

# A COMPARISON OF DIETARY HABITS BETWEEN RECREATIONAL RUNNERS AND A RANDOMLY SELECTED ADULT POPULATION IN SLOVENIA

## PRIMERJAVA PREHRANSKIH NAVAD REKREATIVNIH TEKAČEV IN NAKLJUČNO IZBRANIH ODRASLIH LJUDI V SLOVENIJI

Branko ŠKOF<sup>1\*</sup>, Nada ROTOVNIK KOZJEK<sup>2</sup>

<sup>1</sup>University of Ljubljana, Faculty of Sport, Department for kineziology, Gortanova 22, 1000 Ljubljana, Slovenia

<sup>2</sup>Institute of Onkology Ljubljana, Clinical Nutrition Unit, Zaloška 2, 1000 Ljubljana, Slovenia

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### ABSTRACT

#### Keywords:

dietary habits, healthy nutrition, recreational runners, adult population

**Introduction.** The aim of the study was to compare the dietary habits of recreational runners with those of a random sample of the general population. We also wanted to determine the influence of gender, age and sports performance of recreational runners on their basic diet and compliance with recommendations in sports nutrition.

**Methods.** The study population consisted of 1,212 adult Slovenian recreational runners and 774 randomly selected residents of Slovenia between the ages of 18 and 65 years. The data on the dietary habits of our subjects was gathered by means of two questionnaires. The following parameters were evaluated: the type of diet, a food pattern, and the frequency of consumption of individual food groups, the use of dietary supplements, fluid intake, and alcohol consumption.

**Results.** Recreational runners had better compliance with recommendations for healthy nutrition than the general population. This pattern increased with the runner's age and performance level. Compared to male runners, female runners ate more regularly and had a more frequent consumption of food groups associated with a healthy diet (fruit, vegetables, whole grain foods, and low-fat dairy products). The consumption of simple sugars and use of nutritional supplements by well-trained runners was inadequate with values recommended for physically active individuals.

**Conclusion.** Recreational runners are an exemplary population group that actively seeks to adopt a healthier lifestyle.

### IZVLEČEK

#### Ključne besede:

prehranske navade, zdrava prehrana, rekreativni tekači, odrasla populacija

**Namen.** Spoznati prehranske navade rekreativnih tekačev in jih primerjati s prehranskimi navadami vzorca naključno izbranega dela populacije. Ugotoviti smo želeli tudi vpliv spola, starosti in tekmovalne uspešnosti/stopnje treniranosti rekreativnih tekačev na njihovo osnovno prehranjevanje in upoštevanje prehranskih priporočil pri rekreativnem športu.

**Metode.** Vzorec preiskovancev je sestavljalo 1212 odraslih slovenskih rekreativnih tekačev in 774 naključno izbranih prebivalcev Slovenije v starosti med 18 in 65 leti. Za ugotavljanje prehranskih navad v vzorcu vključenih posameznikov smo uporabili metodo anketiranja. Analizirali smo naslednje parametre prehranskih navad: način prehranjevanja, ritem prehranjevanja, pogostost uživanja posameznih skupin živil, uporabo prehranskih dopolnil, vnos tekočin in pitje alkoholnih pijač.

**Rezultati.** Prehrana rekreativnih tekačev bolj ustreza priporočilom za zdravo prehrano kot prehrana v vzorcu populacije. Prehranski vzorec se izboljšuje s starostjo tekačev in z njihovo tekmovalno uspešnostjo/stopnjo njihove treniranosti. Tekačice se bolj redno prehranjujejo kot tekači in pogosteje uživajo živila iz določenih skupin živil, ki jih povežemo z zdravim prehranjevanjem (sadje, zelenjava, polnozrnatna živila, ribe in manj mastni mlečni izdelki). Rezultati tudi kažejo, da uspešnejši - bolj trenirani tekači - zaužijejo manj enostavnih ogljikovih hidratov, kar je lahko v nasprotju s priporočili za vnos energetskih substratov pri telesni vadbi. Neustrezen je tudi vnos prehranskih dodatkov glede na športno aktivnost.

