



ORIGINAL ARTICLE

## Physical activity in the lifestyle of Czech university students: Meeting health recommendations

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### Abstract

The decline of physical activity (PA) in adults as well as children and youth is a worldwide phenomenon. The aim of this study is to analyse the amount of PA in Czech university students' daily lives. The research on university students was conducted as part of nationwide research on PA in the adult population of the Czech Republic. A total of 906 students at eight selected universities were asked to participate in this study. The response rate was 79.5%. We analysed data from 641 university students: 318 male [mean age  $21.63 \pm 1.73$ ; mean Body Mass Index (BMI)  $23.50 \pm 1.91$ ] and 323 female (mean age  $21.08 \pm 1.53$ ; mean BMI  $21.23 \pm 2.20$ ). The students wore Yamax SW-701 pedometers continuously for seven days. With respect to BMI, the recommendation of 10,000 steps per day on an average day was met by 76% of men and 68% of women of normal weight, 67% of male students who were overweight or obese and 85% of female students who were overweight or obese. Of all monitored days, in both females and males, the number of steps taken on Sunday was significantly lower ( $p < 0.0001$ ) in comparison to other days of a week. No significant differences were found in the number of steps taken among students of normal weight, students who were overweight and students who were obese on any of the monitored days. The majority of Czech male university students are of normal weight. Only 9% of students meet the criterion of 10,000 steps every day. Approximately two-thirds of students meet the 10,000 steps daily criterion on four or more days per week. The lowest number of steps is taken on Sundays; this finding supports the need for intervention programmes to enhance PA on weekends.

**Keywords:** Number of steps, pedometer, BMI, days, weekend

### Introduction

Many studies have addressed the worldwide decline in physical activity (PA) and the increase in the prevalence of overweight and obesity (Sigmundová, El Ansari, Sigmund, & Fromel, 2011; World Health Organization, 2010). PA decline was evident during young adults' transition into early adulthood, with the steepest decline occurring at the time of entering a university (Kwan, Cairney, Faulkner, & Pullenayegum, 2012). In addition to the decline of PA with ageing, negative secular trends have also been found in PA behaviour in the adolescent population (Mak & Day, 2010; Nelson, Neumark-Stzainer, Hannan, Sirard, & Story, 2006; Sigmundová, El

Ansari, Sigmund et al., 2011). One-third of active students in high school became insufficiently active upon transitioning to university life (Bray & Born, 2004). Overall, the transition into early adulthood marks a critical period of life in terms of health-related behaviours: decreases in PA and increases in alcohol consumption and smoking (Kwan et al., 2012). However, for adults who had early experience of PA during adolescence and young adulthood, decline of PA is less substantial (Barnekow-Bergkvist, Herberg, Janlert, & Jansson, 1996). In other words, PA during early adulthood is strongly associated with PA later in adulthood (Nogueira et al., 2009). Moreover, daily PA in childhood had

a significant health effect in adult men, substantially reducing the risk of becoming a regular smoker (Trudeau, Laurencelle, Tremblay, Rajic, & Shephard, 1999).

The effort to mitigate the negative health trends has led researchers to search for new ways of encouraging healthy lifestyles, such as creating a physical-activity-friendly environment or other interventions that can increase PA in the population (Biddle, Brehm, Verheijden, & Hopman-Rock, 2011; Roesch, Norman, Villodas, Sallis, & Patrick, 2010; Sigmundová, El Ansari, & Sigmund, 2011). To contextualise individuals' adaptations to their environment, relevant days of the week should be considered. Previous research has shown that PA patterns on weekends differ from weekday patterns and are related to sex and age (Buchowski, Acra, Ajchrzak, Sun, & Chen, 2004).

Generally, people with higher levels of education engage in more PA than people with lower education levels (Droomers, Schrijvers, & Mackenbach, 2001; Steffen et al., 2006). This phenomenon has not yet been confirmed for the Czech Republic (Sigmundová, El Ansari, & Sigmund, 2011), but other studies have shown that educated people (especially due to their greater likelihood of sedentary employment and little leisure PA) may engage in less PA than less educated people (Vašíčková, Roberson, & Frömel, 2012).

The post-communist block countries (e.g. the Czech Republic) appear to have a tendency to replicate the 'negative' health trends that have been witnessed in economically developed Western countries (Knai, Suhrcke, & Lobstein, 2007). Indeed, Central and Eastern European countries could learn from such 'negative' Western European and global experiences. Uncovering the levels and patterns of PA in Czech university students could help elucidate current health trends.

