medicinska revija
medical review

UDK: 616-008.9:796-057.87
COBISS.SR-ID 212932108

Labović B. S. et al ■. MD-Medical Data 2015;7(1): 021-025

Originalni članci/
Original articles

LIPID STATUS OF PROFESSIONAL ATHLETES

LIPIDNI STATUS PROFESIONALNIH SPORTISTA

Snežana Barjaktarović-Labović[1], Nela Đonović[2], Vesna Andrejević[2], Ines Banjari[3], Hadija Kurgaš[1], Munevera Zejnilović[4]

[1] Primary Health Care Center, Bar, Montenegro
[2] Institute of Public Health, Kragujevac, Serbia
[3] Faculty of Food Technology Osijek, Croatia
[4] Private Health Institution „dr Zejnilović" Bar, Montenegro

Correspondence to:

dr Snežana Barjaktarović-Labović,
specialist of hygiene, narrower specialist of diet therapy,
Primary Health Care Center, Bar, Montenegro,
Jovana Tomaševića 42,
85 000, Bar, Montenegro
e-mail: montelabovic@t-com.me

Abstract

A large number of epidemiological and clinical studies indicate an association between chronic exercise and improvement of lipidemic profil. Dyslipidemia is one of the major risks factors for development of coronary heart disease.
The aim of this study was to compare the lipidemic profile of professional athletes and non-athletes. The study included 60 participants, both sexes, age 18-25 years. Among them, 30 professional athletes and 30 non-athletes participated in the study.
Significant differences were found in serum triacylglycerol, total cholesterol, high-density lipoprotein cholesterol and low-density lipoprotein cholesterol concentrations between groups. These data suggest that athletes and non-athletes with similar nutritive status differ in their lipidemic profiles.

Key words
cholesterol, HDL, LDL, triacylglycerols, athletes

Ključne reči
holesterol, HDL, LDL, triagliceridi, sportisti

INTRODUCTION

A large number of epidemiological and clinical studies indicate an association between chronic exercise and improvement of lipidemic profil. For children and youth sport is a perfect upbringing and socialization activity that can significantly brighten their growth and prepare them for their roles and responsibilities in adulthood. Research shows that playing sports can be very useful and encourage responsible social behavior, better grades in school, the adoption of moral values and healthy living habits. Sport for children and young people is the chance to learn and it is a space in which to exercise for life [(1)]. A large number of epidemiological and clinical studies indicate an association between regular physical activity with a variety of affordable health effects. While the credibility of data on this relationship varies from case to case, it is clear that physical inactivity is a major cause of premature mortality and morbidity from chronic diseases [(2,3,4)].

Physical activity has a beneficial effect on the serum lipid profile . The recognition of the cardiovascular risk in a sedentary lifestyle and of the benefits of regular exercise have led to the promotion of sport as a means to improve health and prevent certain diseases. However, the response of the lipid profile to an exercise session or training program is different depending on the type of exercise undertaken, its intensity and frequency, the duration of each session, and the time spent in such a program [(5)].

Many studies have shown that athletes have bad eating habits, which may endanger their sport performance, but more importantly, it may disturb the athlete's health. In order to achieve optimal body weight athletes, especially female athletes often reduce the intake of food energy. It is a common phenomenon in aesthetic sports like sports and rhythmic gymnastics, skating, ballet, and in athletics. As a result of this diet as well as the desire to maintain a low body weight may appear eating disorders such as anorexia and bulimia [(6)]. Although research on nutrition many athletes, it is mainly engaged in sports that emphasize thinness. On the other hand, there are few studies of nutrition in sports where thinness is less important, such as football, basketball, volleyball, handball [(7)].

A large number of epidemiological studies revealed a relationship between dislipidemia and the prevalence of atherosclerosis and coronary heart disease. Increased physical activity is associated with a reduction in the risk of cardiovascular disease, but there is conflicting information about the optimal intensity and the amount of exercise necessary for this reduction [8].

