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Incidence of health problems in relation with BMI and physical activity of college students

Authors' Contribution:

A – Study Design
B – Data Collection
C – Statistical Analysis
D – Manuscript Preparation
E – Funds Collection

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Abstracts. *Steady decline in habitual physical activity in children and youth has resulted in an increase in body weight with age and a decline in functional ability. Hypokinesia in conjunction with poor diet and stress levels are prerequisites of lifestyle diseases such as cancer, cardiovascular and metabolic diseases and obesity. In this partial research, being part of the VEGA research No. 1/1343/12 "Selected risk factors of obesity and exercise prevention", we looked at the incidence of health problems related to BMI and physical activity in college students. We calculated BMI based on anthropometric measurements of body height and weight. Using the questionnaire method, we collected data concerning subjectively assessed incidence of health problems and overall representation of physical activity (PA) in the lifestyle of respondents. The study group comprised 1,963 students, including 1,169 female and 794 male undergraduates from two Slovak universities. Health problems with the largest incidence were back pain, alergy, low blood pressure, headache, palpitation and respiratory diseases. Our research confirms that a greater representation of PA in students' lives positively relates to a lower BMI. The results of logistic regression confirm a significant relation between BMI and the following health problems: back pain, palpitation, high blood pressure, obesity, low blood pressure and respiratory illnesses. PA significantly corresponds with the occurence of health problems related to upper respiratory tract and high blood pressure.*

Keywords: *Adolescents, anthropometry, physical activity, hypokinesia, civilization diseases, underweight, overweight, obesity.*

INTRODUCTION

Socio-economic conditions have a significant impact on the current lifestyle of the individual classes of population. They participate in the ever increasing number of individuals suffering from various civilization diseases. Our real exercise regimen hardly corresponds with the biological necessity of musculoskeletal load of any individual [9,18]. It is alarming that 60-85% of the world's population consists of people with insufficient physical activity. Several works point to the need of primary prevention in this respect [20,22,37]. One of the major negative lifestyle factors influencing the state of health appears to be the lack of physical activity (hereinafter referred to as PA) [5,6,30,31]. Negative influential factors undermining

one's health may have significant impact on the growth and development of the adolescent, leading to a variety of long-term negative consequences. Lack of PA has resulted in increasingly frequent incidence of overweight and obesity [3,12]. The aforementioned problem is related to the socio-cultural environment as well as to the financial potential.

Body weight in adulthood is largely determined by the earlier amount of adipose tissue in childhood [18,32]. Obesity appearing in the period of growth predisposes individuals to a more frequent and significant development of obesity at a later stage. It creates conditions for development of further serious diseases, such as strokes, cardiovascular diseases, arterial hypertension, diabetes mellitus type II, metabolic syndrome and the like [16,35,39]. Currently, a significant number of the adult population worldwide suffer from obesity [2], and therefore, the World Health Organization (WHO) draws our attention to the emergence of a global epidemic. Overweigth adults represent 1.6 billion of the overall population, of which approximately 400 are obese. Within the population of children under 5 years of age, it is 20 million. According estimates, there is a real threat that by year 2015 about 2.3 billion people will be overweight, of which more than 700 million being obese [13,21]. As per Vítek [39], by year 2020 the above upward trend is expected to cause that two-thirds of all diseases worldwide will be related to the eating habits of the population.

Addressing obesity requires a comprehensive - holistic approach that respects and takes into account its biological, psycho-social and health-related parameters.

In year 2008, every sixth child in the Czech Republic suffered from overweight or obesity. The increase is alarming: from 1996 to 2008, the number of obese children doubled from 10,400 to 24,500, and in adolescents the figure nearly tripled from 6,100 to 16,200. In year 1996 as many as 10,000 children under 15 in the Czech Republic were diagnosed obese, and in 2009 there were already 27,000 of them. In the 15-18 age category less than 9 children were obese out of 1,000 in 1996, while the number increased to 36 obese per a thousand in 2009 [14].

