PHYSICAL ACTIVITY, BODY MASS, BODY COMPOSITION AND THE LEVEL OF AEROBIC CAPACITY AMONG YOUNG, ADULT WOMEN AND MEN

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Abstract
Low level of physical activity is thought to be one of the main factors of many diseases development. Physical activity and aerobic capacity are very important elements of health. The aim of the study was to assess the relations between physical activity, body composition and level of aerobic capacity among young, adult women and men. The study involved 218 physiotherapy students (128 females and 90 males) and 380 physical education students (122 females and 258 males). The questionnaire was applied to assess their level of physical activity. Body mass was measured using Tanita BC 418 MA analyser. Height was measured using a Holtain stadiometer. Skinfold thicknesses were measured using a GPM caliper. Aerobic capacity was assessed indirectly taking into account the results of the PWC_{170} test. The ANOVA analysis was used.The results of the study demonstrated that women and men being physical education students characterised a higher level of physical activity than physiotherapy students. Female students of physical education have a significantly lower fat content and a significantly higher level of aerobic capacity, compared to the students of physiotherapy. Male students of physical education have a significantly lower body mass, lower fat content, lower value of the BMI index, as well as a significantly higher level of aerobic capacity, compared to the students of physiotherapy. The results indicate that women and men who have an active lifestyle characterised normal body fat content, BMI index and a higher level of aerobic capacity.

***Key words**: physical activity, body mass, body composition, aerobic capacity, young, adult women and men*

INTRODUCTION

Sedentary lifestyle, overweight and obesity are major health, clinical, and economical problems in modern societies. The worldwide epidemic of excess body mass is due to imbalance between physical activity and dietary energy intake. World Health Organization (2002) reports that about 60% of the global population do not do the daily minimum recommendation of 30 min of moderate-intensity physical activity. Insufficient physical activity increases the risk of cardiovascular disease (CVD) (atherosclerosis, arterial hypertension, coronary heart disease (CHD), congestive heart failure, cerebral stroke), high content of triglycerides (TG) and low-density lipoproteins in the blood (LDL), obesity, post-meal postprandial hyperinsulinaemia and carbohydrate intolerance, type-two diabetes, osteoporosis, malignant neoplasms, depression, and others (Eriksson 1986, Kampert et al.1996, Kohl et al. 1992, Wei et al. 1999). In addition, a negative impact on the immune system, resulting in lowered immunity and an increased vulnerability to inflammation and infection can be observed. Low physical activity may also lead to decrease of physical fitness, aerobic capacity and dysfunctions of the motor system, pains, and ultimately to further limitation of physical activity (ACSM 1998, Blair et al. 1995).

Regular physical activity plays a very important role in health maintenance and in the prevention of chronic diseases. Numerous adaptive responses take place with regular physical exercises. These adaptations result in a more efficient system for oxygen transport to muscle, improvement of the lipids utilization, instead of the carbohydrates. In addition, the reduction of adipose tissue mass improves mechanical efficiency of movements. Endurance training leads to improving of the cardiorespiratory fitness and results in beneficial metabolic effects (the improvement of the metabolic profile) (Bouchard 1990, 1994, Dunn et al. 1998, National Institutes of Health 1996).

Daily physical activity should contain four fundamental components of physical fitness: cardiorespiratory endurance, musculoskeletal fitness, body mass and body composition and flexibility [Dunn et al. 1998, 1999, Heyward 2006].

Cardiorespiratory endurance is closely connected with the lung, heart and muscle functions. A good level of aerobic capacity determines a high economics of energetic processes. Musculoskeletal fitness requires muscular strength, muscular endurance, and bone strength. Flexibility makes it possible to maintain the optimal spatial structure of motion, which significantly affects the strength, speed and economics of the muscles.

Health benefits of physical activity depend on the frequency, intensity and duration of physical activity (volume of physical activity) (Bouchard 2001, Dunn et al. 1999, Sharkey 1990, 1991).

All adults should perform at least 30 minutes of moderate-intensity physical activity on most, and preferably, all days. 45-60 minutes of physical activity of moderate intensity, performed every day can markedly reduce body mass and body fat mass without dietary caloric restriction in overweight individuals. Yet, the optimal approach in body mass reduction programs appears to be a combination of regular physical activity and caloric restriction. Regular moderate intensity physical activity, a healthy diet, and avoiding unhealthy body fat gain are effective, as well as safe ways to prevent and treat cardiovascular diseases, thus to reduce morbidity and premature mortality.
The objective of the study was to assess the level of fundamental factors of health: physical activity, body mass, body components and aerobic capacity among young, adult women and men.