Most important effect of exercise on human body is on metabolic system specially lipids. Lipid and lipoprotein are risk factors for coronary heart disease. The influence of physical activity on lipid status is achieved through the action of the enzyme lipoprotein metabolism, including lipoprotein and hepatic lipase, and cholesterol ester transport protein [9]. Epidemiological studies suggest that individually measured and programmed physical activity, and the implementation of primarily aerobic physical activity, leading to increased concentrations of HDL cholesterol and lowering the value triglicerida, total and LDL cholesterol [10,11].

The lipid depots in the body are almost inexhaustible energy source during physical activities and their use increases with the duration of the physical activity. Fatty acids which are used for energy production in the muscle during exercise is derived from adipose tissue, circulating lipoproteins and triglycerides in the depot therefore muscle cells. The increase in sympathetic activity, and reduction in insulin secretion is the main stimulus for lipolysis during exercise. Endurance Training cause an increase in the beta adrenergic sensitivity of adipose tissue, and the increased use of fatty acids as an energy source. This adaptive mechanism reaches its maximum after 4 months. Physical activity is of great intensity which exceeds the threshold of aerobic capacity (e.g.. When anaerobic, lactate metabolism causes a drop in pH, because it exceeds the buffer capacity of the body) resulting in an increase in lactate levels in the blood, which facilitates the conversion of free fatty acids and glycerol to triglycerides. This reduces the availability of free fatty acids as an energy source, leaving carbohydrates as their main source of energy during intense exercise [12,13]. Because different sports have the same effect on the lipid status. Bearing in mind that the intensity of the training sets and the type of substrate to be used for energy production, which has a huge impact on the lipid profile [14]. When the intensity of the workout well controlled, the power consumption is a major factor affecting lipids and lipoproteins [15].

Training leads to a series of adaptation, morphological and functional changes at the level of the cardiovascular system, neuromuscular system, as well as lipid athletes. Recent studies have shown that the dosed individually and programmed physical activity leads to increase the concentration of HDL cholesterol, and decreasing triglyceride, total and LDL cholesterol.

OBJECTIVE: The aim of this study was to examine the lipid profile professional athletes and determine whether there is a difference compared to those who do not do sports.

MATERIALS AND METHODS:

The study included 60 participants, both sexes, age 18-25 years. Among them, 30 are professional athletes (female volleyball and male basketball) and 30 are non-athletes. It was uniform distribution of respondents by gender in both groups. In the non-athletes group there were 15 female students from the Faculty of Tourism Bar and the same number of male students from the same university chosen at random. No one in the non-athletes group do not play sports professionally. Condition for entering athletes in the study was that at least five years of professional sports. All subjects were healthy during the study. All subjects measured their height and weight using anthropometry and medical scales Reach tagged according to standard procedures [16]. Based on the values calculated by the Body Mass Index, and the classification of nutritional status was performed according to the recommendations of the World Health Organization [17]. For the analysis of body composition, a method of bioelectrical impedance, Tanita 330 sc. From a blood sample obtained by puncture of the cubital vein, the concentrations of lipids. A blood sample was taken in the morning, after 12 hours of abstinence from food. Total cholesterol (TC), triglycerides (TG), HDL and LDL were determined using standard methods on the device Integra plus. Energy and nutrient intake of respondents was calculated based on data from a retrospective survey of nutrition in the last 24 hours.

Results are reported as the mean ± standard deviation.The results were analyzed using descriptive and inferential statistics. Significan differences betwen groups were detected by non-parametric X^2 test and two-tailed Student' s t- test. For data analysis we used SPSS for Windows 13.0. In determining statistically significant differences between the different variables we used the value of p <0.005 was considered statistically significant.

