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Level of Students 'Functional Abilities as a Parameter for Determining Differences in Triglyceride, Cholesterol, Blood Sugar and Body Composition in Students

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Abstract: *The aim of the study was to determine the differences in the level of fat, sugar and body structure based on the level of functional abilities. The sample of respondents are students of the University of Bihać who also completed the shuttle run test (BEEPT). T-test for independent samples revealed the existence of statistically significant differences between the arithmetic means of the two groups of subjects for (AMAS, p = 0 .011), (BMI p = 0 .000), (FAT%, p = 0.000), (FMKG p) = 0.000). A statistically significant difference was also found in the variable triglycerides (TRIGL p = 0.019), while in the other variables no statistically significant difference was found in the two groups of subjects in favor of subjects who had better results in functional abilities. The coefficient of discriminant canonical correlation is (0.512), as is Wilks lambda, (0.738), which indicates very high discrimination between groups (sig. 000). The greatest contribution to the formation of the discriminatory function was given by the variables FMKG - .801, FATPR -.760, BMI - .707, AMAS - .390, TRIGL - .358, HOLE - .235. The centroids of the groups show a large distance between the results of the groups because they are located at both ends of the coordinate system. The first group consists of positive results of a total of 7 variables, which means that the respondents of the first group had significantly better results in these variables.*
Based on the results, it can be concluded that the increase in cholesterol triglycerides and some parameters of body structure affected the level of health status as well as body composition in students.

Keywords: *functional abilities, triglycerides, body structure.*

Introduction

An active lifestyle has become a key factor in reducing obesity and / or coronary problems associated with human behavior, such as those caused by a lack of exercise or movement. Regular physical activities in students have been shown to have positive effect on improving strength and endurance, which helps in building healthy bones and muscles, control weight, reduces stress and anxiety, and increases self-esteem and may improve blood pressure, cholesterol levels (Physical Activity Guidelines Advisory Committee report, 2008) and favorable cardiovascular risk profiles as well (Andersen, et al., 2006). The prevalence of overweight and obesity has increased significantly in all societies around the world over the past three decades, and all indications are that this trend is likely to continue with far-reaching negative public health effects (Finkelstein EA, at.al. 2012). The risk of type 2 diabetes, cardiovascular disease, certain types of cancer and mortality, and from them and in general, is directly proportional to the degree of obesity (Lu, Y., et al. 2014, McGee, DL. 2005). Health is a state of complete physical, mental, and social well-being and not merely the absence of disease (World Health Organization, 1946). Obesity creates a substantial risk of developing hypertension, Type 2 diabetes, dyslipidemia, and heart disease (Sachdev et al.,2005)

The level of functional abilities, ie the size of energy capacities as well as the level of their use significantly differs from individual persons. Knowledge of these characteristics are important prerequisites for the implementation of those forms of physical activity that will allow to increase and optimal use of the functional capabilities of the organism. Of the energy supply, the biggest problem is the supply of oxygen, because it is related to the activity of the respiratory system, as well as the activity of the cardiovascular system. (Skender, N., 2008). The level of functional abilities is directly related to the performance of aerobic work and is related to the level of physical activity of a person.

The role of energy systems is the conversion of chemical energy into a usable form (adenosine triphosphate, ATP) for all cellular functions. ATP is present in cells in very small amounts. About 5 micromoles of ATP per gram are stored in skeletal muscle, while the amount of creatine phosphate (CP), another phosphate compound rich in energy, is 20-30 µmol per gram of muscle. Degradation and production of ATP in muscles and other cells in the body is an extremely dynamic process. A 70 kg man (sedentary lifestyle) has only about 80 grams of ATP stored in his body. (Vučetić, 2009). In order to satisfy the need for energy, it is necessary to create a sufficient amount of ATP.

