

Research article

## Study of day, month and season pedometer-determined variability of physical activity of high school pupils in the Czech Republic

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### Abstract

Long-term day-to-day monitoring of physical activity (PA) has not been undertaken in adolescents despite PA declines rapidly during adolescence. This study monitored the school year-round pedometer-determined PA of pupils attending high school in the Czech Republic. We assessed their PA levels; appraised the school year-round variability of their PA; and, assessed the associations between their PA levels and weekdays/weekends; months; seasons; and physical education (PE) lessons at school. We observed the PA levels of 10 girls and 2 boys (aged 16.0 ± 0.7 years). Each pupil wore an unsealed pedometer (Omron HJ-105) on the right side of the waist continuously for one year, and recorded steps/day and daily behaviour (e.g. after-school PA, PE lesson) into an activity diary. In total, participants recorded step counts for 2,979 person-days (82.0% of a possible 3,628 person-days). We used the Missing Values Analysis EM function of SPSS to estimate step values that were missing from the dataset. The sample's mean daily step count was 14,727 ± 6,612 steps/day, and repeated ANOVA showed differences in steps/day across the days of the week ( $p < 0.0001$ ), months ( $p < 0.0001$ ) and seasons ( $p < 0.0001$ ). The mean number of steps/day for weekdays (15,733 ± 6,354) was higher ( $p < 0.0001$ ) than weekends values (12,196 ± 6,574), and was higher for days with PE lesson (17,280 ± 5,988) than for days without PE lesson (15,569 ± 6,318) ( $p < 0.0001$ ). The total contribution of PE class (90 minutes) to pupils' daily PA was 10.0% additional steps per PE day. In conclusion, this study contributes to understanding the day-to-day PA variability of adolescent pupils across the school year. Across all months and seasons, pupils achieved notably more steps on weekdays than on weekends; and on PE days than on non-PE days. Research is required to assess these findings for school pupils in other countries.

**Key words:** Day-to-day variability; physical education; adolescents; school year; pedometer.

### Introduction

Although the importance of physical activity (PA) in enhancing the health of adults, children and youth is well documented (US Department of Health and Human Services, 2008), the fluctuations of day-to-day PA levels are less understood. Levels of PA may fluctuate by season, month, day of week (weekdays/weekends), type of day (workdays/non-workdays), and by sport/exercise participation (Tudor-Locke et al., 2004). However, such long-term variability of day-to-day PA behavior has been examined only in adults (Tudor-Locke et al., 2004). The published literature suggested a clear gap in that the long-term day-to-day monitoring of PA has not been attempted

for adolescents, despite that PA declines rapidly during childhood and adolescence (Allison et al., 2007). The study described in this paper addresses this gap in knowledge: we undertook long-term day-to-day monitoring of PA in a sample of adolescents.

This lack of long-term studies that monitor adolescents' PA could be due to the many factors including the relationships between PE and PA (Flohr et al., 2006), the differences in PA levels accomplished on weekends and weekdays (Peiró-Velert et al., 2008), the seasonal variations in habitual PA (Loucaides et al., 2004), as well as methodological considerations e.g. how PA was measured, and length (time duration) of the monitoring frame (Welk et al., 2000). All these factors need to be simultaneously considered in order to understand the wider picture of the variability in PA.

**Relationships between PE and PA:** few studies have examined the relationships between PA and PE programmes (Flohr et al., 2006; Morgan et al., 2007; Tudor-Locke et al., 2006). Research has shown associations between the number of times/week that youth participated in PE and self-reported moderate to vigorous PA (Gordon-Larsen et al., 2000; Morgan et al., 2007; Mota et al., 2008; Myers et al., 1996). It has been suggested that the overall daily PA in children and youth might increase due to regular participation in PE lessons at school (Fairclough and Stratton, 2005a; Fairclough and Stratton, 2005b). Indeed there were differences in children's PA levels in days with and days without a PE lesson in the U.S.A. (Jago et al., 2005; Morgan et al., 2007; Tudor-Locke et al., 2006), in Portugal (Mota et al., 2008), and in Spain (Peiró-Velert et al., 2008). Given that PA guidelines for schools and adolescent pupils are now in place (The President's Council for Physical Fitness and Sport, 2001; US Department of Health and Human Services, 2000), PE in schools is critical for the delivery of such guidelines (Fairclough and Stratton, 2005a; Fairclough and Stratton, 2005b; McKenzie et al., 2006). On average, grades 6 and 7 pupils can add 1,455 and 2,046 steps respectively in one 45-50 minute good quality PE lesson (Flohr et al., 2006; Tudor-Locke et al., 2006). Hence, the study described in this paper monitored children's PA in relation to PE lessons.