RESULTS

The sample consists of 60 individuals, of which 30 sports person and 30 persons of the non-athletes group. In both groups is equal distribution by gender. (Table 1)

***Table 1**. Characteristics of Participants*

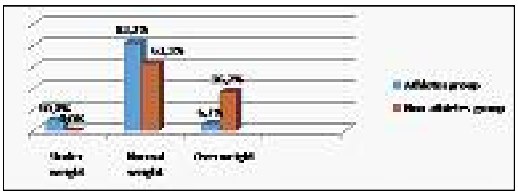
Gender	Athletes		Non-athletes	
	N	%	N	%
Male	15	25	15	25
Female	15	25	15	25
Total	30	50	30	50

***Table 2**. Anthropometric characteristics of subjects (Mean SD)*

	N	Body fat %	Weight (kg)	Height (cm)	BMI (kg/m^2)
Athletes	30	22.06±6.16	72,4±13,3	186±0,1	21,95±2,23
Non-athletes	30	26.85±7.59	76,5±10,7	178±0,1	24,3±1,92

Demographic data such as weight and BMI, respectively are different between athletes and non-athletes group.

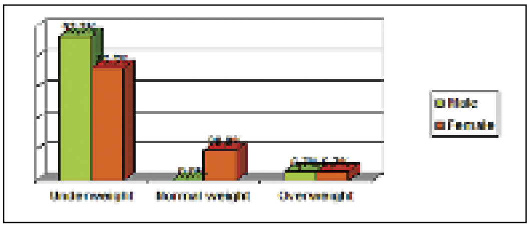
The results of the BMI are shown in Graph 1.



***Graph 1**. BMI Athletes group and non-athletes group*

The difference between the study and non-athletes groups was statistically significant $\chi^2 = 10.049$ df = 2 p = 0.005.

The results of the BMI in sports group are shown in Graph 2.



Graph 2. *BMI in in athletes*

There were significant differences in BMI betwen male and female.χ^2 = 16,492 df=4 p= 0,002

The analysis of body fat is shown in Table 3. and Table 4.

Table 3. *The distribution of subjects in relation to the percentage of body fat in body composition*

Body fat %	Normal values		Elevated		Mean SD
	N	%	N	%	
Athletes	7	23,3	23	76,7	22.06±6.16
Non-athletes	6	20,0	24	80,0	26.85±7.59

There were no significant differences betwen athletes and non-athletes. χ^2 = 0,098 df=1 p= 0,754

Table 4. *Body fat in professional athletes and non-athletes (Mean SD)*

Body fat (%)	Female	Male	p
Athletes	25,90 ± 4,59	17,00 ± 3,80	0,242
Non- athletes	28,50 ± 4,76	17,00 ± 6,41	0, 234

There were no significant differences in body fat (%) according to gender.

The results of serum lipid analysis are shown in Table 5 and Table 6.

Table 5. *Lipid status in athletes and non-athletes (Mean SD)*

	Cholesterol	LDL cholesterol	HDL cholesterol	Triglycerides
Athletes	3,94 ± 0,95	2,73 ± 0,56	1,75 ± 0,47	0,81± 0,45
Non-athletes	4,80 ± 0,97	3,63 ± 0,85	1,33 ± 0,29	0,99 ± 0,46
p	0,332	0,250	0,329	0,367

There were no statistical significant between athletes and non-athletes in value of cholesterol, LDL, HDL and triglycerides.

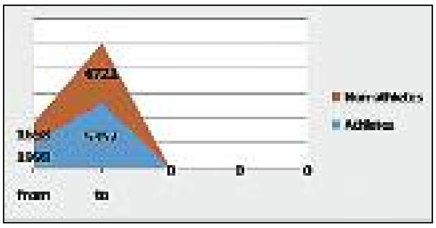
Table 6. *Lipid status in participants*

	Female	Male	p
TC (mmol/l) Athletes	4,00 ± 0,63	3,94 ± 1,22	0,250
TC (mmol/l) Non-athletes	4,50 ± 1,17	4,80 ± 0,71	0,266
HDLC(mmol/l) Athletes	0,82 ± 0,50	1,87 ± 0,41	0,229
HDLC (mmol/l) Non-athletes	1,43 ± 0,16	1,49 ± 0,11	0,274
LDLC (mmol/l) Athletes	2,67 ± 0,42	2,34 ± 0,47	0,210
LDLC(mmol/l) Non-athletes	3,13 ± 0,54	3,12 ± 0,38	0,267
TG (mmol/l) Athletes	0,82 ± 0,50	0,71 ± 0,41	0,207
TG (mmol/l) Non-athletes	1,13 ± 0,52	0,97 ± 0,39	0,258

Note. TG-triglycerides; TC-total cholesterol; HDLC-high-density lipoprotein cholesterol; LDLC-low-density lipoprotein cholesterol;

There was no significant differences between athletes and non-athletes.

