 p.m. (component 1) and 7:00 a.m. to 9:59 a.m. (component 2) (Table 5). In contrast, adolescents' weekday and weekend participation in MVPA exhibited three distinct time components throughout the day. On weekdays these components were 12:00 p.m. to 4:59 p.m. (component 1), 5:00 p.m. to 8:59 p.m. (component 2) and 7:00 a.m. to 11:59 a.m. (component 3) (Table 6), while on weekends the components were 5:00 p.m. to 8:59 p.m. (component 1), 8:00 a.m. to 11:59 a.m. (component 2), and 12:00 p.m. to 4:59 p.m. (component 3) (Table 7). These results suggest that, within each time component, students' participation in MVPA was consistent, yet distinct from other time segments.

DISCUSSION

No previous study has examined age-related differences in the reliability of objectively measured physical activity. Our results indicated that, compared with adolescents in grades 7 to 12, children in grades 1 to 6 exhibit less day-to-day variability in their moderate-to-vigorous physical

TABLE 5. Weekend hourly MVPA scores (Mean ± SD) and principal components analysis for Group I and II students.

Time Periods	Mean ± SD (min)	Factor 1	Factor 2
7:00–7:59 a.m.	6.0 ± 10.6	−0.40	0.73
8:00–8:59	9.3 ± 12.2	−0.10	0.88
9:00–9:59	12.6 ± 13.1	0.34	0.77
10:00–10:59	14.4 ± 13.7	0.55	0.32
11:00–11:59	15.6 ± 13.3	0.67	0.13
12:00–12:59 p.m.	15.0 ± 13.2	0.70	0.12
1:00–1:59	15.6 ± 14.1	0.71	0.07
2:00–2:59	15.7 ± 15.0	0.69	−0.05
3:00–3:59	13.5 ± 13.8	0.71	−0.11
4:00–4:59	13.9 ± 13.8	0.72	−0.08
5:00–5:59	11.9 ± 12.0	0.77	0.01
6:00–6:59	10.2 ± 11.1	0.76	−0.02
7:00–7:59	9.9 ± 11.5	0.75	0.00
8:00–8:59	7.8 ± 10.6	0.64	−0.10

TABLE 6. Weekday hourly MVPA scores (Mean ± SD) and principal components analysis for Group III and IV students.

Time Periods	Mean ± SD (min)	Factor 1	Factor 2	Factor 3
7:00–7:59 a.m.	5.9 ± 5.4	0.21	−0.11	0.56
8:00–8:59	4.8 ± 6.6	0.03	0.16	0.60
9:00–9:59	4.2 ± 5.6	−0.12	0.03	0.73
10:00–10:59	4.5 ± 4.3	0.16	0.05	0.66
11:00–11:59	4.9 ± 6.2	0.13	0.09	0.48
12:00–12:59 p.m.	5.9 ± 6.9	0.58	−0.09	0.31
1:00–1:59	5.0 ± 5.3	0.74	−0.14	0.14
2:00–2:59	9.0 ± 8.1	0.61	0.14	0.20
3:00–3:59	7.3 ± 10.1	0.67	0.22	−0.06
4:00–4:59	7.4 ± 11.3	0.69	0.28	−0.01
5:00–5:59	6.0 ± 9.3	0.36	0.62	0.05
6:00–6:59	5.6 ± 9.3	0.21	0.68	0.16
7:00–7:59	4.0 ± 7.5	−0.02	0.80	0.01
8:00–8:59	3.5 ± 7.6	−0.02	0.71	0.05

activity behavior. Among children in groups I and II, the single-day reliability ranged from 0.46 to 0.49. In comparison, the single-day reliability associated with one day of monitoring among group III and IV students was noticeably lower, ranging from 0.31 to 0.33. At these levels of variability, it was estimated that between 4 and 5 d of monitoring would be necessary to achieve a reliability of 0.80 in children, and between 8 and 9 d of monitoring would be necessary to achieve a reliability of 0.80 in adolescents. Importantly, within all grade levels, the 7-d monitoring protocol produced acceptable estimates of daily participation in MVPA, with 7-d reliability coefficients ranging from 0.76 to 0.86.