METHODS

Participants

The study was conducted on 250 female and 348 male students, who declared that over previous 12 months they had not competitively practised any sport. They took part in obligatory physical activities under their course of study, in the average amount of 16 minutes (students of physiotherapy - Ph) and 36 minutes per day (students of physical education - PE). Moreover, the students of physiotherapy declared additional physical activity in the amount of 2 (females) and 6 (males) minutes per day, and the students of physical education in the amount of 5 (females) and 10 (males) minutes per day. Duration of total physical activity among the studied group of students is presented in tables 1 and 2.

Instruments

Anthropometry
First, their basic somatic indices were recorded. Height was measured using a stadiometer (GPM, Switzerland). Body mass was measured using Tanita BC 418 MA analyser (Tanita Corporation, Japan). Height was measured using a Holtain stadiometer. Skinfold thicknesses (biceps, triceps, subscapular, suprailiac) were measured using a GPM caliper. Fat content was calculated according to Durnin and Womersley [1974]. (SiberHegner & Co. Ltd., Switzerland). Measurements were done on the right side of the body.

Physical activity
Volume (duration) of physical activity was assessed by questionnaire. Total duration of obligatory physical exercises and additional physical activity was expressed in minutes per day.

Aerobic capacity
Aerobic capacity was assessed by an indirect method, using the PWC_{170} (Physical Working Capacity) test (Wahlund 1948, Council of Europe 1993). The PWC_{170} test was based on the performance of two five-minute standard efforts on a Monark cycloergometer 828 E (Monark Exercise AB, Sweden), with an individual load. PWC_{170} was calculated as the workload (power) at a heart rate of 170 beats per minute. The heart rate was measured with a Polar Sport Tester (Polar Electro Oy, Finland). The PWC_{170} index was calculated from the mean HR values recorded at the end of each 5-minute effort. The PWC_{170} index was used to calculate the maximum oxygen uptake (VO_{2max}) from the Karpman formula (Karpman 1969).

Data processing methods

The results of the study were analysed using the ANOVA statistic method, and the STATISTICA 7.0 software (Stat Soft Inc., USA).

RESULTS AND DISCUSSION

The obtained results of the investigations are presented in tables 1-4.

Table 1. Duration of physical activity in leisure time of the female and male physiotherapy (Ph) and physical education (PE) students.

Gender	Group	n	Active n	%	Duration (min/day)
Women	Ph	128	12	9,4	37
	PE	122	46	37,7	64
Men	Ph	90	20	22,5	43
	PE	258	122	47,3	70

Table 2. Total duration (average number of minutes) of physical activity of the female and male physiotherapy (Ph) and physical education (PE) students.

Gender	Group	Duration of physical activity Obligatory (min/day)	Additional (min/day)	Total (min/day)
Women	Ph	16	2	18
	PE	36	5	41
Men	Ph	16	6	22
	PE	36	10	46

The female and male students of physiotherapy (Ph) characterised a much lower level of physical activity in comparison to the female and male students of physical education (PE). Between 128 female students of physiotherapy only 12 (9,4%) do some additional physical exercises regularly. 46 (37,7%) male students of physiotherapy (between 90) do additional physical exercises regularly.

Table 3. The values of selected somatic indices of the female and male physiotherapy (Ph) and physical education (PE) students.

Women	Age (years)	BM (kg)	BF (%)	BF (kg)	LBM (kg)	BMI (kg/m^2)
Ph, n=128	22,0±2,33	60,11±10,36	25,47±5,82	15,82±6,94	44,28±4,17	21,90±3,43
PE, n=122	21,5±3,01	58,37±8,48	23,92±5,54	14,36±5,67	44,01±3,58	21,39±2,96
Difference (%)		3,0	6,5*	10,2	0,6	2,4

Men	Age (years)	BM (kg)	BF (%)	BF (kg)	LBM (kg)	BMI (kg/m^2)
Ph, n=90	22,3±2,6	81,49±13,46	15,89±5,33	13,44±6,22	68,05±8,59	25,00±3,58
PE, n=258	21,9±3,17	76,97±10,58	12,78±4,98	10,18±5,04	66,78±7,16	23,73±2,83
Difference (%)		5,9**	24,3***	32,0***	1,9	5,4***

* p<0,05 ** p<0,01 ***p<0,001

The female students of physiotherapy (Ph) demonstrated a significantly higher fat content by 6,5% (p< 0.05) compared to the students of physical education. According to the standards of World Health Organisation (WHO), both groups demonstrated correct values of the body mass index (BMI).