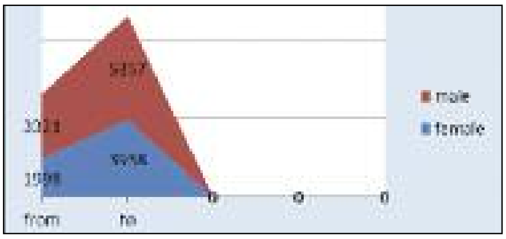
The analysis of daily energy expenditure is shown on Graph 3.



Graph 3. *Energy intake*

Energy intake ranged from 1658 kcal to 5357 kcal. The average energy intake of all subjects was X = 3127.90 ± 1018,01 kcal. Energy intake in the control group ranged from 1658 to 4721 kcal, the average energy intake is X = 2867.47 ± 929.96 kcal.

In relation to energy intake there was statistically significant difference between the study and non-athletes group. t = 2.036 df = 58 p = 0.046.



Graph 4. *Energy intake in athletes*

In the group of athletes energy intake ranged from 1998 to 5357 kcal. In female energy intake ranged from 1998 to 3321 kcal, while in male from 3598 to 5357 kcal. The average energy intake in athletes is X = 3388.33 ± 1048.40.

In the group of athletes there is a statistically significant difference by gender in relation to energy intake. t = 10.476 df = 28 p = 0.000.

DISCUSSION

The main goal of the present study was to examine the serum lipid profile in group af athletes and to compare with non-athletes.To our knowledge this is the first time such a study has been conducted in Montenegro. In the present study, we compared Body Mass Index of athletes and non–athletes person. BMI is a simple index of measure body fat based on height and weight. Calculating BMI was a statistically significant difference between the study and control groups (Graph. 2). Analysis of BMI in athletes has been noted that there is no underweight male and three female were underweight. Also we observed statistically significant differences the value of BMI in relation to gender (Graph. 3). Similar results when the malnutrition of sports female in question were obtained in a study done in India 2011 [(18)]. Although the majority of both groups fed normal in the control group, more than a third of the respondents are overweight and no underweight in that group. If compare a control group in our study with students from University of Novi Sad, which are not professional athletes too, is observed that majority of respondents of both genders have normal nutritional status, while in the category of overweight dominate, as in our study, males [19].

When it comes to athletes, BMI is not a parameter that fully meets the criteria for assessing nutritional status, despite being linked with a moderate amount of fat in the body. It can not evaluate the composition and the amount of body fat in the body, but only the nutritional status [20]. Namely, the value of a BMI greater than 25 mean overweight, however, does not define at the expense of wich tissues is the increased body mass. Therefore, the lack of BMI as an indicator of nutritional status is that it is based on the entire body weight, so that the category of people with overweight may be classified and those with a high proportion of muscle, a normal percentage of fat like is often the case by athletes [21]. Results of anthropometric measurements showed that professional athletes in our sample have a lower body weight compared to a group of peers who are not professionally involved in sports. These results are in agreement with the results of other authors who have dealt with this problem [22].

