

CARDIOVASCULAR RISK IN STUDENTS WITH DIFFERENT LEVEL OF AEROBIC CAPACITY

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ABSTRACT: Study aim: Estimation of cardio-vascular risk in young adults with different level of aerobic capacity. Materials and Methods: In 162 students, 75 women and 87 men in average age 20.19 ± 1.11 and 20.18 ± 0.77 , respectively were assessed: smoking, daily energy expenditure for physical activity, body height and mass, BMI, heart rate, blood pressure, VO_2 max, lipids and glucose concentration in plasma. Cardio-vascular diseases risk were estimated using SCORE system. Comparative analysis CVD risk were done according to the level of VO_2 max. Results: The most developed risk factor CVD was hypercholesterolemia, appearing in 19.5% men and 14.7% women and next smoking, 4.6% and 9.3%, respectively. In low quartile VO_2 max men and women compare to high VO_2 max quartile, was found smaller percentages persons without risk factors (63.3% vs 86.4% and 68.4% vs 73.7%, respectively) and bigger with hypercholesterolemia (36.4% vs 9.1% and 21.1% vs 10.5%, respectively). CVD risk in women was: AR 1%, RR 0.31%, AR60 2.16%, in men 1.02%, 0.43% and 5.49%, respectively. Men from L VO_2 max compare to H VO_2 max had significantly higher relative risk ($p < 0.043$) and risk extrapolated on 60 years ($p < 0.033$). 12 men (54,5%) from L VO_2 max subgroup and 6 (27,3%) from H VO_2 max subgroup had high risk extrapolated on age 60 years (AR 60 > 5%). Differences between subgroups were not significant. Conclusion: between aerobic capacity and relative risk as well extrapolated on 60 years CVD risk we found significant correlation in men. When CVD risk is evaluated aerobic capacity should be taken for consideration.

KEY WORDS: cardiovascular risk, youth, aerobic capacity

INTRODUCTION

As result of many epidemiological study cardiovascular diseases (CVD) are main reason of premature death in Europe and as well significant cause of disability and it generate high costs of medical care. In most cases CVD remain in close relationship to the style of life and reduction of risk factors lead to decrease mortality and mobility from CVD [1,4,5].

Recommendation concerning primary prevention of the cardiovascular diseases are directed, first of all, to the asymptomatic persons with risk factors of the atheromatosis and to the persons burden by cardiovascular diseases in medical family history. Primary prevention should be prescribed for children and especially for youth, because first atherosclerotic lesions in the form of fatty streaks appears in childhood, whereas next phase of illness, including atheromatous plaque were found in youth [6,9].

When prophylaxis aims are established and primary prevention is introduced one should begin from evaluation individual risk of cardiovascular events. Risk of cardiovascular events means probability of ill or death [4]. Value of risk depends from many of personal and environmental factors, named risk factors. [4]. Apart of main risk

factors of CVD such as: older age, male gender, increased concentration of cholesterol, triglycerides and LDL cholesterol, decreased concentration HDL cholesterol, smoking, hypertension and diabetes there are many predispositional risk factors, namely: overweight, obesity, lack of physical activity (PA), positive family history of premature occurring cardiovascular diseases [7,18].

Inadequate level of PA is important and common risk factor in high developing countries, contributed in increased developing civilization diseases, especially cardiovascular diseases. Between level of PA for sport and recreation and aerobic capacity occur significant relationship [3,13,22]. Higher level of PA is associated with lower level of mortality from all reasons, independently from other risk factors. While, low level of aerobic capacity is one from the risk factors of cardiovascular diseases [8,10].

Current European Society of Cardiology (ESC) and Polish Society of Cardiology (PSC) recommendation prescribe evaluation of cardiovascular risk using Heart SCORE Programme [2,4].

The aim of presented study was evaluation of cardiovascular risk using interactive electronic version of Heart SCORE in students with

different level of physical activity and aerobic capacity and assessment relationship between cardiovascular risk and aerobic capacity.

