

Physical activity, body composition and health assessment in current female University students with active and inactive lifestyles

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Abstract:

Optimum physical activity is an important protective factor decreasing the emergence of many diseases, especially non-communicable diseases. In terms of ontogenetic development, an optimum amount and intensity of PA is irreplaceable in each developmental stage. In our case, we focused on younger adult women. The aim of this study was to determine and to compare the total and segmental proportion of body fat in adult women with regular controlled physical activity who meet the basic health recommendations, i.e. a specific amount of weekly physical activity, and physically inactive adult women. The study included 337 women. To assess the level of physical activity the study used the International Physical Activity Questionnaire. To determine body composition and perform a segmental analysis we used a non-invasive method of tetrapolar electrical bioimpedance using the InBody 230 device. To assess the current level of health, a standardized psychodiagnostic tool was used – Life Satisfaction Questionnaire. Statistical result processing was conducted using the Statgraphics programme v. 10.0. Statistical significance was tested at $p \leq .05$, $p \leq .01$. A comparison of the proportion of body fat and segmental analysis in physically active and physically inactive younger adult women clearly demonstrates a significant difference in the compared characteristics in terms of lower values in physically active women and higher values in inactive women. Significant differences were also found in the assessment of health and its partial components.

Key words: Health, body fat, fat free mass, sport, women.

Introduction

Physical activity (PA) is one of the current issues, especially with regard to the health of an individual (WHO, 2004; 2010). Optimum PA represents an important protective factor limiting the onset of many diseases, particularly lifestyle diseases. It also represents an important part of a healthy active lifestyle, which can be defined as a balance between mental and physical health. From an ontogenetic development viewpoint, an optimum amount and intensity of PA has an irreplaceable position in each developmental stage. Clear evidence of the effect of regular and adequate PA on the health of an individual was presented already at the end of 1980s (Blair et al., 1989; Paffenbarger, Hyde, Wing, & Hsieh, 1986). These studies focused especially on the biomedical aspect of health. The current trends and the holistic concept of health also include the psychological, social and spiritual aspects (Blahutková, Řehulka, & Dvořáková, 2005).

The benefits resulting from an active lifestyle in women in younger adulthood have a significant effect on all major components of health (physical, mental, social). In the age category of younger adulthood, an early pathophysiological progress of any of the frequent lifestyle diseases such as diabetes mellitus type II, hypertension, dyslipidemia, cardiovascular disease, etc. is not expected. However, regular PA among women in younger adulthood represents an important primary prevention tool, and at the same time contributes to maintaining an optimum body composition and positive self-assessment. In terms of physical health, an optimum type of physical activity is moderate PA, which in adult women significantly promotes the completion of the bone tissue through osteoblast stimulation, and thereby decreases the overall risk of osteoporosis in later periods (Němcová & Korsá, 2008). Besides other influences, the speed of osteopenic and osteoporotic changes is significantly dependent on bone quality before menopause. With regard to the facts mentioned above, PA can be considered a significant preventive prophylactic factor affecting the dynamics of future degenerative changes in bone tissue (Neville et al., 2002, Savage, Kemper, Ralston & Smith, 2002).

Important indicators of physical health and self-assessment in women in younger adulthood are elemental somatic parameters such as body weight, body mass index (BMI), WHR index, and selected circumferential values. Accordingly, the relationship between individual body composition fractions, in particular the proportion of body fat and its distribution, influence objective and subjective parameters of health in women. As far as BMI is concerned, it has been shown that women perceive themselves as attractive and

subjectively feel the best with BMI values of 19 to 20 kg/m² (Frederick, Peplau, & Lever, 2006). In terms of normative values, this is close to the lower threshold. In terms of body fat proportion, Grasgruber and Cacek (2008) report average proportion in non-athletic women of 20 to 25 %. The motivation for physical activity in women in younger adulthood may be the health component as well as the aesthetic component. Objectively and subjectively perceived satisfaction with the own body has a positive effect on the mental and social health component (Davis & Cerullo, 1996).