**Zaključek.** Vsekakor so rekreativni tekači del populacije, ki si aktivno prizadeva za bolj zdrav način življenja.

\*Corresponding author: Tel: +386 1 520 77 00; E-mail: [branko.skof@fsp.uni-lj.si](mailto:branko.skof@fsp.uni-lj.si)

## 1 INTRODUCTION

A balanced diet promotes energy balance and provides nutritional and metabolic support for the maintenance and preservation of health (1). Together with physical activity, a balanced diet has a beneficial influence on health (2, 3). In epidemiological studies (SENECA study, HALE project), a healthy diet and physical activity are two positive components of lifestyle that affect health and life expectancy (4-6). On the other hand, poor eating habits, especially in combination with other unhealthy behaviours, are an important factor in the majority of chronic non-communicable diseases (CNDs), such as cardiovascular disease, some types of cancer, and diabetes (7). In the presence of a poor and/or inadequate dietary energy and nutrients intake, physical activity also cannot have its optimal health effects. Consequently, people with an active lifestyle require, in addition to a basic diet complying with the criteria of healthy nutrition, additional intake of nutrients to meet the metabolic requirements of their individual physical activity (8). The elements of a health-protecting and health-promoting diet include: food frequency, mode of distribution of daily energy requirements in individual meals (food pattern), macro- and micronutrient composition of food, and food preparation and food consumption patterns (9-11).

Results of studies in Slovenia show that an unhealthy basic dietary pattern is a serious problem, which significantly contributes to a growing prevalence of CNDs (12-16). Studies on the dietary pattern in Slovenia indicate that the basic diet is unhealthy not only on account of its composition but also with regard to food preparation patterns and the timing of food intake. According to data from a national study entitled Health-Related Lifestyle, conducted in 2004, no more than 22.9% of adults in Slovenia consume a healthy or mostly healthy diet (12). Special risk groups are men, people from lower social strata, people with a low level of education, residents of rural areas, especially in the eastern part of the country, and people aged from 25 to 49 years (12, 14, 17).

Nutritional patterns are closely connected with the socio-economic status of people, their cultural environment, beliefs and values, psychological response to various stressful situations, and other elements of lifestyle, such as smoking, alcohol consumption, the level and regularity of physical activity, and mental health (12, 18, 19). Recreational running is a popular sport in Slovenia, and its popularity continues to increase (20, 21). Since lifestyle factors are very closely interconnected and intertwined, the physically active lifestyle of recreational runners may be expected to influence also their diets. Therefore, the aim of our study was to acquire data on the basic and exercise-related dietary habits of recreational runners, and determine if the dietary pattern of physically active

individuals in Slovenia is more appropriate, from the point of view of their health, compared to the dietary habits of the general adult population. We also wished to evaluate the influence of gender, age and training level of recreational runners on the quality of their diet.

## 2 METHODS

### 2.1 Study Group: Sample of Recreational Runners

The study group included 1,212 adult recreational runners aged from 18 to 65 years (51.2% women, 48.8% men) who fully completed the survey questionnaire.

For the needs of the study, the runners were divided into three age groups:

- 18 to 25 years; n = 154
- 26 to 45 years; n = 745
- 46 to 65 years; n = 313

The runners were also divided into three groups according to their running performance. The first group of runners (n = 230) comprised runners whose best time in a 10- or 21-km run would place them among the first fourth of competitors in their age group successfully completing the Ljubljana Marathon race (well-trained runners). The second group of runners (n = 546) included runners whose best running times were comparable to those of the second and third fourths of participants at the Ljubljana Marathon (moderately trained runners), and the third group of runners (n = 436) consisted of runners with running times comparable to the results of the last fourth of participants at the Ljubljana Marathon (less trained runners).

### Reference group

The reference group comprised 774 adult residents of Slovenia (50% male, 50% female) aged  $39 \pm 13.7$  years, selected randomly from the Central Population Register. The group was stratified with respect to Slovenian regions, age and gender. The sampling was done at the Centre for Psychodiagnostic Tools in Ljubljana. All subjects participated in the survey on a volunteer basis.

### 2.2 Description of the Questionnaires Used and the Survey Procedure

Two questionnaires were used in the study.

The questionnaire used for the runners, entitled Life, Training and Health of Runners, was prepared in electronic form. The link to the questionnaire was sent to 5,700 electronic addresses of Slovenian runners registered for the 2010 Ljubljana Marathon.

