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(RESEARCH ARTICLE)

A cross-sectional study on assessment of physical activity level and anthropometric indicators of health risk among students of sixth year of Faculty of Medicine of Sarajevo University.

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Abstract

Overweight and obesity are major public health issues worldwide. There is increased risk of obesity-related morbidity due to accumulation of abdominal fat. Regulation of body weight depends on physical activity and diet. Young adulthood is very critical period due to a tendency to gain weight and adopt poor dietary and exercise habits. This study aimed to investigate the relationships of the anthropometrical parameters with physical activity domains in everyday life and sedentary behavior among students of sixth year of the Faculty of Medicine of Sarajevo University. A cross-sectional study was conducted during May 2020. The survey covered 56 students, aged 24, who responded online to questionnaire. A self-administered questionnaire composed of two blocks of questions. In the first block of the questionnaire, questions were related to sex, and anthropometric measures. The second block referred to the practice of physical activity (vigorous, moderate, and walking), and sitting during seven days. The data collected were processed by the descriptive statistical procedure. Overweight and obesity was found at 11(19.65%). In sample 46.43% performed vigorous intensity activities that meet with WHO criteria, 58.93 performed moderate intensity activities that meet with WHO criteria, and 39.29% performed walking activities that meet with WHO criteria. There were positive, statistically significant difference between indicators of abdominal obesity and the average time spent during 7 days in vigorous physical activity. Health and physical educators can utilize these findings to better understand that physical activity, trying to balance diet and activities.

Keywords: Anthropometric measurements; Abdominal obesity; Weight Gain; Sedentary lifestyle

1. Introduction

Overweight and obesity are conditions in which excess body fat has accumulated to an extent that may impair health. Common health consequences of overweight and obesity are noncommunicable diseases such as: cardiovascular diseases; diabetes; musculoskeletal disorders; some cancers [1].

The prevalence of overweight and obesity has increased dramatically over past four decades. According to WHO statistics 39% of adults aged 18 years and over were overweight in 2016, and 13% were obese [2]. Once overweight and obesity were a high-income country problem. Now they have been on the rise in low- and middle-income countries. Intercountry comparable overweight and obesity estimation from 2008 emphasizes problem in Bosnia and Herzegovina: 60.7% of the adult population (> 20 years old) were overweight and 26.5% were obese [3].

Diagnostic criteria for obesity include several anthropometric parameters: body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR). The BMI is defined as a person's weight (in kilograms) divided by the square of person's height (in meters). It is a crude measure of overall adiposity. Those with a

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BMI greater than or equal to 25 are considered being overweight, and those with a BMI greater than or equal to 30 are considered being obese. The WHO STEPS protocol for measuring WC instructs that WC should be measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch-resistant tape that provides a constant 100 g tension. Hip circumference should be measured around the widest portion of the buttocks, with the tape parallel to the floor. WHR (i.e. the waist circumference divided by the hip circumference) is a measure of body fat distribution. It provides an index of both subcutaneous and intraabdominal adipose tissue [4,5]. Waist-to-height ratio is defined as a person's waist circumference divided by person's height. It is a measure of centralized obesity [6].

There is increased risk of obesity-related morbidity due to accumulation of abdominal fat. Abdominal obesity is defined as: a BMI above 30.00 (Table 1) or a WC of >94cm in men and >80cm in women and a WHR above 0.90 for males and above 0.85 for females (determined for European men and women, respectively) (Table 2).

WHtR is the best predictor of cardiovascular risk in both men and women. For people under 40 a cutoff level is 0.5. Boundary value for men is 0.54, and for women is 0.49. The cutoff levels lie between 0.5 and 0.6 for people aged 40–50, and for people over 50 the critical values start at 0.6 [6].

