Medicina Sportiva
Med Sport 12 (3): 86-91, 2008
DOI: 10.2478/v10036-008-0017-7

THE OCCURENCE AND DISTRIBUTION OF CARDIOVASCULAR SYSTEM DISEASES RISK FACTORS AMONG YOUTH WITH DIFFERENT LEVELS OF PHYSICAL ACTIVITY

Krzysztof Mazurek[1(A,C,D,E,F)], Anna Czajkowska[2(A,B,D,E,F)], Grażyna Lutosławska[3(A,D,E,F)], Piotr Żmijewski[4(B,C,D,F)], Marzena Malara[3(B,E)]

[1]Department of Sports Medicine, Józef Pilsudski Physical Education Academy, Warsaw, Poland
[2]Department of Physiology, Józef Pilsudski Physical Education Academy, Warsaw, Poland
[3]Department of Biochemistry, Józef Pilsudski Physical Education Academy, Warsaw, Poland
[4]Ph.D. studies - Józef Pilsudski Physical Education Academy, Warsaw, Poland

Abstract

Introduction: The majority of modifiable risk factors depends on the level of physical activity.

The aim of the research: The purpose of this study is to assess the occurrence, distribution, and intensification of risk factors in the development of circulatory system diseases in students and the correlation between physical activity and the appearance of risk factors.

Materials and methods: 162 students (75 females and 87 males) were recruited for the study. The subjects' physical activity (PA) was assessed by using the Seven-Day Physical Activity Recall (SDPAR) questionnaire. The participants were divided into two subgroups: with a low (LPA) and a high (HPA) level of physical activity. The assessed factors were measured: resting pulse rate, arterial blood pressure, serum lipid and glucose concentration, tobacco smoking, and the family history concerning the occurrence of coronary heart disease and diabetes mellitus.

Results: The subjects' average values BMI were normal. The average PA among women presented was as follows: LPA value was 4.62 hours/week (1315.52 kcal/week) and HPA value was 18.88 hours/week (6739.09 kcal/week). The LPA males spent 6.47 hours/week (2456.77 kcal/week) on physical activity whereas the HPA males spent 17.32 hours/week (8653.48 kcal/week). Males and females in HPA subgroup, when compared with subjects from LPA subgroup, showed lower average resting pulse rate values and lower average systolic/diastolic arterial blood pressure values in men, and diastolic arterial blood pressure in women. In the case of HPA subgroup, in both men and women, lower average values of glucose, TC, LDL, TC/HDL, and higher average HDL values were recorded. Dyslipidemia was found among 58 subjects (0.35), including 31 males (0.35) and 27 females (0.36). Dyslipidemia turned out to be more frequent in the case of LPA women than in the case of HPA women (0.42 and 0.21, respectively). Among male subjects, dyslipidemia was found in 5 LPA and 5 HPA males. 7 women and 4 men were tobacco smokers (2 HPA women and no HPA men). The positive family history of cardiovascular diseases was reported by 31 subjects (0.19) and the positive family history of diabetes mellitus was reported by 16 subjects (0.09).

Conclusions: Subjects in the HPA group, when compared with LPA group, showed lower average resting heart rate values, lower average systolic/diastolic arterial blood pressure values among men, and diastolic arterial blood pressure among women, as well as lower concentration of glucose, TC, LDL cholesterol and lower values of TC/HDL indicator, and higher HDL cholesterol concentration. The most frequently reported risk factors were dyslipidemia and tobacco smoking among women as well as dyslipidemia and hypertension among men. Negative correlation was found between the level of physical activity and resting pulse rate among men and women as well as between the level of physical activity and glucose concentration among women. No correlation was found between the level of physical activity expressed in energy expenditure and lipid fractions, and between the level of physical activity and arterial blood pressure.

***Key words**: youth, physical activity, risk factors, cardio-vascular diseases*

Introduction

Detection and identification of risk factors and cardiovascular diseases risk assessment among asymptomatic people is of crucial importance in primary prophylaxis (1-3). A beneficial modification of children and youth's lifestyle effectively decreases the risk of clinical forms of cardiovascular diseases among adults (4,5).