The questionnaire used for the reference group, entitled Values, Lifestyle and Health of Slovenians, is a modification

of the above questionnaire. Data were gathered by personal interviews. The selection and training of the interviewers were carefully planned.

For the needs of the study, only those sections of the questionnaires dealing with socio-demographic data, lifestyle and dietary habits were selected. On the basis of equal or similar questions in both questionnaires, we wished to compare the results for both groups of respondents.

To allow comparability with other studies, above all, a study investigating the dietary habits of the adult population of Slovenia from the point of view of health protection performed in 2009, the selected food groups, frequencies of intake of selected foods, and units of measurement were similar or the same as in the study above (9). Moreover, some questions about food frequency were also similar or the same.

## 2.3 A Sample of Selected Variables

### 2.3.1 Biological Variables

For each subject, we recorded gender, age and three body measurements: body height (BH), body weight (BW) and body mass index ( $BMI = kg/m^2$ ). On the basis of the BMI values, we divided the survey participants into four groups (12, 14):

- underweight ( $BMI < 18.5 kg/m^2$ )
- normal weight ( $BMI 18.5 - 24.9 kg/m^2$ )
- overweight ( $BMI 25 - 29.9 kg/m^2$ )
- obesity ( $BMI \text{ over } 30 kg/m^2$ )

### 2.3.2 Socio-demographic Variables

The following socio-demographic variables were included in the survey: educational level, economic status (net personal income) and living environment.

### 2.3.3. Selected Lifestyle Factors

Sports activity. This was defined with the frequency and duration of any type of sports activity pursued by the subject; its quantity was expressed in hours per week.

### 2.3.4 Variables Concerning Dietary Habits

#### 2.3.4.1 Type of Diet

The survey participants described their diets as: varied, vegetarian or vegan.

#### 2.3.4.2 Dietary Pattern

The subjects were asked about the number and type of meals that they normally ate during the day.

#### 2.3.4.3 Frequency of Intake of Individual Food Groups

The subjects were asked how often they consumed the following foods: fruit, vegetables, whole grain foods, white starchy foods, low-fat dairy products, whole milk products, red meat, white meat, fish and seafood, and sweets (see Table 3). For each food group, they selected one of the following answers:

- 1 - At least once a day
- 2 - 4 to 6 times a week
- 3 - 1 to 4 times a week
- 4 - a few times per month or less frequently

#### 2.3.4.4 Food Supplements

The subjects were asked if they used dietary supplements; if the answer was yes, they were asked to indicate in a list of 18 supplements those that they normally used.

#### 2.3.4.5 Fluid Intake

We inquired about the daily intake of different beverages. From this information the total daily intake of fluids was calculated.

#### 2.3.4.6 Use of Alcohol

For this variable, the subjects indicated the frequency of drinking alcoholic beverages.

### 2.3.5 Fulfilment of the Criteria of a Healthy Diet

Fulfilment of the criteria of a healthy diet by the runners and reference subjects was evaluated on the basis of selected parameters from the general model of healthy nutrition (7, 14, 17, 22). The following parameters were selected: dietary pattern, appropriate consumption of fruit and vegetables, appropriate food composition, intake of fluids, and alcohol consumption (see Table 8).

## 2.4 Statistical Analysis

Data from the questionnaires were analysed with the SPSS programme (18.0). When assessing the statistical significance of differences between individual groups of subjects, Pearson's Chi square test was used for variables with ordinal data, while t-test for independent samples and variance analysis (ANOVA) was used for variables on a linear numerical scale. Difference testing was done at a risk level  $\alpha = 5\%$ .

## 3 RESULTS

### 3.1 Basic Biological Characteristics

The female runners participating in the survey had an average age of  $37.7 \pm 10.5$  years, an average height of  $166.9 \pm 6.9$  cm, and an average weight of  $62.1 \pm 8.8$  kg.

They were on average 1 cm taller ( $p < 0.05$ ) and 4.4 kg lighter ( $p < 0.001$ ) than the women in the reference group, who had an average age of  $39.1 \pm 13.8$  years.

The male runners were aged on average  $38.4 \pm 19.9$  years, had an average height of  $179.9 \pm 9.7$  cm and an average weight of  $79.2 \pm 9.7$  kg. They were 1.3 cm taller ( $p < 0.05$ ) and 4.5 kg lighter ( $p < 0.001$ ) than the men in the reference group, who were on average a year older than the runners.