**Weekends versus weekdays:** Less consideration has been paid to the variability of PA across the days of the week, although fluctuations of PA levels by day of the week have been noted (Jago et al., 2005; Peiró-Velert et al., 2008). Spanish adolescents (12-16 years) were less active on weekdays than during weekends (Peiró-Velert et

al., 2008). Conversely, in girls (5–16 years) in New Zealand, mean weekday step counts were  $\approx 30\%$  higher and showed less variability than mean weekend steps (Duncan et al., 2008b). Similarly, a year-round study of adult PA (Tudor-Locke et al., 2004) reported more steps achieved on weekdays than on weekends. When PA was monitored by heart rate monitor, schoolchildren and teenagers were less active during free days than during school days (Garvarty et al., 2003).

**Seasonal variations in habitual PA:** Daily PA is influenced by exogenous factors (Togo et al., 2005), where short day length and extremes of ambient temperature could hinder regular participation in outdoor PA (Center for Disease Control and Prevention, 1997). Few studies have explored how PA fluctuates across the seasons of the year. As ambient temperature/rainfall affected the daily step counts in children aged 5–12 years, it needed to be considered when comparing PA across different time periods of the year (Duncan et al., 2008b). Duncan et al. (2008b) found out the association between  $10^\circ\text{C}$  rise in mean ambient temperature and increase in weekday steps and weekend/day steps in boys, and between moderate rainfall and substantial decreases in weekday and weekend/day steps in both sexes. Thus, the effects associated with the seasonal variations are important. For instance, Pivarnik et al., (2003) found that adult weekly leisure-time energy expenditure was  $\approx 15\text{--}20\%$  higher during spring and summer. Similarly, primary school children achieved less mean total daily steps counts in winter than in summer (Loucaides et al., 2004).

**How PA was measured:** Studies have frequently assessed PA subjectively via self-reported questionnaires (Currie et al., 2004; Lasheras et al., 2001; Prochazka et al., 2001). The usefulness of such questionnaires seems subject to the age group for whom PA was being measured (Harris et al., 2009; Jørstad-Stein et al., 2005; Tudor-Locke and Myers, 2001). In children aged 8–14 years, PA questionnaires could be an alternative to objective PA measurement (Stockton et al., 2009), with acceptable reliability and validity (Wong et al., 2006). However, this seems true for short periods of recall (e.g. 7 day recall). Generally in children, objective measures are usually preferred (Welk et al., 2000). Hence the current study objectively monitored the variability of PA in adolescents.

**Length of monitoring frame – the duration of objectively measured PA levels:** Where PA was assessed objectively (e.g. using pedometers and/or accelerometers), it was usually measured for short periods (e.g. for 5 days, 2 weeks or 3 months) (Duncan et al., 2006; Flohr et al., 2006; Schofield et al., 2005). Few studies have analysed the natural variability of PA across substantially longer periods of time. E.g., Tudor-Locke et al. (2004) assessed one year of continuous self-monitored pedometer data for 23 adults.

We simultaneously examined all the above factors that the literature suggested could be associated with the variability of PA in the high school period. The aim of the current research was to continuously monitor the PA of young adolescent pupils (15 years old) for an extended period of time (1 year) using an objective motion sensor measure (pedometer). The two specific objectives were to:

- collect one school-year pedometer monitored PA data from high school pupils and assess their PA levels; and,
- appraise the variability of PA levels of these pupils and, its associations with weekdays/weekends; months; seasons; and the provision of PE lessons at school.

## Methods

### Participants

This study was approved by Palacky University, Czech Republic. The school where the study was implemented was selected on the basis of a previous successful collaboration with its PE teacher, who appreciated the pedometer-determined data of pupils. During the school year of the monitoring, the PE teacher agreed to provide the pedometer service (e.g. battery change), in addition to the supervision of the pupils and their motivation. Pupils were informed about the study aims. The inclusion criteria were that participants were ambulatory and willing to self-monitor their PA behaviour for 1 school year (Tudor-Locke et al., 2004). All participating pupils and their parents provided written consent; participants received no incentives, and could withdraw from the study if they wished.