The male students of physiotherapy demonstrated significantly higher body mass values, by 5,9% (p< 0.01) and higher fat content, by 24,3-32,0% (p< 0.001), which led to higher values of the body mass index BMI (p<0.001) as compared to the students of physical education. According to the standards of World Health Organisation (WHO), the students of physical education demonstrated correct values of the body mass index (BMI), whereas the students of physiotherapy were exactly on the border between correct level and overweight.

Table 4. Aerobic capacity indices in the PWC_{170} test of the female and male physiotherapy (Ph) and physical education (PE) students.

Women	VO_{2max} (L/min)	VO_{2max} (mL/kg/min)	PWC_{170} (W)	PWC_{170} (W/kg)
Ph, n=128	2,29±0,24	38,59±5,03	103,06±23,15	1,72±0,34
PE, n=122	2,35±0,24	40,71±4,98	110,19±22,41	1,90±0,31
Difference (%)	2,6	5,5**	6,9*	10,5***

Men	VO_{2max} (L/min)	VO_{2max} (mL/kg/min)	PWC_{170} (W)	PWC_{170} (W/kg)
Ph, n=90	3,11±0,44	38,59±5,51	183,23±43,44	2,26±0,44
PE, n=258	3,15±0,44	41,51±6,99	189,10±42,48	2,48±0,57
Difference (%)	1,4	7,6**	3,2	10,0***

* p<0,05 ** p<0,01 ***p<0,001

The female students of physiotherapy achieved similar level of VO_{2max} expressed in absolute values (L/min) compared to the students of physical education. The relative values (mL/kg/min) in the female students of physiotherapy were significantly lower, by 5,5% (p<0.01) compared to the students of physical education.

According to Astrand and Rodahl (1986) female students of physiotherapy achieved medium (average) level of aerobic capacity.

The research results indicate that the female students of physiotherapy achieved significantly lower level of PWC_{170} index, by 6,9% in absolute values (p<0.05) and by 10,5% in relative values (p<0,001).

The results of the male students were similar to female students. The male students of physiotherapy achieved similar level of VO_{2max} expressed in absolute values (L/min) compared to the students of physical education. The relative values (mL/kg/min) in the male students of physiotherapy were significantly lower by 7,6% (p<0.01) compared to the students of physical education.

According to Astrand and Rodahl (1986) male students of physiotherapy achieved very low level of aerobic capacity, whereas male students of physical education achieved low level of aerobic capacity.

The research results indicate that the male students of physiotherapy achieved slightly lower level of PWC_{170} index, by 3,2% in absolute values (a difference not important statistically) and significantly lower, by 10,0% in relative values (p<0,001).

DISCUSSION

Regular participation in physical activity rather than any inherited component of fitness that is related to health (Hein et al. 1992).

Both physical activity and physical fitness are now accepted as independent risk factors for several chronic diseases. The identification of low level of physical activity and physical fitness enable remedial strategies.

Health benefits depend on the volume of physical activity (frequency, intensity and duration) [Bouchard 2001, Sharkey 1990].

Moderate-intensity physical activity on most days of the week reduces the risk of coronary heart disease (CHD) by 50% and the risk of hypertension, diabetes, and colon cancer by 30% [U.S. Department of Health and Human Services 1996]. Moderate level of physical activity (1,25 to 2,5 hours in the week) decreases the risk of breast cancer by 18% in postmenopausal women (McTiernan et al. 2003).

Centers for Disease Control (CDC) and the American College of Sports Medicine (ACSM) endorsed the following statement regarding physical activity for health benefits: 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week [Pate et al. 1995].

In the Institute of Medicine (IOM) report stated that 30 minutes of daily physical activity may be insufficient for fully health benefits and to maintain an optimal body mass for many individuals. The IOM recommended 60 minutes of daily moderate-intensity physical activity (Blair et al. 2004, Brooks et al. 2004). This recommendation is consistent with recommendations made by other organizations, i.e. Health Canada (2003), World Health Organization (Brooks et al. 2004).

Yet, too high volume of physical activity may be associated with negative health consequences (Fahey and Swanson 2008, Kesaniemi et al. 2001). Fahey and Swanson [2008] demonstrated the model of optimal amount of physical exercise to protective while minimizing the risk of sudden death. The model predicted that the optimal amount of vigorous exercise (6 METS or more) is 30 minutes a day, six sessions a week (5443 kJ/week), with a range of 4 to 7 days a week (3600 to 6364 kJ/week). Physical inactivity or exercising below the 6 METS threshold led to an increased relative risk. Exercising vigorously 7 days a week for 2,5 hours per day also led to increased relative risk.