The basic factors indicating an optimum level of health promoting PA include the frequency, intensity, duration and type of the activity performed. With regard to women in the period of younger adulthood and the amount of PA, a general concept of 10,000 steps per day might be accepted (Hatano, 1993; Tudor-Locke, Hatano, Pangrazi, & Kang, 2008). In a weekly regime the optimum amount of PA seems to be 150 minutes of moderate intensity (3–6 METs), or 75 minutes of intensity exceeding 6 METs (American Heart Association; American College of Sports Medicine; US Department of Health and Human Services, 2008). To meet these basic recommendations in terms of healthy physical activity, currently a number of sports activities are available.

The main objective of the present study was to determine and compare the subjective assessment of health and its components, and the overall as well as segmental proportion of body fat in physically active women who meet the basic health recommendations for weekly physical activity, and in physically inactive women in the age of adulthood.

Material & methods

Participants

The survey included a total of 337 adult women. Of the total number, 114 women with average age of 22.5 (SD = 2.73) years represented a group of physically active (athletic) women. The number of non-athletic women was 243 with average age of 23.7 (SD = 4.19) years (Table 1). The women participating in our study were undergraduate students of Palacký University in Olomouc. For the purposes of valid categorization into physically active and inactive women we used the International Physical Activity Questionnaire (IPAQ). Physically inactive women were considered those who reported increased values of sedentary behaviour during a week (7 days) and whose energy expenditure during physical activity was lower than 600 MET-minutes/week (IPAQ Manual, 2005). All procedures were conducted in accordance with the Declaration of Helsinki. In terms of ethical aspects, all participants in the survey were fully informed of its purpose and of a possibility to terminate their participation at any time without giving a reason. All participants were informed of further data processing and ensuring anonymity. Each participant was involved on a voluntary basis and consented to data processing and publication. All participants signed an informed consent form before participating.

Instruments of body composition and health assessment

To determine the proportion of body fat and to perform a segmental analysis we used a non-invasive method of tetrapolar electrical bioimpedance (BIA) using the InBody 230 instrument (Biospace, South Korea). The accuracy of body weight measurement was 100 g. During the BIA examination all recommended procedures were observed (Heyward & Wagner, 2004). Body height was measured by the A-213 anthropometer (Trystom, Czech Republic) with a permissible error of measurement of 2 mm.

To assess the current level of health satisfaction, the research study used a standardized psychodiagnostic tool – Life Satisfaction Questionnaire (LSQ) (Rodná & Rodný, 2001). The Czech version of the LSQ is based on the original German questionnaire Fragebogen zur Lebenszufriedenheit (FLZ) (Fahrenberg, Myrtek, Schumacher, & Brähler, 2000). Each of the specified items contains seven statements. For each statement in each item the proband tries to express the current level of satisfaction by selecting on a seven-grade scale. 1 = very dissatisfied, 7 = very satisfied (Rodná & Rodný, 2001).

Statistical analysis

Statistical result processing was conducted using the Statgraphics programme v. 10.0 (Statistica, Tulsa, USA). For each variable, basic statistical quantities were calculated and distribution normality verified. Normality was assessed using the Shapiro-Wilk normality test. To assess the differences between the average values of independent samples, the double-choice Student's t-test was used. The level of statistical significance was tested at $p \leq 0.05$; $p \leq 0.01$. The statistical significance is expressed in common p values as well as in d values, where d is the Cohen's coefficient for effect size defined as a difference between two means divided by a standard deviation for the data.

$$d = \frac{M_1 - M_2}{SD_{pooled}}, \text{ where } SD_{pooled} = \sqrt{\frac{(n_1 - 1) \cdot SD_1^2 + (n_2 - 1) \cdot SD_2^2}{n_1 + n_2 - 2}}$$

The most frequent assessment of effect size d is 0.2 – small effect, 0.5 – moderate effect and 0.8 – large effect (Thomas, Nelson & Silverman, 2011, Cortina, Nouri, 2000).