The aim of the study is to analyse the amount of PA undertaken by Czech university students in their daily lives. Specific aims are as follows:

- to analyse the amount of PA (number of steps) per day for men and women separately;
- to analyse the amount of PA (number of steps) overall per week, on working days and on weekends, for men and women;
- to describe the proportion of students by their Body Mass Index (BMI) categories (based on self-reported height and weight) and the proportion of students meeting a generally accepted health criterion of PA for adults – achieving 10,000 steps per day (Tudor-Locke, Hatano, Pangrazi, & Kang, 2008).

## Methods

### *Ethics*

The current study was undertaken in the Czech Republic after approval by the Institutional Research Ethics Committee at Palacky University. Participation was voluntary; participants received no incentives. Young adults were provided with information about the aims, objectives and methods of the study before the start of PA monitoring. Data were anonymous and confidential, and data protection was observed at all times. Each participant gave informed consent for inclusion in the study.

### *Participants*

The study of university students was a part of nationwide research on PA in adults in the Czech Republic (Research grant of Ministry of Education, Youth and Sports of the Czech Republic 'Physical activity and inactivity of inhabitants of the Czech Republic in the context of behavioural changes' reg. No. 6198959221). A total of eight universities from different regional towns (Sigmundová, El Ansari, & Sigmund, 2011) joined the nationwide research effort and participated in the study between the years 2008 and 2010. Each selected town represented a delineated region within the Czech Republic (Brno – Southern Moravia; Olomouc – Central Moravia; Ostrava – Northern Moravia; České Budějovice – Southern Bohemia; Hradec Králové and Liberec – Eastern Bohemia; Plzeň – Western Bohemia; and Ústí nad Labem – Northern Bohemia). Afterwards, study years or entire study groups of students were randomly selected, regardless of their study focus (students were either technically or teaching oriented; some were physical education students, and some were not). A total of 906 students were chosen from the selected schools, and 720 of those students actively participated in the research (response rate of 79.5%). Responses with missing and incomplete data (weight, height, age and sex) were excluded from the analysis. In accordance with the study by Tudor-Locke, Giles-Corti, Knuiman, and McCormack (2008), we did not include extreme values (number of steps more than 30,000 per day or less than 1000 in a particular day). In total, 79 participants were excluded from the analysis. Finally, we analysed data from 641 university students – 318 male (mean  $\pm$  SD: age  $21.63 \pm 1.73$ , BMI  $23.50 \pm 1.91$ ) and 323 female (mean  $\pm$  SD: age  $21.08 \pm 1.53$ , BMI  $21.23 \pm 2.20$ ). In accordance with the WHO (Branca, Nikogosian, & Lobstein, 2007), we defined overweight as a BMI greater than or equal to  $25 \text{ kg/m}^2$  and obesity as a BMI  $\geq 30 \text{ kg/m}^2$ . Participants with BMI  $< 25 \text{ kg/m}^2$  are considered to be normal weight.

*Assessment of PA and inactivity*

Number of steps was determined using the pedometer Yamax SW-701. The Yamax SW-701 pedometer has been tested (in terms of number of steps) against direct observation (actual steps were tallied with a hand counter) at different speeds. In comparison to a hand counter, the Yamax SW-701 did not significantly overestimate or underestimate the number of steps at any speed. Of the ten types of pedometers, the Yamax SW-701 was the most accurate at predicting steps, distance and gross kilocalories for walking (Crouter, Schneider, Karabulut, & Bassett, 2003). This pedometer is suitable for applied PA research (Schneider, Crouter, & Bassett, 2004). In general, pedometers are more accurate for assessing steps than for assessing distance or kilocalories (Crouter et al., 2003).

University students wore Yamax SW-701 pedometers continuously for seven days (at least 10 hours per day), excluding sleeping, hygiene and bathing times. The week-long PA monitoring was based on continuous, all-day monitoring using the pedometer and a personal log (to record the data from the pedometer and to provide more detailed information about the type and duration of PA and physical inactivity). Students recorded actual time and number of steps measured by the pedometer in their personal log every morning and evening. During the day, they could also record the time and the actual number of steps as they entered and left school and at the beginning and end of a session of organised or unorganised PA. In the evening, students recorded the duration of PA (with a minimum

duration of 10 minutes) performed during the day (such as walking, running, dancing, football, volleyball, basketball, gardening, housekeeping, etc.). Students also recorded information about the duration of sedentary activities, such as watching TV, working on a computer, studying, reading, sitting during transportation, sitting at school, etc. Participants were asked to wear the pedometer on either the left or the right side of the hip, as previous research showed that pedometers did not significantly differ in their estimates when used on either side of the body (Crouter et al., 2003). Students were informed to put the pedometer on in the morning, remove it before sleeping and take it off only during water-based activities (the device is not waterproof).