One of the factors to change this state appears to be an increase in the volume of regularly conducted PA, establishing an active healthy lifestyle, particularly among children and youth [4,28,34]. Exercise as a form of PA affects not only reduction of body weight, but it also improves mental state, reduces anxiety, increases positive self-esteem and supports stress management [15,23]. The period of late adolescence, the transition from high school to college, is one of the major milestones in changing the lifestyle of the maturing youth. This period is characterized by the individuals becoming independent and responsible for their daily routine and lifestyle. Adapting to the new environment, coping with various demanding and stressful situations related to studies and increasing responsibility for oneself represent new trends in the lifestyle of college students. Current health models take into account the influence of intrapersonal and interpersonal characteristics towards a healthy lifestyle, health-related behaviour as well as the risk behaviour of the adults. Factors of healthy lifestyle include sufficient physical activity, healthy eating habits, regimen, mental balance, getting enough sleep, and stress resistance [10,16,24]. Due to the ever persisting problem in our society associated with the lack of PA, unhealthy lifestyle, overweight and obesity, we decided to follow these on a group of university undergraduates. We investigated how the above variables are related to the life of undergraduates and their health problems. We tend to believe that university students represent an intellectual group with access to the latest information and knowledge.

Reveal the coexistence of the incidence of health problems in relation to different levels of BMI and physical activity among students in their first year of university study.

Assuming that there is significant relation between physical activity and certain diseases, we set the following sub-hypotheses:

1. The existence of relationship between high blood pressure and BMI

2. The existence of relationship between physical activity and palpitation
3. The existence of relationship between physical activity and headaches in college students

METHODOLOGY

The cross-section research group comprised first-year students at Pavol Jozef Šafárik University in Košice and Technical University of Košice, who attended physical education classes. As many as 1,963 undergraduates took part in the research (mean 21.52, standard deviation SD 2.61). Of the total sample, there were 1,169 females (mean 21.68, SD 2.22) and 794 males (mean 21.28, SD 2.83).

Data were obtained via the questionnaire method and somatometric examination of body weight and height. Using those values, we calculated BMI (BMI = kg/m²). Body weight was diagnosed using an OMRON BF551 Body Composition Monitor device. BMI values were categorized into different levels according WHO (<18.5 underweight, 18.5 - 24.99 optimum weight, 25 - 29.99 overweight, 30 - 34.99 class I obesity, 35 - 39.99 class II obesity, >40 class III obesity). When processing the results, in order to correctly apply the chi-squared test, we merged the class I, II and III obesities into a single category called "obesity". The questionnaire was applied in September 2012, at the start of the first semester. For this work, we have chosen the following questions out of the research project questionnaire battery: "Do you suffer from any of the following health problems?" (closed-ended question), "What has been the amount of your overall physical activity (gardening, housework, schoolwork, doing sport, exercise etc.) within the past year?" (semi-closed question with options: a) excessive (5); b) adequate (4); insufficient (3); minimum (2); other (1)). When processing the results, we used basic descriptive mathematic statistics (characteristics of the mean, standard deviation), chi-square and logistic regression (Sheather, 2009). Statistical significance of the results was determined at $p<0,05$ and $p<0,01$.

This work is part of VEGA research grant No. 1/1343/12: "Selected risk factors of obesity and physical prevention", being researched at P. J. Šafárik University, Institute of Physical Education and Sport in Košice.

RESULTS

In the research, we focused on the incidence of health problems among undergraduates indicated by them in a questionnaire drawn up by ourselves. It was a subjective assessment of their own health problems. The obtained data were evaluated within the total cohort and according gender (Fig. 1).

The most frequently occuring health problem was back pain, reported by 67.3% of the total sample of respondents, of which 41.40% were women. Other health problems with higher representation among women included: alergy 20%, low blood pressure 23.6% or headaches17,6%. Palpitation was reported by 15.4% of respondents, of which 5,8% were men and 9.6% women. The occurence of respiratory diseases was 11.6%, of which 5.8% were reported by men and 6.4% by women, thus proving a near balance among genders. The lowest numbers reported in the merged cohort describe the incidence of high blood pressure 8%, obesity 5.7% and diabetes 1.8%, equally divided among 0.9% males and 0.9% females.