Numerous epidemiological research indicate that the majority of risk factors linked to improper nutrition, lack of physical activity, and tobacco smoking may be responsible for 75% new cases of coronary arterial disease (6-8). The study conducted among the population of Warsaw revealed that the decrease in systolic pressure and the decrease in the number of

tobacco smokers from 1984 to 2001 contributed to the decrease of global mortality rate caused by cardiovascular diseases by 50% and 23% among the male and female population, respectively. The decrease in the number of deaths caused by cardiovascular diseases after 1991 was ascribed to favorable changes in dietary habits of the Polish population, mainly lower animal fat consumption, the decrease in the percentage of smoking male population, and the improvement of hypertension and hyperlipemia treatment results (9). According to the present guidelines, normal values of arterial blood pressure (BP) are subdivided into three categories: optimal, normal and normal high blood pressure. This subdivision originates from the fact that people with normal systolic high blood pressure (130-139 mm Hg BPs) and diastolic (85-89 mm Hg BPd) are at higher risk of the developing a coronary arterial disease than people with optimal values (≤120 mm Hg BPs and ≤80 mm Hg BPd) (11, 21).

In prevention of cardiovascular diseases, an adequate level of physical activity, particularly during leisure time, is of an importance. The lack of physical activity is considered an independent, yet modifiable risk factor in the development of ischemic heart disease (1,10,11).

In the middle-age population, the frequency of ischemic heart disease is inversely proportional to physical activity (11). Numerous research findings suggest that people engaged in a regular, no shorter than 30 minutes, three times per week, exercise activity at a low to moderate intensity level (60% to 75% VO_2max), benefit from the effects of health training. This type of exercise entails diverse health benefits, also in primary prophylaxis of cardiovascular diseases (3). The advantages of physical exercise are: an improvement in circulatory-respiratory fitness, favorable modification of lipid profile, reduction of arterial hypertension, increase in insulin sensitivity and glucose uptake by the muscles, and, finally, body fat and stress level reduction (11,12). Also, other findings show that physical training combined with a low-cholesterol diet leads to regression of atherosclerotic changes in coronary arteries which is very positive form of therapy in secondary prophylaxis (13,14).

In comparison with other European countries, Polish population, including youth, displays a relatively low physical activity level (15,16). The survey conducted in 2002-2004 among the Polish adult population (17) indicated that 35.9% of the respondents reported high and moderate physical activity, whereas 37.4% led a sedentary lifestyle.

The aim of this research was to assess the occurrence, distribution and intensification of cardiovascular diseases risk factors among the first year students, and also to assess the correlation between physical activity level and the occurrence of risk factors.

Materials and methods

162 students, (75 females and 87 males) were recruited for the study. The subjects were the first year students of the Physical Education Academy in Warsaw (142 students: 66 females and 76 males) and the first year students of the Cardinal Stefan Wyszyński University in Warsaw (20 people, including 11 males and 9 females). With respect to age and anthropometric indicators, the students at Cardinal Stefan Wyszyński University did not differ from the Physical Education Academy student population. However, they were characterized by a lower physical activity level. All the students volunteered for the research. The research was approved by the Senate Bioethical Committee of the Physical Education Academy.

The personal questionnaire contained information on smoking and the family history of tobacco smoking, diabetes mellitus, and cardiovascular diseases. The family history was considered positive if parents had type 1 or 2 diabetes mellitus and/or cardiovascular diseases (coronary artery disease including myocardial infarction, hypertension, stroke, for a mother – before the age of 65, for a father – before the age of 55). Physical activity was evaluated by using the Seven-Day Physical Activity Recall (SDPAR) questionnaire (18). For the assessment of energy expenditure associated with physical, recreational and sport activity, physical activity of moderate, high and very high intensity level was taken into consideration, to which energy expenditure values of 4METs, 6METs and 10METs corresponded, respectively. Based on the assessed energy expenditure (METs per week), the subjects were divided into subgroups of high (HPA) and low (LPA) physical activity by cutting of the upper and lower quartile of METs values.