Results

The results section presents the main findings concerning the comparison of the monitored parameters in adult women regarding their level of physical activity. It is the level of physical activity that represents the principal determinant of the categorization into an active lifestyle or lifestyle with prevailing physical inactivity.

The overall proportion of body fat in physically active adult women was on average 20.9 %. The average identified value of body fat proportion in physically inactive women was 27.8 %. The identified difference of 6.9 % between the two samples was statistically significant and could also be considered significant in terms of effect size ($p \leq 0.01$; $d = 1.05$) (Table 1).

The proportion of body fat suggested significant differences in relation to the distribution of fat tissue in the whole body. The segmental analysis showed an average proportion of body fat in the upper limbs in physically active women of 16 to 17 %. In physically inactive women the values of body fat in the upper limbs were 24 to 25 %. The identified differences between the monitored samples were statistically as well as materially significant in all items. The proportion of body fat in the area of the trunk in physically active and physically inactive women showed notable as well as materially significant differences. The proportion of body fat in terms of individual segments suggested the largest percentage values in the area of the lower limbs in both monitored samples. In physically active women the value of body fat was around 24 %. In physically inactive women the values of body fat proportion exceeded 31 %. More than a seven percent difference in the proportion of body fat in the area of the lower limbs between the monitored samples was statistically as well as materially significant (Table 1).

Table 2 shows the values concerning the assessment of health and its components. The results confirm that women with an active lifestyle with physical activity assess their health much more positively in comparison with physically inactive women of the same age. The differences were found to be statistically significant ($p \leq 0.01$). Similarly, the differences in terms of effect size show a significant effect ($d = 0.76$). Moreover, most health subcomponents show significantly higher values in physically active women compared with physically inactive women. In terms of effect a significant difference was observed in the components of somatic health condition, mental condition and physical condition (Table 2).

Table 1. Body fat and segmental analysis in woman with active and inactive lifestyle

Body composition (woman)	Active				Inactive				Δ	p	d
	M	SD	Min.	Max.	M	SD	Min.	Max.			
Age (yrs.)	22.5	2.73	16.9	30.5	23.7	4.19	17.5	34.6	1.2	< 0.01	0.26
Body height (cm)	168.6	6.12	154.0	183.5	169.4	7.45	155.5	189.0	0.8	ns	0.09
Body weight (kg)	60.4	6.81	44.5	80.4	64.7	9.13	49.4	87.5	4.3	< 0.01	0.41
BMI (kg/m ²)	21.7	3.14	17.6	28.5	23.9	5.21	16.7	38.4	2.2	< 0.01	0.39
PBF (%)	20.9	6.27	7.3	30.8	27.8	4.53	15.6	36.8	6.9	< 0.01	1.05
FFM (kg)	47.1	5.47	38.2	67.1	46.2	7.26	37.7	64.9	0.9	ns	0.11
PBF RA (%)	16.5	6.19	3.9	30.5	24.2	5.06	10.2	34.9	7.7	< 0.01	1.12
PBF LA (%)	16.9	6.28	4.1	30.9	25.1	4.98	10.4	35.4	8.2	< 0.01	1.19
PBF TR (%)	16.2	6.18	4.9	28.5	24.9	5.24	12.6	39.5	8.7	< 0.01	1.24
PBF RL (%)	24.5	5.46	10.8	34.3	31.5	4.87	16.4	43.8	7.0	< 0.01	1.10
PBF LL (%)	23.9	5.51	10.7	34.2	31.9	5.11	16.7	44.6	8.0	< 0.01	1.21

Note: BMI–body mass index; PBF–percent body fat; RA–right arm, LA–left arm, TR–trunk, RL–right leg, LL–left leg; M–mean; SD–standard deviation; Min.–minimum; Max.–maximum; Δ –difference of mean; p –statistical significance; d –effect size (Cohen) - small effect (0,20–0,49), medium effect (0,50–0,79), large effect ($\geq 0,80$)