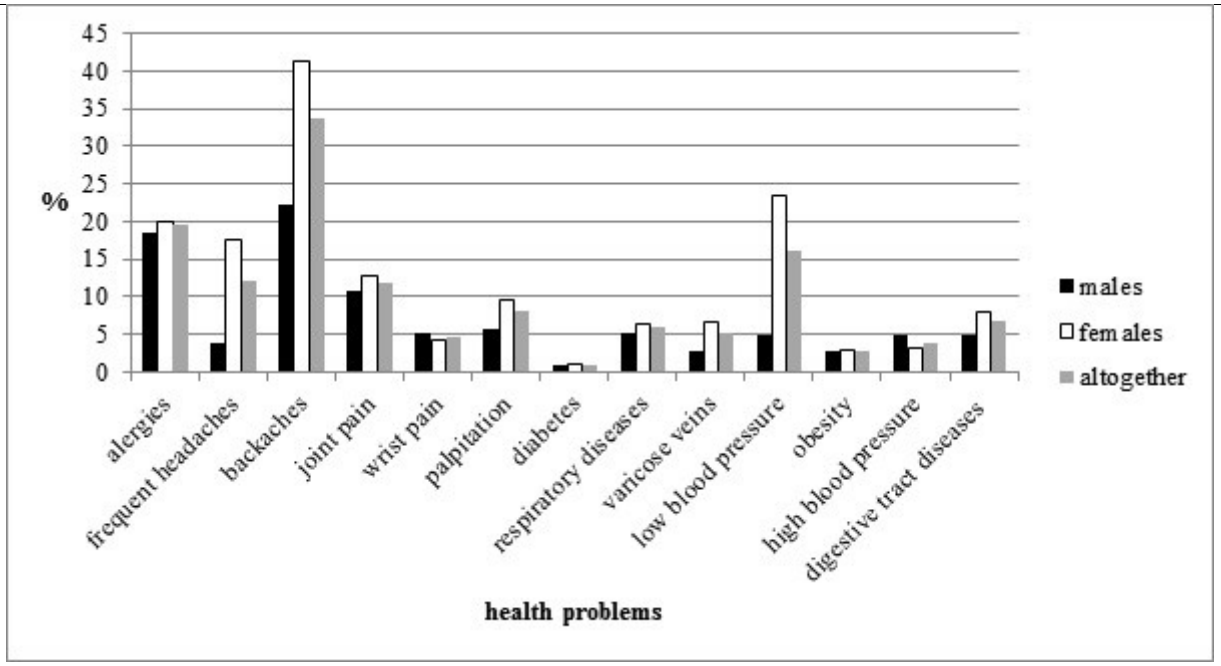

Fig. 1. *Percentage of the incidence of selected health problems among college students*

Table 1. Percentage of students in each BMI category

		BMI classification											
Gender		underweight		normal weight		overweight		class I obesity		class II obesity		class III obesity	
		n	%	n	%	n	%	n	%	n	%	n	%
	Males n=1169	28	3,5	519	65,4	198	24,9	36	4,5	10	1,3	3	0,4
	Females n=794	145	12,4	845	72,3	139	11,9	33	2,8	5	0,4	2	0,2

Somatometry-surveyed BMI values, compared to other more exact methods, only rather indicatively highlight the riskiness of obesity in individuals. The mean BMI value in the merged-gender group was 22.60 (SD 3.79), in the males group it was 23.80 (SD 3.79) and in females 21.77 (SD 3.56). BMI values in the male and female groups varied significantly, in favour of females, despite the fact that in both cohorts the mean remained within the standard (Pearson's Chi-squared test 101.36, $p<0.01$), namely about 72.3% female and 65.4% male student results. In females, overweight was reported in 24.9% of cases, class I obesity in 4.5% and class II obesity in 1.7% of the group (Table 1). Following the merge of the 3 degrees of obesity into one, according BMI values, obesity is observed in 9.6% of the subjects (3.4% women and 6.2% men). However, obesity was subjectively stated only by 2.8% of the probands within the female group and by 2.9% subjects in the male group.

