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Do WHR and BMI Have an Impact on Back Pain Occurrence in University Students' Community

Summary

The article aimed either to confirm or refute the hypothesis about university students and their higher waist to hip ratio or BMI ratio being the cause of back pain, compared with other students. The hypothesis should have been confirmed or refuted by the analysis carried out on the impact of WHR and BMI in relation to subjective back pain reported by university students. The method of analysis was an extensive questionnaire executed in 2012 at Technical University of Košice and Pavol Jozef Šafárik University in Košice. There was a sample of 1993 university students, 809 men and 1184 women, aged of 21.3±2.6 on average. The back pain was diagnosed on the basis of its subjective evaluation by students. The collected data were then divided, due to statistics purposes, into groups of men versus women and groups with back pain present versus back pain absent. The statistics ratio of central importance was the arithmetic average and the rate of variability chosen was a standard deviation. The percentages of BMI and WHR within the single intervals of evaluation scale were compared and contrasted mutually and the differences were evaluated with the use of logical analysis. Our research did not confirm the hypothesis. The number of students with back pain was not higher when the values of indices analysed were higher than normal. The survey confirmed ambiguity of the indices' influence on back pain, thus the indices cannot confirm or refute their impact on back pain occurrence.

Keywords: back pain, WHR index, body mass index, obesity, overweight, university students, physical development assessment

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Introduction

Hard physical work has been disappearing steadily and modern technologies availability makes our lives easier on one hand, but degenerates it in some way, on the other hand. There is less and less movement in our present high--technology society along with movement decrease and increase of civilisation diseases among which back pain can be included.

Obesity expert Petr Sucharda claims that obesity (obesity indicator is waist circumference) definitely is a civilizational disease. The only solution is to find time for physical exercises in every day hurry [1]. University students cumulate negative health factors such as: unbalanced work regime with high degree of irregular psychical load, inappropriate diet etc. [2]. The survey aims to analyse the potential impact of overweight and obesity on back pain occurrence in university students.

According to National Institute of Health Statistics the back pain in its various forms is the reason of suffering 8 out of 10 questioned people during their lives. More than 28% (in the last three months) suffered from particular part of back pain [3]. The more serious point seems to be that the number of people with chronic back pain increases. Overweight and obesity worsen various chronic health problems, back pain included. Obesity can increase mechanical burden upon spine by increasing compressive force or can cause prolapse of various spine structures during physical activities performance. Obese people are also at higher risk of accidental injuries in the spinal area. Obesity can trigger back pain due to systematic chronic inflammation. The surveys also show that abdominal obesity triggers more spine problems than overall obesity does. Obesity also indirectly contributes to degeneration of vertebra discs in a complicated process of change in the nutrition of spine structures [4].

Obesity – factors and diseases

Obesity is one of the most serious health problems of the 21st century. It causes 10 to 13% of deceases, shortens the average life length by six to seven years. Fulmeková points out that obesity factors are genetic, behaviour, physiological, environmental, cultural and social, all of the mentioned resulting in energy unbalance. This unbalance leads to adipose tissue increase [5].

Hurried life style, working under pressure, stress, sudden supply of energy after all day hunger, lack of movement, sedentary regime – common activities of university students performed daily need no further survey in order to be identified.

It is not an easy task to evaluate energy supply. Some authors, on the basis of direct measuring or questionnaires, found out that obese people do not eat more than people with normal weight [6], [7]. The others examined students in cante-

ens and present more frequent food supply as well as greedy way of eating. [8], [9]. Risk factors of obesity are divided according to Plevková into two groups: influenceable and non influenceable. Out of non influenceable factors we should mention genetic predispositions, medication use or chronic diseases. Influenceable factors of obesity are food intake frequency, energy expenditure, sleep frequency, alcohol intake or sweet drinks intake [10]. The diseases accompanying obesity are heart and veins diseases, digestive tract diseases, diabetes, high blood pressure, joint problems but also asthma, allergies and last but not the least psychical problems of the obese people being judged by the society [11].