About 60 pupils attending first grade classes (two classes, mean pupil age  $16.0 \pm 0.7$  years) of the high school in Olomouc city (Moravia region, Czech Republic) were approached by word of mouth (by the researcher) at the beginning of each monitored year. Of the 120 pupils approached, 29 actually agreed to participate and started with the monitoring. Sixteen pupils dropped out of the study: some did not wish to complete the one-year monitoring (11 pupils dropped out within 1–2 months of the beginning of the monitoring); and another 5 pupils did not appear to have worn their pedometers regularly (several breaks in the continuity of the pedometer data, each of a duration of  $> 1$  week). In comparison with girls, boys were more likely to drop out of the study. Thus, data only from 13 pupils who completed the pedometer monitoring across the complete duration of the school year were available. One of the 13 participants (a girl) who completed the monitoring had a high mean steps per day during the whole monitored school year (27,772), and hence her data was also excluded from the current analysis as it was felt that such an outlier could bias the results. Complete data were obtained from 12 pupils – 10 girls and 2 boys, aged  $16.0 \pm 0.7$  years, and with BMI  $22.16 \pm 2.41 \text{ kg}\cdot\text{m}^{-2}$  (data from the beginning of the research).

### Measures and procedures

Each pupil was provided with and wore an unsealed pedometer (Omron HJ-105) firmly on the right side of the waist continuously for one year. At walking speeds of  $\geq 80 \text{ m}\cdot\text{min}^{-1}$ , the Omron pedometer generates mean step values that are within  $\pm 1\%$  of the actual steps undertaken (Crouter et al, 2003). However in free-living PA, pedometers might overestimate the steps/day (Schneider et al, 2004). Participants wore the belt constantly excluding sleeping, hygiene and bathing for the minimum of 10

hours a day. In addition, pupils recorded the steps/day from the pedometer, and their daily behavior (physical activity, inactivity, type and duration of any sport/exercise) into a special diary (activity calendar). As pupils' PA could differ on schooldays when PE lessons were provided in comparison to schooldays without PE (Morgan et al., 2007), we obtained (from the classroom teacher) information about the days when the school provided compulsory PE lessons. All participants regularly attended the weekly 90-minute PE lesson that was delivered without a break.

We employed the same methodology to monitor the 12 pupils over two school years. Eight pupils were monitored for 12 months (16 November 2005 – 15 November 2006); and another 4 pupils for 12 months (16 November 2007 – 15 November 2008). However, due to missing pedometer values for the months of July and August (summer holidays), we analyzed only 10 months of each of the two school years. In summer (July/August) there is no school attendance; pupils change their activity levels due to the holidays; and data for these two summer months were missing as pupils were not under teacher supervision and/or motivation and either removed or forgot to use their pedometers.

Information about the average seasonal temperature, cloudiness and weather (rain, snow, thunderstorm, etc.) was obtained from the Czech Hydrometeorological Institute for both monitored school years. The values suggested that the seasonal weather conditions prevalent in first monitoring period (16 November 2005 – 15 November 2006) were comparable to the weather conditions in second monitoring period (16 November 2007 – 15 November 2008). Although the weather analysis by day or month would be valuable, such an analysis is beyond the scope of this study. Generally, the Czech Republic displays warm summers with mean temperatures  $>20^{\circ}\text{C}$  (measured four times within 24 hours); cold winters with mean temperatures ranging between  $-5^{\circ}\text{C}$  to  $+3^{\circ}\text{C}$ ; and intermediate springs/ autumns with mean temperatures  $\approx 10^{\circ}\text{C}$ .

### Statistical analyses

Statistical analysis was undertaken employing SPSS version 18.0 (SPSS, Inc., Chicago, IL). We obtained step values data for 2,979 person-days, which is 82.1% of a possible 3,628 person-days (if 8 pupils had provided 302, and 4 pupils provided 303 days of monitoring, i.e. 10 months of a school year). Following Tudor-Locke et al. (Tudor-Locke et al., 2004), missing step values from our dataset were estimated using the Missing Values Analysis EM function of SPSS. We used three variables to estimate the missing step values for each pupil (17.9% of data were supplemented with average values of steps): the pupil's unique identifier; day of the week; and month where a given datum was missing. This generated a corrected dataset.

The vernal/autumnal equinoxes and the summer/winter solstices delineated the seasons: autumn (23 September – 20 December); winter (21 December – 20 March); spring (21 March – 20 June); and summer (21 – 30 June and 1 – 22 September). The corrected data (number of steps/day) were analyzed for descriptive statistics

( $M \pm SD$ , 95% confidence interval) for the 10 months of the school year (16 November 2005–15 November 2006; and 16 November 2007–15 November 2008, excluding July and August). The number of steps/day for each pupil was then compared by day of week; by weekdays versus weekends; by days with PE classes versus those without; by month; and by season. Repeated measures analysis of variance (ANOVA) to the corrected data (12 pupils) examined associations with day, month, season, weekdays/weekends, and days with/without PE classes. In case of significant differences between more than three categories, Bonferonni post hoc pairwise comparisons were used. The significance level was set at  $p < 0.05$ .

