The Effect of Physical Activities on Somatic Parameters of the Selected Czech University Students – Some Selected Results

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ABSTRACT

Purpose: The current trend is an increasing sedentary lifestyle in all age categories. Among university students, there is an alarming decline in physical activity while increasing the percentage of total body fat compared to high school students. The main goal of the study is to describe the current state of body composition of university students and to assess the impact of physical activity / inactivity in this specific age group, which has changed very dynamically in recent years due to the coronavirus pandemic. Methods: A total of 358 probands with a mean age of 20.87 ± 1.43 years were involved in the research, of which 234 women (65.4%) had a height of 167.9 ± 6.3 cm and a body weight of 61.3 ± 10.0 kg, BMI 21.7 ± 3.2 , body fat 25.9 ± 6.4 %, skeletal muscle mass 24.7 ± 3.3 % and 124 men (34.6 %) with body height 180.9 ± 7.7 cm, body weight 77.6 ± 12.4 kg, BMI 23.6 ± 2.8 , body fat 15.8 ± 5.4 %, skeletal muscle mass 37.0 ± 5.6 %. For the purposes of valid categorization into high active, minimally active, and inactive probands, the International Standardized Physical Activity Questionnaire (IPAQ) was used, which monitors physical activity in the last 7 days. The questionnaire includes questions regarding the frequency and time spent in each intensity of physical activity, as well as the time spent sitting. The non-invasive method of bioelectric tetrapolar impedance using the InBody 230 device was used for the analysis of somatic parameters. The Takei hand dynamometer was used for the diagnosis of muscle strength. Some selected results: According to IPAQ, probands were classified as inactive (16%), minimally active (58%) and high active (25%), the analysis of selected aspects of physical activity shows that men are more active than women, but both sexes spend more than 5.5 hours a day sitting on average. A total of 39% of probands have higher level of total body fat than the recommended norms. Conclusion: The study showed that lower levels of physical activity are associated with higher values of total body fat in university students. At the same time, within our sample both sexes out of 84% comply with general recommendations regarding the volume and intensity of physical activity.

Keywords: physical activity, body composition, IPAQ, body fat, skeletal muscle mass, university students

INTRODUCTION

The increasing trend of sedentary behavior together with obesity is one of the biggest societal problems of the current population (Blair et al., 2009). Obesity is caused mainly due to faulty eating habits and low physical activity (PA). It contributes significantly to the development of a number of serious chronic diseases, which are well-documented by many studies, such as coronary heart disease, breast and colon cancer, osteoporosis, noninsulin-dependent diabetes or depression (Sattelmair et al., 2011; Friedenreich et al., 2011; Wolin et al., 2009; Jeon et al., 2007; Weyerer et al., 1992; Lane et al., 2006; Pietiläinen et al., 2008).

More than 57% of the adult population in the Czech Republic, especially men, are overweight or obese, and this proportion has not been able to decrease in the long term (Daňková, 2010; MZČR, 2014). That is why PA plays an irreplaceable role in a person's life. It is a physical movement that is associated with increased energy output and skeletal muscle activity. PA can be implemented as a leisure activity, a form of active transport or within an organized/unorganized activity. The basic factors that determine the optimal level of health-promoting PA are frequency, intensity, duration, and type of activity. Recommendations from the World Health Organization (World Health Organization, 2020) and the American College of Sports Medicine and the American Heart Association (Haskell et al., 2007) state that adults between the ages of 18 and 64 should perform moderate-intensity PA at least 150-300 of moderate-intensity aerobic PA, or at least 75-150 minutes of vigorous intensity aerobic PA a week and should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle group on 2 or more days a week. The recommendation must be understood as a supplement to routine activities of daily living, which are usually of moderate intensity or last less than 10 minutes. Adherence to these recommendations has demonstrable benefits in all components of health, which is also confirmed by studies (Máček & Radvanský et al., 2011; Reiner et al., 2013; Warburton et al., 2006; Sigmundová et al., 2013; Sofková et al., 2011). Unfortunately, 80% of children and adolescents worldwide do not follow this recommendation, and most of them carry this unhealthy habit to a later age (Hallal et al., 2012; Sallis et al., 2016). Bray et al. (2004) reported that almost half of US university students do not participate in moderate or vigorous PA. Antošová et al. (2014) demonstrate that 32 % of adults show low physical activity, moreover, in the Czech Republic as well as in the world, there is a noticeable decrease in physical activity among the population. Also, a large proportion of children are insufficiently physically active, and only 20% of girls and 25% of boys fulfilled the recommendation to devote at least 60 minutes a day to physical activity. Girls are more likely to leave sports as they get older, and interest in organized sports among adolescent youth also stagnates (Rychtecky & Tilinger, 2017).