The US Department of Health and Human Services (HHS) has issued guidelines regarding the types and amounts of physical activity that provide substantial health benefits for physical activity for individuals 6 years and older. These 2008 Physical Activity Guidelines for Americans (US Department of Health and Human Services 2008) Key Guidelines for Adults recommended:

- All adults should avoid inactivity. Some physical activity is better than none, and adults who participate in any amount of physical activity gain some health benefits.
- For substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Aerobic activity should be performed in episodes of at least 10 minutes, and preferably, it should be spread throughout the week. -For additional and more extensive health benefits, adults should increase their aerobic physical activity to 300 minutes (5 hours) a week of moderate-intensity, or 150 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity activity. Additional health benefits are gained by engaging in physical activity beyond this amount.
- Adults should also do muscle-strengthening activities that are moderate or high intensity and involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits.

The results presented in this article showed insufficient (below a minimum 30 minutes per day) level of physical activity in most of the female and male students of physiotherapy. Probably this is a cause of high body mass level, body fat content and body mass index in male group. Nevertheless physical inactivity of female students of physiotherapy there were no differences of indices of body composition compared to female students of physical education. Probably it is an effect of low level of ecosensitivity (low sensitivity on environmental factors) in women.

Low level of physical activity in female and male students of physiotherapy results in lower level of aerobic capacity. Nevertheless physical inactivity of female students of physiotherapy, this group achieved medium level of aerobic capacity. This confirms low level of ecosensitivity in women. In contrary, despite of very high level of physical activity of the students of physical education, they had a low level of aerobic capacity. This confirm high level of ecosensitivity in men.

CONCLUSION

1. The less favourable body proportions among the male and female students of physiotherapy, compared to those of the male and female students of physical education, were probably the result of their very low level of physical activity.

2. The low level of physical activity among the male and female students of physiotherapy was accompanied by a lower level of aerobic capacity, whereas high physical activity among the male and female students of physical education was accompanied by a higher level of aerobic capacity.
3. The study indicates a significant effect of physical activity on the level of body mass, body fat content and aerobic capacity in tested groups.
4. Average level of aerobic capacity, despite of physical inactivity of the female students of physiotherapy indicates low level of ecosensitivity in women.
5. Very low level of aerobic capacity despite of higher level of physical inactivity in comparison to the female students of physiotherapy indicates high level of ecosensitivity in men.
6. High level of BMI index of the students of physiotherapy indicates increased risk of cardiovascular disease.

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TJELESNA AKTIVNOST, TJELESNA TEŽINA, SASTAV TIJELA I NIVO AEROBNOG KAPACITETA KOD MLADIH ADOLESCENATA ŽENA I MUŠKARACA

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Sažetak

Smatra se da je nizak nivo tjelesne aktivnosti jedan od glavnih faktora za razvoj mnogih bolesti. Tjelesna aktivnost i aerobni kapacitet su veoma važni elementi zdravlja. Cilj istraživanja je bio da se procjeni odnos između fizičke aktivnosti, građe tijela i nivoa aerobnog kapaciteta između mladih adolescenata žena i muškaraca. Istraživanje je uključilo 218 studenata fizioterapije (128 djevojaka i 90 muškaraca) i 380 studenata tjelesnog odgoja (122 djevojke i 258 muškaraca). Korišten je upitnik da bi se procjenio njihov nivo tjelesne aktivnosti. Tjelesna masa je mjerena vagom Tanita BC 418 MA. Visina je mjerena Holtain visinomjerom. Kožni nabori mjereni su kaliperom GPM. Aerobni kapacitet testiran je indirektno, preračunavajući rezultate postignute na PWC_{170} testu. U analizi podataka je korištena ANOVA. Rezultati istraživanja pokazuju da studentkinje i studenti fakulteta za tjelesni odgoj imaju veći nivo fizičkih aktivnosti nego studenti fizioterapeutskog fakulteta. Djevojke fakulteta za tjelesni odgoj imaju statistički značajno niže vrijednosti potkožnog masnog tkiva i viši nivo aerobnog kapaciteta u odnosu na studentkinje fizioterapije. Studenti fakulteta za tjelesni odgoj i sport imaju značajno manju tjelesnu masu, manje potkožnog masnog tkiva, niže vrijednosti BMI, kao i, značajno viši nivo aerobnog kapaciteta u odnosu na studente fakulteta fizioterapije. Rezultati ukazuju da žene i muškarci koji imaju tjelesno aktivan stil života imaju i normalne vrijednosti potkožnog masnog tkiva, vrijednosti BMI te viši nivo aerobnog kapaciteta.

Ključne riječi: *tjelesna aktivnost, tjelesna masa, građa tijela, aerobni kapacitet, mladi adolescenti djevojke i muškarci*

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