National Reference Standards are, in professional circles, commonly accepted evaluation criteria of body overweight and obesity. The surveys of such a type have a long term tradition in Slovakia. Thus Slovakia has been among the states with very well observed and checked growth characteristics of children population and long term surveys had been obtained this way on growth trends of Slovak children and youth. At the same time we are one of a few countries that have their own national BMI standards measurements.

BMI and WHR index

BMI and WHR indexes are nowadays perceived as the most relevant attributes for obesity diagnosis and classification. BMI index expressed as the ratio of weight in kilograms to squared height has been in use since 1972 when it was first used in Journal of Chronic disease by Ancel Keys. Classification is the same for both sexes and the interval of ideal and healthy weight is 18,5–25 kg/m2 [12]. Figure 1 presents female and male figures with the zones where measuring is carried [13].

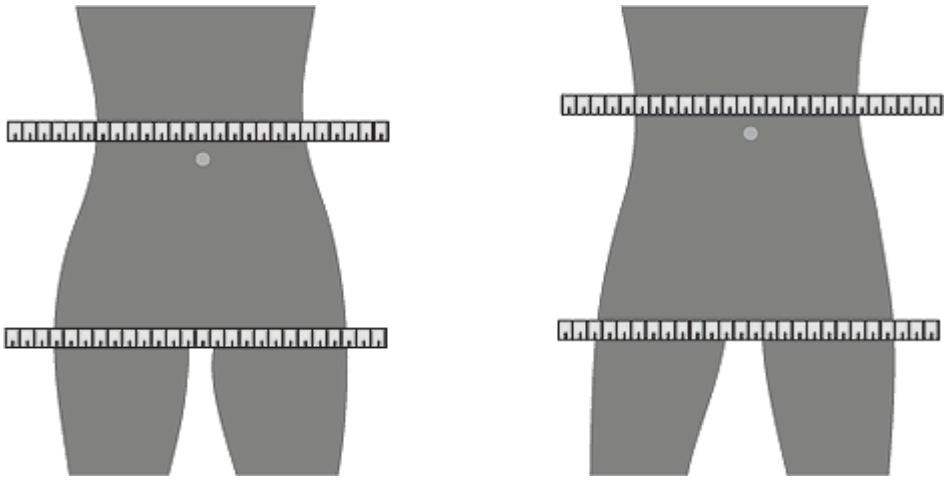

Figure 1. Specification of zones for body circumference measuring [13]

WHR index defines the distribution of body fat. The evaluation differs according to sex, adequate distribution being 0,75–0,8 for female and 0,85–0,9 for male. See Chart 1. The lower values of the indices mean peripheral fat distribution (accumulation of fat in hips and bottom area) which is normal for women, usually genetically conditioned, not easily influenced by physical exercises, but brings no health risks. Higher values indicate central and risky distribution and the increase of values also increases the risk of cardiovascular diseases. Risky distribution of fat is also called abdominal obesity [13].

Chart 1. Evaluation scale of WHR index

WHR (waist/hips)	(peripheral)	(balanced)	(central)	(risky)
men	**< 0,85**	**0,85–0,9**	**0,9–0,95**	**>0,95**
women	**< 0,75**	**0,75–0,8**	**0,8–0,85**	**>0,85**

Source: [13].

The study of IDEA might be of interest as more than 6400 doctors participated in 63 countries including Slovakia. Using the sample of more than 177 000 respondents aged 18 to 80, the conclusion was that waist circumference is the highest in the states of eastern Europe and South America [15].

They best express diet habits and local genotype. They enable to capture early changes and undertake systematic measures. Their disadvantage is that not all the states have professionals needed to carry out extensive anthropometric surveys which are usually costs and organisation demanding. These surveys have a long tradition in Slovakia. The first ever was carried in Czechoslovakia in 1951 and subsequent surveys were carried every first year of a following decade. Thus Slovakia has been among the states with very well observed and checked growth characteristics of children population and long term surveys had been obtained this way on growth trends of Slovak children and youth. At the same time we are one of a few countries that have their own national BMI standards [16].