Overweight, found in 337 undergraduates, reached the highest percentage in the merged gender group, where men accounted for 58.8% and women 41.2%. Also the sample of 89 obese students had a higher representation of men (55.1%). Out of the obese sample, class I obesity was reported in 69 cases, thus being the most representative, with more men (52.2%) than women (47.8%). 173 persons were reported underweight, of whom there were 83.8% women and only 16.2% men. As it is shown, the incidence of overweight in both cohorts is comparable, whereas the results in the categories underweight and obesity vary considerably. Generally, more critical values occured in the male cohort, while in females the values are only critical in underweight.

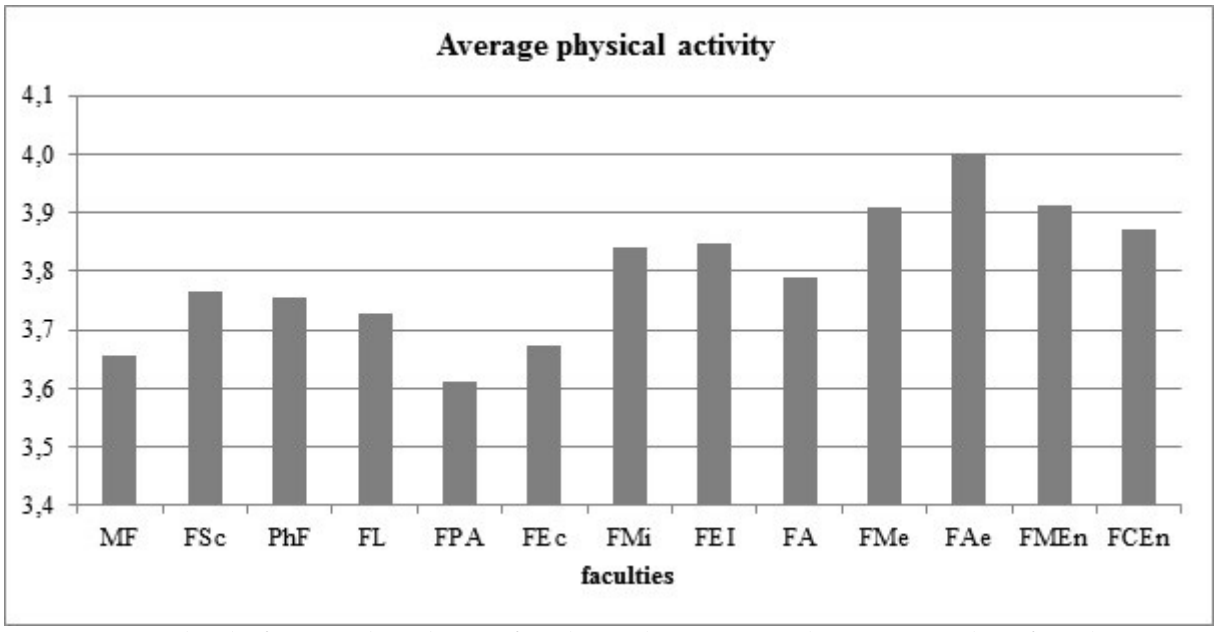

Fig. 2. *Average level of PA in the cohorts of undergraduates. Legend: FMe - Faculty of Medicine, FSc - Faculty of Science, PhF - Philosofical Faculty, FL - Faculty of Law, FPA - Faculty of Public Administration, FMe - Faculty of Metallurgy, BER - Faculty of Mining, Ecology, Process Control and Geotechnology, FMEn - Faculty of Mechanical Engineering, FA - Faculty of Arts, FEc - Faculty of Economics, FAe - Faculty of Aeronautics, FEI - Faculty of Electrical Engineering and Information Technology*

Significant difference was found between BMI and genders ($p < 0.05$, $\chi^2 = 101.36$). In order to carry out Pearson's Chi-squared test, it was necessary to merge the class II and class III obesity categories. When assessing the incidence of overweight and class I obesity, we have to take into account the fact that this group usually includes sporting individuals with above-average musculature, usually more typical for men. We also believe though that active weight modification is more widespread among women.