*Statistical analysis*

Statistical analysis was undertaken using STATISTICA v.8 and SPSS v.18. For the pedometer data, analysis of variance (ANOVA) test with related Fisher's least significant difference (LSD) post-hoc test and coefficient of effect size  $d = (M_1 - M_2) / SD_{\text{pooled}}$  (Cortina & Nouri, 2000) computed any significant differences between the number of steps achieved on working days and on the weekend and between number of steps (respective self-reported PA and inactivity) of males and females and between cohorts. For the self-reported data, to assess any significant differences in self-reported PA and inactivity, we used the non-parametric two-tailed Kruskal-Wallis test and the relevant  $\eta^2$  coefficient (from the effect size coefficients). In line with other studies (Morse,

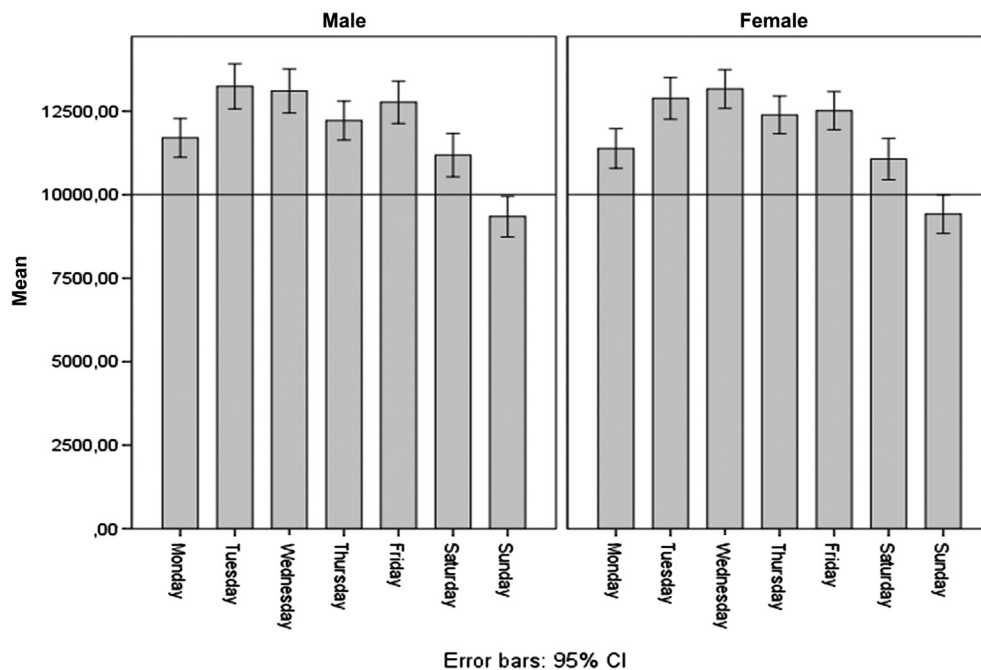


Figure 1. Number of steps per day by gender.

1999),  $\eta^2 = 0.01$  was considered to be low effect,  $\eta^2 = 0.06$  medium effect and  $\eta^2 = 0.14$  large effect.

**Results**

*Average number of steps per week – analysis by day of week*

ANOVA for repeated measures showed differences in the number of steps between individual days of monitoring ( $F_{(6, 641)} = 48.44; p < 0.001$ ). Fisher LSD post-hoc test did not show differences between Tuesdays, Wednesdays and Fridays – on these days, men reported equal numbers of steps. Men take a lower and significantly different ( $p < 0.001$ ) number of steps on Sundays in comparison to all other days (Figure 1). For women, no significant difference was found between the number of steps taken on Tuesday, Wednesday, Thursday and Friday, but on Sundays they were found to take a lower and significantly different ( $p < 0.001$ ) number of steps compared to the other days.

Of all monitored days, Sunday showed – both in males and females – the lowest, significantly different number of steps ( $p < 0.0001$ ) in comparison to the number of steps taken on other days. The effect of

weight according to BMI (normal, overweight and obese) on the number of steps taken was not significant, and according to post-hoc LSD testing, no significant differences were found between steps taken by students with normal weight, overweight students and those with obesity on any monitored days.

*Differences in PA between weekdays and weekends*

Independent of sex, we find differences between the PA of university students on working days and on weekends ( $F_{(1, 641)} = 193.26; p < 0.001; d = 0.60$ ). Figure 2 shows that both males and females achieved a lower, significantly different number of steps on weekends than on working days.