Based on the anthropometric measurements of body mass and height the Body Mass Index (BMI) was calculated. Resting systolic (BPs) and diastolic (BPd) blood pressure was measured by using the Korotkow's method. Arterial blood pressure limits were assessed according to JNC VI (21). In the serum of venous blood collected from the antecubital vein from fasting subjects in the morning, the following values were assayed: glucose, total cholesterol (TC), HDL-cholesterol (HDL) and triglyceride (TG) levels. LDL cholesterol (LDL) level was calculated based on Friedewald's formula. Based on the obtained results TC/HDL was calculated. Norms for lipid fractions were accepted according to the Third Report of National Cholesterol Educational Program (NCEP) (11). The significance of the between-group differences was tested by means of t Student test and U Mann-Witneya'a test. Linear regression analysis was conducted by using r Pearson's and r Spearman's tests. All calculations were performed by using Statistika 5.0 software (USA).

Results

Table 1. *Age, BMI, resting heart rate and resting blood pressure (mean, ±SD)*

Variables	Men			Women		
	LPA n=22	HPA n=22	p	LPA n=19	HPA n=19	p
Age (years)	20.15 ±0.68	20.14 ±0.77	p>0.05	20.15 ±1.03	20.34 ±1.25	p>0.05
BMI	22.79 ±2.41	23.84 ±2.53	p>0.05	21.61 ±2.59	21.31 ±1.69	p>0.05
HR (bpm)	80.05 ±11.13	67.73 ±8.81	p<0.001	78.58 ±11.30	72.21 ±6.33	p<0.05
BPs (mmHg)	125.68 ±6.95	124.09 ±8.40	p>0.05	120.00 ±4.71	121.21 ±8.37	p>0.05
BPd (mmHg)	82.50 ±5.93	80.45 ±6.35	p>0.05	79.21 ±3.82	78.42 ±5.28	p>0.05

Women in total group (n=75), compared to men in total group (n=87), have significant statistical smaller values BMI as well systolic blood pressure (BPs) and diastolic blood pressure (BPd) but higher heart rate values (HR).

Table 2. *Physical activity of the students based on the number of hours and energy expenditure per week (mean, ±SD)*

Variables	Men			Women		
	LPA n=22	HPA n=22	p	LPA n=19	HPA n=19	P
PA (hrs)	6.47 ±2.05	17.32 ±113.77	<0.001	4.62 ±1.97	18.88 ±4.77	<0.001
PA (kcal)	2456.77 ±863.71	8653.48 ±1547.78	<0.001	1315.52 ±570.48	6739.09 ±2056.32	<0.001
PA (MET)	32.50 ±10.73	113.77 ±20.18	<0.001	21.68 ±8.45	111.03 ±28.58	<0.001
TEE (kcal)	18611.61 ±2294.23	23936.41 ±2906.66	<0.001	14501.24 ±1737.59	18683.63 ±2802.11	<0.001

PA - physical activity, TEE – total energy expenditure

Women in total group, compared to men in total group, have significant statistical smaller values physical activity (PA kcal), (PA MET) and total energy expenditure (TEE kcal) per week.

Table 3. *Glucose, lipid fraction and atherogenic index (mean ±SD)*

Variables	Men			Women		
	LPA n=22	HPA n=22	p	LPA n=19	HPA n=19	p
Glucose (mmol·L^{-1})	4.94 ±0.61	4.75 ±0.48	p>0.05	4.70 ±0.48	4.32 ±0.31	p<0.01
TC (mmol·L^{-1})	4.58 ±1.01	4.43 ±0.56		4.60 ±0.48	4.37 ±0.36	p>0.05
TG (mmol·L^{-1})	0.82 ±0.43	0.76 ±0.33		0.59 ±0.26	0.64 ±0.22	
LDL (mmol·L^{-1})	2.77 ±0.98	2.61 ±0.59		2.76 ±0.55	2.51 ±0.36	
HDL (mmol·L^{-1})	1.40 ±0.29	1.49 ±0.41		1.57 ±0.28	1.57 ±0.30	
TC/HDL	3.36 ±0.84	3.16 ±0.94		3.02 ±0.58	2.86 ±0.49	

Women in total group, compared to men in total group, have significant statistical smaller values: glucose, TG and TC/HDL and significant statistical bigger HDL.