The nutritional status of the subjects in both groups is presented in Table 1.

**Table 1.** Nutritional status of subjects (in %) in the study group ( $n = 1,212$ ) and the reference group ( $n = 774$ ) expressed as body mass index (BMI) (12, 14).

Nutritional status (kg / m <sup>2</sup> )	Runners (%)	Reference group (%)	Cramer's V	p
Underweight (BMI <18.5)	1.9	1.4	0.048	0.088
Normal weight (BMI 18.5 to 24.9)	72.8	50.8	0.456	0.000
Overweight (BMI 25 to 29.9)	23.5	37.2	0.257	0.000
Obesity (BMI >30)	1.8	10.6	0.598	0.000

The proportion of subjects with a normal body weight was significantly higher ( $p < 0.001$ ) among the runners, whereas the proportion of overweight and obese individuals was significantly higher in the reference group ( $p < 0.001$ ).

### 3.2 Socio-demographic Data and Economic Status

The runners had a significantly higher ( $p < 0.001$ ) educational level than the reference subjects.

As many as 68.1% of the runners and only 17% of the reference subjects were university educated (college diploma, bachelor's, master's or doctoral degree). Personal income was also higher in the study group than in the reference group ( $p < 0.001$ ). Only 25.4% of the runners and as many as 67% of the reference subjects had a net monthly income of less than 900 EUR. The two groups also differed significantly with respect to their living environment ( $p < 0.001$ ). Nearly half (47.7%) of the

recreational runners included in the survey came from major urban centres, whereas most reference subjects (49.1%) lived in rural areas.

### 3.3 Sports Activity

As expected, the runners were significantly more active physically ( $p < 0.001$ ) than the reference subjects.

The runners engaged in sports activities on average  $3.6 \pm 1.5$  times a week for a total of  $6.0 \pm 3.1$  hours a week, whereas the reference subjects practiced sports on average  $2.5 \pm 2.0$  times a week for a total of  $3.8 \pm 3.9$  hours a week.

### 3.4 Adherence to the General Principles of a Healthy Diet

#### 3.4.1 Type of Diet

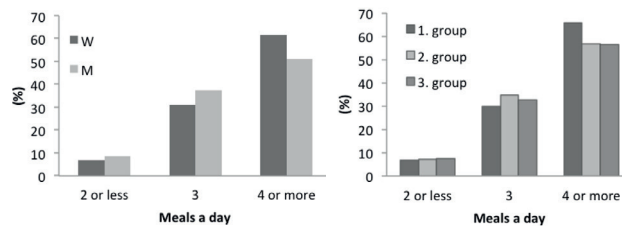
The great majority of runners (89.6% female and 95.6% male) and reference subjects (97.6% male and 94.3% female) consumed a mixed diet. In both groups, there were significantly more vegetarians ( $p < 0.001$ ) among the women than among the men. Among the runners, there were 7.2% of vegetarians (9.9% female and 4.4% male), compared to 2.6% of vegetarians (4.6% female and 0.5% male) in the reference group. Vegans constituted 0.2% of the study group and 0.3% of the reference group.

Diet type did not vary with the runners' performance or age.

#### 3.4.2 Dietary Pattern

The runners divided their daily food intake into significantly more meals than the reference subjects ( $p < 0.001$ ). The runners mostly ate four meals a day (most frequent answer), while the reference subjects mostly ate three meals a day.

Nearly two thirds of the runners (58.7%) and less than half of the reference subjects (46.8%) divided their daily food intake into four or more meals. A very irregular eating schedule (two or only one meal a day) was reported by 6.9% of the runners and 13.7% of the reference subjects. In the study group, women reported eating significantly more meals ( $p < 0.01$ ) than men (Figure 1 left). The number of daily meals increased with age ( $p < 0.05$ ), and well-trained runners ate more daily meals ( $p < 0.05$ ) than less trained individuals (Figure 1 right).



**Figure 1.** Consumption (in %) of main meals by runners according to gender (left; W = women; M = men) and running performance level (right; 1 = well-trained runners, 2 = moderately trained runners, 3 = less trained runners).