Table 1 Classification of adults according to BMI [5]

Classification	**BMI (kg/m^2)**	**Risk of comorbidities**
Underweight	≤ 18.5	Low (but risk of other clinical problems increased)
Normal	18.5-24.9	Average
Overweight	25–29.9	Increased
Obese class I	30-34.9	Moderate
Obese class II	35-39.9	Severe
Obese class III	≥40	Very severe

Table 2 Cut-off points of waist circumference and WHR and risk of metabolic complication [4]

Indicator	**Cut-off points**	**Risk of metabolic complications**
Waist circumference	>94 cm (M); >80 cm (W)	Increased
Waist circumference	>102 cm (M); >88 cm (W)	Substantially increased
Waist-hip ratio	≥0.90 cm (M); ≥0.85 cm (W)	Substantially increased

M, men; W, women

Regulation of body weight depends on physical activity and food consumption patterns. By WHO physical activity is defined as any bodily movement produced by the contraction of skeletal muscles that requires energy expenditure. Physical activity generally refers to the subset of physical activity that enhances health [7,8]. There are several activity domains in everyday life. Occupational work activities are undertaken during the course of work. Transportation physical activities are undertaken during traveling from place to place, including to places like work, stores, movies, and so on. Household and other chores activities are undertaken around home, like housework, gardening, yard work, general maintenance work, and caring for family. Leisure-time physical activities are undertaken in the individual's discretionary free time, like recreation, exercise or sport [5,9]. All forms of physical activity can provide health benefits if undertaken regularly and of sufficient duration and intensity [10].

The level of PA intensity depends on the magnitude of the effort required to perform an activity. Moderate PA produces a moderate increase in respiration rate, heart rate and sweating for at least 10 min duration. On an absolute scale, moderate intensity refers to the PA that is performed at 3.0–5.9 times the intensity of rest. Vigorous physical activities are defined as those producing increases in respiration rate, heart rate and sweating for at least 10 min duration and vigorous intensity refers to PA that is performed at 6.0 or more times the intensity of rest for adults [9,10].

Physical inactivity, or sedentary behavior, can be defined as any waking behavior characterized by a low level of energy expenditure while sitting, reclining, or lying (television viewing time, working at a computer, talking with friends on

the telephone, driving a car, meditating or eating) [5,8,11]. A primary cause of most chronic diseases is physical inactivity [12].

There are erosions in PA patterns through adolescents' age, mostly from ages 15 to 18, and during young adulthood (18–29 year). Early development in childhood of overweight leads to obesity in adulthood. Nevertheless the transition between adolescence and young adulthood is a period of increased risk of development of obesity. As longitudinal studies have shown, a substantial amount of weight is gained during the transition from adolescence to young adulthood. This trend is present in both males and females [13,14].

PA patterns of general population, as well as of young adults, have been limited explored in Bosnia and Herzegovina. Exploring this health-related factor is necessary to implement a health promotion program. This study aimed to investigate the relationships of the anthropometrical parameters with physical activity domains in everyday life and sedentary behavior among students of sixth year of the Faculty of Medicine of Sarajevo University.

2. Methods

2.1. Design and Sample

A cross-sectional study was conducted during May 2020 at Faculty of Medicine of Sarajevo University. The survey covered 56 students from the sixth year of study, aged 24, who responded online to questionnaire.

The study was performed according to the research ethics guidelines laid down in the Declaration of Helsinki [15].

2.2. Data Collection

For the collection of data was applied a self-administered questionnaire composed of two blocks of questions. In the first block of the questionnaire, questions were related to sex, and anthropometric measures (height, weight, waist and hip circumference). The second block referred to the practice of PA using the short version of the International Physical Activity Questionnaire (IPAQ). IPAQ is used to obtain internationally comparable data on health–related PA for use with young and middle-aged adults (15-69 years) [16,17]. It contains 7 open-ended questions providing information on time spent in vigorous- and moderate- intensity PA, walking, and in sedentary activity during the previous 7 days.

2.3. Anthropometric status assessment

Height and weight were used to calculate BMI, waist and hip circumference to calculate WHR, and waist circumference and height were used to calculate WHtR.