Present reliabilities are in agreement with the results of previous studies employing objective measures of physical activity in free-living children and adolescents. Janz et al. (14), utilizing an earlier CSA model (5032), examined the between-day reliability of objectively measured physical activity in children aged 7–15 yr. The intraclass reliability coefficient for 4-d of monitoring ranged from 0.75 to 0.78, while 6-d reliability coefficients ranged from 0.81 to 0.84. DuRant et al. (7) assessed the between-day reliability of heart rate monitoring in children aged 3 to 5 yr. In agreement with the current study, the single measurement reliability of the heart rate indices ranged from 0.48 to 0.49, indicating that just over 4 d of monitoring was required to estimate an individual's daily heart rate with a reliability of 0.80. Although comparisons across study populations and modes of activity monitoring should be made with caution, the convergence of findings with respect to between-day reliability coefficients suggests that between 4 to 7 d of objective monitoring are required to estimate reliably daily physical activity in children and adolescents. Our observation that young children exhibit less day-to-day variability in their daily physical activity behavior than adolescent youth should be replicated in other samples.

TABLE 7. Weekend hourly MVPA scores (Mean ± SD) and principal components analysis for Group III and IV students.

Time Periods	Mean ± SD (min)	Factor 1	Factor 2	Factor 3
7:00–7:59 a.m.	1.1 ± 4.1	−0.12	0.31	−0.05
8:00–8:59	1.3 ± 4.1	−0.08	0.61	0.04
9:00–9:59	2.3 ± 5.2	0.03	0.79	0.08
10:00–10:59	3.2 ± 6.7	0.03	0.83	0.05
11:00–11:59	4.1 ± 7.1	0.00	0.79	0.29
12:00–12:59 p.m.	4.1 ± 6.7	−0.01	0.18	0.54
1:00–1:59	5.5 ± 8.5	−0.07	0.13	0.72
2:00–2:59	5.9 ± 8.8	0.07	0.01	0.73
3:00–3:59	5.9 ± 9.8	0.09	0.03	0.77
4:00–4:59	4.5 ± 6.8	0.21	−0.08	0.63
5:00–5:59	4.1 ± 7.3	0.82	−0.04	0.08
6:00–6:59	3.6 ± 6.8	0.81	−0.06	−0.02
7:00–7:59	4.0 ± 8.0	0.70	−0.06	0.15
8:00–8:59	2.7 ± 6.3	0.82	−0.04	0.04

A number of studies using objective measures of physical activity in youth have documented marked differences in weekday and weekend physical activity behavior (1,10,21) leading to recommendations to measure both types of days (19). In the current study we observed several important differences in weekday and weekend MVPA. First, in agreement with descriptive studies using self-report methods (18), physical activity on both weekdays and weekends declined considerably with age and was consistently higher in boys than girls. Second, in contrast with younger children who exhibited significantly higher levels of MVPA on weekends, adolescent youth exhibited significantly lower levels of MVPA on weekends relative to weekdays. Of note, the transition from higher to lower MVPA on weekends occurred earlier among girls than boys. From a methodological standpoint, our findings strongly support the need to include weekend days when employing objective measures of physical activity in children and adolescents. From a public health perspective, our findings with respect to adolescents suggest that weekend leisure time may be an appropriate target for physical activity intervention programs. Importantly, the observed differences in weekday and weekend MVPA may have been, in part, attributable to age-group differences in the amount of time spent sleeping on weekends or time spent outdoors.

The minimum amount of time children need to wear an activity monitor on a daily basis has important implications for subject compliance and overall study costs. Thus, one goal of this study was to examine whether specific time periods during the day were representative of an entire day's physical activity behavior. Results from the principal components analysis revealed two distinct time components for children and three distinct time components for adolescents. These findings indicated that, within each time component, students' participation in MVPA remained consistent, yet distinct from other times during the day. Thus, if students in grades 3 to 6 only wore an activity monitor between the hours of 7 a.m. and 11 a.m. the recorded data may not be representative of physical activity behavior during other parts of the day. These results partially replicate those of DuRant et al. (7) who found young children's heart rate patterns to exhibit three distinct time components during the day: morning (7:00 a.m.-11:59 a.m.), early afternoon (12:00 p.m.-2:59 p.m.), and late afternoon (3:00 p.m.-6:59 p.m.). Consequently, it appears necessary to monitor for an entire day or sample from multiple times of the day when objectively quantifying physical activity behavior in youth.

In summary, the results of this study indicate that objective monitoring devices such as the CSA 7164 are feasible for use in population-based field studies involving children and adolescents. For all grade levels, between-day intraclass reliability coefficients for the 7-d monitoring period were found to be in the acceptable range (R = 0.76–0.87). Depending on age, between 3 and 5 d of monitoring are required to achieve a reliability of 0.70, whereas between 5 and 9 d of monitoring are required to achieve a reliability of 0.80. Consistent with previous research recommendations, it is important that monitoring be performed either continuously or intermittently over an entire day and that both weekdays and weekend days be included in the monitoring period. These results give empirical guidance to investigators planning to use accelerometers in studies of children and adolescents.

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