### 3.4.3 Eating Three Main Meals

Breakfast was eaten regularly by 87.6% of the runners and 65.7% of the reference subjects ( $p < 0.001$ ) (see Table 2).

**Table 2.** Consumption of main meals by the runners and the reference group (in %).

	Runners (%)	Reference group (%)	Cramer's V	p
I eat breakfast daily	87.6	65.7	0.276	0.000
I eat lunch daily	94.1	92.2	0.085	0.047
I eat dinner daily	77.1	78.9	0.021	0.885
I eat all three main meals daily	62.1	50.6	0.112	0.002

Three main meals a day were eaten by 66.4% of female runners, which was significantly above ( $p < 0.001$ ) the proportion of male runners eating three main meals a day (57.9%). Similarly, three main meals were eaten by a greater proportion of well-trained runners ( $p < 0.05$ ), compared to less trained runners.

### 3.4.4 Frequency of Eating Different Foods

**Table 3.** Food frequency data for the runners (study group, S) and the reference group (R) (in %).

Food group	Frequency of intake							
	At least once a day		4-6 times per week		1-3 times per week		Several times a month or never	
	S	R	S	R	S	R	S	R
Fruit	60.1	48.3	29.3	21.2	9.5	27.7	0.9	2.8
Vegetables	61.5	52.1	28.1	23.1	8.8	23.9	1.2	2.3
Whole grain foods	33.7	9.6	34.3	11.4	21.7	35.8	10.2	43.2
White starchy foods	4.7	12.3	22.6	26.8	59.1	57.3	13.6	3.6
Low-fat dairy products	18.9	10.9	23.2	14.1	30.8	39.0	26.9	36.0
Whole milk products	5.4	11.8	9.4	15.4	46.2	47.7	39.1	25.1
Fish and seafood	1.8	1.4	14.6	2.4	66.2	49.4	17.4	46.8
Red meat	2.3	7.6	10.9	14.2	57.9	61.5	29.0	16.7
White meat	2.8	5.0	24.0	15.7	63.5	68.7	9.9	10.6
Sweets and pastry	9.7	8.4	15.0	12.7	41.1	36.5	34.2	43.4

The runners consumed fruit and vegetables, whole grain foods, fish, white meat and low-fat dairy products significantly more frequently ( $p < 0.001$ ) than the reference group, whereas their consumption of white starchy foods, red meat, and whole milk products was significantly less frequent than ( $p < 0.001$ ) in the reference group.

Female runners consumed fruit and vegetables, whole grain foods, low-fat milk, low-fat dairy products, fish and white meat significantly ( $p < 0.001$ ) more often than male runners. By contrast, female runners reported significantly ( $p < 0.001$ ) less frequent consumption of red meat, white starchy food, and whole milk products than men.

The results also revealed considerable differences in diet between individual age groups of runners. Compared to younger subjects, runners aged over 45 years consumed significantly less sweets ( $p < 0.05$ ), less meat - both red ( $p < 0.05$ ) and white ( $p < 0.001$ ), and less whole milk products ( $p < 0.001$ ), but they ate more fruit and vegetables ( $p < 0.05$ ) and more fish ( $p = 0.051$ ). With improving running performance, the runners' consumption of rapidly degradable carbohydrates (foods made from white flour and starch) and white meat decreased in frequency ( $p < 0.05$ ), while their consumption of whole grain cereals increased ( $p < 0.05$ ). For all other selected foods, there were no significant differences in the frequency of consumption between groups of runners with a different training status.

### 3.4.5 Nutritional Supplements

More runners (54.3%) than the reference subjects (29.4%) ( $p < 0.001$ ) reported supplementing their diet with an additional intake of vitamins, minerals and other food supplements. The most frequently used nutritional supplements are presented in Table 4.

**Table 4.** The use of food supplements by the runners and the reference subjects, in %.

Food supplement	Runners (%)	Reference group (%)	Cramer's V	p
Multivitamin tablets	29.1	14.6	0.167	0.000
Vitamin C	14.6	9.2	0.123	0.000
Magnesium	24.9	8.1	0.201	0.000
Omega 3 fats	13.4	6.2	0.109	0.000
Iron	10.1	4.8	0.124	0.000
Calcium	11.8	7.3	0.089	0.002
Group B vitamins	5.8	3.8	0.078	0.034

Compared to male runners, female runners were significantly more likely ( $p < 0.01$ ) to use dietary supplements (Table 5).