2.4. PA assessment

From different domains of PA and sitting several variables were analyzed: the frequency and time spent per week in vigorous physical activities, the frequency and time spent per week in moderate physical activities, the frequency and time spent per week in walking, and the frequency and time spent per week in sitting.

The separate scores on walking, moderate-intensity and vigorous-intensity activity were calculated by multiplying the minutes spent in each activity by the number of days of the activity. The volume of each activity was computed by weighting each type of activity by its energy requirements defined in METs to yield a score in MET–minutes. METs are multiples of the resting metabolic rate and a MET-minute. According to the guidelines for data processing and analysis of the IPAQ MET-min per week for each of walking, moderate- and vigorous intensity activities were calculated as follows: walking = (3.3 × walking min × walking days); moderate activity = (4.0 × moderate activity min × moderate activity days); vigorous activity = (8.0 × vigorous activity min × vigorous activity days). Sum of these activities gives total MET-minutes/week:

Total MET-minutes/week = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days)

Total physical activity score was used for classification level of PA: high (≥3000 MET-min /Week), moderate (600-2999 MET-min /Week) and low (<600 MET-min /Week) [18].

The WHO global recommendation on PA for health for adults (aged 18–64 years) is at least 150 minutes of moderate-intensity activity per week, or at least 75 minutes of vigorous-intensity physical activity throughout the week or an equivalent combination of moderate-intensity and vigorous-intensity activity [10]. Vigorous and moderate physical

activities for each subject measured were classified as meeting or not meeting WHO criteria for physical activity for health.

2.5. Statistical analysis

Statistical analyses were performed using the Statistical Package for Social Sciences software (IBM, version 23.0). Continuous data were presented as mean and standard deviation (SD) and compared using Student t-test. In the bivariate analysis, the association (using Pearson's chi-squared test) of anthropometric measures were estimated according to the average time spent at the weekly level in walking, moderate-intensity, vigorous-intensity activity, and sitting. Differences were considered statistically significant at $p<0.05$.

3. Results

3.1. General information of students participated in the study

A sample included 56 students, of which 43 (76.79%) were female and 13 (23.21%) were male. A more detailed profile of the students' characteristics is presented in Table 3.

Table 3 General information of students participated in the study

Variable		**Females**	**Males**	**p**
Number of students (%)		43 (76.79%)	13 (23.21%)	
Anthropometric measures	Weight (mean±SD)	61.86±0.98 kg	89.46±3.47 kg	<0,0005
	Height (mean±SD)	168.97±0.81 cm	183.08±1.60 cm	<0,0005
	BMI (mean±SD)	21.76±0.36 kg/m^2	26.69±0.95 kg/m^2	<0,0005
	WC (mean±SD)	70.95±1.20 cm	90.77±4.13 cm	<0,0005
	WHtR (mean±SD)	0.42±0.05	0.50±0.08	<0,0005
	Hip circumference (mean±SD)	93.80±1.22 cm	96.62±3.99 cm	0,368
	WHR (mean±SD)	0.76±0.08	0.94±0.07	<0,0005
Average time spent at the weekly level in	Vigorous PA	73.84±13.83 min	167.31±36.34 min	**0,029**
	Moderate PA	207.67±29.88 min	186.92±37.08 min	0,723
	Walking	161.40±27.04 min	185.77±61.24 min	0,683
	Sitting	297.21±20.75 min	420.00±58.93 min	**0,016**
MET-minutes per week		1984.52±1290.27	2699.19±1718.04	<0,0005

Male students compared to female declared more time spent in vigorous PA (t test: $p=0.029$; $p<0.05$); and sitting (t test: $p=0.016$; $p<0.05$).

3.2. Anthropometric measures and health risk

It is showed by Table 4 that the majority of the students (76.78%) were of normal weight according to BMI. The BMI > 24.9 was found at 11(19.65%). Based on the WC, metabolic risk was determined in 10 (17.86%) subjects. Based on the WHtR, a higher health risk was found in 8 (14.29%) subjects. Based on the WHR, a higher health risk was found in 11 (19.64%) subjects.