### Results

Table 1 depicts the distribution of the data by the variables under investigation. The number of days that included PE lessons was fairly small as the school provided two consequential PE lessons on one day rather than two separate PE lessons on two different days.

**Table 1.** Distribution of the corrected data by variables under investigation.

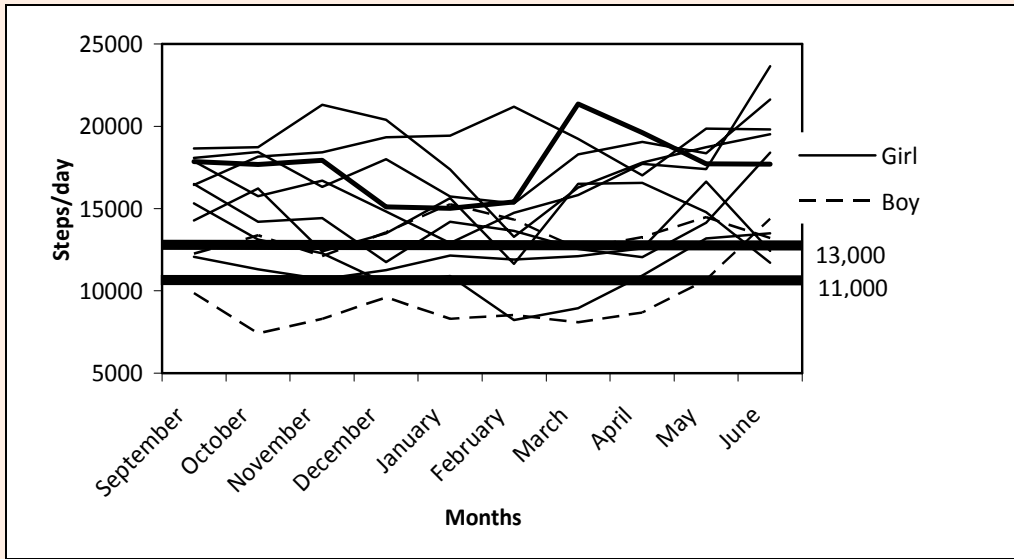
Variable	Person-days data (%)*	
Day	Weekdays	71.6
	Weekends	28.4
School day	Days with PE lessons	18.0
	Days without PE lessons	82.0
Season	Spring	30.4
	Summer	10.3
	Autumn	29.4
	Winter	29.9

\* The categories of each variable add to 100%

Figure 1 displays the variability in mean steps/day for each pupil during the school year categorized by months (school year in the Czech Republic is 10 months). The pupils' mean steps/day was  $15,729 \pm 7,557$ . Most of the pupils reached and exceeded the international guidelines for the number of daily steps (11,000 for girls; 13,000 for boys; at least 5 days a week) (The President's Council for Physical Fitness and Sport, 2001).

Figure 2 summarizes the mean steps/day categorized by month of the school year and by mean steps/day accomplished on weekdays compared with weekends. There were significant differences across the months ( $F = 8.563$ ,  $p < 0.0001$ ). The lowest and highest mean step counts were in February and June respectively ( $13,239 \pm 5,753$  and  $16,631 \pm 8,366$  steps/day). Across all months, pupils achieved significantly more steps/day on weekdays than weekends. The highest numbers of steps/day were on June weekdays and April weekends. The mean values for weekdays were significantly higher than weekends ( $15,733 \pm 6,354$  and  $12,196 \pm 6,574$  steps/day respectively;  $F = 224.24$ ,  $p < 0.0001$ ).

Figures 3 and Figure 4 show significant variability in the mean steps achieved on each day of the week ( $F = 42.4$ ,  $p < 0.0001$ ) for the two groups of pupils. Across the four seasons, for the group of eight pupils monitored from November 2005 to November 2006, the highest mean values were on Wednesdays when PE was provided at school ( $18,722 \pm 6,016$  steps/day) (Figure 3). For the



**Figure 1.** Mean steps/day for 10 months for twelve adolescent pupils.

remaining four pupils (monitored from November 2007 to November 2008), the highest mean values were on Tuesdays when PE was provided at school ( $14,494 \pm 4,762$  steps/day) and Fridays (Figure 4). These findings supported that weekly PA might be influenced by regular PE lessons.