In order to restore ATP and thus keep its concentration in the muscle cell constant, energy from chemical sources that release energy without the presence of oxygen is used, and these are the so-called anoxidative or anaerobic energy processes, and from chemical sources that require the presence of oxygen and these are the so-called. oxidative or aerobic energy processes (Guyton and Hall, 2003).

A sedentary lifestyle is a risk factor for a range of chronic heart disease and obesity, and the importance of regular physical exercise for the student population is very important. Adequate levels of physical exercise during the week along with proper eating habits improves weight reduction and maintains within optimal limits. Physical exercise must be in accordance with the needs and goals and based on the initial diagnostic condition of the person performing it. The intensity and extent of exercise must be individual without risk to the health of the individual, but to provide an increase in the level of motor skills.

The results of many studies show the positive effects produced by physical programs activities or exercise on blood pressure values in normotensive or hypertensive individuals, lipidogram (mainly on the level of total cholesterol, HDL cholesterol and triglycerides), regulation of body weight and especially the composition of the body (its non-fat component and segments of the fatty component, especially the visceralbody fat) in overweight and obese individuals (Mišigoj – Duraković, M., at al. 2012).

The aim of this study is to analyze differences in body structure, triglyceride levels, cholesterol and blood sugar based on functional ability parameters tested through a beep test

MATERIALS AND METHODS

This research was done within a project funded by the Ministry of Education and Science of the Federation of BiH. The aim of this project is to determine the level of physical activity of students at the University of Bihać and the relationship with the morphological characteristics, body composition, functional abilities and health status of students The survey was carried out among student population in 2021 (Skender, N. at al. 2021).

Sample of respondents

The sample of respondents are students of the University of Bihać, a total of 125 male and female students aged 21.5, ± 2.15 years. Students are divided into two groups. The group also consisted of students with better results in functional abilities and the other group consisted of students with poorer results in functional abilities.

Functional ability measures

We used the Beep test (BEEPT) to measure functional abilities. The sample of variables consisted of functional abilities by which we assessed the level of aerobic capacity through Beep test. The test is performed in such a way as to measure a distance of 20 meters, a metronome is determined to measure the speed of each section. After each level run, the speed of the examinees increases. Respondents run to the extreme. When they stop, the number of levels and the number of sections run within the levels are recorded. After that, the level of oxygen consumption is read on the tables. Complete test protocol was taken from the site (Ramsbottom, R., Brewer, J., and Williams, C. 1988, Copyright© Loughborough University 2002).

Health status measurement

Health status of students was measured through: SUK - Blood sugar, HOL - Cholesterol, TRIGL – Triglycerides. The results of the health condition were measured by blood analysis in the certified medical laboratory "Alfa" in Bihać. Laboratory analysis was done in the morning before consuming any nutrition.

Body composition measures

BIA was measured using a TANITA body composition parameter analyser (the model of TANITA body composition analyser BF-350) in relation to the body composition and age of the subjects. This body composition assessment set includes the following variables: AMAS - WEIGHT - body weight, FAT% - Percentage of total body fat, FFM - fat free mass. The mass of fat released consisted of muscle, bone, tissue, water and other masses of fat released in the body, TBW - total body water. The total mass of water in the body is the amount of water expressed in lb, kg, or st.lb. BMI Body mass index - body mass index (estimate of body weight) is the ratio of height to weight. BMRKCAL: Basal metabolic rate - the basic metabolic rate represents the total energy released from the body to maintain normal body function in the resting phase such as respiration and circulation (1kcal = 4.184 kJ), FMKG - FAT MASS - total weight of fat mass per kilogram of body weight (in kg, lb).

Statistical analysis

All results were processed by statistical mathematical procedures, Descriptive Indicators, T-test and Discriminant Analysis, using IBM SPSS Statistics software, 20. Manifest variables applied in this study were processed by standard descriptive procedures in order to determine the normality of the distribution, which was tested by the Kolomogorov - Smirnov procedure. For the obtained results, the following parameters were calculated: Arithmetic mean - Mean, Standard error - Error, Standard deviation - St. dev., Variance, Minimum value - Min, Maximum value - Max, Range, Rank, Coefficient of curvature - SKEWNESS, Coefficient of elongation - KURTOSIS.