**Table 5.** The use of food supplements by male and female runners, in %.

Food supplement	Male runners (%)	Female runners (%)	Cramer's V	p
Multivitamin tablets	29.2	28.9	0.004	0.892
Vitamin C	14.5	14.7	0.003	0.922
Group B vitamins	5.1	6.4	0.028	0.306
Magnesium	24.4	25.4	0.012	0.670
BCAA	5.1	1.5	0.101	0.000
Omega 3 fats	15.0	11.9	0.045	0.098
Iron	7.2	14.1	0.115	0.000
Glutamine	5.3	1.8	0.099	0.000
Calcium	9.6	15.9	0.087	0.002

Female runners differed from the males in their intake of iron (14.1% vs. 7.2;  $p < 0.001$ ) and calcium (15.9% vs. 9.6%;  $p < 0.001$ ). By contrast, male runners were significantly more likely than the females to supplement their diet with branched chain amino acids (BCAA) (5.5% vs. 1.5%;  $p < 0.001$ ) and glutamine (5.3% vs. 1.8%;  $p < 0.01$ ).

The results also showed that well-trained runners were significantly ( $p < 0.001$ ) more likely to use nutritional supplements than less trained runners. Differences between well-trained and less trained runners in the use of food supplements are presented in Table 6.



**Table 6.** The use of food supplements by the runners according to running performance/ training status, in %.

Food supplement	Well-trained runners (%)	Moderately trained runners (%)	Less trained runners (%)	Cramer's V	p
Multivitamin tablets	39.1	36.3	30.6	0.066	0.161
Vitamin C	21.3	17.1	13.3	0.073	0.108
Group B vitamins	10.3	5.9	4.7	0.078	0.077
Magnesium	38.2	31.6	22.3	0.123	0.002
BCAA	10.3	3.5	1.4	0.152	0.000
Omega 3 fats	23.5	16.2	9.7	0.130	0.001
Calcium	15.4	14.5	11.5	0.045	0.423
Iron	25.0	9.8	5.0	0.215	0.000
Glutamin	11.0	4.4	2.2	0.139	0.000

### 3.4.6 Fluid Intake

Daily fluid intake did not differ ( $p > 0.05$ ) between the group of runners (2.09 L) and the reference group (2.13 L), but there were statistically significant differences in the types of fluid consumed. The runners drank more water ( $p < 0.05$ ) and tea ( $p < 0.001$ ), but significantly less ( $p < 0.001$ ) coffee, sweet beverages and other fluids (especially beer and other alcoholic beverages).

Fluid intake among the runners differed according to age ( $p < 0.001$ ). The highest fluid intake was recorded for runners under 25 years of age ( $2.26 \pm 0.97$  L), and the lowest for runners aged over 45 years ( $1.96 \pm 0.89$  L).

Daily fluid intake also differed significantly ( $p < 0.001$ ) with regard to the runners' performance. The highest daily fluid intake ( $2.39 \pm 1.06$  L) was recorded for well-trained runners (group 1) and the lowest for less trained runners (group 3) ( $1.97 \pm 0.88$  L).

Daily fluid intake did not differ between the genders, but there were statistically significant differences ( $p < 0.001$ ) in the types of fluid ingested. Male runners drank more sweet beverages, milk and other fluids (especially beer and other alcoholic beverages), whereas female runners preferred coffee, tea and water.

### 3.4.7 Consumption of Alcoholic Beverages

The runners drank alcoholic beverages less frequently ( $p < 0.001$ ) than the reference group (see Table 7). Very frequent alcohol consumption (once a week or more frequently) was less common among the runners than among the reference subjects (36% vs. 45.7%). By contrast, the proportion of subjects who reported drinking alcohol rarely was significantly higher ( $p < 0.001$ ) in the group of runners than in the reference group (42.4% vs. 32.7%).