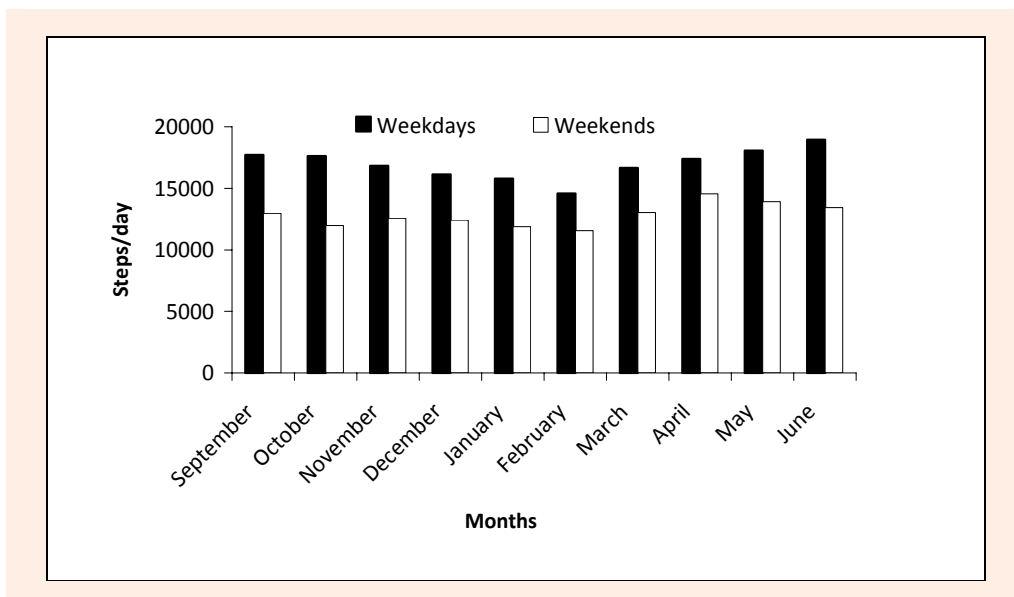
Regardless of the season, pupils accumulated on average  $17,280 (\pm 5,988)$  steps on school days that had PE lessons (two lessons without a break,  $\approx 90$  minutes). This was  $\approx 10\%$  (about 1,711 steps) more than what they would, on average, achieve on school days without PE lessons ( $15,569 \pm 6,318$  steps).

Figure 5 illustrates the variability in the mean steps/day by season, weekdays with/without PE lessons, and weekends. The differences in number of steps/day achieved across the four seasons were significant ( $F = 21.17, p < 0.0001$ ), particularly between spring and autumn ( $p = 0.0001$ ), spring and winter ( $p < 0.0001$ ), and

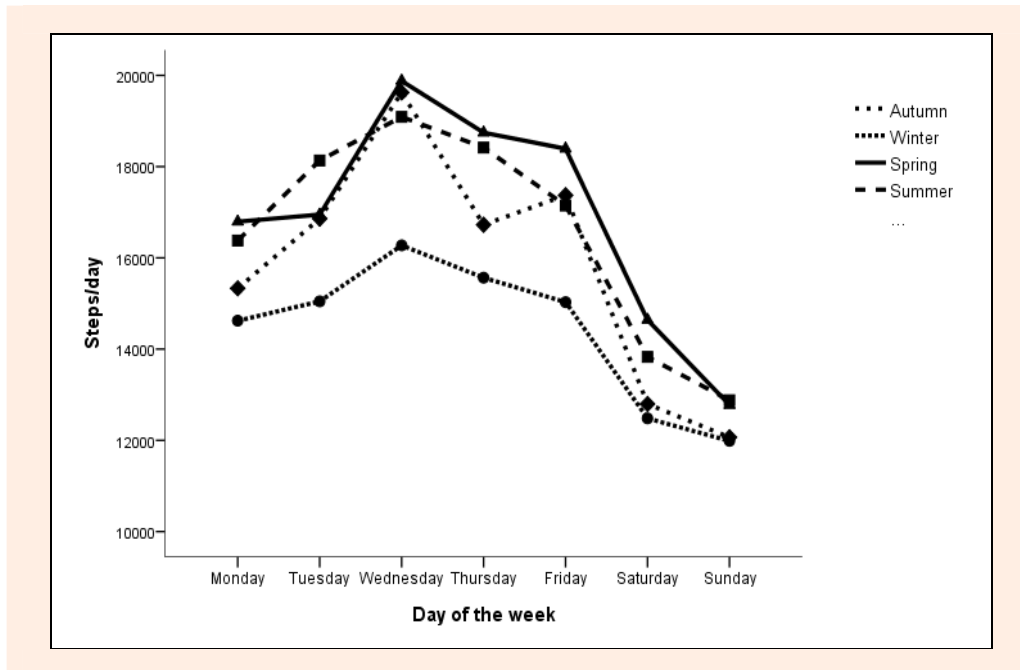
summer and winter ( $p < 0.0001$ ). There were also differences in the mean steps/day on days with and without PE lessons ( $F = 129.69, p < 0.0001$ ).

