ORIGINAL PAPER

UDK: 613.73:613.24/25

DOI: 10.5937/hraish2202034H

Relationship between physical exercise and nutritional status

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Abstract

Sedentary lifestyle and physical inactivity are some of the leading risk factors for cardiovascular diseases and total mortality. The aim of this study was to examine the effects of dosed physical exercise on the nutritional status of recreational athletes. In this study, we included 50 respondents of both sexes between the ages of 18 and 55, who engage in recreational physical exercise, were included in the study. All subjects had their body mass and height measured before the start of exercise and after three months, based on which the body mass index (BMI), waist circumference, and body fat percentage were determined. The exercise was carried out according to the plan 3 times a week for 75 minutes and combined anaerobic training (45 minutes) and aerobic training (30 minutes). The average body weight of all subjects at the beginning of the study was 81.74 kg, while at the end it was 80.16 kg. The average body weight of men at the end of the study was 1.95 kg less than the initial value, while it was 0.71 kg less for women. There is a statistically significant difference in BMI, waist circumference and fat percentage in the total number of respondents at the beginning and at the end of the study. Regular physical activity and exercise have a positive effect on BMI, waist circumference and body fat percentage, showing the importance of exercise in the prevention of obesity and chronic non-communicable diseases.

Key words: *physical activity; exercise; nutritional status.*

INTRODUCTION

Sedentary lifestyle and physical inactivity are one of the leading risk factors for cardiovascular diseases and total mortality [1]. On the other hand, physical activity and exercise are associated with a reduced risk of cardiovascular disease and an improvement in the cardiometabolic risk factor and weight loss through the creation of a negative energy relationship [2]. Regular exercise has a beneficial effect on body composition, cardiorespiratory integrity, insulin sensitivity and quality of life [3]. Physical activity, by definition, is any body movement created by the activity of the skeletal muscles, which also results in energy consumption [4].

The minimum dose with proven effects in the prevention of chronic non-communicable diseases is 150 minutes of moderate physical activity or 75 minutes of high-intensity exercise or a combination of both [5]. For additional health benefits, adults should increase moderate-intensity aerobic physical activity to 300 minutes per week or 150 minutes of vigorous-intensity physical activity per week or a combination of moderate and vigorous intensity [6]. According to the data of the national survey in Serbia, 43.6% of the population in Serbia sat or stood during their work, and this is significantly more in Belgrade (61.2%) compared to Sumadija and Western Serbia (36.4%), i.e. South and Eastern Serbia (37.2), where women significantly more

often than men spent time sitting or standing during work (48.3% vs 38.7%) [7]. Total of 8.8% of Serbian residents engaged in fitness, sports or recreation at least 3 times a week, while every ninth resident of Serbia (11.3%) spent at least 90 minutes in such activities during their free time per week. In 2013, 4.8% of Serbian residents engaged in intensive physical activities aimed at strengthening muscles at least three times a week [7].

Physical inactivity is associated with an increased risk of developing chronic non-communicable diseases. obesity, malignant diseases, cardiovascular diseases, diabetes, stroke, etc. [8]. In a study conducted in Japan on obese people with risk factors for cardiovascular disease who exercised 2 to 4 times a week for 6 months, there was a significant loss of body weight, waist circumference, but a decrease in serum lipids [9]. A sedentary lifestyle is increasingly associated with the occurrence and mortality of colon cancer [10]. Fletcher indicates that the most active people have approximately a 40% lower risk of developing heart disease, compared to those who do not exercise at all [11]. Studies that assessed physical activity using questionnaires showed that higher levels of physical activity are associated with a reduced risk of type 2 diabetes, while greater amounts of physical activity can contribute to the prevention of the disease [12]. Considerable evidence suggests that people should engage in physical activity and exercise to mitigate the negative impact of aging on their cognitive functions [13].

The aim of this study was to examine the effects of dosed physical exercise on the nutritional status of recreational athletes.