The data obtained, via using the method of questionnaire, allowed us to compare the amount of PA carried out at individual faculties during the past year. Within our sample, mainly the students of the Faculty of Aeronautics do sport and exercise regularly (Fig. 2). Their average value on the scale from 1 to 5 reached 4.00 - adequate physical activity (SD 0.94). The faculty with the lowest level of PA, at 3.6 (SD 0.78), proved to be the Faculty of Public

Administration. Among the faculties, significant difference was found in the amount of PA at the level of $p < 0.05$, in favour of the Faculty of Aeronautics (Kruskal – Wallis rank sum test 30.00).

The incidence of PA with respect to BMI was another of the relationships investigated in our research. A statistically significant relationship was found between BMI and PA in both, the cohort of males as well as females. (Fig. 3).

Significant relationship between BMI and PA was found in the cohort of males ($p< 0.02$ and $\chi^2 = 18.82$, using Pearson`s Chi – squared test). In the cohort of females, the relationship between BMI and PA proved significant at $p < 0.01$ and $\chi^2 = 21.09$ (Pearson`s Chi – squared test). In order to correctly apply the chi-squared test, we merged the class II and class III obesities into a single category called "obesity", as well as physical activities level 1 and 2.

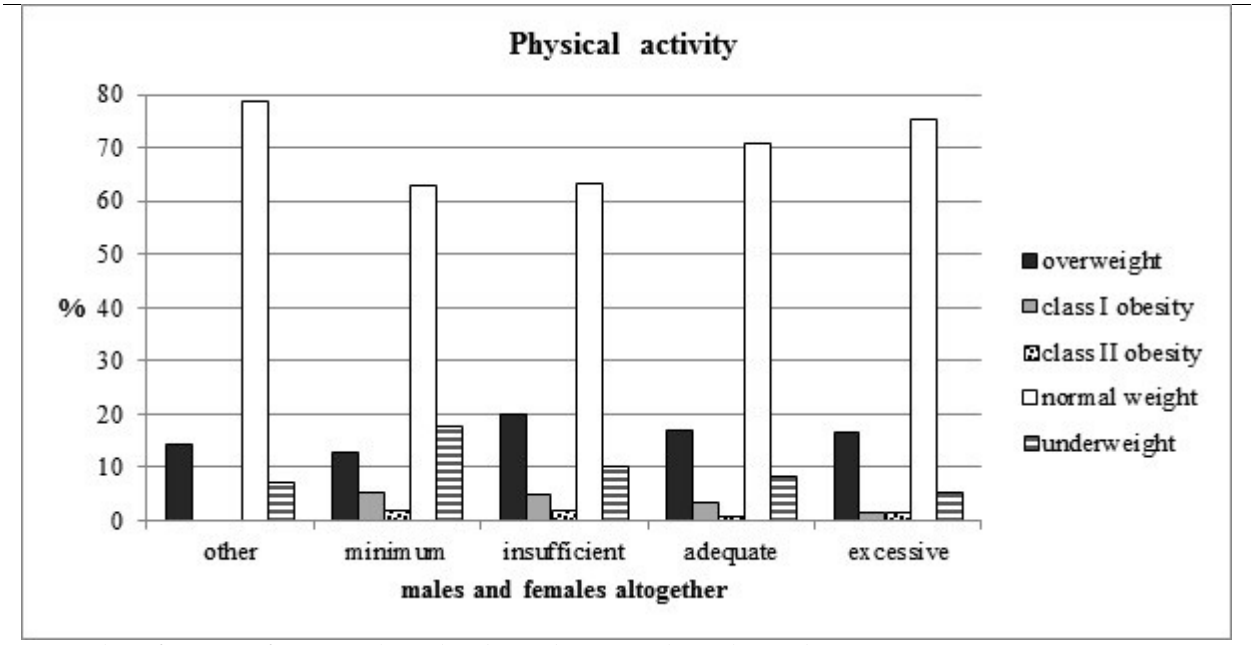

Fig. 3 Classification of BMI and PA levels in the merged genders cohort

Of the female students who reported adequate PA, 74.5% have normal weight. Of those reporting excessive PA, 76.6% have normal weight. In the cohort of men, of those who reported adequate PA, 65.4% have normal weight. Excessive PA was reported by 74.6% of male students with normal weight. In the cohort of men, we have to take into account the fact that the overweight category usually includes sporting individuals with above-average musculature. In our case, it was reported so by 25.2% male respondents in the adequate PA category and 20.9% male respondents in the excessive PA category.

Table 2 shows the incidence of health problems and their relation to PA and BMI, coeficients of logistic regression (positive and negative dependence) and levels of significance.
Significant relationship was found among BMI and the following: back pain, palpitation, high blood pressure, obesity, low blood pressure and respiratory diseases (see statistics in Table 2).