Table 4 Anthropometric indicators of health risk

Indicator	Classification / Cut-off (health risk)	Females Number (%)	Males Number (%)	Total Number (%)
BMI	Underweight ≤ 18.5 (Low)	2(4.65)	-	2(3.57)
	Normal 18.5-24.9 (Average)	38(88.37)	5(38.46)	43(76.78)
	Overweight 25–29.9 (Increased)	3(6.98)	5(38.46)	8(14.29)
	Obese class I 30-34.9 (Moderate)	-	3(23.08)	3(5.36)
WC	<94 for males and <80 females (Average)	38(88.37)	8(61.54)	46(82.14)
	≥94 <102 for males and ≥80 <88 for females (Increased)	4(9.30)	3(23.08)	7(12.50)
	≥102 for males and ≥88 for females (Substantially increased)	1(2.33)	2(15.38)	3(5.36)
WHtR	<0.54 for males and <0.49 for females (Average)	38(88.37)	10(76.92)	48(85.71)
	≥0.54 for males and ≥0.49 for females (Increased)	5(11.63)	3(23.08)	8(14.29)
WHR	<0.95 for males and <0.85 for females (Average)	38(88.37)	7(53.85)	45(80.36)
	≥0.95 for males and ≥0.85 for females (Increased)	5(11.63)	6(46.15)	11(19.64)

3.3. PA assessment

Pattern of PA was determined on the basis of PA scores and levels were calculated

Table 5 Pattern of PA

Pattern of PA		Females Number (%)	Males Number (%)	Total Number (%)
PA level	Low (MET<600)	4(9.30)	2(15.39)	6(10.71)
	Moderate (600-3000)	31(72.09)	6(46,15)	37(66.08)
	High (MET≥3000)	8(18.61)	5(38.46)	13(23.21)
Vigorous PA	<10 min/week	17(39.54)	3(23.08)	20(35.71)
	10-75 min/week	9(20.92)	1(7.69)	10(17.86)
	≥75 min/week	17(39.54)	9(69.23)	26(46.43)
Moderate PA	<10 min/week	1(2.32)	2(15.38)	3(5.36)
	10-150 min/week	17(39.54)	3(23.08)	20(35.71)
	≥150 min/week	25(58.14)	8(61.54)	33(58.93)
Walking	<60 min/week	13(30.23)	2(15.39)	15(26.78
	60-150	14(32.56)	5(38.46)	19(33.93)
	≥150 min/week	16(37.21)	6(46,15)	22(39.29)

According to the IPAQ scoring system, 10.71% of students had low level of PA, 66.08 were moderate and 23.21 were high physically active.

In sample 46.43% performed vigorous intensity activities that meet with WHO criteria, 58.93 performed moderate intensity activities that meet with WHO criteria, and 39.29% performed walking activities that meet with WHO criteria.

3.4. Correlation between anthropometric indicators of health risk and PA pattern

Correlations between the different tested variables are presented in Table 5.

Table 5 Pearson correlation between anthropometric indicators of health risk and PA pattern.

Indicator	The average time spent during 7 days in			
	Vigorous PA	**Moderate PA**	**Walking**	**Sitting**
BMI	P=0.003 (0.384)	P=0.348 (0.126)	P=0.602 (-0.071)	P=0.403 (0.114)
WC	P=0.005 (0.368)	P=0.914 (0.015)	P=0.563 (0.079)	P=0.078 (0.237)
WHtR	P=0.023 (0.303)	P=0.914 (-0.015)	P=0.836 (0.028)	P=0.196 (0.175)
WHR	P=0.003 (0.387)	P=0.384 (-0.119)	P=0.930 (-0.012)	P=0.457 (0.101)

There were positive, statistically significant difference between indicators of health status and the average time spent during 7 days in vigorous PA.