The World Health Organization (WHO) has long termed the transition from high school to university as a critical period in terms of the development of obesity and a decrease in the volume of physical activity intensity. (WHO Consultation on Obesity (1999: Geneva & Organization, 2000; Sacheck et al, 2010; American College Health Association, 2008; Bray et al., 2004). It is in this context that major changes, including a sharper increase in sedentary behavior and increased values of the fat component (Magoc et al., 2010). The aim of the study is to describe the current state of body composition of selected Czech university students and to evaluate the influence of physical activity/inactivity in this specific age group.

METHODS

The research methodology was based on empirical scientific approach with the use of quantitative approach based on the deductive process of implemented measuring. The main aim was to obtain objective data and results based on them, subsequent interpretations and answers to the formulated research questions with final conclusions. The main goal of the study is to describe the current state of body composition of university students and to assess the impact of physical activity / inactivity in this specific age group on some parameters of body composition.

Based on the set goals, two research questions (RQ) were formulated:

RQ1: Is body composition related to different levels of physical activity in university students?

RQ2: What are the differences in selected somatic parameters between men and women university students?

Subjects

A total of 358 probands (124 males and 234 females) aged 18-26 years (mean age 20.87 \pm 1.43 years) were involved in the study. The research sample were consisted of students from all ten faculties of Masaryk University. They were initially briefed of the measurement procedures and the aims of the study, and then requested to sign informed consent forms. The research was voluntary without any financial contribution and followed valid code of ethics committee of Masaryk University and legal regulations of the Czech Republic. Consenting students were invited in spring semester of 2022 in the week of 7th to 11st March 2022, always in the office to complete online standardized International Physical Activity Questionnaire (IPAQ) and participate in somatic parameters measurements. The measurement takes place without shoes. All jewelry and watches must be removed before the measurement. The measurement cannot be performed if the proband has a pacemaker, metal implants or during pregnancy.Probands could leave the research at any time. Interpretation of the results from the analysis of body composition were provided to each proband to use for their personal purpose and as a benefit possible recommendation of PA and health risks were included for free.

Physical activity

The International Standardized Physical Activity Questionnaire (IPAQ) was used for the purposes of valid categorization into high active, minimally active, and inactive probands (Craig et al.,2003) in the Czech version. The Czech version was created from English and like in other countries, went through a standardization translation procedure, including back translations into English and their analysis. Respondents evaluated the frequency of operating individual types of PA by the number of days and duration (continuously at least 10 minutes) in an average day, over the last seven days. The questionnaire can be used in a short or long version, for the purposes of the study a short version of the questionnaire was used. The questionnaire records physical activity in the last 7 days, the questions are focused on frequency and time spent performing different intensity of physical activity - vigorous, moderate, walking and also time spent sitting at least 10 minutes continuously. The value obtained from the calculation is the metabolic equivalent (MET) – MET-minutes/week, which is then scaled into physically inactive, minimally active and high active according to the physical recommendations (IPAQ manual, 2006). Time spent sitting is not included in the final calculation.

Somatic parameters

Somatic parameters were measured by calibrated InBody 230 device. The InBody device provides a non-invasive method of bioelectrical tetrapolar impedance (BIA) for analysis of five basic body segments separately (trunk, left arm, right arm, left leg, right leg). BIA method is sought after as a sufficiently valid and reliable method applicable to a wide spectrum of the population (Anderson et al.,2012; Kyle et al., 2004). Body height was measured by stadiometer Seca217 with an accuracy of 0.5cm without any footwear. Body weight (with an accuracy of 0.1kg), body fat percentage (%BF), skeletal muscle mass (SMM), fat free mass (FFM), proteins, minerals, BMI, WHR index, total body water, visceral fat level were measured after emptying the bladder and in light clothing. During the BIA measurement all recommended procedures were observed (Heyward & Wagner, 2004).

Statistical analysis

The obtained somatic parameters were processed through Lookin Body120 software. Descriptive statistics (mean, median, standard deviation-SD) were calculated for all variables. Statistical processing was conducted using the R software (R Core Team 2016). One-factor ANOVA was used to test the significance of differences three groups (inactive, minimally active and high active). Tukey HSD post hoc test was used to assess differences between IPAQ categories. The significance was set at p < 0.05. Standard range of body fat percentage is 10-20% for men and 18–28% for women (Biospace, 2008). All types of PA were converted to MET-min-week-1. Total PA includes vigorous PA, moderate PA, and walking.