MATERIALS AND METHODS

Study were carry out in 162 volunteer (75 women and 87 men), students of Physical Education Academy in Warsaw. Subjects were informed about aim and condition of study as well as to abstain from smoking, alcoholic beverages and intensive physical efforts during 24 hours preceding of examinations. Study were carry out after acceptance of Ethic Commission.

Examination included: smoking, body high and mass, body mass index (BMI). Physical activity was assess on the base of daily energy expenditure for sport and recreation activity, using Seven-Day Physical Activity Recall (SDPAR) questionnaire [19]. In rest was measured heart rate (HRr), systolic and diastolic blood pressure (SBPs, DBPr) by Korotkow method. Aerobic capacity was evaluated by direct

TABLE 1. AVERAGE VALUES (\pm SD) SOMATIC AND PHYSIOLOGIC INDICES IN SUBJECTS

Variables	Women [n=75]	Men [n=87]	Statistical significance [p<0.05]
Age [years]	20.19 \pm 1.11	20.18 \pm 0.77	ni
Body height [cm]	167.54 \pm 5.41	180.61 \pm 6.04	p<0.001
Body mass [kg]	60.14 \pm 7.54	76.59 \pm 8.75	p<0.001
BMI	21.41 \pm 2.36	23.48 \pm 2.48	p<0.001
SBP [mmHg]	119.50 \pm 7.23	124.60 \pm 7.24	p<0.001
DBP [mmHg]	78.31 \pm 5.25	81.87 \pm 5.89	p<0.001
TC [mmol/L]	4.55 \pm 0.56	4.52 \pm 0.73	ni
HDL [mmol/L]	1.56 \pm 0.30	1.43 \pm 0.36	p<0.01
LDL [mmol/L]	2.68 \pm 0.52	2.68 \pm 0.77	ni
TG [mmol/L]	0.67 \pm 0.31	0.81 \pm 0.37	p<0.01
Glucose [mmol/L]	4.45 \pm 0.42	4.76 \pm 0.56	p<0.001
PA [met/wk]	58.70 \pm 37.08	71.11 \pm 32.41	p<0.01
VO ₂ max [ml/min/kg]	41.06 \pm 4.70	48.41 \pm 6.44	p<0.001
Smoking [%]	9.3	4.6	ni

Legend: BMI – body mass index, SBP – systolic blood pressure, DBP – diastolic blood pressure, TC-total cholesterol, HDL- high density cholesterol, LDL-low density cholesterol, TG-triglycerides, PA (met/wk) – energy expenditure for physical activity (met/week), ni – not significance

TABLE 2. AVERAGE VALUES (\pm SD) VO₂MAX AND ENERGY EXPENDITURE IN MEN AND WOMEN OF LOWER AND UPPER QUARTILE SUBGROUPS OF VO₂MAX

Variables	Women LVO ₂ max [n=19]	Women HVO ₂ max [n=19]	Men LVO ₂ max [n=22]	Men HVO ₂ max [n=22]	Statistical significance p< 0.05
VO ₂ max [ml/kg/min]	35.5 \pm 1.8	47.6 \pm 2.1	40.3 \pm 2.5	48.9 \pm 3.0	Sex: p<0.001 PA: p<0.001 ^{na}
VO ₂ max [ml/FFM/min]	48.1 \pm 2.9	60.8 \pm 2.6	47.8 \pm 2.8	55.7 \pm 3.9	Sex: ni PA: p<0.001 ^{na}
PA-DEE [kcal/kg/day]	8.31 \pm 6.03	10.06 \pm 6.35	8.40 \pm 3.98	10.97 \pm 5.17	Sex: ni PA p<0.01

Legend: FFM - fat-free mass, PA-DEE: daily energy expenditure for physical activity, L - low level, H - high level, na – not applicable, since relative VO₂max was the classification criterion

method of measures maximal oxygen consumption (VO₂max), during exercise on bicycle ergometer (Monark Ergomedic 874 E, Sweden). Analyzer Sensor Medics 2900/2900c USA was used for gas analysis. Lipid profile and glucose concentration was measured in venous blood serum in fasting state.