*Proportion of students by BMI and by meeting health recommendations for number of achieved daily steps*

In males, 83% reported normal weight ( $BMI < 25 \text{ kg/m}^2$ ), 16% were overweight and 1% were obese ( $BMI \geq 30 \text{ kg/m}^2$ ). In females, 95% reported normal weight, 4% were overweight and 1% were reportedly obese. The recommendation of 10,000 steps per day (for health-enhancing daily number of steps achieved) was met, on an average day, by 74% of males and 69% of females in our sample. The recommendation was met by 67% of overweight or obese male students and 85% of overweight or obese female students.

A detailed analysis of meeting health-enhancing daily number of steps showed that, on average, both men and women meet the criterion on four days out of the week. Approximately 9% of students, regardless of sex, meet the health criterion of 10,000 steps every day. Only 67% of men and 64% of women meet this criterion on four or more days per week. Figure 3 shows that 2.5% of women and 3.3% of men do not meet the criterion of 10,000 steps a day on any monitored day.

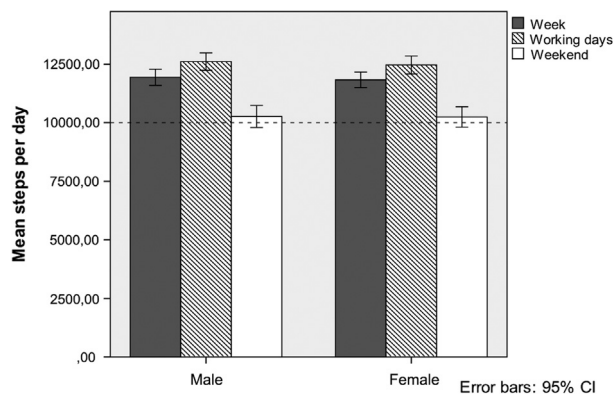


Figure 2. Average number of steps per working days, weekend and week, by gender.

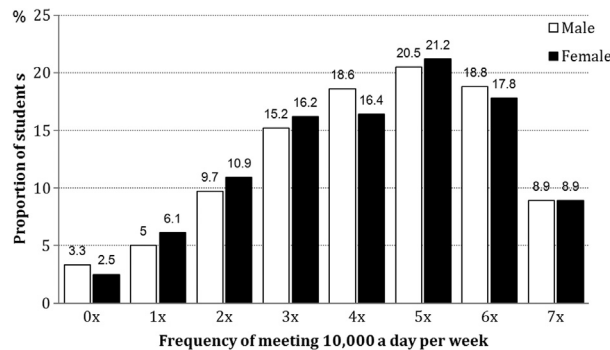


Figure 3. Proportion meeting health recommendations (10,000 steps per day) in university students by gender and by number of days of meeting recommendation during the week.

## Discussion

In terms of the first objective, the analysis of PA on individual days showed that Sunday is the most critical day of a week in terms of the number of steps taken. Our monitored university students (both male and female) take the lowest number of steps on weekends. Sunday is the most critical day regarding the amount of PA performed by adults, as has been confirmed repeatedly in literature (Tudor-Locke et al., 2005; Vašíčková et al., 2012). Effects of overweight or obesity on the number of steps taken on Sunday were not observed in our sample, and our results thus do not comply with findings that argue that Sunday is a particularly critical day for overweight or obese people (Clemes, Hamilton, & Lindley, 2008; de Looze et al., 2012).

The current study shows different numbers of steps on particular days of a week. In terms of the number of steps taken, Tuesday, Wednesday and Friday are equal for male and female students. Differences on other days could be influenced by the diverse study programmes during the semesters and at different universities. Numbers of steps on particular weekdays may differ due to varied campus and university settings (class rooms, libraries, canteens, shops, dormitories and sports gymnasiums) and according to the classes and study duties found in the daily schedule (Yan, Sigmund, Sigmundová, & Yan, 2007).

Regarding objective two, the present study found differences in PA (number of steps) between working days and weekends. Similar to our research, other studies have reported differences in PA patterns on weekdays and weekends (Buchowski et al., 2004; Lake, Townshend, Alvanides, Stamp, & Adamson, 2009; Sigmundová, El Ansari, Sigmund et al., 2011; Young, Jerome, Chen, Laferriere, & Vollmer, 2009). Both female students and male students show significantly lower PA on weekends than on working days. A similar pattern of weekly PA in adults has been confirmed by international studies (Behrens & Dinger, 2007; Tudor-Locke et al., 2004). Understanding the differences in PA patterns (for example, during weekdays and weekends) can aid in the development of suitable intervention programmes (Lake et al., 2009; Young et al., 2009).