Table 4. *Distribution of lipid cardiovascular diseases risk factors (fractions)*

Variables	Men			Women		
	LPA n=22	HPA n=22	p	LPA n=19	HPA n=19	p
TG	0.05	0.05	p>0.05	0	0	p>0.05
TC	0.27	0.18		0.21	0.05	
HDL	0.09	0.05		0.16	0.16	
LDL	0.32	0.23		0.32	0.16	
TC/ HDL	0.14	0.05		0.11	0.05	
Dyslipidemia	0.36	0.36		0.42	0.21	

Between women and men in total groups, no significant statistical differences in range of fractions in subjects with abnormal values of lipids were found.

Table 5. *Distribution of non-lipid cardiovascular diseases risk factors (fractions)*

Variables	Men			Women		
	LPA n=22	HPA n=22	p	LPA n=19	HPA n=19	p
HPs	0.00	0.09	p>0.05	0	0.05	p>0.05
HPd	0.23	0.14		0	0	
HP in total	0.23	0.23		0	0.05	
Family history	0.32	0.14		0.42	0.37	
CVD	0.23	0.14		0.32	0.16	
DM	0.09	0.00		0.21	0.21	
Smokers	0.09	0.00		0.16	0.11	

HPs - systolic hypertension, HPd - diastolic hypertension, CVD - cardiovascular disease, DM - diabetes mellitus

Between women and men in total groups, no significant statistical differences in range of fractions in subjects with abnormal values of blood pressure, positive family history for CVD or DM and who are smokers were found. Also, no significant correlation was found between physical activity expressed in time of PA and energy expenditure (METs and kcal) and lipid profile fractions as well between physical activity and systolic and diastolic arterial blood pressure. A significant negative correlation was found between physical activity and resting heart rate value among females and males, respectively (r -0.31, p≤0.01 and r -42, p≤ 0,01) and between physical activity and serum glucose level among women (r -0.23, p≤0.05).

Discussion

The examined students had normal average BMI values. Significant differences in BMI values were found between males and females, however no differences of any statistical significance were noted between LPA and HPA groups.

Weekly energy expenditure associated with physical and recreational activity among LPA women was lower (approximately 1315 kcal) according to recommended values whereas, in the case of LPA

men, it slightly exceeded the recommended level 2000kcal/week. With respect to HPA subgroups, energy expenditure considerably exceeded the recommended norms of pro-health physical activity. The differences in energy expenditure between HPA and LPA subgroups (among men and women) were of high statistical importance.

The average resting pulse rate values in the case of both the female and male subjects in HPA subgroup were significantly lower in comparison with male and female subjects in LPA subgroup. Resting heart rate value is considered a cardiovascular risk factor. Presently, it is not clear whether a higher resting heart rate value constitutes an independent risk factor or an indirect risk factor affecting a higher energy expenditure, or a marker of other disturbances which may reveal as cardiovascular diseases in the future (19). It is evident that physical activity is one of the best physiological methods to slow the heart rate whereas double product is an indicator of oxygen consumption by the myocardium and correlates with coronary arterial blood flow among healthy people (20).

Among female students, the average arterial blood pressure values were within optimal values limits whereas the average arterial blood pressure values among men were higher and considered normal.