Back pain

Increased tension of paravertebral muscles during movement is the main reason of back pain. Tense muscles trigger mechanical pressure on the spine and nerve structures. Even the resting muscle tension is source of pain, too. Slight degree of obesity, in fact, has no influence on the spine disorders [17].

From bio mechanic point of view the higher degree of obesity really matters as then the abdominal wall is overloaded and cannot contract sufficiently. The truth is that obese people have no serious problems as their muscles are in harmony and their posture is balanced. The reason of back pain is muscle disbalan-

ce, movement coordination disorder and movement stabilization disorder which means no engagement of dynamic spiral muscle strings with predominant activity of vertical resting strings in the process of movement. Obese people need to manage coordination and stabilisation of their movement, losing weight being secondary issue then. The spiral stabilisation of spine (SM system) leads to engagement of all body muscles and their sufficient repletion which then leads to carbohydrates and fats decrease in mitochondria of muscle apparatus. This form of exercise is, in fact, obesity treatment while the diet itself without exercises leads to body devastation and muscle mass loss obviously resulting in back pain. The abdominal fat supports the spine and when on a diet, the loss of fat triggers higher pressure on discs and back pain development. That is why diet needs to be accomplished with a suitable form of exercise. Dr. Richard Smíšek recommends SM system of exercises [18].

Methodics

The sample of respondents consisted of university students from two universities in Košice (n=1993, male=809, female=1184), their average age was 21,3±2,6 years. Diagnosis was carried out in September of 2012 in the first two weeks of winter semester in academic year 2012/2013. The students participating were the ones with obligatory or optional Physical Education lessons as part of their study plan. Subjective information on presence or absence of back pain was obtained from students with the use of questionnaire. To diagnose body weight professional medical scale OMRON BF511 was used while physical height was measured using a professional measuring tape with 0,5cm accuracy. BMI was calculated automatically by the scale used with 0,1kg/m2 accuracy. Waist circumferences were measured with the use of flexible measuring tape with 1,0cm accuracy and the internationally applicable conditions were met as given by WHO [3]. After that the WHR values were calculated with the accuracy of 0,01. For the purpose of analysis, the data obtained were divided according to sex and then the two groups of respondents were divided according to back pain presence or absence. The statistical rate used for central tendency was arithmetic average and the rate of variability chosen was standard deviation. Percentages of values of BMI and WHR parameters in individual intervals of evaluation scale were mutually compared and variances evaluated with the use of logical analysis.

The WHR ratio was calculated according to (1) [13]:

WHR= waist/hips ratio (1)

The BMI ratio was calculated according to (2) [14]:

BMI = weight in kilograms/squared height in metres (2)

The study uses the research data obtained within the solution of VEGA project "Particular risk factors of obesity and movement prevention" No. 1/1343/12.

Results and discussion

The average value of BMI in a set of men and women (n = 1993) was 22,63±3,86 (kg/m^2), and the fact of interest is that students who claimed back pain have average value of BMI by 0,81(kg/m^2) lower, see Chart 2. The highest differences in percentage distribution of BMI value were observed in the scale of overweight, where percentage of students with back pain was lower by 3,9% (15,5%) and in the scale of malnutrition, on the other hand, was by 3,5% higher. The differences were not so significant in other intervals.

Chart 2. Percentage distribution of BMI values at students with/without back pain, average values and standard deviation – men and women.

BMI (kg/m^2)	<18,5 (malnutrition)	18,5–25 (ideal weight)	25–30 (overweight)	>30 (obesity)	average value
with back pain (n = 671)	10,7%	70,2%	15,5%	3,6%	21,44±3,86
without back pain (n = 1322)	7,2%	68,3%	19,4%	5,1%	22,07±3,86
total (n = 1993)	8,9%	69,3%	17,4%	4,4%	21,81±3,86

Source: own research, 2012.

The average value of BMI in men (n = 809) was 23,83±3,86 (kg/m^2) and was almost identical in both groups of men, with and without back pain. The most significant differences were observed within ideal weight group where students with back pain were 4,1% less (60,7%) while within overweight interval group they were 2,9% (28,7%) more, for more information see Chart 3.