We used the value of 10,000 steps as the criterion for meeting health recommendations as this is accepted for the general adult population (Tudor-Locke, Hatano et al., 2008). In this study, the criterion of 10,000 steps is met daily by only approximately 9% of male students and 9% of female students. With respect to WHO Global strategy (World Health Organization, 2006), various types and amounts of PA on most days of a week ( $\geq 4$  days) reduce the risk of cardiovascular disease, diabetes and cancer (World Health Organization,

2010). The American Heart Association recommends that all adults accumulate 30 minutes of PA on most days of a week. Additional benefits will likely be derived if activity levels exceed this minimum recommendation. At least 60 minutes of PA on most days of a week is recommended for adults who are attempting to lose weight (Lichtenstein et al., 2006). Using the adult cadence of 100 steps/minute (Tudor-Locke et al., 2011), this recommendation could be fulfilled by the achievement of 10,000 steps on four or more days of a week.

The recommendations were met on four or more days per week by 67% of men and 64% of women. Czech university students are more physically active than the adult population of regional towns, in which 51% of inhabitants meet the health recommendations (Sigmundová, El Ansari, & Sigmund, 2011). Previous research studying university students from 23 countries showed that, of students from Central and Eastern Europe, only 32% of men and 18% of women met the recommended frequency of leisure-time PA (Haase, Steptoe, Sallis, & Wardle, 2004). Better results were accomplished by university students from Australia, where 47% of males and 51% of females from a total of 103 students achieved 10,000 steps per working day (Villanueva, Giles-Corti, & McCormack, 2008). A Canadian study found students who reported engaging in moderate and strenuous PA for a total of 30 minutes (all at once or in 10–15-minute blocks) at least five days per week. A total of 51% of these students were categorised as active (Irwin, 2007). Similarly, results from a Spanish study indicated that 45% of university students are not active enough, especially females (Hoyos et al., 2011). The average daily values of number of steps taken by participants in this study are higher than those found in a cross-sectional study of the Czech population, where men reached an average value of 11,200 steps/day and women 10,612 steps/day (Sigmundová, Zacpal, & Sigmund, 2010). This result shows that in some cases university students have a higher level of PA than that of the general population.

In relation to the third objective, in this sample of university students from the Czech Republic, 16% of male students and 4% of female students were overweight, and only 1% of male students and 1% of female students were obese. The prevalence of overweight and obesity in our sample is low in comparison to the results of a study of the population of Czech university students, in which 14% of students were overweight or obese (Vašíčková, Frömel, & Nykodým, 2008). These values may be influenced by the fact that overweight or obese students are less likely to participate in similar studies. A national study of the Czech adult population between the ages of 18–24 years living in regional

towns reported the prevalence of overweight and obesity (based on self-reported height and weight) in 4% of women and 26% of men (Sigmundová, El Ansari, & Sigmund, 2011).

### Limitations

Despite a large amount of analysed data (641 students  $\times$  7 days), this study has limitations. The analysis includes students from faculties of sports, which may partly influence the final results regarding levels of PA. The use of pedometers lacks a blinded display, and participants also registered the number of daily steps into the record charts. These facts suggest that pedometers could be 'semi-objective' (Sigmundová, El Ansari, Sigmund et al., 2011). Step counts could be higher in our study due to the use of unsealed pedometers and resulting reactivity. Reactivity to unsealed pedometers, causing increased steps, can last for a period of one week (Clemes & Deans, 2012).

Only a small number of overweight or obese people joined the research; most respondents were of normal weight. Compared to the population of Czech university students (Vašíčková et al., 2008), our sample may have been slightly biased; thus, caution should be exercised when generalising the results. The body composition of the participants was not monitored, and this study did not include the influence of environment and background of colleges and universities, which can influence PA behaviour in students.

### Conclusions

The day on which the lowest number of steps was taken was Sunday. On an average day (averaged over seven days), 69% of female students and 74% of male students met the criterion. Only 9% of students met the criterion on a daily basis. Approximately two-thirds of students met the criterion of 10,000 steps on four or more days a week. Lower PA was recorded on the weekend than on working days, both in male and female students. The majority of male Czech university students (83%) show normal weight, as do female students, at 95%. Only 1% of students are obese. Further research should focus on the possibility of enhancing PA, especially on weekends, and the performance of recommended PA on a daily basis. Positive findings in the level of BMI and PA show a reasonable basis for health promotion among university students. Further research should address the relationship between a physically active lifestyle and students' transitions to adulthood in the area of Central and Eastern Europe.

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