**Discussion**

To the best of our knowledge, the study described in this paper could be the first to assess levels of PA of high school adolescent pupils over the period of the school year. Ambulatory activity is more challenging to estimate with questionnaires (Bassett et al., 2000), hence we monitored the sample using pedometers. Pedometers are most accurate at measuring the number of steps undertaken (Crouter et al., 2003, Hendelman et al., 2000). Although the day-to-day variability in steps/day could reflect true behavioral instability, such variability appears not to be arbitrary and could possibly be explained by some factors e.g. day of the week and participation in regular exercise



**Figure 2.** Mean steps/day by weekdays and weekends across the school year (12 pupils; 10 months).



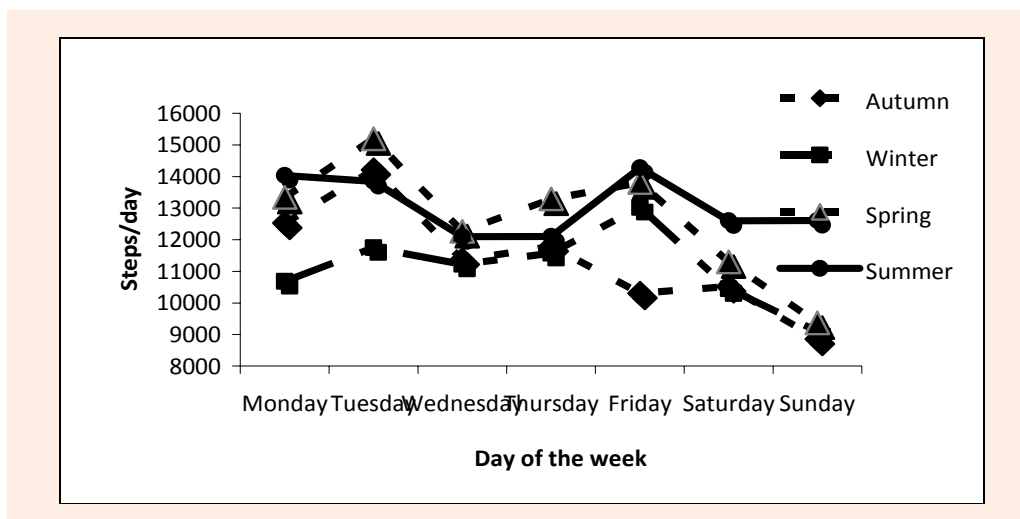
**Figure 3.** Variability in mean steps/day by days and by season (8 pupils; November 2005 - November 2006).

(Tudor-Locke et al., 2004).

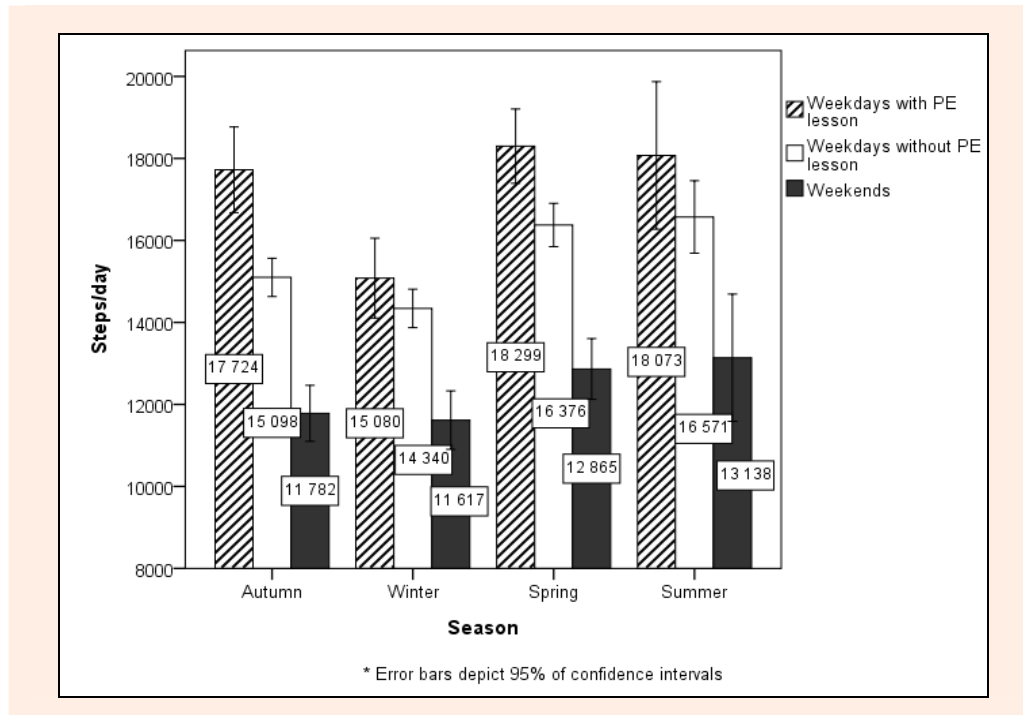
Our first objective was to collect one school-year PA data using pedometers in order to assess the PA levels of high school pupils. Using objective measurements, generally, 74.8% of girls' and 34.3% of boys' step counts met international step-based recommendations (11,000 for girls; 13,000 for boys) (The President's Council for Physical Fitness and Sport, 2001). This contrasts with Shiely and MacDonncha (2009), who measured PA by self-reported questionnaires and found that <11% of their 28 participants met the international moderate-intensity PA guidelines for adolescents. Indeed, many studies that compared school-age children's PA levels with international recommendations used self-reported rather than objective measures (Liou and Chiang, 2004).