We also revealed statistically significant relationship between PA and health problems associated with diseases of the upper respiratory tract and high blood pressure (further referred to as HBP). In case that PA increases by 1, the chance of experiencing respiratory disease dicreases 0.7-times. Also, according out findings, when PA increases by 1, the chance of having HBP gets 1.55-times higher. Such result is but hard to explain. One possibility to do so is (see Methodology: the answer to the question concerning PA) that the way our questionnaire reports the answers is not relevant in order to detect such relationship, and therefore, the relationship found can not be considered logical.

In this research, gender has a significant influence on the occurence of frequent headaches. When compared with men, the chances of having frequent headaches for women are 4.15-times higher than not having headaches. PA and its effect on frequent headaches is only slightly above the level of significance ($p = 0.06$). This trend suggests that higher volumes of PA are associated with a lower incidence of headaches.

The odds ratio in the case of BMI indicates the likelyhood of the problem getting more serious if the value increases by 1. Back pain proved most frequent in 67.3% of students. According to our findings, for woman, the probability to have back pain is 1.93-times higher than not having it, when compared to men. The third most frequently occuring disease was low blood pressure. For woman, the probability to have low blood pressure is 4.14-times higher than not having it, compared with men. If BMI increases by 1, the probability of having low

Table 2. Significance of the differences in health problems related to the female gender, PA and BMI

	GENDER WOMAN			BMI			PA		
HEALTH PROBLEMS	Logistic regression coefficient	Level of statistical significance p	Odds ratio	Logistic regression coefficient	Level of statistical significance p	Odds ratio	Logistic regression coefficient	Level of statistical significance p	Odds ratio
Alergies	-0,00	0,981	1,00	-0,00	0,861	1,00	-0,12	0,139	0,89
Frequent headaches	1,42	0,000	**4,15**	-0,02	0,413	0,98	-0,18	**0,064**	0,84
Backache	0,66	**0,000**	**1,93**	-0,03	**0,023**	0,97	-0,02	0,802	0,98
Joint pain	0,14	0,385	1,15	0,04	**0,050**	1,04	0,09	0,387	1,09
Wrist pain	-0,29	0,216	0,75	0,02	0,481	1,02	0,12	0,447	1,12
Palpitation	0,11	0,584	1,11	-0,09	**0,001**	0,92	-0,13	0,238	0,88
Diabetes	-0,25	0,631	0,78	-0,01	0,856	0,99	-0,45	0,109	0,64
Respiratory diseases	-0,12	0,582	0,89	-0,06	**0,048**	0,94	-0,35	**0,004**	0,70
Varicose veins	0,93	**0,000**	**2,53**	0,01	0,721	1,01	-0,13	0,348	0,88
Low blood pressure	1,42	**0,000**	**4,14**	-0,10	**0,000**	0,91	-0,14	0,116	0,87
Obesity	0,47	**0,170**	**1,60**	0,34	**0,000**	1,40	-0,14	0,511	0,87
High blood pressure	-0,30	0,241	0,74	0,11	**0,000**	1,12	0,44	**0,020**	1,55
Diseases of the digestive tract	0,15	0,473	1,16	-0,05	**0,056**	0,95	-0,20	0,092	0,82