RESULTS

Somatic parameters of men and women participants are presented in Table 1. A total of 358 probands with a mean age of 20.87 ± 1.43 years were involved in the research, of which 234 women (65.4%) had a height of 167.9 ± 6.3 cm and a body weight of 61.3 ± 10.0 kg, BMI 21.7 ± 3.2 , body fat 25.9 ± 6.4 %, skeletal muscle mass 24.7 ± 3.3 % and 124 men (34.6%) with body height 180.9 ± 7.7 cm, body weight 77.6 ± 12.4 kg, BMI 23.6 ± 2.8 , body fat 15.8 ± 5.4 %, skeletal muscle mass 37.0 ± 5.6 %. Men had 1.9 higher BMI and 10.1% lower body fat percentage than women. They also had a significantly higher prevalence of total PA. Men are more active by 245 MET-min/ week than women in the context of total PA. Waist-Hip Ratio (WHR) means ratio of waist and hip circumference was measured by InBody230 device (r= 0.901 comparing with value measured by anthropometry). The average WHR for both sexes were 0.86. Higher WHR values were revealed in women relative to the recommendation. The recommended ranges for WHR are 0.80~0.90 for male and 0.75~0.85 for female. Abdominal obesity is diagnosed in case of over 0.90 for male and 0.85 for female. It was observed that 19% of men and 42% of women have abdominal obesity.

	men (n = 124)		women (n = 234)	
	Mean	SD	Mean	SD
Age	21,21	1,56	20,70	1,33
Height (cm)	180,90	7,73	167,93	6,35
Weight (kg)	77,66	12,46	61,38	10,05
BMI (kg/m ²)	23,64	2,80	21,75	3,21
Body fat (%)	15,80	5,41	25,97	6,40
SMM - Skeletal muscle mass (kg)	37,05	5,63	24,70	3,32
Protein (kg)	12,94	1,86	8,85	1,11
Minerals (kg)	4,49	0,70	3,23	0,42
TBW - Total body water (l)	47,66	6,77	32,97	4,01
FFM - Fat free mass (kg)	65,10	9,32	45,05	5,52
WHR - Waist-Hip Ratio	0,86	0,06	0,86	0,05
BMR - Basal Metabolic Rate (Kcal)	1 776,14	201,41	1 343,01	119,28
Activity (MET-min/week)	2 253,69	1 504,35	2 008,89	1 759,20

Table 1. Selected somatic parameters of men and women participants

Differences between the groups are recorded in Figure 1. We can observe a decreasing trend of the fat component with increasing PA in both sexes. A significant statistical difference within male with different levels of physical activity were demonstrated in body fat percentage (p = 0.04). Tukey post-hoc test shows significant differences only between inactive and high active groups of women (p = 0.04).

Similar results can be observed with skeletal muscle mass (SMM). A significant statistical difference within male with different levels of physical activity were demonstrated in SMM (p = 0.01). Tukey post-hoc test shows significant differences only between minimally active and high active groups of men (p = 0.01). No significant statistical differences were demonstrated for women (p = 0.09, respectively p = 0.07 for high active and inactive group).

According to IPAQ Scoring Protocol (IPAQ, 2008), probands were classified into three levels of physical activity as inactive (16%), minimally active (58%) and high active (25%). It was observed, that 84% of both sexes follow the general recommendations regarding the volume and intensity of physical activity. Anyone who met the one of the following 3 criteria was included in the category minimally active.

- 3 or more days of vigorous activity of at least 20 minutes per day OR
- 5 or more days of moderate-intensity activity or walking of at least 30 minutes per day OR
- 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 600 MET-min/week.
- Anyone who met the one of the following 2 criteria was included in the category high active.
- Vigorous-intensity activity on at least 3 days and accumulating at least 1500 METminutes/ week OR
- 7 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum of at least 3000 MET-minutes/week

• The other probands were classified into inactive category. They reported no activity or some activity was reported but not enough to meet minimally active or high active.



Figure 1. Body fat according to gender and level of PA

A total of 39% of probands are out of the standard range of body fat percentage than the recommended norms in Figure 2.