The average value of BMI in women (n = 1184) was 21,81±3,86 (kg/m^2) and the factor of interest is that female students with back pain have the average value of BMI by 0,63 (kg/m^2) lower. The differences in classification intervals were most significant in the scale of overweight. There were by 3,7%(10%) less female students with back pain. Ideal weight was observed in 74,3% in the group with back pain, which contributes to 2,9% difference. Similar finding as in total sample of women was observed in the group of women with back pain in malnutrition interval where there were by 2,7% (13,2%) more female students without back pain, see Chart 4.

Chart 3. Percentage distribution of BMI values in students with/without back pain, average values and standard deviation – male

BMI (kg/m^2)	<18,5 (malnutrition)	18,5–25 (ideal weight)	25–30 (overweight)	>30 (obesity)	average value
with back pain (n=181)	3,9%	60,7%	28,7%	6,7%	23,82±3,86
without back pain (n=628)	3,5%	64,8%	25,8%	5,9%	23,84±3,86
Total (n=809)	3,6%	63,9%	26,5%	6,0%	23,83±3,86

Source: own research, 2012.

Chart 4. Percentage distribution of BMI values in students with/without back pain, average values and standard deviation – female

BMI (kg/m^2)	<18,5 (malnutrition)	18,5–25 (ideal weight)	25–30 (overweight)	>30 (obesity)	average value
with back pain (n=490)	13,2%	74,3%	10%	2,5%	21,44±3,86
without back pain (n=694)	10,5%	71,4%	13,7%	4,4%	22,07±3,86
total (n=1184)	11,6%	72,6%	12,1%	3,7%	21,81±3,86

Source: own research, 2012.

When analysing WHR index the following findings were observed. The average WHR in the group of male was 0,82±0,08 and the value is similar in both compared samples so we can assume that the value has no connection with back pain. Most men, 57,8%, ranked into the group of peripheral body fat distribution. However, we observed differences in values distribution in the classification chart for body fat distribution. There are by 2,7% (24,3%) more man with back pain in the interval of balanced distribution and by 3,2% (12,7%) more in average distribution than the students without back pain. The opposite is true in peripheral and risky distribution, with more significant difference in risky distribution of fats where there are by 3,2% (5,0%) less students with back pain than students without back pain, see Chart 5.

The average value in the group of female was 0,78±0,08 and it was similar in both compared samples, like in male groups (with and without back pain). Most women, up to 47,8% ranked into the peripheral body fat distribution. The differences between female students with and without back pain were shown in

peripheral and balanced form of distribution. WHR values lower than 0,75 were observed in 49,4% female students with back pain which is 3,1% more in comparison with the second group of women, see more in Chart 6. The opposite result was obtained when comparing percentages of female students in WHR interval from 0,75 to 0,80 which represents a balanced distribution of fat. There are 2,7% (27,5%) less female students with back pain in this group compared to other group. In central and risk distribution groups the difference is neglectable.

Chart 5. Percentage distribution of WHR values in students with/without back pain, average values and standard deviation – male

WHR	<0,85 (peripheral)	0,85–0,9 (balanced)	0,9–0,95 (central)	>0,95 (risky)	average value
with back pain (n=181)	58,0%	24,3%	12,7%	5,0%	0,82±0,08
without back pain (n=628)	60,7%	21,6%	9,5%	8,2%	0,82±0,08
total (n=809)	57,8%	22,2%	10,2%	9,8%	0,82±0,08

Source: own research 2012.

Chart 6. Percentage distribution of WHR values in students with/without back pain, average values and standard deviation – female

WHR	<0,75 (peripheral)	0,75–0,8 (balanced)	0,8–0,85 (central)	>0,85 (risky)	average value
with back pain (n=490)	49,4%	27,5%	14,3%	8,8%	0,78±0,08
without back pain (n=694)	46,3%	30,2%	14,5%	9,0%	0,78±0,08
Total (n=1184)	47,5%	29,1%	14,4%	9,0%	0,78±0,08

Source: own research 2012.

Complex BMI and WHR values as from survey are in Chart 7.

