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SELF-EVALUATION OF YOUNG MEN'S EFFICIENCY BASED ON EXERCISE PARAMETERS

Key words: efficiency evaluation, self-evaluation, health indicators, health behaviours.

ABSTRACT

The two main tasks of the WHO are population health and its examination. In recent years special attention has been paid to the use of subjective indicators, including self-evaluation, in health examination. The main aim of this study was to compare the results of exercise tests carried out on a group of young men with their self-evaluation results to verify the reliability of the obtained data. Selected health behaviours with a significant impact on both exercise test results and self-evaluation were analysed. The sample comprised a group of thirty-two students who undertook a treadmill test to determine the basic parameters of their aerobic capacity. Also, a questionnaire modeled after the Polish version of the Nottingham Health Profile (NHP) and Health Behaviour in School-Aged Children (HBSC) was employed to examine health state and selected health behaviours. The results of exercise tests revealed a significant correlation between the subjects' VO_2max level and self-evaluation of health and efficiency as well as participation in physical activities. According to the American Heart Association indications, the examined men's physical efficiency was on a high level; however, over one half of subjects (59.4%) rated it incorrectly (in most cases it was underestimated). As this study results show, the inquiry data concerning efficiency evaluation are not sufficient.

INTRODUCTION

Physical efficiency is one of positive health measures and is also the basis of a good state of mind [8, 25]. Many authors ascribe to physical efficiency a cultural and social significance [13, 19].

In questionnaires which examine both the state of mind and health, self-evaluation is one of the most commonly used subjective measures. It is one of factors determining the quality and length of life, similar to physical and psychical conditions [9]. Health self-evaluation, which is considered by the WHO to be one of the main subjective measures of population health, is often used in international comparative analyses [2, 8, 10].

Apart from the subjective measures one can also distinguish objective ones [16] such as morbidity rate, mortality rate, medical examination results, exercise tests, fitness tests and body composition measurements. In reference to health, the objective measures yield information on the working efficiency of particular systems and on the body's adaptation to exercise. From the physiological standpoint health and the efficiency of adaptive mechanisms are interdependent [17].

Many authors emphasize the relevance of self-evaluation and its results in analyses of Poles' health state in comparison with results of similar international studies [18, 26]. The results of numerous studies which compare self-evaluation

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with selected health state measures and the quality and satisfaction of life, indicate a statistically significant dependence [15, 23, 24]. Also, in studies of medical conditions such as postoperative surgeries, where the subjects were under constant medical care, special attention was paid to patients' self-evaluation [3, 13, 21, 31].

When analyzing studies emphasizing the significance of self-evaluation in relation to physical and psychical health, a question emerges regarding the convergence of subjective indicators (like self-evaluation) and objective evaluation. The question is whether the self-evaluation results are comparable with normalised estimation (in this study with the results of exercise test)?

The aim of this work is to compare exercise test results achieved by a group of young men with their self-evaluation results, in consideration of selected health-oriented behaviours. The comparative analysis will allow us to verify and compare the inquiry data concerning self-evaluation and the results of exercise tests.

METHODS

The research, which consisted of two parts, involved a group of thirty-two students aged 21-24 ($\bar{x} = 21.6 \pm 0.9$) with an average body mass of 74.4 kg ± 10.3, body height of 181.1 cm ± 7.6, and the BMI = 22.9 ± 2.83, who declared a good or a very good health state and no contraindications regarding exercise tests, all of which were confirmed later by the medical doctor present during the examination. The sample was considered homogeneous in relation to physical activity due to the fact that none of the subjects had undertaken any regular sport activity before. Among the examined men twelve declared irregular spontaneous participation in some form of recreation (moderately active group), while the rest of the men did not take part in any physical activity (inactive group).