Table 2. Health assessment in woman with active and inactive life style

Health evaluation (woman)	Active M \pm SD	Range	Inactive M \pm SD	Range	Δ	p	d
Somatic health condition	5.5 \pm 1.27	1–7	4.2 \pm 1.53	1–7	1.3	< 0.01	0.90
Mental condition	5.6 \pm 1.19	1–7	4.3 \pm 1.41	1–7	1.3	< 0.01	0.97
Physical condition	5.5 \pm 1.22	1–7	4.1 \pm 1.48	1–7	1.4	< 0.01	1.00
Mental performance	5.4 \pm 1.19	1–7	4.8 \pm 1.32	1–7	0.6	< 0.01	0.47
Immunity	5.3 \pm 1.48	1–7	5.0 \pm 1.62	1–7	0.3	ns	0.19
Pain frequency	5.1 \pm 1.54	1–7	4.2 \pm 1.59	1–7	0.9	< 0.01	0.57
Disease frequency	5.2 \pm 1.63	1–7	4.7 \pm 1.71	1–7	0.5	< 0.05	0.30
Health Total Index	37.4 \pm 6.21	15–49	31.9 \pm 7.24	17–49	5.3	< 0.01	0.76

Legend: M–mean; SD–standard deviation; Δ –differences; p –statistical significance; ns–non-significant; d –effect of size (Cohen)

Discussion

The results concerning the proportion of body fat in physically active and physically inactive women were anticipated. The primary aspect is the difference in lifestyles, i.e. between physically active and physically inactive women. In the present survey, the results were specific values concerning the proportion of overall and segmental body fat and their differences in a specific group of physically active and physically inactive women, in our study these were undergraduate students.

In the present study, the sample of women who engage in regular physical activity was characterized by average body height of 168.6 cm and body weight of 60.4 kg. The BMI value was 21.7 kg/m², which is the health standard according to the WHO. The value of one of the basic somatic health indicators, i.e. the proportion of body fat, was 21 %. Such proportion of overall body fat in the sample of physically active women can be assessed positively regarding the recommended normative overall proportion of body fat in women (20 to 25 %). It can be objectively assumed that regular physical activity has an effect on a reasonable proportion of the fat fraction. In the present study we did not focus on the preferences, structure, and type of physical activity, but rather on the amount and intensity, which are supposedly decisive in promoting the health benefits of an active lifestyle in the monitored women. The findings presented in this study confirm this assumption.

The group of physically active women were compared with a sample of women of the same age who do not engage in any regular physical activity. In this context, this sample of women might be identified as inactive. It is generally assumed that the population between twenty and thirty years of age is the one with the lowest morbidity and mortality rate. However, it should be emphasised that the results of research studies focusing on the risk factors affecting the population of undergraduate students conclude that the health condition in these students is generally worse compared with non-student population of the same age (Kvintová, 2011).