67.7 % of men and 57.7% of women were classified as standard of body fat percentage, while 20.2% of men and 33.8% of women were above the limit. Standard range of body fat percentage is 10-20% for men and 18-28% for women. Average body fat percentage in high active men and women is 14.3% and 24.3%. Average body fat percentage in inactive men and women is 18.3% and 27.4%. The difference of 4% a 3.1% between two categories is significant statistical difference (p = 0.04).



Classification of the individuals according to %BF and gender

Figure 2. Classification of body fat range percentage by gender

Note: Normal range (according to INBody): men 10-20%, women 18-28% (Biospace, 2008)

BMI mean values were in the normal range according to WHO (18.5 – 24.9).

75 % of women and 73 % of men were classified as standard weight. Men were more overweight (23 %) and obese (2 %), than women overweight (10 %) and obese (3 %).

DISCUSSION

It can be assumed that PA influences somatic parameters. Although many authors confirm the beneficial effect of PA on the body health, the results of research analysing risk factors affecting the university students point out that the health status of university students is generally worse than the health status of the non-student population of the same age (Kvintová, 2016). The authors describe college as an important transition into adolescence, when their lifestyle, PA levels, and eating habits are built. This behaviour can influence the emergence of overweight and obesity and other factors that can increase the risk of chronic diseases that do not yet occur in this age group. The study was focused on volume and intensity, which are substantial for supporting the health benefits of an active lifestyle in university students. As stated in the introduction, it is appropriate to maintain the functional state of the individual to comply with general recommendations that relate to the volume or intensity of PA. Nykodým et al. (2011) reported that 65.3 % of students fulfil at least one of the recommendations for PA. It was observed, that 84% of both sexes follow the general recommendations regarding the volume and intensity of physical activity. Results of this study are not so critical, compared with 40 to 50% of American students which were physically inactive (Keating et al., 2005). The IPAQ is considered as a reliable and valid tool for self-reported physical activity levels across a range of age groups and countries of origin, which is confirmed by several studies (Ekelund et al., 2006), that have also examined validity of IPAQ in comparison with other measuring devices.

In this study, we examined the association of somatic parameters with individual level of PA. It was found, that with increasing physical activity the body fat percentage decreases.

Additionally, these findings were independent of gender. The presented results are consistent with findings of previous research conducted. It has been demonstrated that for a total of 39 % of probands are out of the standard range of body fat percentage than the recommended norms. 67.7 % of men and 57.7 % of women had normal level of body fat percentage, while 20.2 % of men and 33.8 % of women were above the limit. Average body fat percentage in high active men and women is 14.3 % vs. 24.3 %. Average body fat percentage in inactive men and women is 18.3 % vs. 27.4 %, which are quite similar values as reported by Savegnago et al., 2014. Average body fat percentage in inactive men and women was 18 % and 26 %. Average body fat percentage in high active men and women was 14.1 % and 25.8 %. Standard range of body fat percentage is 10–20 % for men and 18–28% for women. The assumption demonstrated in studies that men are more physically active than women was confirmed (Frömel, Novosad a Svozil, 1999). Men are more active by 245 MET-min/week than women in the context of total PA (2253 vs. 2008 MET-min/week).

There are a few limitations to the study that need to be considered. The main limitation of the study is the size of the research group with lower sample of male probands. Moreover the selected group is represented only by students at Masaryk University in Brno. Limitation of the study may

be that the probands were self-selected and may represent a healthier sample of university students, which may be one of the reasons it does not reflect the real state. Therefore, it can be assumed that the results of the presented study only reflect the state of specific group of population and cannot be completely generalized. It is assumed that research on a larger population group could bring similar conclusions or specify the trends to outlined.

CONCLUSION

The findings of the study have revealed that higher level of PA is associated with lower body fat percentage in university students. Significant statistical difference was demonstrated between inactive and high active groups of women (p = 0.04). However, significant statistical differences between some PA groups were not demonstrated. In terms of WHO PA guidelines both sexes out of 84% comply with general recommendations regarding the volume and intensity of physical activity. Men are more active by 245 MET-min/week than women in the context of total physical activity. 67.7 % of men and 57.7 % of women were classified as standard of body fat percentage, while 20.2 % of men and 33.8% of women were above the limit. The research sample is based on the voluntariness. The results cannot be fully generalized. Although some results of the measurement of somatic parameters in the selected sample of probands do not directly confirm the deteriorating condition of university students, as was evidenced by some presented foreign studies. It is recommended that future studies will be investigated further by using a larger sample of probands and more complex reference methods to measure level of PA and somatic parameters.

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