The first part of the study involved the use of a diagnostic auditorium questionnaire aimed to determine the manner in which the tested students spent their free time, their physical and recreational activity taken at present and in the past and their health-oriented behaviours. The questionnaire consisted of eighteen questions (see Appendix). The students had been informed about the aim and form of the study. The first part of the questionnaire concerned self-evaluation and health-oriented behaviours. The second part included questions about the ways the students spent their free time and their participation in sport and recreational activities. The third part contained questions about their age, sex and current place of residence. The questions were partially patterned on the Polish version of the Nottingham Health Profile (NHP) [5, 20] as well as on the Health Behaviour in School-Aged Children: A WHO Collaborative Cross-national Study (HBSC) international standard questionnaire, both used in subjective health state evaluation [7, 24].

The second part of the study involved exercise tests aimed to determine the subjects' aerobic capacity and body composition, and to assess lactic acid concentration before and after exercise. The study was given approval by the Bioethical Committee. The examination was conducted in the presence of a medical doctor who assessed the group's ability to take part in the test and monitored the whole process.

After the biometrical measures the subjects took part in a non-invasive measurement of body composition using bioelectrical impedance with Akern Bia 101 and Bodysgram and Bodyscan software. The students were positioned in recumbency for the examination. Eight electrodes were placed on the skin of the dorsal surface of both the left and the right hand and on the right and the left leg. Body composition was established on the basis of capacitive reactance and resistance values with the use of Bodysgram and Bodyscan software. Then, the subjects were acquainted with the appropriate movement technique before taking the treadmill test (Trackmaster). The aerobic capacity evaluation was carried out during an incremental test. The starting speed was set to 4 miles per hour (mph) and increased by 0.5 mph every two minutes until it reached the maximum oxygen uptake (VO_2max). Gases were analyzed on each respiratory cycle using a computerized ergospirometer (Oxycon Mobile, Jaeger): pulmonary ventilation (VE), oxygen uptake (VO_2) and removal of carbon dioxide (VCO_2). The oxygen uptake was given in ml/kg and it was calculated by body mass. The heart rate (HR) was monitored with a Polar Sport tester (PE 3000). Before the test and 3 minutes after its completion capillary blood samples were taken from the ear lobe. Also, lactic acid concentration was marked with a Hach Lange Spectrophotometer.

APPENDINX: QUESTIONNAIRE

I. Health self-evaluation and health behaviours

1. How would you rate your health state?
a) very good b) good c) satisfactory d) poor e) bad

2. Do you suffer or have you ever suffered from?
a) cardiovascular diseases b) digestive system diseases c) respiratory system diseases
d) kinetic system diseases e) nervous system diseases f) other……

3. Are you satisfied with your appearance?
a) yes b) rather yes c) rather no d) no

4. Do you smoke?
a) no, I have never smoked b) no, I don't smoke anymore c) yes, sporadically
d) yes, up to a few cigarettes a day e) yes, up to one pack a day f) yes, over one pack a day

5. Do you drink alcohol, if so, how often do you drink?
a) no b) yes, sporadically c) yes, at least once a month
d) yes, at least once a week e) yes, a few times a week

6. In your opinion, which of the following factors influences our health the most?
a) nutrition b) stress c) physical activity d) use of stimulants e) other …..……

7. Do you consider your lifestyle healthy?
a) definitely yes b) rather yes c) rather no d) definitely no

II. Efficiency self-evaluation and physical activity

8. Do you consider yourself a physically active person?
a) definitely yes b) rather yes c) rather no d) definitely no

9. How would you rate your efficiency (fitness)?
a) very good b) good c) satisfactory d) poor e) bad

10. Apart from physical education lessons, have you participated in any kind of sports activity?
a) no b) yes, sporadically c) yes, regularly

11. Do you participate in sports activity at present?
a) no b) yes, sporadically c) yes, regularly

12. The amount of time you devote to physical activity per week is…
a) over 5 hours b) from 3 to 5 hours c) from 1 to 3 hours d) less than an hour

13. The amount of your free time per day is:
a) over 10 hours b) from 6 to 10 hours c) from 3 to 6 hours
d) from 1 to 3 hours e) less than an hour