The sample of the monitored physically inactive women was characterized by average body height of 169.4 cm and body weight of 64.7 kg. The BMI value was 23.9 kg/m², which is a standard value; however, there is a trend of higher values moving towards the overweight zone. In comparison with the sample of physically active women, physically inactive women were taller by one centimetre, heavier by three kilograms, and their BMI value was by two index points higher. With regard to the normative values, the basic somatic characteristics of inactive women were in the zone of average value variation. A different situation applies to one of the basic indicators of physical health, i.e. the amount of body fat. The results of the overall and segmental proportion of body fat in current physically inactive women showed significant differences. These differences concerned a higher proportion of body fat in comparison with the group of physically active women with an active lifestyle. The average value of the overall proportion of body fat in physically active women was almost 28 %. This value is beyond the recommended proportion of body fat, which should be between 20 and 25 % in healthy non-athletic women (Grasgruber & Cacek, 2008). Similarly, the segmental proportion of body fat in the lower limbs (more than 31 %) can be considered unsatisfactory with regard to the age of the probands (Boneva-Asiova, Boyanov, 2008). In this context, these findings are considered negative with regard to the level of physical health in physically inactive women. The current unsatisfactory condition might have further negative consequences in other developmental stages, and result in a specific lifestyle disease. The results of the study were individually analysed by means of feedback; practical recommendations were provided to the study participants. With regard to the identified values, the recommendations concerned basic measures in the area of lifestyle. An essential recommendation in the area of PA with an emphasis on prevention for inactive women in younger adulthood includes at least 30 minutes of physical activity on most days of the week by means of elementary locomotion activities such as walking, cycling, aerobic activities, and swimming (Býma, Hradec, Herber & Karen, 2004, Sigmundová et al., 2013). Similarly, the basic concept of 10,000 steps per day can be an appropriate recommendation (Hatano, 1993; Tudor-Locke, Hatano, Pangrazi, & Kang, 2008). Sophisticated recommendations with a clearly defined frequency of regular activity, precisely defined intensity (individually set heart rate, METs, VO₂ max, maximum pulse reserve), duration and type of activity, could, with regard to the long-term physical inactivity in the monitored undergraduate students, have a negative effect on the adherence to a possible change of their lifestyle during the initial stages. Should such change in terms of adopting an active lifestyle associated with regular PA in long-term physically inactive women be motivational and long lasting, the initial recommendations should be of a basic nature and respect individual possibilities and needs. At the beginning, the activity need not match the physiological parameters of optimized controlled PA, but most importantly, it should not discourage the individual or arouse emotionally negative reactions. In terms of PA recommendations and prescription, emphasis is placed on adequacy with a presumption of adherence to PA, subsequent adaptation and further development (Máček & Radvanský et al., 2011).

Behavioural habits associated with physical activity and subsequently with an active lifestyle represent a significant factor affecting the health of an individual. It turns out that it is necessary to increase the awareness of the relationships between physical activity and health. Edwy (2015) states that increased awareness of the relationships might influence the lifestyle of students and at the same time positively increase their motivation for adopting or maintaining an active lifestyle. The present study focused on the assessment of health in female undergraduate students with respect to their level of physical activity. The results confirm a significantly higher degree of subjectively perceived health and its components in those students, whose lifestyle includes regular

physical activity. It is obviously difficult to define the causal associations; however, the assumption of a positive relationship between physical activity and health is apparent throughout the study. This fact is also observed in other similar studies (Fagaras, Radu, & Vanvu, 2015; Pedišić, Rakovac, Titze, Jurakić, & Oja, 2014).

In general, the significance of PA is emphasised in the context of overall quality of life of an individual and with respect to a primary preventive nature. Besides indisputable physiological effects on the health of an individual, regular physical activity has an entertaining, affiliative, harmonization and recuperative function. With regard to disease symptomatology, Hošek defines significant functions of regular PA such as anti-stress and anti-depressive. It is also necessary to highlight the positive effect of PA in the context of involuntional changes and ageing, where PA has a meliorative and anti-involuntional role (Hošek, 2000). Regular and optimum PA, which respects individual needs, brings clear advantages for all health components as well as individual stages of human ontogenetic development.

Conclusions

The values concerning the overall proportion of body fat in physically active adult women and physically inactive adult women show statistically as well as materially significant differences. Similar results were observed in the assessment of the proportion of body fat by means of a segmental analysis of various parts of the body. The assessment of health and its components confirms that women with an active lifestyle, which includes physical activity, assess their health much more positively in comparison with physically inactive women of the same age. The differences were found to be statistically as well as materially significant. The most significant difference in health subcomponents were observed in the areas of somatic health condition, physical health condition, and mental condition. In terms of the frequency, intensity and duration of PA, physically active female undergraduate students meet the WHO PA guidelines on a weekly basis with respect to the health-preventive benefits, and at the same time show higher values of health assessment. Physically inactive female undergraduate students do not meet the health-preventive recommendations and at the same time achieve lower values of the assessment of health and its components.

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