Results

Table 1 shows the results of the central dispersive parameters of measuring instruments for all variables covered by this study. The values of minimum and maximum result, arithmetic mean, standard deviation, variance, skewness and kurtosis are shown. A good look at the table shows a good balance of descriptive statistics results. The results are within the normality of the distribution of the applied manifest variables. Analyzing standard deviation and variance it is seen that significant variability between variables.

Based on kurtosis and skewness, we can assess the balance of results, which shows the mesocourt distribution of these results. This was quite to be expected because the sample was taken from the natural population by the method of random sampling, and the number of 125 respondents is quite sufficient for normal distribution when it comes to applied variables that we treated in the paper.

The central dispersive parameters have been analyzed in Table No. 2, where the central dispersive parameters were performed for both groups of respondents. The first group consisted of 59 subjects who had better results in the Beep test of functional abilities and the second group consisted of subjects with poorer results in the beep test. Based on the results of central dispersive parameters, it can be seen the existence of a certain difference in some variables such as body weight, triglycerides, body mass index, percentage of fat mass, and fat mass per kg of body weight.

***Table 1.** Descriptive parameters for all respondents, Descriptive Statistics for all samples*

	N	Min	Max	Mean		Std. Dev	Var	Skewn		Kurt	
	Stat.	Stat.	Stat.	Stat	Std. Er	Stat	Stat	Stat	Std. Er	Stat	Std. Er
AMAS	125	42.70	101.30	66.1968	1.220	13.648	186.26	.536	.217	-.407	.430
BMI	125	16.10	34.60	23.5808	.35531	3.97246	15.780	.458	.217	-.271	.430
FAT%	125	5.60	43.60	25.1328	.76318	8.53266	72.806	.036	.217	-.524	.430
FMKG	125	1.30	42.50	17.3408	.75504	8.44157	71.260	.738	.217	.346	.430
FFMKG	125	25.80	73.70	49.1468	.87758	9.81162	96.268	1.081	.217	.520	.430
TBW	125	27.50	54.00	36.1024	.62838	7.02549	49.357	1.220	.217	.472	.430
BMRKCAL	125	1244.00	2249.00	1561.86	19.96	223.23	49835.32	1.068	.217	.414	.430
BEEPT	125	1.80	12.10	4.9224	.21571	2.41169	5.816	1.352	.217	1.114	.430
SUK	125	3.60	6.90	4.9096	.04723	.52799	.279	.783	.217	2.393	.430
HOL	125	2.00	7.80	4.4184	.07970	.89112	.794	.835	.217	1.602	.430
TRIGL	125	.80	5.08	1.4515	.04816	.53844	.290	2.975	.217	15.755	.430

Table 2. *Central tendency measurments for two groups of respondents*

Group Statistics					
	GR	N	Mean	Std. Dev	Std. Er. Me.
AMAS	1	59	62.9373	12.95286	1.68632
	2	66	69.1106	13.68838	1.68492
BMI	1	59	21.9559	3.17502	.41335
	2	66	25.0333	4.07066	.50106
FAT%	1	59	21.4220	7.46560	.97194
	2	66	28.4500	8.09241	.99611
FMKG	1	59	13.5068	6.14379	.79985
	2	66	20.7682	8.77444	1.08006
FFMKG	1	59	49.4466	10.39937	1.35388
	2	66	48.8788	9.32709	1.14809
TBW	1	59	36.2000	7.61013	.99076
	2	66	36.0152	6.51654	.80213
BMRKCAL	1	59	1553.72	237.649	30.939
	2	66	1569.13	211.095	25.984
SUK	1	59	4.9186	.46367	.06036
	2	66	4.9015	.58296	.07176
HOL	1	59	4.2881	.77462	.10085
	2	66	4.5348	.97484	.11999
TRIGL	1	59	1.3331	.33529	.04365
	2	66	1.5574	.65471	.08059