The subjects were arranged according to their relative VO₂max and the results of those from the lower (LVO₂max) and upper (HVO₂max) quartiles were subjected to further analysis. Using interactive electronic version HEART SCORE for high risk countries [24] for each subjects were evaluated following indices, describing of cardiovascular risk:

1. Absolute CVD risk- AR -define probability of fatal cardiovascular events in 10 years (in percentage)
2. Relative CVD risk- RR - define as risk of fatal cardiovascular events for given person compare to the same gender and age person without risk factors, prognoses on period 10 years
3. Absolute risk extrapolated to age 60 - AR60 - define as percentage probability risk of fatal cardiovascular events after age 60 (in percentage).

Taking into consideration classification subjects on lower and upper quartile VO₂max subgroups, statistical analysis were carry out according to relationship between cardiovascular risk indices (AR, RR, AR60) and aerobic capacity.

Analysis of data in women and men in lower and upper quartiles VO₂max was perform by two-way ANOVA. Assay of normal spread data was carry out using Kolmogorow-Smirnow test. Assessing differences between groups was made using U Mann-Whitney test for variables with anomalous spread or Student-t test for independent data and variables with normal spread. Differences of percentages frequency appearing risk factors were account by chi square test. The level of p<0.05 was considered significant. Estimation were carry out by Statistica v.5 programme of Statsoft.

RESULTS

Somatic and physiological characteristics of subjects were presented in table 1. In table 2. differences between men and women of low and high VO₂max in absolute and relative VO₂max and PA-DEE were presented. Distribution of risk factors calculated by Heart Score system among men and women were showed in table 3 and calculated by

TABLE 3. DISTRIBUTION OF RISK FACTORS CALCULATED BY HEART SCORE SYSTEM AMONG MEN AND WOMEN

	Women n=75		Men n=87	
	n	[%]	n	[%]
Without risk factors	57	76.0	65	74.7
Hypercholesterolemia	11	14.7	17	19.5
Smoking	7	9.3	4	4.6
Hypertension	0	0.0	1	1.1

Heart Score System cardiovascular risk among men and women was presented in table 4. In table 3 only single risk factors were presented, because two or more risk factors not appeared in any subjects. In fig 1. distribution of risk factors in men and women of lower and upper quartile subgroups of VO₂max was presented.

Because of no statistical difference in cardiovascular risk between VO₂max subgroups in women, only in VO₂max subgroups of men cardiovascular risk calculated by Heart Score System was presented (table 5.)

DISCUSSION

Many of studies found that atherosclerosis is chronic disease process, beginning in early period of life [6,11]. Anatomicopathologic investigations carried out in person from 2 to 39 years old, were found significant distribution of atherosclerotic lesions. The latter demonstrate in children and young adults burden of classic risk factors, association of initial atheromatous lesions, such as fatty steaks and atheromatous plaque [1,12,17].

Prognostic risk of cardiovascular events is important marker of prevention process. Different method have been used for evaluation CVD risk [11,16]. Current guides ESC and PSC recommended using Heart SCORE System (Systematic COronary Risk Evaluation) [2,18]. Heart SCORE System worked out on the base of longitudinal epidemiological studies from 12 European countries, divided on low and high risk countries, which Poland belong. For calculation of cardiovascular risk events during 10 years, is taken under consideration: age, gender, smoking, systolic blood pressure and total cholesterol concentration [24]. Estimated risk according to SCORE not consider physical activity. Whereas, in ESC and PSC recommendations it is stressed, that lack of PA or its insufficient level increase cardiovascular risk.

TABLE 4. CARDIOVASCULAR RISK CALCULATED BY HEART SCORE SYSTEM AMONG MEN AND WOMEN

	Women n=75			Men n=87		
	AR [%]	AR60 [%]	RR	AR [%]	AR60 [%]	RR
$\bar{x} \pm SD$	1.00 ± 0.00	2.16 ± 0.68	0.31 ± 0.80	1.02 ± 0.15	5.49 ± 1.38	0.43 ± 0.88
min	1.00	1.00	0.00	1.00	4.00	0.00
max	1.00	4.00	3.00	2.00	11.00	3.00
mediana	1.00	2.00	0.00	1.00	5.00	0.00

Legend: AR - absolute cardiovascular risk, AR60 - risk extrapolated to age 60, RR- relative cardiovascular risk

SCORE System could be use only for person without diagnosed coronary heart disease. Young persons with low total risk, who are burden by classic risk factors, such as smoking, hypercholesterolemia, hypertension, have higher relative risk of cardiovascular events compare to persons in the same age and gender without of risk factors. Threshold value according to SCORE, for high absolute risk of CVD amount ≥5%. Total cardiovascular risk in context of ESC recommendations means probability development all cardiovascular events on atherogenic background, with fatal and non fatal course in 10 years period. Absolute cardiovascular risk is define as probability fatal cardiovascular events in 10 years period.