blood pressure decreases 0.91-times. The probability of HBP grows with increasing BMI. BMI increased by 1 will lead to a 1.12-times higher likelyhood of HBP. We also found a significant link between obesity and BMI. After an increase in BMI by 1, the likelihood of getting obese will get 1.4-times bigger. Even the occurence of palpitations is substantially affected by BMI. Any rise in BMI by 1 leads to reducing the chance of having palpitations 0.92-times. Other health problems, such as alergies, joint pain, wrist pain, headache, digestive tract diseases and varicose veins did not show any significant relationship to PA or BMI.

DISCUSSION

The current way of life is characterized by a lack of PA, subsequently reducing the population's level of fitness and consequently decreasing performance in different areas of life. Among the factors inducing the above complications are considered bad motion and posture habits acquired in childhood, but also insufficient regeneration and recovery, overall inactivity, genetic predisposition, gender and age. Other well-known factors include muscular imbalance, overloading the muscles, mainly the postural muscles (sitting in lectures, on public transport, long-term incorrect posture), which thus weaken as a result [11]. The time spent sitting in front of the TV, PC or during studying, is listed among the most commonly reported sedentary

activities in research studies concluded in Hungary, Spain and Finland [17,33,36]. Even in our study, the most numerous group of students reported back pain as their health problem. Muscle imbalance and loose support apparatus are indicators and triggers for headaches, caused by tense nouchal muscles. A typical symptom tends to be dull pressure pain. The reported mean BMI values in the cohorts of undergraduate male and female students are comparable with the results from abroad. Research [40] showed a mean BMI of 23.1 (SD 2.2) of male students and 21.9 (SD 2.8) of female students attending optional PE classes. Female college students of relevant age from South Africa [38] reached a mean 21.8 (SD 2.62). In addition, further study results [8] point to a lower proportion of overweight among female students.

Reduction in heart rate and a decrease in blood pressure are some of the factors indicating the role of organism adapting to physical load. Nevertheless, we tend to believe that the indicators further include low weight (particularly in female students). This research proves the coincidence of low pressure and BMI. Blood pressure is an important indicator of a functioning circulatory system. The occurence of high blood pressure, among others, is also influenced by body weight, as has been confirmed by our study. It corresponds with the findings that PA reduces the risk of hypertension [1,19,29]. Following an increase in PA by 1, chances of having HBP increase 1.55-fold. Such result is but hard to explain. One possibility to do so is (see Methodology: the answer to the question concerning PA) that the way our questionnaire reports the answers is not relevant in order to detect such relationship. Therefore, the relationship found may not be considered logical.

Obesity is considered a serious risk factor for coronary heart disease. Obese patients are more prone to hypertension, and a rise in blood pressure correlates with the increase in obesity [26]. We should also take into consideration the finding that with increasing BMI values for normal weight and overweight, the chances of heart palpitations decrease. The heart, which is the most important organ for life, is the best indicator of the positive impact of sport on our bodies. During the training it adapts to the increased functional load. It is capable of delivering much more oxygenated blood to the working muscles. We may justify this phenomenon by a probably better muscle mass (particularly in men) and a better level of fitness. Closely connected to the cardiovascular system is also the process of breathing. PA has a positive impact on improving the lung function. It strengthens the heart and improves the transport of oxygen throughout the body, thus reducing the risk of occurence of many diseases. The lungs are able to hold more air, and so their vital capacity increases. Adequate load on the body improves and maintains good function of the immune system. The physiological effect of PA, namely of the aerobic one, is reflected in improved function of the transport system. The work of heart becomes more economical and it positively affects the blood pressure. With respect to the respiratory system, it is associated with an increase in vital capacity. On the whole, PA improves functional ability of the organism and thus allows it to manage activities of daily life with less effort.