Analysis of differences in arithmetic means of two groups of T-test subjects

Determining the differences between the two groups of respondents was performed on the basis of the T-test for independent samples (Table 3). T-test analysis for independent samples revealed the existence of statistically significant differences for four body composition tests and a health test. T-test showed that there are statistically significant differences for the following body composition tests (AMAS t = -2.582, p = 0 .011), (BMI t = 4.673, p = 0 .000) t, (FAT%, t = - 5.027, p = 0.000), (FMKG t = -5.300, p = 0.000). For other variables of body structure, no statistically significant difference was found between the arithmetic means of the two groups of subjects. A statistically significant difference was also found in the variable representing the health status of triglycerides (TRIGL t = -2.369, p = 0.019), while no statistically significant difference was found in the other variables in the two groups of subjects.

Table 3. *T-test for Independent Samples Test*

	Levene's Test for Equ of Var.		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tai)	Mean Difference	Std. Error Difference	95% Confidence Inter. of the Difference Lower	Upper
AMAS	.477	.491	-2.582	123	.011	-6.17332	2.39126	-10.90668	-1.43996
			-2.590	122.590	.011	-6.17332	2.38383	-10.89212	-1.45452
BMI	5.344	.022	-4.673	123	.000	-3.07740	.65855	-4.38096	-1.77385
			-4.738	120.850	.000	-3.07740	.64956	-4.36339	-1.79141
FAT%	.867	.354	-5.027	123	.000	-7.02797	1.39806	-9.79534	-4.26060
			-5.050	122.871	.000	-7.02797	1.39172	-9.78283	-4.27311
FMKG	7.568	.007	-5.300	123	.000	-7.26140	1.37019	-9.97360	-4.54920
			-5.403	116.558	.000	-7.26140	1.34398	-9.92320	-4.59961
FFMKG	2.987	.086	.322	123	.748	.56782	1.76430	-2.92451	4.06015
			.320	117.289	.750	.56782	1.77513	-2.94765	4.08329

TBW	3.848	.052	.146	123	.884	.18485	1.26373	-2.31663	2.68632
			.145	114.903	.885	.18485	1.27476	-2.34023	2.70992
BMRKCAL	.958	.330	-.384	123	.702	-15.40755	40.13506	-94.85245	64.03735
			-.381	116.816	.704	-15.40755	40.40319	-95.42527	64.61017
SUK	.439	.509	.180	123	.857	.01713	.09497	-.17086	.20512
			.183	121.409	.855	.01713	.09377	-.16851	.20277
HOL	3.575	.061	-1.554	123	.123	-.24671	.15876	-.56096	.06753
			-1.574	121.384	.118	-.24671	.15674	-.55702	.06359
TRIGL	12.655	.001	-2.369	123	.019	-.22437	.09473	-.41188	-.03687
			-2.448	99.169	.016	-.22437	.09165	-.40623	-.04252

Discriminative analysis

To determine global differences through discriminative analysis, the following values were calculated; discrimination coefficient, canonical correlation coefficient, percentage of explained group variability, Bartlett's value CHI square test, CHI square degrees of freedom, Wilks lambda value, and probability error hypothesis rejection the value of the canonical correlation is equal to 0. The criterion for the discriminant strength of the applied variables was the so-called Wilks lambda. Significant discriminant variables were used in the interpretation of the results and they explain a certain percentage of variability. (Skender, 2004).

Based on Table 4, we can determine that one statistically significant discriminant function was isolated. We estimate this on the basis of the coefficient of discriminant canonical correlation, which is .512, indicating a very high discrimination between groups, which is statistically significant at the level of $p < .01$, (sig..000). Based on these results, we determine the affiliation of each entity to one of the analyzed groups.