III. Personal data

14. Sex
a) female b) male

15. Age
a) 15-25 years old b) 26-35 years old c) 36-45 years old d) 46-55 years old
e) 56-65 years old f) over 65 years old

16. Occupation
a) student b) office worker c) physical laborer d) unemployed, pensioner, annuitant

17. Net monthly income
a) parents' dependent b) up to 800 PLN c) over 800 up to 1,500 PLN
d) over 1,500 up to 2,500 PLN e) over 2,500 up to 3,500 PLN f) over 3,500 PLN

The results were processed statistically and arithmetic means ($\overline{x}$) and standard deviations (SD) were calculated. The variables were analysed with Student's t-test. Moreover, the Pearson product-moment correlation coefficient (r) was calculated. The level of statistical significance was set at $p \leq 0.01$.

RESULTS

Self-evaluation results

Among the examined men sixteen of them considered their health state to be very good, fifteen good, one person satisfactory, and no one considered it poor or bad. Twenty-two subjects were satisfied with their appearance. Three regarded themselves as highly active, seven moderately active, seven slightly active, and the rest (fifteen people) as completely inactive.

When it comes to subjects' self-evaluation of body efficiency the examined students, the results were: very good (3 students), good (12), satisfactory (12) and poor (6).

In relation to participation in sports and recreational activities, eight of the questioned men declared active participation, twenty-four participated in recreational activities sporadically or did not take up any physical activity at all.

Furthermore, 86% of the students indicated physical activity as a basic component of a healthy lifestyle.

Efficiency measurement results

The subjects' biometric indices are listed in Table 1. It shows that despite the similar age and limited participation in physical activities the subjects achieved different results of biometrical measurements, especially when it comes to body weight, which varied between 50.5 kg and 96 kg, and the body height between 166.5 cm and 190 cm. The BMI varied between 17.4 and 29.3 and in many cases was very low.

The subjects did not have obesity problems (Tab. 2). Only two students revealed a higher body fat percentage index which exceeded 40%.

Table 1. Subjects' age and biometric parameters. The upper row shows trait means with their standard deviations and the lower one presents the range of trait variability

Average	Age	Body height	Body weight	BMI
$\overline{x}$ ± S.D.	21.6±0.9	181.0±7.6	74.4±10.3	22.9±2.8
min–max	21–24	166.5–190.0	50.5–96.5	17.4–20.3

Table 2. Bioelectrical impedance analysis of body composition. The upper row shows the average percentage and standard deviations of fat tissue content, fat free mass and muscle tissue in their range of trait variability

Average	Fat tissue content (%)	Fat free mass (%)	Muscle tissue (%)
$\overline{x}$ ± S.D.	21.2±8.6	78.9±8.6	54.9±4.4
min–max	09.0–46.9	53.1–91.0	46.3–66.4

Table 3 contains the results of the exercise test which also indicated significant differences among the individuals. The maximal oxygen uptake (VO_2max; per 1 kg of the body mass) was taken as the main parameter in the evaluation of subjects' ability to perform a long-lasting physical exercise. The lowest VO_2max value was 34 ml/kg/min, while the highest was 58 ml/kg/min, and the average amounted to 47 ml/kg/min. The pulmonary ventilation results varied from 82 l/min up to 163 l/min. Similar differences were noted in the lactic acid

concentration after straining, where the minimum value amounted to 5.0 mmol/l, while the maximum to 14.5 mmol/l, and the average result equaled 8.5 mmol/l.

During the analysis it was found that the men with the highest VO_2max scores gained also the highest running velocity (V), which is shown by the high Pearson product-moment correlation coefficient ($r = 0.87$). The other dependencies between the examined parameters (VE, HR, LA) indicated a positive correlation; however, the correlation coefficient (r) did not exceed 0.5.

self-evaluation and the maximal oxygen uptake reached where Pearson's product-moment correlation coefficient amounted to $r = 0.53$.

The students who considered themselves physically active reached a higher VO_2max level amounting to the average score of 51.7 ml/kg/min, while the average value of the maximal oxygen uptake of the physically inactive men amounted to 45.5 ml/kg/min ($p \leq 0.01$) (Fig. 1c).