We found lower values in systolic and diastolic blood pressure among men as well lower diastolic blood pressure among women in HPA subgroups, compared to students from LPA subgroups. All hypertensive subjects presented a mild form of hypertension (I° hypertension). Elevated arterial blood pressure was indicated in the case of 2 women, including one in the HPA subgroup as well as among 21 men, including 5 in LPA and 5 in HPA subgroup. One abnormal result of blood pressure could not serve as a sufficient criterion for recognized arterial hypertension. The diagnosis of arterial hypertension among people with modestly exceeded resting heart rate values requires several measurements and further examination, including 24-hour arterial blood pressure monitoring. With regard to young people with mild arterial hypertension, a non pharmacological treatment is recommended in primary prophylaxis. Numerous research data shows a favorable effect of regular physical activity on arterial blood pressure value reduction (6,21). The associated occurrence of arterial hypertension and hypercholesterolemia increases considerably the risk of coronary arterial disease and requires a more rigorous level of therapeutic intervention procedures, in particular, those involving dietary intake and physical activity. The risk of coronary heart disease increases significantly among people with diabetes mellitus, particularly when diabetes mellitus is accompanied by other risk factors, like in metabolic syndrome. (11). The average serum glucose level values were significantly lower among the females. Also, women engaged in a high physical activity level showed significantly lower glucose concentration in comparison with the group displaying a low physical activity level. Similar differences, while statistically insignificant, were recorded among men.

Elevated TC and LDL concentration among young adults and low HDL concentration increases the risk of atherosclerosis development and its complications, including coronary heart disease (10,11,22). The average values of lipid profile indicators and atherogenous indicators were normal among the subjects. The women obtained better results of triglyceride level, HDL cholesterol level and cholesterol index (TC/HDL). Both among men and women in the HPA subgroup showed lower average values of TC, LDL, TC/HDL and higher HDL values were noted in comparison with LPA subgroup. Presented data are supported by the results associated with the impact of physical activity on lipid profile noted by other authors. The research conducted among the first year students of Physical Education Academy Warsaw, revealed that serum lipid fractions concentration and atherogenic indicators show the positive direction of changes in the case of the group with a higher physical activity level, yet showing no statistical significance (24). In another research examining this issue, one stated the positive impact of physical activity on lipid profile, depending on energy expenditure, only among men. In the case of HPA women, one revealed higher LDL cholesterol and lower HDL cholesterol concentration in comparison with LPA women. The author explains these results by referring to the impact of high physical activity level on disturbances in the secretion of female hormones that could cause unfavorable changes in lipid profile (25). In the research assessing the impact of systematic aerobic exercises among middle-aged women on health indicators, one revealed significant decrease of TC, LDL-cholesterol and triglyceride concentration and the increase of HDL-cholesterol concentration after 24 days of training (26). Presented research indicated that the most frequent risk factors among students include lipid disorders and hypertension among men as well as lipid disorders and smoking among women. Lipid profile disorders most often revealed borderline high TC and LDL values, and low HDL values. The highest percentage of dyslipidemia was found in the case of the LPA female subgroup (8 women, 0.42), whereas in the case of the HPA subgroup lipid disorders were found in 4 women (0.21).

In the case of the compared male groups, similar correlation was revealed. Elevated TC and LDL, and TC/HDL indicators as well as low HDL values were indicated among a lower number of HPA students.

11 subjects (0.06), 7 females and 4 males were tobacco smokers. In the case of HPA subgroup no man

smoked. With respect to women in HPA subgroup, only two were smokers. Tobacco smoking is a significant risk factor of circulatory system diseases development among people of both sexes. Giving up smoking should be the first step in primary prophylaxis of circulatory system diseases (9,10). In research associated with pro-health activities, an emphasis on a beneficial impact of physical activity on the reduction of stimulants is placed (24). The family history concerning the occurrence of diabetes mellitus and/or cardiovascular diseases was the next risk factor assessed in the research (3,11). A positive family history of diabetes mellitus and cardiovascular diseases was reported by 47 subjects (0.19 of CVD, 0.09 of DM). A positive family history was more frequently reported by women (30 females vs 17 males), which is likely to be a results of a higher state of awareness of the family members' health condition. Individuals with a positive family background should be referred to a primary prevention, including lipid profile determination. Linear regression analysis indicated negative correlation between the level of physical activity and resting pulse rate both among men and women, as well as between the level of physical activity and glucose concentration among women. No significant correlation was found between physical activity lipid profile indicators or between physical activity and systolic and diastolic arterial blood pressure. This outcome may suggest that students entering the study program at the Physical Education Academy engaged in a systematic sport and recreational physical activity with high energy expenditure for a considerably short period of time.