Wilks lambda was used as a criterion for the discriminative strength of the applied system of variables, which is also very high with .738, which also indicates high discrimination between the two groups of respondents.

Analyzing the matrix of the structure of table number 5, which shows the correlations of individual manifest variables with the discriminant function, ie explain the relative contribution of each variable in the formation of the discriminant function. The greatest contribution to the formation of the discriminatory function was given by the variables FMKG - .801, FAT% -.760, BMI - .707, AMAS - .390, TRIGL - .358, HOL - .235.

Table 6 presents the centroids of two groups of subjects, namely the 1st group of subjects with better results in functional abilities and the 2nd group of subjects with poorer results in functional abilities. We can conclude that the two groups are very distant from each other because they are located at two ends of the coordinate system. The first group consists of positive results of a total of 7 variables, which means that the respondents of the first group had significantly better results in these variables. On the negative pole are the respondents of the second group who have a very small and negative projection in the variables FFMKG -.049, SUK -.027, TBWKG -.022.

Table 4. *Discriminant Canonical analyasis*

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.356a	100.0	100.0	.512
Test of Function	**Wilks' Lambda**	**Chi-square**	**df**	**Sig.**
1	.738	35.598	12	.000

Table 5. *Structure Matrix*

	Funct.
	1
FMKG	.801
FAT%	.760
BMI	.707
AMAS	.390
TRIGL	.358
HOL	.235
BMRKCAL	.058
FFMKG	-.049
SUK	-.027
TBWKG	-.022

Table 6. *Centroids at Groups*

Grupa	Funct.
	1
1.00	-.626
2.00	.559

Discussion and Conclusion

This study aimed to determine the level of differences in body structure and some health status parameters such as triglycerides, cholesterol and blood sugar in two groups of University student respondents. The groups were formed on the basis of better and worse results in performing the beep test which is a classic test of functional abilities that assesses aerobic abilities in students. Based on that, we assessed the level of their physical activities as it is the functional abilities that develop through physical activity. The universities are an ideal environment for the promotion of physical activity and significance for the health condition of the student. The results of the t-test showed a significant difference between the two groups of the subjects. Subjects of the better group (59) of subjects had a lower weight of approximately 6.5 kg. , better BMI by 4 index points, better results with the percentage of fat mass and fat mass per kg of body weight. Skender et al. (2021) also found a high level of association of BMI with the level of functional abilities BEEP test. All this indicates that body composition highly influences the level of functional abilities, which was shown here through four variables with very high statistical significance. Observational studies provide compelling evidence that regular physical activity and a high fitness level are associated with a reduced risk of premature death from any cause and from cardiovascular disease in particular among asymptomatic men and women (Darren E.R. Warburton 2006).