Smoking was an important factor which influenced the scores of maximal oxygen uptake and self-evaluation (Figs. 1d, 2a, b). The smokers

Table 3. Treadmill exercise test results. In the upper row, there are average values and standard deviations of heart rate (HR), maximum oxygen uptake (VO_2max), pulmonary ventilation, (VE), running velocity (V) and lactic acid concentration after straining in the range of trait variability

Average	HR (b/min)	VO_2max (ml/kg/min/)	VE (l/min)	V (mph)	LA (mmol/l)
$\bar{x} \pm$ S.D.	194.8 ± 14.7	47.0 ± 5.7	121.2 ± 21.7	7.8 ± 0.9	8.5 ± 2.3
min – max	134.0 – 214.0	34.3 ± 58.0	53.0 ± 163.0	6.0 ± 9.5	5.0 ± 14.5

Comparison of self-evaluation and efficiency measurement results

The selected parameters of oxygen efficiency are presented in the diagrams and were compared with health behaviours. The parameters included the subjects' self-evaluation.

The group of men who considered their health state to be very good gained much higher maximal oxygen uptake values, and the differences were statistically significant ($p \leq 0.01$). There were no indications of satisfactory or bad health estimation in relation to self-evaluation of one's health (Fig. 1a). Pearson's product-moment correlation coefficient ($r = 0.39$) showed a positive correlation between the maximal oxygen uptake and health state self-evaluation results.

The efficiency self-evaluation results indicated a relation with the maximal oxygen uptake results (Fig. 1b). The average value of maximal oxygen uptake among the men who estimated their efficiency as very good or good amounted to 49.9 ml/kg/min, while among those whose efficiency was rated satisfactory or bad the result was 44.6 ml/kg/min and the differences were statistically significant ($p \leq 0.01$). The other relevant correlation was between the efficiency

achieved an average VO_2max level equal to 48.9 ml/kg/min, however the non-smokers reached 45.3 ml/kg/min (a statistically significant difference). Simultaneously, it was noticed that smoking influenced both the men's health state self-evaluation together with their efficiency.

The awareness of the negative influence of smoking on the human body was high among the examined students (Figs. 2a, b). Moreover, it can also be noticed that in relation to efficiency self-evaluation it was higher ($r = 0.52$) than in relation to health state evaluation ($r = 0.38$). There were no indications of a high efficiency estimation in the smoking group, and six men (35%) evaluated their health state as very good ($n = 17$). In the non-smoking group the majority (81%) estimated both their efficiency and health state as very good or good.

Another aspect under study was the influence of alcohol consumption on the maximal oxygen uptake results (Figs. 3a, b). The subjects who indicated a higher rate of alcohol consumption achieved lower values of the maximal oxygen uptake (the difference was not statistically significant). It must be emphasized that the men with a higher rate of alcohol consumption participated in physical activity less often. This fact