New ESC recommendation point out, when absolute cardiovascular risk reach 5% according to SCORE, total risk is higher and reach average level about 10%, however total risk for men is higher than women [4].

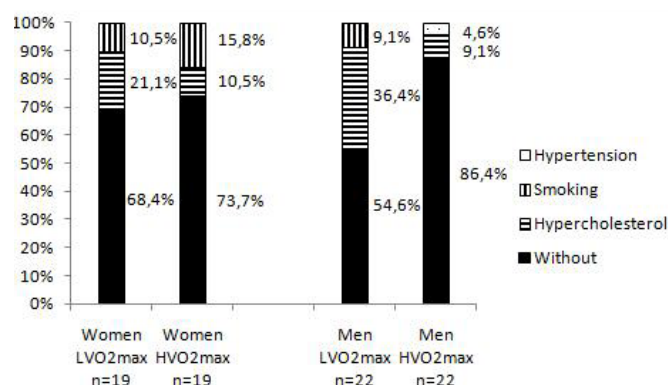


FIG 1. DISTRIBUTION OF RISK FACTORS IN MEN AND WOMEN OF LOWER AND UPPER QUARTILE SUBGROUPS OF VO₂MAX

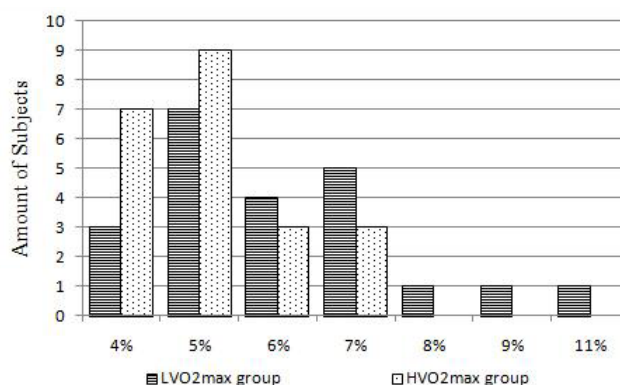


FIG 2. NUMBERS OF MEN ON THE EACH LEVEL OF CARDIOVASCULAR RISK EXTRAPOLATED ON AGE 60 FROM LOWER AND UPPER QUARTILE OF VO₂MAX

TABLE 5. CARDIOVASCULAR RISK CALCULATED BY HEART SCORE AMONG MEN OF LOWER AND UPPER QUANTILE SUBGROUPS OF VO₂MAX

Cardiovascular risk	LVO ₂ max n=22	HVO ₂ max n=22	Statistical significance p< 0.05
AR [%]	1.05 ± 0.21	1.00 ± 0.00	ni
AR60 [%]	6.09 ± 1.72	5.09 ± 1.02	p<0.05
RR	0.77 ± 1.07	0.23 ± 0.75	p<0.05

Legend: AR - absolute cardiovascular risk, AR60 - risk extrapolated to age 60, RR- relative cardiovascular risk, ni- no significance

Long standing influence risk factors on total risk could be calculated by reference current level of risk, for instance, for 20 years old person, to the level of risk which one reach in age 60 years [5].

In our subjects, average values somatic and physiological indices holds in normal range. Men differ significantly from women by bigger value: height, body mass, BMI, systolic and diastolic blood pressure, triglycerides and total cholesterol concentration, energy expenditures for sport and recreation physical activity and VO₂max. In women we found significantly bigger HDL cholesterol concentration and bigger percentage of smokers (without statistical significance). There are not significant difference in total cholesterol and LDL cholesterol concentration.