Chart 7. Complex BMI and WHR values as from survey

Key factor	WOMEN			MEN		
	Number of respondents	BMI values	WHR values	Number of respondents	BMI values	WHR values
Respondents with back pain	**490**	21,44±3,86	0,78±0,08	**181**	23,82±3,86	0,82±0,08
Respondents without back pain	**694**	22,07±3,86	0,78±0,08	**628**	23,84±3,86	0,82±0,08
TOTAL	**1184**	21,81±3,86	0,78±0,08	**809**	23,83±3,86	0,82±0,08

Source: own research, 2012.

Conclusion

The above presented analysis of results does not provide conclusions which would clearly contradict or confirm our hypothesis. Shiri in the meta-analysis of 96 studies on obesity impact on back pain sorts obesity into four groups but also claims that these studies bring controversial knowledge in this area [4]. Our results confirm the controversy and ambiguity of the obesity impact, too. We expected higher percentage of students with overweight in a group of back pain occurrence. But that was not proven. Out of differences observed the most significant seem to be the following ones: average BMI value in the total sample of male and female was 22,63±3,86 (kg/m^2) and the factor of interest is that students who claim the back pain have average BMI value by 0,81(kg/m^2) lower. The same knowledge, though not so significant, was present in the group of female. In the group of women with back pain occurrence the average BMI value was by 0,63 (kg/m^2) lower. In the total sample the percentage of students with back pain occurrence in the interval of overweight was by 3,9% lower. In the group of men with back pain occurrence there were by 4,1% less students with ideal weight. In the group of female with back pain in overweight interval there were by 3,7% more. The analysis of WHR index values is also inconsistent and partially denies the knowledge from literary sources as well as our expectations. Average WHR values in men were 0,82±0,08, in women 0,78±0,08 and did not influence the back pain occurrence. Higher percentage of men with back pain, by 2,7%, higher, was observed in the interval of balanced fat distribution and by 3,2% higher in central fat distribution. In women with back pain occurrence WHR index values lower than 0,75 were found in 49,4% of female which is 3,1% more when compared with the second group of women. The results cannot clearly stipulate whether the overweight and obesity impact on back pain occurrence is negative.

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Abstrakt

Ovplyvňuje pomer pása a bokov (WHR) a index telesnej hmotnosti (BMI) bolesti chrbta u vysokoškolákov?

Cieľom článku bolo buď potvrdiť alebo vyvrátiť hypotézu o súvislosti vyššieho WHR a BMI v spojení s bolesťou chrbta univerzitných študentov v porovnaní s inými študentmi. Hypotéza sa mala buď potvrdiť alebo vyvrátiť na základe analýzy vplyvu WHR a BMI vo vzťahu k subjektívne pociťovanej bolesti pozorovanej u študentov univerzity. Metódou analýzy použitou v prieskume je rozsiahly dotazník z roku 2012 na TUKE v KE a UPJŠ v KE. Vzorka pozostávala z 1993 univerzitných študentov, 809 mužov a 1184 žien s priemerným vekom 21,3±2,6. Bolesť chrbta sme diagnostikovali na základe subjektívnej bolesti uvedenej vo výpovediach študentov. Pre štatistické spracovanie boli potom údaje rozdelené do skupín muži verzus ženy a skupina s prítomnou bolesťou a bez bolesti chrbta. Štatisticky významný je aritmetický priemer a mierkou variability zasa štandardná odchýlka. Percentuálne údaje o BMI a WHR v rámci jednotlivých intervalov hodnotiacej škály sa porovnali a rozdiely sa vyhodnotili pomocou logickej analýzy. Náš výskum nepotvrdil hypotézu. Počet študentov s bolesťou chrbta nebol vyšší pri vyšších ako normálnych hodnotách skúmaných indexov. Prieskum potvrdil nejednoznačnosť vplyvu jednotlivých položiek na bolesť chrbta, tie teda nemôžu potvrdiť či vyvrátiť ich vplyv na bolesť chrbta.

Kľúčové slová: bolesť chrbta, WHR index, BMI, obezita, nadváha, univerzitní študenti, hodnotenie fyzického vývinu.