The fact that doing regular physical activities affect the health status and longevity in a positive way is a clear phenomenon, which lowers the death risk between %20-35 as taking part in regular exercises. Moreover, provided that the person is phsically active, the death risk especially by cardiovascular diseases diminishes dramatically by almost half. In a study which were carried about with former football players aged between 40-50, participants were divided into two groups as active (n=30); who scored above 3000 metabolic equivalent of task (MET) and sedentary group (n=30); who scored below 3000 MET-minutes/week. Several blood tests such as complete blood count, serum lipids and thyroid functions which include hemoglobin (Hb), hematocrit (Hct), red blood cell count (RBC) and white blood cell count (WBC), triglyceride (Tg), low-density, lipoprotein cholesterol (LDLc), high-density lipoprotein cholesterol (HDLc) and total cholesterol (Tc) were examined. Also, Bioelectric Impedance Measurements (BIA) were applied to the participants. Among the participants, there were no significant differences in dietary habits, alcohol consumption and smoking levels. However, those who are in active group that have more active lifestyle had significantly higher body weight, body mass index and body fat levels when compared to the physically active group ($p < 0.001$). Both two groups were considered as overweight according to the BMI mean values. According to the result of this study, there were no statistically significant differences in blood parameters between groups and the blood counts and thyroid functions were found within the normal reference ranges. However, Tg, Tc and LDL levels of sedentary group (SG) were higher than active group (AG). While Triglyceride value were 153.18 ± 91.81(mg/dL) in AG, it was 191.54 ± 126.14 (mg/dL) in SG.($p < 0.162$). Also, total cholesterol level in AG was 205.63 ± 38.15(mg/dL), while it was 223.03 ± 35.71(mg/dL) in SG ($p < 0.073$). Low-density, lipoprotein cholesterol (LDLc) level was 118.11 ± 28.23 (mg/dL) in AG, and 130.91 ± 30.41(mg/dL) in SG ($p < 0.046$). According to the results of this study, sedentary former football players had higher levels of cardiovascular risks with higher body weight, LDLc, BF% and BMI values (Melekoglu, T. at al. 2019) . The fact that body composition, serum lipids concentration and body fat levels are significant indicators of coronory heart disease, type 2 diabetes and metabolic abnormalities is an obvious phenomenon. Moreover, high body mass index, low-density lipoprotein cholesterol and body fat levels are related to higher metabolic risks. Most importantly, obesity and owerweight is one of the primary risk factors of mortality. Furthermore, adiposity can give rise to cancers such as colon, breast, kidney and endometrium (Goh G H, L. At al. 2014).

In a study conducted (Kelley GA, Kelley KS. 2006), which included the effects of aerobic exercise in adult men for at least 2 months, indicated significant reductions in total serum cholesterol (2%) and triglycerides (9%), increased HDL levels cholesterol (3%) and the trend of lowering LDL-cholesterol levels

It is known that elite athletes live longer and healthier than sedentary individuals according to the literature studies. High-intensity and mid-intensity training have beneficial effects on health and daily life. In this sense, cardiovascular system is improved with regular training and its effects are seen in body with wider heart and muscle structures. Moreover, doing regular exercise slows down the biological aging process such as body composition and cardiorespiratory functions. In contrast, in sedentary individuals, there is a risk of cardiovascular diseases as serum lipids are negatively affected by gain weight. Active life provides a healthier body composition, blood values and less risks of cardiovascular diseases (Green DJ. at al. 2012).

The level of functional abilities that can be significantly increased by increasing physical activity, especially in the student population dominated by a sedentary lifestyle, due to obligations at their faculties is very important and should work to improve conditions for more active sports, more physical activity and better organization of physical exercise in colleges.

Of the variables representing the health condition of the variable (TRIGL), triglyceride levels made the greatest discrimination in relation to discriminant canonical function. In addition, the variable cholesterol also has a strong association with discriminant canonical function. In our study, we confirmed that insufficient physical activity in students affects the increase in triglycerides and cholesterol. This clearly shows that the decrease in aerobic capacity caused by lower levels of movement in students can significantly affect the increase in blood triglycerides in the student population. These results can serve to better promote physical activity and guide the student population to align their obligations with the required physical activity. (Žanetić, M. et al. 2021). Given that the research was conducted during the pandemic, it probably affected the level of movement in students and had a negative effect on physical activity and negatively reflected on the level of increased triglyceride levels in students, which was confirmed in their study (Sabic, E., Skender, N., et al., 2021).

There is ample evidence to conclude that a level of physical activity of 150 to 250 minutes per week, in the absence of intervention to reduce caloric intake, produces modest weight loss. (Donnelly JE, Blair SN, Jakicic JM at al. 2009., Slentz CA, Duscha BD, Johnson JL at al. 2004).

This study showed that insufficient physical activity measured through functional abilities has a negative effect on body structure and triglycerides, which significantly affects the deterioration of health in students.

The conclusion derived from this research is that the results we obtained must be used to increase the level of physical activity in leisure time in order to reduce the effects of a sedentary lifestyle that are reflected in the health of students.

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