Further, prevalence estimates for compliance with national PA guidelines could vary distinctly subject to the guidelines that were employed as comparators (Pate et al., 2002). However as our sample's mean step counts were

high when compared to a recent pedometer intervention study in high school pupils in the USA (Zizzi et al., 2006), where < 25% of participants met the recommended step guidelines, this provided assurance that our sample's PA levels would generally satisfy international guidelines. Notwithstanding, the mean step counts in our sample were higher in comparison to levels reported in previous studies in children (Armstrong and Welsman, 2006), adolescents (Flohr et al., 2006), and adults (Tudor-Locke et al., 2004). This high PA levels might be due to the fact that four of our participants regularly participated in organized after-school PA (floorball) several times/week. Nevertheless, the step counts were high also in our pupils who were not participating in after-school PA programmes ( $14,306 \pm 6,658$  steps/day). For instance, girls (5-16 years) in New Zealand achieved  $\approx 11,537$  and  $\approx 8,812$  steps on weekdays and weekends respectively (Duncan et al., 2008a). Both these values were substantially lower than their counterparts in our study.



**Figure 4.** Variability in mean steps/day by days and by season (4 pupils, November 2007-November 2008).



**Figure 5. Variability in mean steps/day by season, weekdays with/without PE lessons, and weekends\***

In relation to the study's second objective, our sample achieved notably more steps on weekdays as compared to weekends, with Sunday being the least active day. This 'high weekdays-low weekends' PA patterns are in agreement with Tudor-Locke et al. (Tudor-Locke et al., 2004) who monitored the year-round PA levels of a young adult sample from two southern universities in the USA. Our findings are also in agreement with Duncan et al. (2008a) who examined three weekdays and two weekend days step counts in a multiethnic sample of female children and adolescents 5-16 years old.

As regards the variability of PA by day, the number of daily steps achieved by our sample significantly differed by the day of the week (weekdays/weekends; provision/ non provision of school PE lesson). This is in agreement with Tudor-Locke et al. (2004) who examined adults in the USA and found that the day-to-day variability in steps/day were consistent with the fluctuations in PA associated with the day of week (weekday versus weekend day, and sport/exercise participation day versus non-participation day). Our findings also supported Tudor-Locke et al. (2002) who researched older adults and reported that the day-to-day PA variability distinctly reflected the expected oscillations associated with the day of week (i.e., PA in scheduled exercising weekdays > non-exercise weekdays > weekend days). However, the variability of PA by day observed in our sample is in contrast with a study of young adolescents (Flohr et al., 2006) that noted that the number of steps/day was consistent across the classification of the day (i.e., physical education vs. health education days vs. weekend days). The lack of PA variability by day reported by Flohr et al. (2006) might be because they monitored their adolescents for a fairly short period of time (2 weeks only) in one season. This point suggested that it would be appropriate for studies that examine the variability in PA in young

adolescents to undertake a longer period of monitoring, in contrast to older adults where shorter durations (9 days) of monitoring were able reveal variability in PA levels (Tudor-Locke et al., 2002).