4. Discussion

The purpose of this study was to investigate the relationships of physical activity domains in everyday life and sedentary behavior with the anthropometrical parameters among students of sixth year of the Faculty of Medicine of Sarajevo University. A cross-sectional study was conducted during May 2020 and included 56 students. Anthropometric measures (height, weight, waist and hip circumference) were used to calculate BMI, WHtR and WHR, the anthropometric markers related to risk of metabolic complication. The majority of the students (76.78%) were of normal weight according to BMI. The BMI > 24.9 was found at 11(19.65%). Based on the waist circumference, metabolic risk was determined in 10 (17.86%) subjects. Based on the WHtR, a health risk was found in 8 (14.29%) subjects. Based on the WHR, a higher health risk was found in 11 (19.64%) subjects.

Overweight and obesity prevalence has been reported in all age groups worldwide [2], including college students as well [19]. In terms of the BMI for students from the University of Banja Luka there were 22.40% overweight students, while 2.40% of them were obese [20]. Applying BMI, 21.9 % and 20.6% of students were classified as overweight and obese, respectively during a cross-sectional study at the Colleges of Medicine and Nursing at the King Saud bin-Abdulaziz University for Health Sciences, National Guard Health Affairs, in Riyadh, Saudi Arabia. Abdominal obesity was prevalent in 26.9% and 42.2% of students based on WC and WHtR, respectively [21].

Male students compared to female declared more time spent in vigorous PA (t test: $p=0.029$; $p<0.05$). The same finding has been reported in study carried out in the health colleges of King Khalid University [22].

According to the IPAQ scoring system, in present study 10.71% of students had low level of PA, 66.08 were moderate and 23.21 were high physically active. Some studies showed a high prevalence of physical inactivity among university students [22,23]. In our sample 46.43%, 58.93, and 39.29% of the students performed vigorous intensity activities, moderate intensity activities, and walking activities that meet with WHO criteria. Miller reported that nearly half and nearly three-fifth of university students were vigorously and moderately physically active [24]. The high prevalence of inactivity among university students in some study can be explained by environmental factors [22].

There was statistically significant relationship found between anthropometric indicators of health status and the average time spent during 7 days in vigorous PA. There are various research results of effect of PA on BMI. Cameron emphasized strong positive associations between obesity and lower physical activity [25]. Aziz reported that some students were obese and still have high physical activity level while some are normal in BMI and having low physical activity level [26].

Increased the prevalence of obesity observed in USA had the greatest magnitude of in the following groups: 18- to 29-year-olds (7.1% to 12.1%), and those with some college education (10.6% to 17.8%) [27].

5. Conclusion

This study has some limitations. The cross-sectional design does not allow to follow changes in anthropometric indicators depending on undertake different intensity of physical activity. In this study, the reverse causality could explain observed associations between PA and the outcomes analyzed. Some individuals in this study may have started the practice of PA for having found themselves obese. Nevertheless the present study highlights an important issue of the health of college students: the anthropometric indicators of abdominal obesity can be increase despite satisfied level of physical activity. It is important to raise awareness about the possible discrepancy between energy consumption and energy intake. When physical activity intensifies, there is often an increase in appetite and increased caloric intake. If the caloric intake does not correspond to energy consumption, there may be an increase in body weight. It is suggested to keep a diary with data on the type and number of meals, and the type and amount of food. Understanding strategies to adopt healthy life style would make health college students competent to promote and disseminate healthy lifestyle to the public.

6. Supplementary file

6.1. Appendix IPAQ SF (17)

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

□ No vigorous physical activities → Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?

_____ hours per day

_____minutes per day

3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis?

Do not include walking.

_____days per week

□ No moderate physical activities → Skip to question 5

4. How much time did you usually spend doing moderate physical activities on one of those days?

_____ hours per day

_____ minutes per day

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

_____days per week

□ No walking → Skip to question 7

6. How much time did you usually spend walking on one of those days?

_____hours per day

_____minutes per day

7. During the last 7 days, how much time did you spend sitting?

_____ hours per day

_____ minutes per day

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that they have no competing interests.

Statement of informed consent

Informed consent was obtaıned from all ındıvıdual participants ıncluded ın thıs study.

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