**Table 7.** Alcohol use by the runners and the reference group, in %.

Frequency of drinking alcohol	Runners (%)	Reference group (%)	Cramer's V	p
Daily	3.5	6.6	0.063	0.005
Two to 3 times a week	14.0	16.7	0.035	0.124
Once a week	18.5	22.4	0.051	0.025
Less than once a week and more than once a month	42.4	32.7	0.095	0.000
Never	21.6	21.7	0.000	0.993

Alcohol drinking is significantly more frequent ( $p < 0.001$ ) among men than among women. Regular drinking of alcohol (3 times a week or more often) was reported by 24.1 % of male runners and 11.9 % of female runners.

Runners over 45 years of age consumed alcohol significantly more frequently ( $p < 0.001$ ) than younger runners, but there were no significant differences in alcohol consumption between groups of runners grouped according to running performance.

### 3.5 The Fulfillment of the Criteria of a Healthy Diet

The runners' diet was more in line with the selected criteria of healthy nutrition ( $p < 0.001$ ) than the diet of the reference group.

**Table 8.** The proportion (%) of runners and reference subjects complying with selected criteria for healthy nutrition (adapted from 12, 14, 17, 22).

Criteria of healthy nutrition		Runners (%)	Reference group (%)	p
Dietary pattern:	Number of daily meals (3 to 5)	58.8	46.8	0.000
	Breakfast (daily)	87.6	65.7	0.000
	Number of main meals (3)	62.4	50.6	0.000
Consumption of fruit and vegetables:	Vegetables (daily)	61.5	52.1	0.000
	Fruit (daily)	60.1	48.3	0.000
Appropriate food composition:	Whole grain foods (4-6 times a week or more often)	68.0	21.0	0.000
	White OH (less than once a week)	13.6	3.6	0.000
	Low-fat dairy products (4-6 times a week or more often)	42.2	25.0	0.000
	Whole-milk products (less than once a week)	39.0	25.2	0.000
	Red meat (less than 1-3 times a week)	86.9	78.2	0.002
	Fish and seafood (more than 3 times a week)	14.6	2.4	0.000
	Sweets and pastry (less than once a week)	34.2	43.4	0.004
				0,267
Intake of fluids:	Adequate (more than 2 L a day)	85.1	82.2	
	Sweet beverages (never)	44.4	41.8	0.066
Alcohol consumption:	Less than once a week	54.3	64.1	0.003

#### 4 DISCUSSION

The paper presents the results of the first study in Slovenia that compared the nutritional habits of physically active subjects with those of a general population sample. The results show that the runners' diet was more in line with the general criteria of healthy nutrition (see Table 8) than the diet of the reference group.

The majority of runners as well as the majority of reference subjects consumed a varied diet.

A vegetarian diet was significantly more common among the runners than in the reference group ( $p > 0.001$ ). It was especially frequent among female runners, every tenth woman in this group (9.9%) being vegetarian. By contrast, only 4.6% of women in the reference group followed a vegetarian diet, which is in agreement with findings from population studies in Slovenia (9, 12, 14).

Our results suggest that the number and distribution of daily meals in Slovenian recreational runners are in line with recommendations for healthy nutrition and more appropriate than in average adults in Slovenia. Two thirds of the runners participating in the study divided their daily food intake into three to five meals. The majority ate regularly breakfast and lunch, and two thirds ate all three main daily meals. This is not important only from the point of view of healthy eating habits, but is of vital

importance also for adequate energy support to the regular training process in physically active individuals.

The key problems in the field of dietary habits, which are related to the frequency of consumption of individual food groups (inadequate intake of fruit and vegetables, excessive use of fatty meat and meat products, frequent consumption of fried food, and excessive use of refined cereals), were much less pronounced among the runners compared to the reference population or to the data from previous studies performed in Slovenia (Table 3) (9, 12, 14, 17).

A distinct feature of the runners' diet was an emphasis on foods rich in slowly degradable carbohydrates. Runners showed a marked preference for whole grain cereal products over products made of rapidly degradable carbohydrates (white flour, starch). This trend increased with the runners' training level and was more pronounced in female runners. Slowly degradable carbohydrates have an important place in a healthy basic diet, but according to recommendations for sports nutrition, they are less suitable as an additional energy substrate around physical exercise (8, 23).

The frequency of consumption of foods rich in carbohydrates was significantly higher among the runners than in the reference group (see Table 2). These results suggest that the relative contribution of carbohydrates



to the daily energy intake of a Slovenian runner is considerably above values reported for the general adult population (46.9%) (9), and may well fall in the range from 50% to 70% recommended for physically active individuals (23).