METHODS

The study included 50 respondents of both sexes, aged between 18 and 55 years, average age of 33.8 years, who engage in recreational physical exercise under the supervision of a qualified sports coach.

All subjects had their body mass and height measured before starting exercise and after three months, on the basis of which BMI (Body Mass Index) and waist circumference were determined. Body weight (BW) and body height (BH) were measured in the morning using a calibrated anthropometer. The patients were stripped down to their underwear. BMI was determined based on these two values using the formula $BMI = BW/(BH)^2$ (kg/m^2). The recommendation of the World Health Organization (WHO) was used to assess nutritional status [14]. Waist circumference was measured at the middle of the distance between the lowest point of the rib arch (*arcus costalis*) and the front upper femoral spine of the pelvic bone (*spina iliaca anterior superior*), while the patients were in a standing position. Abdominal obesity was determined based on waist circumference values, also according to WHO recommendations [14]. Percentage of body fat was determined on the bioimpedance and the classification was made according to Bray [15].

The exercise was carried out according to the plan 3 times a week for 75 minutes and it was a combined anaerobic (45 min)-aerobic training (30 min). Diet is not included in the exercise.

Statistical analysis

In this study, we used descriptive and analytical statistical methods. The normality of the distribution was examined based on descriptive parameters, normality tests (Kolmogorov-Smirnov and Shapiro-Wilks test) and graphic methods. All data were processed in SPSS 20.0 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp).

RESULTS

A total of 50 subjects with an average age of 33.8 years were included in the research, of which there were 35 male subjects with an average age of 33.6 years and 15 female subjects with an average age of 34.3 years (**Table 1**).

Table 2 shows the results of body weight and height measurements at the beginning and end of the study. The average body weight of all subjects at the beginning of the study was 81.74 kg, while at the end of the study it was 80.16 kg. The average body

Table 1. Demographic characteristics of participants.

Gender			Age				
	N	%	AS	SD	Median	Minimum	Maximum
Male	35	70%	33.6	8.8	32.0	18	55
Female	15	30%	34.3	5.0	34.0	28	45
Total	50	100%	33.8	7.8	32.5	18	55

weight at the end of the study was 1.95 kg less than the initial value, while in women it was 0.71 kg less. When we compare the values of body weight in relation to gender, we found statistically significant difference in men ($p < 0.001$), however, this difference when it comes to women is not statistically significant ($p = 0.224$) (**Table 2**).

Distribution by gender of waist circumference values shows statistical significance in both men ($p < 0.001$) and women ($p < 0.001$) (**Figure 2**).