Conclusions

HPA students (in comparison with the LPA group) showed lower average resting pulse rate values, lower average systolic/diastolic arterial blood pressure values among men and diastolic arterial blood pressure among women. In the case of male and female HPA subgroup, in comparison with LPA subgroup, one indicated lower concentration of glucose, TC, LDL-cholesterol, and lover values of TC/HDL indicators, and higher HDL concentration. The most frequent risk factors turned out to be dyslipidemia and smoking among women as well as dyslipidemia and arterial hypertension among men. Negative correlation was indicated between the level of physical activity and resting pulse rate among men and women, and between the level of physical activity and glucose concentration among women. No correlation was indicated between the level of physical activity expressed in energy expenditure, and lipid fractions and arterial blood pressure.

References

1. Haskell WL, Lee IM., Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc* 2007; 39: 1423-34.
2. Kavey RE, Daniels SR, Lauer RM, et al. American Heart Association guidelines for primary prevention of atherosclerotic cardiovascular disease beginning in childhood. *Circulation* 2003;107:562-1566. doi:10.1161/01.CIR.0000061521.15730.GE
3. European guidelines on cardiovascular disease prevention in clinical practice. *Eur J Cardiovasc Prev Rehab* 2003; 10 suppl. 1: S1 – S78
4. Magnussen CG, Raitakari OT, Thomson R, et al. Utility of currently recommended pediatric dyslipidemia classifications in predicting dyslipidemia in adulthood. Evidence from the Childhood Determinants of Adult Health (CDAH) Study, Cardiovascular Risk in Young Finns Study, and Bogalusa Heart Study. *Circulation* 2008;117:32-42. doi:10.1161/CIRCULATIONAHA.107.718981
5. McMahan CA, Gidding SS, Fayad ZA. et al. Risk scores predict atherosclerotic lesions in young people. *Arch Intern Med* 2005; 165: 883–90. doi:10.100/archinte.165.8.883
6. Hayman LL, Meininger JC., Daniels SR, et al. Primary prevention of cardiovascular disease in nursing practice: focus on children and youth: A Scientific Statement From the American Heart Association Committee on Atherosclerosis, Hypertension, and Obesity in Youth of the Council on Cardiovascular Disease in the Young, Council on Cardiovascular Nursing, Council on Epidemiology and Prevention, and Council on Nutrition, Physical Activity, and Metabolism. *Circulation* 2007; 116(3): 344-57. doi:10.1161/CIRCULATIONAHA.107.184595
7. Knoflach M, Kiechl S, Kind M, et al. Cardiovascular risk factors and atherosclerosis in young males: ARMY study (Atherosclerosis Risk-Factors in Male Youngsters). *Circulation*. 2003; 108: 1064–1069. doi:10.1161/01.CIR.0000085996.95532.FF
8. McGill HC Jr, McMahan CA, Zieske AW, et al. Effects of nonlipid risk factors on atherosclerosis in youth with a favorable lipoprotein profile. *Circulation* 2001; 103: 1546–50.
9. Rywik S., Piotrowski W., Rywik T. i wsp. Czy spadek umieralności z powodu chorób układu krążenia ludności Polski związany jest z obniżeniem globalnego ryzyka sercowo-naczyniowego zależnego od zmian w stylu życia? *Kardiol Pol* 2003;5: 350-4.
10. Grundy SM, Cleeman JI, Merz CN, et al. for the National Heart, Lung, and Blood Institute, American College of Cardiology Foundation, and American Heart Association. Implications of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel III guidelines. *Circulation* 2004; 110: 227–39. doi:10.1161/01.CIR.0000133317.49796.OE
11. Third Report of National Cholesterol Educational Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) Final Report. *Circulation* 2002; 106: 3143-353.
12. Jegier A, Stasiołek D. Skuteczna dawka aktywności ruchowej w prewencji pierwotnej chorób układu krążenia i promocji zdrowia. *Med Sport* 2001; 5 (Supl. 2): S109-S118.
13. Strong JP. Częstość występowania i stopień zaawansowania miażdżycy u osób w wieku dojrzewania oraz u młodych dorosłych. *JAMA-PL* 1999; 1 (10), 651-60.
14. Tuzcu EM, Kapadia SR, Tutar E, et al. High prevalence of coronary atherosclerosis in asymptomatic teenagers and young adults: evidence from intravascular ultrasound. *Circulation* 2001; 103: 2705–10.
15. Drygas W, Skiba A, Bielecki W i wsp. Evaluation of physical activity of the citizens from six European countries. „Bridging East-West Health Gap". *Med Sport* 2001; 5 (suppl. 2): S119-S128.
16. Mazurek K, Wit B, Mróz A i wsp. Health positive behavior of students Warsaw Physical Education Academy and cardiovascular diseases risk. *Med Sport* 2004; 8 (suppl 2): S69-S70.
17. Drygas W, Kwaśniewska M, Szcześniewska D i wsp. Ocena poziomu aktywności fizycznej dorosłej populacji Polski. Wyniki programu WOBASZ. *Kardiol Pol* 2005;63:6 (supl. 4): S1-S5.
18. Seven-Day Physical Activity Recall. *Med Sci Sports Exerc* 1997; 29 (6 suppl.): S89-S103.