Body composition according to the American Association for Health, Physical Education, Recreation and Dance (AAHPERD, 1989) is the ratio of fat, muscle and bone tissue in the entire body weight. According to the recommendations of the ACE (American Concil of Exercise) there is a division that includes five category classification of body fat for men and women, and value for athletes are 6-13%, for athletes 14-20% [23]. Our study showed that there is not statistical difference between athletes and control group in relation to the percentage of body fat in body composition (Table 1). Analysis of the value of BMI and body fat percentage showed that the percentage of fat is not directly correlated with BMI. In athletes, the gain of body weight is usually at the expense of muscle mass [24]. The survey was conducted among Belgrade adolescents, adolescent athletes had significantly lower BMI and percentage of body fat than adolescents non athletes [25]. Also, a comparative analysis of anthropometric and spirometric parameters in athletes in Novi Sad have shown that athletes had significantly lower BMI and percentage of fat compared to non-athletes, as well as male compared to female[26]. Analysis of the percentage of body fat among students of the Faculty of Sports and Physical Education in Montenegro showed that the average value of adipose tissue are in the range of values for athletes [27]. In our study, athletes have BMI lower than in the control group, however, contrary to expectation, even two thirds of athletes have a larger proportion of body fat than recommended in the total body weight. If we compare the average percentage of body fat athletes in our study (25.90 ± 4.59) with other studies, indicate that the percentage of fat mass in the body composition of our athletes is higher than normal [28].

According to Michael John Davidson [29], the average daily energy needs of athletes in active training and competition are between 4000 and 5000 kcal. Energy and nutrient intake of respondents was calculated based on data from a retrospective survey of nutrition in the last 24 hours and ranged from 1658 kcal to 5357 kcal in non-athletes, and from 1998 to 5357 kcal in athletes. In women athletes energy intake ranged from 1998 to 3321kcal, with men from 3598 to 5357 kcal. We found no significant differences in the energy intake between athlets and non-athletes. (x^2 = 58.000, df = 56 p = 0.40). The average energy intake for athletes is 3388.33 ± 1048.40. (Chart.4). There was not statistically significant differences by gender in athletes. In athletes group male had higher energy intake than female. Such energy intake, as well as the relationship between the sexes corresponds to the results of previous research on the diet of athletes, although it must be taken into consideration that level of physical activity of athletes included in this study is significantly lower than in the world of research [30,31,32,33].

Results of this study showed that recommended levels of cholesterol has 86.7% athletes and 73.3% of controls. Higher values have twice as more subjects in group of non athletes. It was observed that in the group of athletes something more male have elevated serum cholesterol compared to women but the difference was not statistically significant. Neither in cross-sectional study carried out in Hamadan University of Medical Sciences (Hamadan, Iran) during 2010-2011 there were no significant differences in lipid parameters between the subjects with different level of physical fitness [34]. When it comes to levels of triglycerides showed statistically significant differences between groups of athletes and group of non athletes. Haigh et al. examined the serum lipid levels in runners and got results very similar to ours. Namely, hi found out that the changes in total cholesterol and LDL-cholesterol levels were not significant compared to those in the control group while the decrease in triglyceride level was significant [34]. The results of our study showed that athletes have lower total cholesterol, LDL cholesterol and triglyceride levels, and higher serum HDL than people who are not involved in sports (Table 4). Our results are consistent with numerous studies by other authors, which can be explained by the chronic effects of sports activities in increasing the protein lipase [36,37]. According to the results of our research is yet another who has proven that regular and sustained physical activity with that of professional athletes has increased lipolytic activity, while decreasing lipogenesis.

CONCLUSION

These data suggest that athletes and non-athletes with similar nutritive status differ in their lipidemic profiles. Although it had long been ignored as a preventive and therapeutic approaches in the treatment of patients with cardiovascular risk, physical activity and sport today proving their multiple positive effects on health. Physical interaction induces changes in lipoprotein metabolism, and thus reduces the cardiovascular risk. The influence of physical activity on lipid status is achieved through the action of the enzyme lipoprotein metabolism, including lipoprotein and hepatic lipase, and cholesterol ester transport protein.