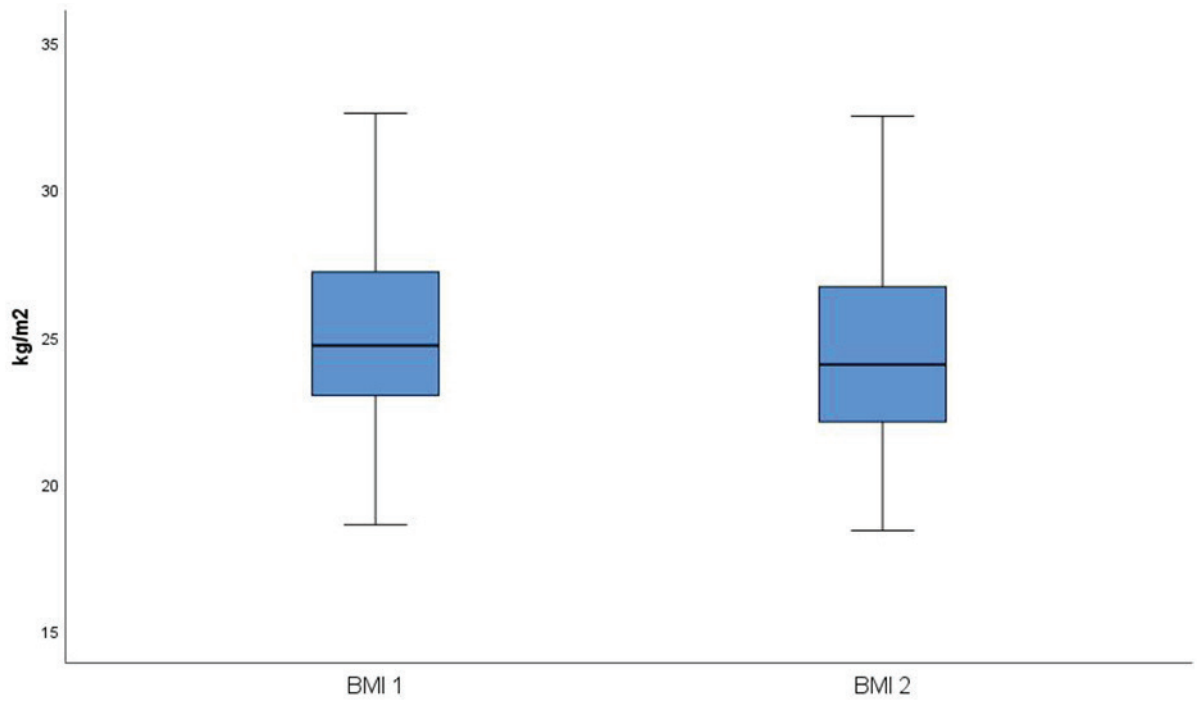
In relation to the percentage of body fat by gender, there is a statistically significant difference between these two measurements in men ($t = 6.274$; $p < 0.001$) and in women ($t = 4.497$; $p < 0.001$) (**Figure 3**).

Table 2. Results of measuring body weight and body height at the beginning and at the end of the study.

Gender		N	AS	SD	Median	Minimum	Maximum	P
Male	BH (cm)	35	1851.1	6.57	185.00	174.00	198.00	
	BW (kg) 1	35	89.62	14.10	86.80	63.90	130.20	0.001
	BW (kg) 2	35	87.67	14.36	83.80	62.30	127.90	
	BH (cm)	15	168.20	4.71	169.00	160.00	175.00	
Female	BW (kg) 1	15	63.35	9.68	62.60	52.10	89.10	
	BW (kg) 2	15	62.64	9.05	61.20	52.60	87.00	0.224
	BH (cm)	50	180.04	9.88	181,50	160.00	198.00	
Total	BW (kg) 1	50	81.74	17.68	82.35	52.10	130.20	
	BW (kg) 2	50	80.16	17.34	81,25	52,60	127.90	0,001

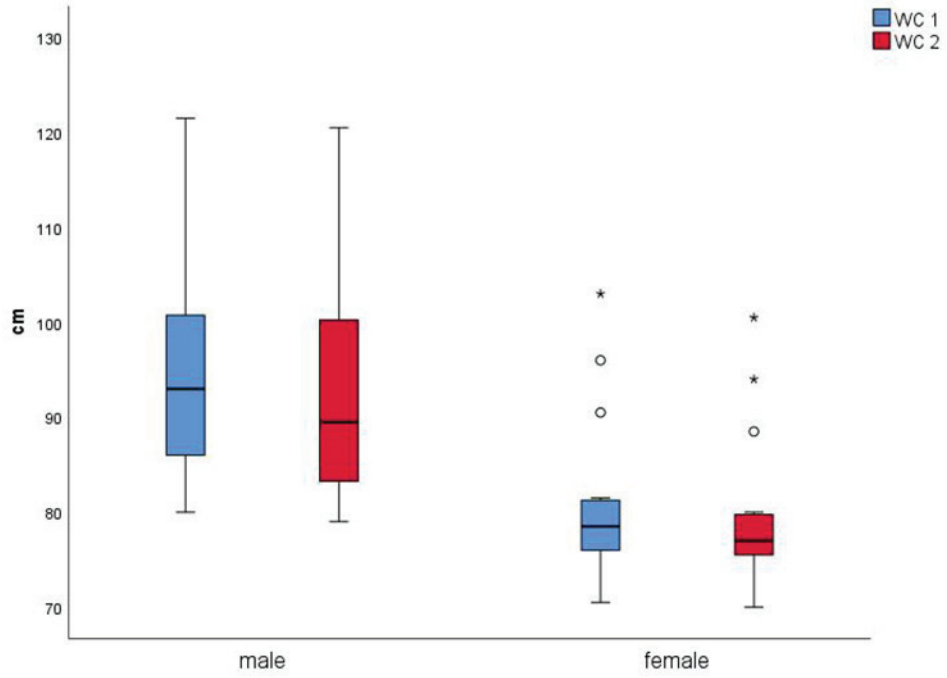
BH (cm) – Body height
BW (kg) 1 – Body weight at the beginning of the study
BW (kg) 2 – Body weight at the end of the study