19. Undas A, Podolec P, Kopeć P i wsp. Konsensus Rady Redakcyjnej PFP dotyczący tzw. nowych czynników i markerów ryzyka sercowo-naczyniowego, które mają potencjalnie istotne znaczenie w strategii zapobiegania chorobom sercowo-naczyniowym. *Forum Profilaktyki* 2007; 2 (7): 1-8.
20. McArdle WD, Katch FI, Katch VL. The cardio-vascular system and exercise. In: Essentials of exercise physiology. Lippincott Williams & Wilkins, Philadelphia, 2000: 263-95.
21. JNC VI. The six report of the Join National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. *Arch Intern Med* 1997; 157: 2413-46.
22. Jolliffe CJ, Janssen J. Distribution of lipoproteins by age and gender in adolescents. *Circulation* 2006; 114: 1056-62. doi:10.1161/CIRCULATIONAHA.106.620864
23. Zasady postępowania w nadciśnieniu tętniczym. Stanowisko Polskiego Towarzystwa Nadciśnienia Tętniczego. *Nadciśnienie Tętnicze*, 2000; 4: B1-B34.
24. Wojtyczek B. Ocena zachowań prozdrowotnych i wybranych wskaźników stanu zdrowia studentów I roku Akademii Wychowania Fizycznego. Praca doktorska, AWF Warszawa, 2004.
25. Makara M. Aktywność fizyczna, sposób żywienia a profil lipidowy oraz stężenia insuliny i adiponektyny w osoczu młodych kobiet i mężczyzn. Praca doktorska, AWF Warszawa, 2008.
26. Piotrowska-Całka E. Aqua aerobic jako forma promocji zdrowia i poprawy jakości życia u systematycznie ćwiczących kobiet. Praca doktorska, AWF Warszawa, 2006.

Received: June 01, 2008
Accepted: August 11, 2008
Published: September 03, 2008

Address for correspondence:
Dr hab med. Krzysztof Mazurek
University of Physical Education
Deaprtment of Sports Medicine
00-968 Warsaw 45
PO Box 55
Poland
e-mail: kmazurek46@wp.pl

Anna Czajkowska: aniaczajkowska@wp.pl
Grażyna Lutosławska: grazyna.lutoslawska@awf.edu.pl
Piotr Żmijewski: zmijewski@op.pl
Marzena Malara: marzena.malara@wp.pl