We know that body weight in adulthood is largely determined by the amount of body fat accumulated earlier during childhood. According Kytnárova [25], despite the important role of genetics, about 96% of patients with childhood obesity later indicate exogenous obesity (mostly caused by superfluous food intake and lack of exercise). Only 4% of children show endogenous obesity, which significantly extends into the emotional-social ties of the individual, into shaping his confidence, self-realization efforts, it influences the social activity of its holder, his physical ineptitude, indolence, submissiveness, but mainly personal inferiority and a low degree of personal values. Motion and physical activity serve as prevention of many diseases [27]. Even at a minimum range, it supports subjective well-being in adolescents, as well as self-satisfaction. It further contributes to increasing their life satisfaction and contributes to experiencing positive emotions more frequently. Our research showed a statistically significant

connection between individual levels of BMI and PA both, in the cohorts of men and women. The highest proportion of adequate PA was found in women (67.9%), and the second highest in men (63.4%) belonging to the normal weight group. In case of answers stating "other PA" (see Methodology), the highest occurence of such PA was reported in the group of men, followed by the second most frequent in the group of women. Women in the underweight category and men in the obesity category showed statistically significant minimum or insufficient PA. With the increase of PA, the percentage of BMI in both sets of students decreased in the categories of underweight, overweight and obesity.

We are aware that spontaneous PA declines significantly in the period of adolescence, being described as a period of relatively good health and low mortality. Youth PA does not only depend on the opportunities, but with age it is also influenced by their interests and motivation, and it is closely linked to one's lifestyle [7]. It leads to correct mental hygiene and is beneficial to their healthy development. It affects not only the physical entity of man, but also has implications for the improvement of many psychical symptoms [37]. We realize that PA acts significantly only at a certain intensity, regularity, nature and duration [32]. Its shortage leads to increasingly frequent occurence of overweight and obesity.

It is undisputed that the trend of reducing the number of PA hours for undergraduates has a negative impact on their health condition and may be one of the reasons behind the decline of hours spent doing PA, the increase in proportion of adipose tissue on body composition and increased functional fitness. The importance of physical education classes for university students in relation to their body composition, namely fat percentage, is shown in [40].

CONCLUSION

Based on our investigation, we can conlcude that there is significant relationship between PA and respiratory system disorders, as well as high blood pressure. This study confirmed coexistence of the incidence of back pain, joint pain, palpitation, respiratory diseases, low blood pressure, obesity, and high blood pressure in undergraduates, related to BMI. Respiratory diseases and high blood pressure proved to be significant in relation to both of the criteria. A higher incidence of elevated BMI values occured in the men cohort (where though we also have to consider individuals with greater musculature), whereas in women there was a higher incidence of underweight.

Our presupposition of the existence of relationship between BMI and hypertension in undergraduates has been confirmed significantly, which means that with the increase of BMI by 1, the risk of experiencing high blood pressure gets 1.12-times higher. On the other hand, our presumption of the existing relation between PA by university students and their heart palpitations has not been confirmed. And finally, although the third assumption concerning the existing relationship between PA and headaches reported by the students has not been confirmed significantly, a certain tendency towards such relation still remains.

We learned that as much as 9.6% of the study group probands (3.4% females and 6.2% males) suffer from obesity. The problem is that only 2.8% of those women and 2.9% of the men are able to subjectively evaluate this right. Lack of objectivity in the youth's self-esteem is, to a certain extent, also a result of self-education. In this regard, the rise of the level of students' knowledge has to be pointed out.

We found out that with increasing BMI values for normal weight and overweight, the chances of heart palpitations decrease. In the context of the above findings, we support the need for preventive measures in terms of maintaining PA in the way of life of college students. From

this perspective, only an interdisciplinary approach can help to identify the determining interactions between PA and bio-psycho-social factors in overweight and obese undergraduates. Preserving the number of PE lessons at universities and increasing the range of information and knowledge can help to reduce the risk of diseases.

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