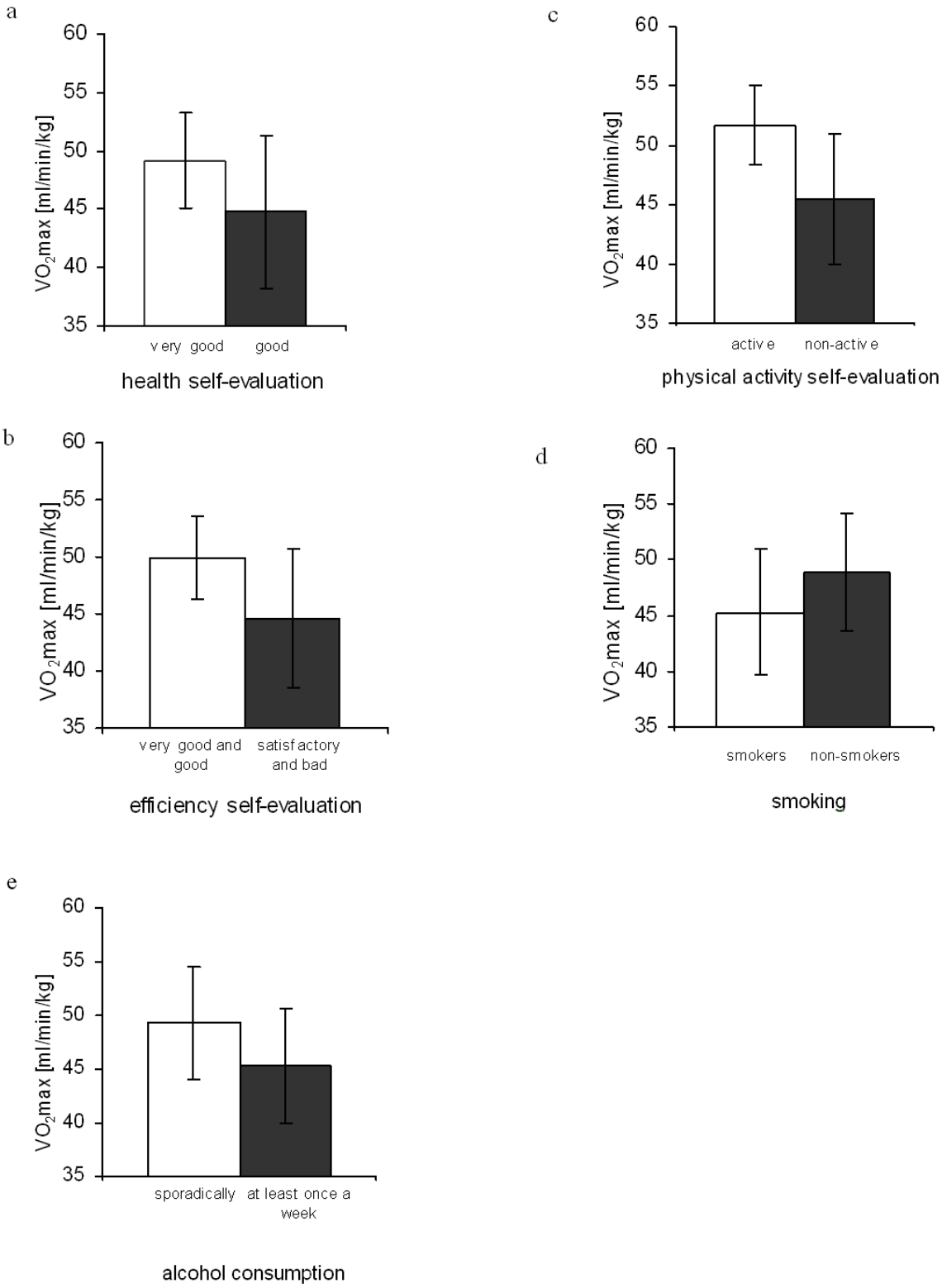

Figure 1. Mean values and standard deviation of maximum oxygen uptake (VO_2max) in relation to health self-evaluation (a), efficiency self-evaluation (b), physical activity self-evaluation (c), smoking (d) and alcohol consumption (e)