Sažetak

Veliki broj epidemioloških i kliničkih studija ukazuju na vezu između redovne fizičke aktivnosti i raznih efekata na zdravlje ljudi. Dislipidemija je jedan od glavnih faktora rizika za nastanak koronarne srčane bolesti.
Cilj ovog istraživanja je bio da se uporedi lipidni profil profesionalnih sportista i onih koji se profesionalno ne bave sportom. U istraživanju je učestvovalo 60 ispitanika, oba pola, starosti 18-25 godina. Među njima, 30 profesionalnih sportista i 30 nesportista.
Pronađene su značajne razlike u serumskoj koncentraciji triglicerida, ukupnog holesterola, HDL holesterola i LDL holesterola između ispitivanih grupa. Dobijeni podaci ukazuju da kod sportista i nesportista sa sličnim nutritivnim statusom postoje razlike u lipidnom statusu.

REFERENCES

1. Bačanac Lj.Petrović N., Manojlović N. Priručnik za roditelje mladih sportista.Beograd, 2009.

2. Warburton E.R.D, Crystal Witney N, Shannon S.D.B.Health benefits of psychical activity:the evidence.CMAJ.2006;174:6

3. Taylor RS, Brown A, Ebrahim S, et al. Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. Am J Med. 2004;116:682-92.

4. World Health Organization (WHO). WHO global strategy on diet, physical activity and health. Food Nutr Bull 2004; 25(3):292-302.

5. Boraita A. Plasma Lipid Profile Is Improved by Participation in Sports, but at What Intensity?. Rev Esp Cardiol.2004;57(6):495-8.

6. Weimann E, Witzel C, Schwidergal S, Boehles HJ: Peripubertal pertubacions in elite gymnasts caused by sport specific training regimes and inadequate nutritional intake. Int J Sport Med. 2000;21:210-5

7. Mišigoj-Duraković M, Pedišić Ž, Sorić M: Prehrambene navike i prevalencija pušenja u sportaša ekipnih sportova, Hrvatski Športsko medicinski Vjesnik. 2006; 21: 84-90.

8. Kraus WE, Houmard JA, Duscha BD, et al. Effects of the amount and intensity of exercise on plasma lipoproteins. N Engl J Med. 2002;347:1483-9.

9. Wannamethee SG, Schaper AG. Physical activity in the prevention of cardiovascular diesase: an epidemiological per¬spective. Sports Med. 2001;31:101-14.

10. Secco HD, Paffenberger RS, Lee IM. Physical activity and coronary heart disease in men: The Harvard Alymni Health Study.Circulation. 2000;102:975-80.

11. Lilić LJ, Stefanović R, Kocić M, et al. Promene lipidnih parametara i antropometrijskih pokazatelja uhranjenosti u period intenzivnih priprema vrhunskih sportista. ActaMedica Medianae. 2009;48(4):5-9.

12. Apor P. Effectiveness of exercise programs in lipid metabolism disorders. Orv Hetil.2003;144:507—13

13. Hernandez-Torres R.P, Ramos-Jimenez A, Torres-Duran P.V, Romero-Gonzalez J, Mascher D, Posadas-Romero C et al. Effects of single sessions of low-intensity continuous and moderate-intensity intermittent exercise on blood lipids in the same endurance runners. Journal of Science and Medicine in Sport. 2009; 12: 323—31.

14. Ferguson MA, Alderson NL, Trost SG, Davis PG, Mosher PE, Durstine JL. Plasma lipid and lipoprotein responses during exercise. Scand J Clin Lab Invest. 2003;63:73-9

15. Lohman GT, Roche FA, Martorell R, editors. Anthropometric standardization refernce manuel. Champaign, IL: Human Kinetics. 1991.

16. WHO. Obesity: Preventing and Managing the global Epidemic.2000.

Available from: www.who.int

17. Raman T, Marwaha K, Puri S, Tandon N, Dhir S, Agarwal N, Bhadra K, SainiIndian N. Effects of sports training & nutrition on bone mineral density in young Indian healthy females J Med Res 2011; 134: 307-13

18. Simić S, G. Vasić G, D. Jakonić D, Telesna visina, telesna masa i uhranjenost studenata univerziteta u Novom Sadu. Medicina danas. 2010; 9 (4-6) :141-6

19. Pietrobelli A, Faith MS, Allison DB, Gallagher D, Chiumello G, Heymsfield SB. Body mass index as a measure of adiposity among children and adolescents: a validation study. J Pediatr. 1998; 132(2):204-10.