The present study also identified seasonal differences in PA levels. The Czech Republic has warm summers, cold winters, and intermediate springs/ autumns; our sample recorded their lowest step counts in winter. This agreed with Tudor-Locke et al. (2004). However, regardless of type of the day (weekends versus weekdays with PE lessons versus weekdays without PE lessons), our sample's mean winter steps/day ( $13,635 \pm 6,250$ ) was slightly higher than in Greek-Cypriot urban school children aged 11-12 (Loucaides et al., 2004). However our step counts in summer ( $15,805 \pm 7,188$ ) were approximately the same as in rural school children of the same study.

Our sample's increase in the number of steps/weekdays and steps/weekends across the seasons (from winter to summer months) were 14.2% and 11.6% more steps on weekdays and weekends respectively. These increases were greater than those reported in Canadian adults in pedometer-based study (Chan et al., 2006), and comparable to the increases in study of a pediatric sample (1,115 Auckland children aged 5-12 years) (Duncan et al., 2008b). Collectively, these season-gradients of PA might suggest that the effects of the seasons on PA might not be homogeneous on all age groups, with an age-related gradient where seasons have more effects on adults than on adolescents and young children's PA. Other researchers (Pivarnik et al., 2003) have supported such a proposal, where adult weekly leisure-time energy expenditure was  $\approx 15-20\%$  higher during spring and summer. Likewise, primary school children accomplished less mean total steps/day in winter than in summer (Loucaides et al., 2004). Indeed the short day length

in addition to the extremes of ambient temperatures could be a hampering factor to repeated participation in outdoor PA (Togo et al., 2005).

In addition, our findings confirmed the contribution of PE classes to daily PA. In the U.S.A. where school's daily curriculum provided PE lessons (30 minutes), pupils (grades 3-6) accumulated 20% more in-school steps (Morgan et al., 2003). Similarly (Flohr et al., 2006), grade 7 pupils averaged 2,046 steps during their PE classes (50 minutes long) which amounted to 18% of their total steps/day on PE days i.e. the absolute contribution of the PE class to daily PA was 18% in young adolescents (Flohr et al., 2006). In our sample, the absolute contribution of the PE class (90 minutes) to the daily PA of pupils was 10%. However, this increase in steps/day on the PE day was relatively stable throughout the school year regardless of the content of the PE lessons, and regardless of whether or not pupils participated in after-school PA. Hence, our findings supported the role of compulsory PE lessons, and that such lessons crucially influence the total PA levels in adolescent pupils during each week. This further confirmed the important role of PE in delivering health-enhancing PA.

This research contributed to understanding the day-to-day PA variability in adolescent pupils. However, the study has limitations. Although objective monitoring of PA in youth is feasible and provides more accurate prevalence rates than self-reported measures (Pate et al., 2002; The President's Council for Physical Fitness and Sport, 2001), it entails more respondent burden for the long-term monitoring. This point might contribute to explain the sample size of the present study particularly that no incentives were offered to the participants. Our participants also recorded their daily step counts. Such self-monitoring could have motivated them to modify, or perhaps increase, their habitual steps/day throughout the school year. Nevertheless, the sample's mean steps/day values highly exceeded the current PA recommendations for adolescents (The President's Council for Physical Fitness and Sport, 2001). This suggested that the findings should not be readily generalizable to other Czech adolescents, and further research is required on the pedometer-determined PA levels of a more representative sample of Czech high school pupils.

## Conclusion

The present study identified day, month and season variability in year-round pedometer-determined PA of adolescent pupils. Across all months and seasons, pupils achieved notably more steps on weekdays than on weekends, with Sunday being the least active day. Moreover, regular PE lessons contributed considerably to the total PA levels in these adolescent pupils. The increase in steps/day on days with PE was relatively stable throughout the school year regardless of month, season and the content of PE lessons. Further research into the day-to-day variability of school year-round PA might focus on sex-specific PA patterns; and the contribution of PA performed in different periods of the school day (e. g. school PA, after-school PA, etc.) to the daily total PA needs in different environmental and cultural settings.

## Acknowledgements

The authors acknowledge and thank the school and participants who took part in this study. This study was supported by the research grant of Ministry of Education, Youth and Health of the Czech Republic [6198959221]. We also thank the anonymous reviewers for their constructive comments that helped strengthen the article.

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### Key points

- Pedometer appears to be suitable for long-term monitoring of physical activity in adolescents.
- Day of the week, month and season are significant factors in pedometer-determined day-to-day variability of physical activity of adolescent pupils.
- Across all months and seasons, pupils achieved notably more steps on weekdays than on weekends, with Sunday being the least active day.
- Regular PE lessons contribute considerably to the total physical activity levels in adolescent pupils. The increase in steps/day on days with PE is relatively constant throughout the school year regardless of month, season and the content of PE lessons.



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