The results of measuring the body mass index at the beginning and at the end of the study show that there is a statistically significant difference between those values ($p < 0.001$) when we talk about the total number of subjects (**Figure 1**).



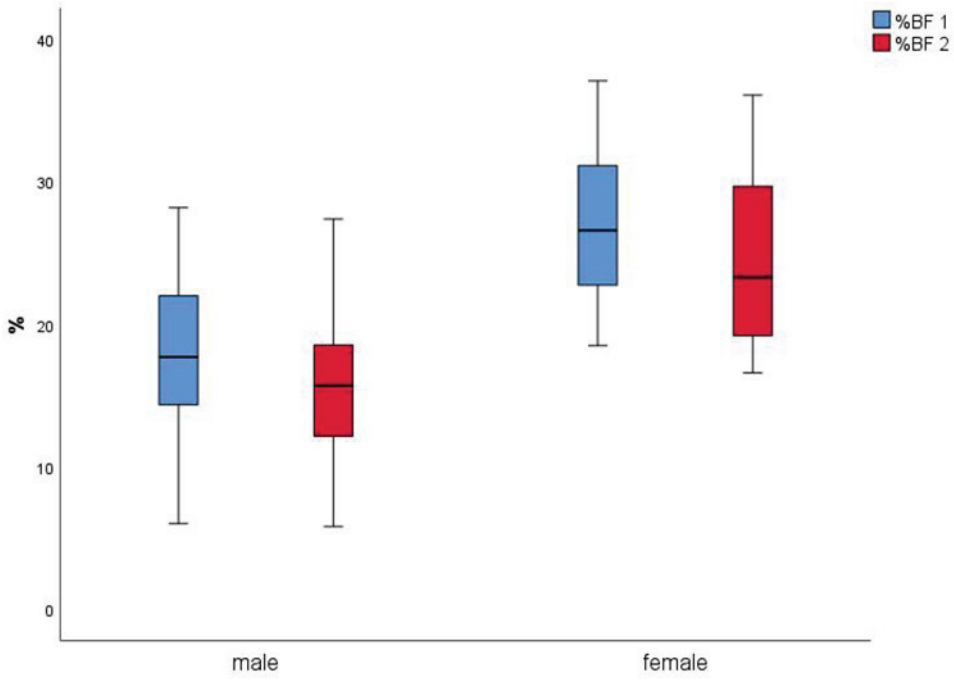
BMI – Body Mass Index

Figure 1. Comparison of Body Mass Index values at the beginning and at the end of the study in the total number of participants.



WC – Waist cirmumference

Figure 2. Comparison of waist circumference values at the beginning and at the end of the research by gender.



%BF - Percent of body fat

Figure 3. Comparison of fat percentage at the beginning and at the end of the study according to the gender.