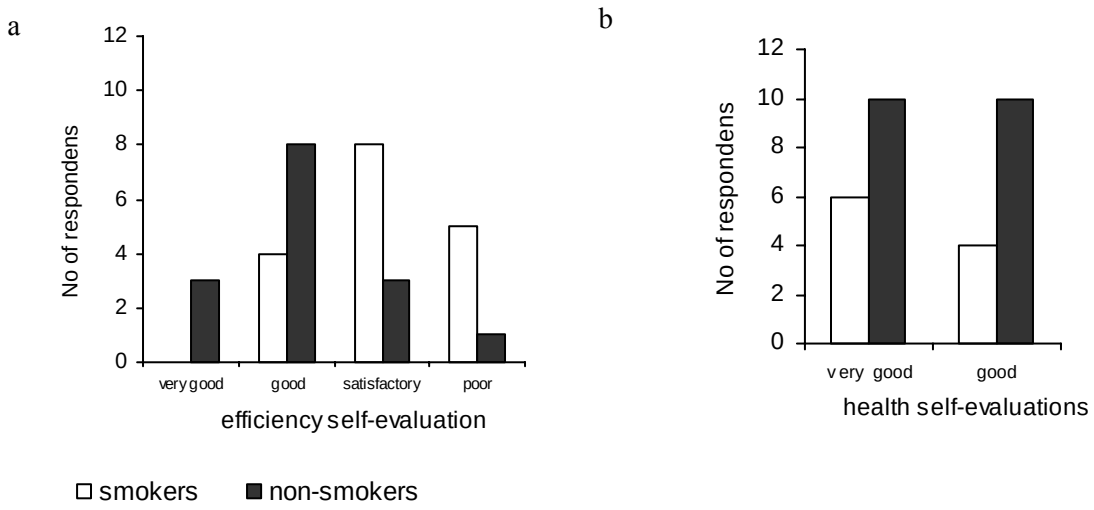

Figure 2. Body efficiency (a) and health (b) self-evaluation of smokers and non-smokers

Figure 3. Efficiency (a) and health (b) self-evaluation of alcohol consumers

explains the positive correlation between alcohol consumption and both health state and efficiency self-evaluation (r = 0.32 and r = 0.41, respectively). The indicated correlation between smoking and alcohol consumption and self-evaluation showed that the self-evaluation rate was higher in efficiency evaluation than in health evaluation (Figs. 3a, b).

Among the men who declared high, average or low appearance satisfaction there was a relevant diversity in the fat tissue and muscle tissue measurement results. The men with a high percentage of muscle tissue in their body also dsiplayed a higher appearance satisfaction. The latter was lower among the men with a low percentage of muscle tissue (positive, r = 0.35). Similarly, it was noticed that the higher the adipose tissue density was, the lower the appearance satisfaction was (negative, r = –0.18) (Fig. 4).

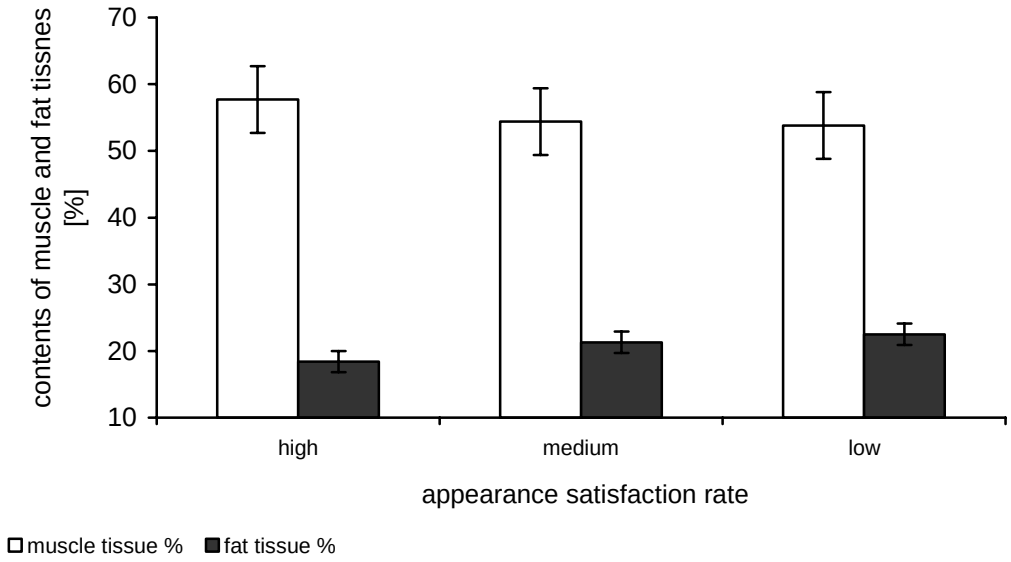

Figure 4. Average adipose tissue and muscle tissue percentage index among students with different levels of appearance satisfaction

The analysis of subjects' efficiency carried out according to the American Heart Association indications [30], showed that three subjects (9.4%) had a high physical efficiency level, twenty-two (68.8%) good physical efficiency level, and seven (21.9%) average physical efficiency level. There were no indications of a satisfactory or a low efficiency rate.