20. Malina P, Katzmarzyk P. Validity of the body mass index as an indicator of the risk and presence of overweight in adolescets. American Journal of Clinical Nutrition. 1991;70(suppl), 131–6.

21. Jovanović J i sar. Krvni pritisak, frekvencija srčanog rada i lipidni status kod profesionalnih vaterpolista i rukometaša. Med. Pregled. Novi Sad. 2005; LVIII(3-4): 168-74.

22. Cvetković M. Sportska dijagnostika. Skripta. Novi Sad;2009. 27

23. Stokić E, Srdić B, Peter A, Ivković-Lazar T. Masna masa tela u normalnoj uhranjenosti, Med.Pregled. 2002; LB (9-10): 407-11.

24. Maksimović M, Ristić G, Maksimović J, Backović D, Vuković S, Ille T, Milović V. Povezanost fizičke aktivnosti i nekih parametara stanja uhranjenosti adolescenata. Srpski arhiv za celokupno lekarstvo 2009; vol. 137 (1-2): 58-62.

25. Gaćeša-Popadić J, Barack O, Drapšin M, Klašnja A, Srdić B, Jakovljević-Karaba D. Comparative analysis of anthropometric and spirometric parameters in athletes. Praxis medica 2008; 36 (3-4):57-61.

26. Popović S, Petković J,Bojanić D, Muratović A. Analiza procenta masnog tkiva kod studenata Fakulteta za sport i fizičko vaspitanje u Crnoj Gori. VI. međunarodni simpozijum „SPORT I ZDRAVLJE", Tuzla.2013.

27. Maly T. Body composition profile of elite women volleyball players. International Journal of Volleyball Research. 2010; 10 (1):17-18.

28. Michael John Davidson. The Grapplers Guide to Sports Nutrition.

Available from: www. breacingmuscle.com

29. Peerkhan N. Phil M, Srinivasan V. Nutrition Knowledge, Attitude and Practice of College Sportsmen. Asian Journal of Sports Medicine. 2010; 1 (2): 93-100.

30. Lun V, Erdman KA, Reimer RA Evaluation of nutritional intake in Canadian high-performance athletes. Clin J Sport Med. 2009; 19(5): 405-11.

31. Hassapidou N. Manstrantoni A. Dietary intakes of elite female athletes in Greece. J. Human Nutr & Dietetics 2001; 14 (5): 391

32. Haigh, J.R., C.A. Fruin, R. Pinn and E.J. Lea, 1988. Lipids and platelet function in runners. J. Sports Med. Jun, 22(2): 66-70.

33. Sanghavi S, Rachit J, Devanshi U, Comparative Study Of Lipid Profile Of Sports Persons And Sedentary Persons. National Journal of Integrated Research in Medicine (NJIRM.) 2012; 3(3): 3-6

34. Hossain-Alizadeh J, Goodarzi MT. Body fat and plasma lipid profile in different levels of physical fitness in male students. J Res Health Sci. 2014;14(3):214-7.

35. Thompson P, Crouse S, Goodpaster B, Kelley D, Moyna N, Pescatello L. The acute versus the chronic response to exercise. Med Sci Sports Exerc 2001; 33(Suppl 6):S438-S45.

36. Lippi G, Schena F, Salvagno G, Montagnana M, Ballestrieri F, Guidi G. Comparison of the lipid profile and lipoprotein(a) between sedentary and highly trained subjects. Clin Chem Lab Med. 2006;44(3):322-6.

37. Kiperos G, Tripolitsioti A, Stergioulas A. The effects of anaerobic training in serum lipids and arachidonic acid metabolites. Biology of exercise. 2010; 6.2.

■ The paper was received on 20.10.2014. Revised on 28.11.2014. Accepted on 05.12.2014.