DISCUSSION

The obtained results in our study show that there was a significant correction of all examined parameters of the state of nutrition after exercise. The results are in agreement with the results of Sanalai *et al*. who assessed the nutritional status of 92 subjects of both sexes who did combined types of exercises [16].

In a study at Duke University in North Carolina (USA), Willis *et al*. included 119 subjects who did aerobic and weight training (anaerobic) and showed that the subjects lost an average of 1.63 kg in body weight, 2.04% fat percentage, in waist circumference 1.66 cm which led to a significant difference in all of the mentioned parameters [17]. In our research, we came to similar results compared to the mentioned study, that is, we also got statistically significant differences in all of the mentioned parameters. Also, the exercisers managed to reduce their BMI by 0.44 overall, which has similar results to the study conducted by Hellenius *et al.* on 157 healthy men with mild to moderate risk of cardiovascular disease who reduced their BMI by 0.30 [18].

In a study by Tan *et al.* on 30 patients with type 2 diabetes who exercised for 6 months, no significant difference was found in body weight and BMI, while there was a statistically significant difference in fat percentage [19]. In a study of 60 pre-obese and obese women with metabolic syndrome, Dianatinasab *et al.* showed that body weight decreased by 2.81 kg, body mass index also decreased by 1.15 kg/m^2, fat percentage decreased by 2.34% [20].

In a study in Turkey conducted by Ucan, 37 subjects were divided into three groups: one that did aerobic exercises, one that did weight-bearing exercises, and a group that did a combined type of exercises (aerobic and weight-bearing) 3 days a week during the examined 10 weeks, and there was a significant difference in all parameters of the state of nutrition [21].

Evaluating waist circumference as an indicator of abdominal obesity, Mc Tiernan *et al.* showed on 202 sedentary subjects, of which 102 males and 100 females aged between 40 and 75, who engaged in physical exercise for 12 months, showed that waist circumference was significantly lower in both sexes at the control measurement [22].

Analyzing the percentage of body fat, Jin *et al.* observed a significant difference between two control measurements in a study of 20 subjects [23], which coincides with our study, while the study by Park *et al*, which was conducted in Japan, included 30 women who exercised for 24 weeks leading to a loss of 10.3% body fat [24].

In the study conducted by Topsakal *et al.* in 2018 at the Faculty of Sports Sciences "Cerrahpasa", Istanbul University in Turkey, 32 male subjects participated, randomly selected among members of a fitness club, divided into 2 groups of 16 subjects each - one group conducted an aerobic type of training, while the second group conducted a combined type of training (aerobic and with load) [25]. The duration of the training was 8 weeks, while the subjects exercised 3 days a week for an hour. In this research, the change in the body composition of the subjects was monitored, that is, similar parameters were monitored that we also used during the conduct of our research. For all three examined parameters of the state of nutrition, the results of the study between the two control measurements were that body weight decreased by 2 kg, body mass index by 0.61 kg/m^2, and body fat percentage by 1.4%, showing a statistically significant difference, which correlates with the data obtained in our study.

In a study that examined the effect of endurance exercises and combined endurance and strength exercises on body composition and physical capacity in women with abdominal obesity [26]. The subjects were from the Department of Internal Medicine of the University of Medical Sciences in Poznań, Poland. The criteria for inclusion in the study were: age between 18 and 65 years, obesity (BMI ≥ 30 kg/m^2), waist circumference (> 80 cm), percentage of body fat (≥ 33%). After the examination, 44 of them were selected for the study and divided into group A (exercises for endurance) and group B (exercises for endurance and strength). After the withdrawal of one respondent from group A and 5 from group B, the survey was completed by 21 respondents in group A and 17 respondents in group B. We specifically examined the exercisers from group B, since they did the same type of training as in our study. The obtained results were that: body mass index decreased by 1.0 kg/m^2, waist circumference by 7.7 cm, body fat percentage by 2.0%.