Close to half the runners in our study (49.2%) consumed low fat dairy products much more often than whole milk products, and restricted their consumption of meat. Compared to the reference subjects, the runners more often substituted red meat with fish and poultry. These findings suggest that the contribution of fats (especially unsaturated and trans fatty acids) in a runner's diet is below the level reported for the general adult population (38.7%) (9). The comparatively frequent use of fish in the daily nutrition and omega 3 fats as a nutritional supplement also indicates that the intake of unsaturated fats among runners is more favourable than in the general adult population of Slovenia.

The nutritional habits and physical activity level of the subjects in our study were reflected in their nutritional status. The proportion of runners with normal weight was significantly higher ( $p < 0.001$ ) in comparison to the reference group, whereas the proportion of overweight and obese persons was higher ( $p < 0.001$ ) in the reference group (Table 1).

The recreational runners in our study used more nutritional supplements than the reference subjects. On the other hand, the proportion of reference subjects who reported using food supplements was significantly higher than in previous studies (9). According to nutritional recommendations, food supplements should be used only when a person's basic diet does not meet their energy and nutrient requirements (24). Thus, the decision to use a food supplement must be based on an analysis of the dietary intake. There is no firm scientific evidence that additional intake of vitamin C, multivitamins and magnesium, commonly used by runners, actually has favourable effects. While these supplements were used widely also by our runners, BCAA, a supplement recommended for sports nutrition, was used by only 10% of them.

Ribič and Kranjc (2014) have established that adults in Slovenia with a low level of formal education and, consequently, a low economic status have poor eating habits. These authors also report that people in urban centres have a healthier dietary pattern than people living in rural areas. Our results fully confirm the strong influence of socio-demographic factors (education, socio-economic status, living environment) on dietary habits in adults, observed also in other domestic and foreign studies (17, 25).

The runners in our study represent a very specific group that differs markedly from average adult Slovenians in all

selected socio-demographic parameters. They had better education (68.1% were university educated, compared to only 17% in the reference group) and a higher economic status, and they lived mostly in urban centres. Such superior education and the resulting higher level of knowledge and awareness, as well as better opportunities due to a higher economic status, are inter-related factors, allowing an individual to adopt a healthier lifestyle (25).

The results of this study clearly show that the concern for healthy nutrition among runners increases with running performance and training level. Successful runners, who normally also train more intensely, have a more regular dietary pattern, they eat more daily meals and are more likely to consume all three main meals than less successful runners. Runners who train more pay greater attention to the type of carbohydrates they consume, giving marked preference to slowly degradable carbohydrates. They also eat more fish and use more dietary supplements. This might be an additional factor for better running performance and is in line with nutritional guidelines for physical activity (8).

As in other similar studies (9, 12), the present results confirm that women are more rigorous than men in following the guidelines for healthy eating, regarding both the organization (meal timing, food preparation) as well as composition and energy content of their diet (appropriate food choices). Men are generally less willing to follow recommendations and are traditionally inclined to less healthy behaviour patterns, also in the field of nutrition (26, 27).

Furthermore, our results confirm that nutrition in older age groups of runners is more in line with recommendations for healthy eating than that of younger runners. The period between 18 and 45 years of age is a work-intensive period of life, characterized by stress and mobility, which often result in less healthy eating (11). With advancing age, health becomes an increasingly important value, and healthy eating also receives more attention.

## 5 CONCLUSION

The diet of recreational runners is in closer agreement with recommendations for healthy eating than the diet of an average adult resident of Slovenia. Runners' eating habits improve with age and training level. Female runners eat more regularly than males and more frequently consume food groups associated with a healthy diet (fruit, vegetables, whole grain foods and low fat milk products). The fact that runners have better eating habits than the general population is related to their better education, higher income, and life in urban centres. However, their eating habits still fall short of dietary recommendations for adult recreational and competitive sports.

Since the results of this study suggest that runners are an exemplary population group who actively strive for a healthier lifestyle, providing additional educational support for this population segment, aimed at further improving their dietary habits, is a rational and probably also economically justified public health measure. Further research in this field would be beneficial.

## CONFLICTS OF INTEREST

The authors declare that no conflicts of interest exist.

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## ETHICAL APPROVAL

Not required.

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