Risk factors don't occur in 57 (76%) women and 65 (74.7%) men according to SCORE, only single risk factors were found in remained students. The most frequent risk factor was hypercholesterolemia, burden 19.5% men and 14.7% women, consecutive risk factor was smoking, 4.6% and 9.3%, respectively.

Women and men from LVO₂max subgroup, compare to HVO₂max subgroup, have significantly lower energy expenditure for sport and recreational physical activity and significantly lower relative VO₂max, in relation to body mass and fatty free body mass.

Analyzing prevalence of risk factors in lower and upper quartile in men and women, we found smaller percentage persons without of risk factors in LVO₂max subgroups compare to HVO₂max (68.4% vs 73.7% in women, 54.6% vs 86.4% in men) and bigger percentage persons with hypercholesterolemia (21.1% vs 10.5% women and 36.4 vs 9.1% men), respectively. (Fig. 1). Smoking students appear only in LVO₂max men subgroup (9.1%), whereas among women as well in LVO₂max (10.5%) and HVO₂max (15.8%). The most stronger factor negatively influenced on total risk is smoking. It is especially noticeable after extrapolation absolute risk on age 60. 60 years old men, without risk factors, have calculated absolute risk, arise from age and gender, about 5.02%. In the same age men with hypercholesterolemia absolute risk increase to about 6.36%, with systolic hypertension to about 7%, whereas in smokers to about 9.75%. In case of accumulation two or more risk factors, absolute risk increase several times [4,15].

In student women average values of absolute cardiovascular risk (AR), relative risk (RR) and risk extrapolated on age 60 (AR60) were low. Because of those reason comparative analysis between women's LVO₂max and HVO₂max subgroups were not carry out.

Average absolute risk in men was low as well, relative risk amount 0.43 in relationship to reference group, whereas average risk extrapolated on age 60 turn out 5.49%±1.38 and in accordance with SCORE was assess as high.

Men from lower quartile VO₂max had significantly bigger relative risk (p<0.043) and risk extrapolated on age 60 (p<0.033) compare to men from upper quartile VO₂max.

12 men (54,5%) from LVO₂max subgroup and 6 (27,3%) from HVO₂max subgroup had high risk extrapolated on age 60 years (AR 60>5%). Differences between subgroups were not significant. It should be stressed, that AR 60>7% had 3 men from lower quartile VO₂max (Fig. 2).

Aerobic capacity correlated more with cardiovascular risk, than physical activity measured by numbers of hours spend for PA or energy expenditure on the latter. Because of those prophylaxis aims for PA should be directed on achieving higher level of physical fitness, what in the effect, bring decrease of cardiovascular risk [8,10].

In young people burden by risk factors, who have low absolute risk, extrapolation on age 60 permit evaluate what level of risk they reach at those age, when risk factors will remain on the similar level.

Because atheromatous process as well as cardiovascular risk characterized continuous and long standing course, suitable changes of style of life in young people could reduce in fundamental way their present risk and decrease enhance of risk connected with aging. ESC recommendation emphasized that evaluation of total CVD risk in asymptomatic persons, who have not high level of risk factors is particularly important [2,16].

Study of European society show, that many people, also young, have moderately increase level of many risk factors, which clustering could cause unexpected high total CVD risk [14, 21, 23].

Study carried out among young adult in Greece confirm correlation between risk indices, evaluated according to SCORE, like relative risk and risk extrapolated on age 60, to many intensive atheromatous features, what justify usefulness SCORE procedure in primary prevention in young adult people [20].

CONCLUSIONS

Average value of risk extrapolated on age 60 in women was low, whereas in men was high. Among men from upper quartile VO₂max, higher percentage of persons without risk factors was found, moreover latter subgroup characterized significantly lower relative risk and lower risk extrapolated on age 60 in comparison to subgroup from lower quartile of VO₂max.

Between aerobic capacity and cardiovascular relative risk as well risk extrapolated on age 60 in men occur significant relationship. Evaluation of cardiovascular risk according to SCORE, should take under consideration, such additional risk factors as low level of aerobic capacity, which could cause increase of total risk in people.

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