In a 2019 study by Can and associates, which examined the effect of exercise on body fat percentage and body mass index, 442 volunteers participated, of which 180 were women and 262 were men, who were divided into three groups, the first group doing aerobic exercises, other exercises with load, and the third did aerobic and exercises with load [27]. Each of the mentioned groups was measured before the start of the study and then the final measurement. We were interested in the group that performed the combined type of exercises, as in our study. The results of the examination of the body mass index, body weight and body fat percentage show that in each of the mentioned parameters, there was a statistically significant difference between the two control measurements when it comes to female and male persons.

According to the US physical activity guidelines, adults should get 150 minutes to 300 minutes of moderate-intensity activity per week, or 75 minutes to 150 minutes of vigorous-intensity aerobic physical activity per week, or a combination of moderate- and vigorous-intensity aerobic activity, and should also work

muscle-strengthening activities, two or more days a week [28].

The recommendations of the World Health Organization for adults are to spend at least 150 minutes of moderate to vigorous intensity aerobic physical activity per week, in a series of 10 minutes or more [6]. The Department of Health, Social Services and Public Safety of the United Kingdom has given recommendations for physical activity which on a weekly basis is 150 minutes of moderate intensity in series of 10 minutes or more [29]. One way to approach this is to exercise for 30 minutes, five times a week. An alternative to that is 75 minutes of intense physical activity that can be divided on a weekly basis or a combination of moderate and vigorous intensity activities. In addition, physical activity to improve muscle strength must be carried out at least two days a week.

Assessing the level of physical activity on an individual level, as well as on the level of the entire population, can be difficult mainly due to the multidimensional nature of physical activity itself. It is clear that there are various dimensions to physical activity with independent health benefits. With the advancement of technology, it is possible to generate multidimensional "profiles" of physical activity that provide a more complete representation of physical activity and offer different options that can be tailored to the individual [30].

STUDY LIMITATIONS

The study had certain limitations, primarily related to the type of study, as well as the fact that the number of participants cannot be considered representative.

CONCLUSION

Regular physical activity and exercise have a favorable effect on nutritional status parameters such as BMI, waist circumference, percent of body fat, and consequently lead to a reduction of risk factors for cardiovascular diseases and prevention of chronic non-communicable diseases.

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Veza između fizičkog vežbanja i stanja uhranjenosti

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Kratak sadržaj

Sedentarni način života i fizička neaktivnost su jedan od vodećih faktora rizika za kardiovaskularne bolesti i ukupan mortalitet. Cilj rada je ispitivanje efekata doziranog fizičkog vežbanja na stanje uhranjenosti rekreativaca. U ispitivanje je uključeno 50 ispitanika oba pola starosti između 18 i 55 godina, koji se rekreativno bave fizičkim vežbanjem. Svim ispitanicima je pre početka vežbanja i nakon tri meseca merena telesna masa i telesna visina na osnovu koje je određen indeks telesne mase (ITM), obim struka, i određivan je procentat telesne masti. Vežbanje je sprovedeno po planu 3 puta nedeljno po 75 minuta i to kombinovano anaerobni (45 min) i aerobni trening (30 min). Prosečna vrednost telesne težine svih ispitanika na početku istraživanja bila je 81.74 kg, dok je na završetku bila 80.16 kg. Prosečna vrednost telesne težine muškaraca je na završetku istraživanja bila manja od početne vrednosti za 1.95 kg, dok je kod žena bila manja za 0.71 kg. Postoji statistički značajna razlika u ITM, obimu stuka i procentu masti kod ukupnog broja ispitanika na početku i na kraju istraživanja. Redovna fizička aktivnost i vežbanje povoljno deluju na vrednosti ITM, obima struka i procenta telesne masti pokazujući značaj vežbanja u prevenciji gojaznosti i hroničnih nezaraznih bolesti.

Ključne reči: *fizička aktivnost; vežbanje; stanje uhranjenosti.*