Only thirteen men (40.6%) rated their efficiency level correctly. The majority (50%) of the assessments were underrated and 9.4% were overrated. In conclusion, the students' self-evaluation error equaled 59.4%.

DISCUSSION

The literature devoted to health reveals that health assessment relies strongly on results of statistical surveys, in which respondents evaluate their health behaviour, physical efficiency and quality and satisfaction of life. In recent years, special attention has been paid to the use of subjective measures in health state evaluation [2, 28]. The use of standard international questionnaires in health behaviour research such as the HBSC [7] or SF36 [11, 29] allows a comparison of self-evaluation results obtained from various social [15, 16, 19], national [8, 18, 21], age [22, 31] or other groups. Factors such as sex [1, 12, 23], age [31] and education [15, 19] play an important role in self-evaluation of health state and physical efficiency. Research results show that women's self-evaluation is lower than men's and that younger people evaluate their health state much higher than older people, similarly to people with a higher education or to singles [12, 24]. What is important, people with a low social status indicated a lower rate of their health state, which implies the importance of one's financial situation [12, 15]. However, the sample in the present study was homogeneous in terms of sex, age, marital status, education, financial status (all were parents' dependants) and health.

In the present study the subjects' self-evaluation of efficiency, physical condition and health were high. The students' aerobic capacity estimated on the basis of maximum oxygen uptake amounted to 47.04 ml/kg/min. Despite the students' minimal participation in regular exercise it appears to be slightly lower than in the case of the active students of physical education (49 ml/kg/min) [29, 30]. According to the AHA assessment of physical efficiency all of the examined students can be classified into the group with 'good' VO_2max estimation (VO_2max scores from 43 to 52 ml/kg/min) [6].

Considering the results of both subjective and objective examination a discrepancy can be noted between the way the examined men

comprehend health as it is, and the way they evaluate themselves as healthy people. According to the survey the subjects did not notice the analogy between health and efficiency level. Over a half of them (53%) rated their health as very good; however, only 9% indicated a high efficiency level.

What is more, 86% of the examined men were aware of the fact that physical activity is the main element of a healthy lifestyle; however only 31% considered themselves to be active persons. The high awareness of the impact of physical activity on health in the examined group was confirmed by the significant dependency between efficiency self-evaluation and exercise test results. The less active men who rated their efficiency as good and satisfactory reached a relatively lower level of maximum oxygen uptake in relation to the active men with a high rate of efficiency.

Only 41% of self-evaluation results and exercise results were accurate, which means that over one half of the subjects estimated their efficiency level incorrectly. As the research results indicate, the estimation error in 59% was connected with the high awareness of the influence of negative health behaviours on human body efficiency (hypokinesis, drug abuse, smoking). On the other hand, the same factors had little influence on the results of subjects' health self-evaluation. It can be explained by the subjects' young age or by following the popular belief that health is the absence of illness.

In conclusion it must be noted that regardless of the lowered efficiency self-evaluation, the results of the objective exercise tests indicate a significant correlation between VO_2max scores, health state and efficiency self-evaluation. Also, the influence of regular physical activity on VO_2max estimation proved to be vital: the active group gained higher scores. The examined men indicated that, among the given health behaviours, smoking and alcohol consumption influenced their efficiency to a greater degree than their health. Moreover, frequent alcohol consumption was not distinctly reflected by the maximum oxygen uptake level, but it did have a relevant significance in the self-evaluation process.

The research results revealed that the inquiry data concerning efficiency self-evaluation and data from physical efficiency tests for over 50% of young men are divergent, and the subjects' self-evaluation is lowered.

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