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Original article

Dietary intakes, nutritional habits, and nutritional supplement use of collegiate athletes: a sample from a university in Turkey

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Abstract. *Objective:* This study aimed to assess supplement use, nutritional habits, and dietary intakes in collegiate athletes. *Participants and Methods:* One hundred twenty-seven athletes participated in this study. The questionnaire was conducted by the researcher using face-to-face interview method. *Results:* The energy intake was 3084.3±1564.0 kcal in women and 3981.9±1531.7 kcal in men. Energy and all nutrient intakes were above the recommended level. It was found that 49.6% of the athletes used nutritional supplements (≥2 days/week over the past year). The most used supplements were sports drinks (33.1%), multivitamin/mineral supplements (26.0%), and protein powder (21.3%). Athletes learned the information about supplements mostly from coaches (31.5%), internet (28.3%), and friends (21.3%). It was found that 51.2% of the athletes skipped meals. *Conclusion:* It was concluded that the athletes mostly obtained the information about supplements from coaches and internet. It was determined that the use of supplements was high among the athletes and their dietary consumption was higher than the energy and nutrient requirements of the athletes.

Key words: eating habits, supplementation, athletes, sports nutrition

Introduction

Nutrition for sport is the provision of essential nutrients, including fuels and fluids, to provide energy for training, competition, and general health (1,2). Nutritional habits are important for athletic performance and recovery because they influence energy consumption, nutrient intake, and hydration status (3). Sports nutrition guidelines contain several topics such as breakfast consumption, hydration, and the use of nutritional supplements (4,5).

Nutrition knowledge is believed to influence dietary intake and dietary behaviors (6,7). Athletes have both very accurate and inaccurate information about nutrition, and they obtain this information from various resources. According to studies, books, sport-specific magazines, school, mass media, the internet, coaches, sports instructors, dietitians, and physicians are the common nutrition resources for the athletes (8-12). Health professionals advise not only athletes but also all people on healthy eating and lifestyle habits. For this reason, the education of future health professionals is also very important (13). Turkish athletes do not receive any nutrition education as part of routine curriculum, so when they become collegiate athletes, they have a very limited nutritional knowledge base (14,15).

Collegiate athletes may encounter various obstacles that affect their healthy nutrition intake. Among these obstacles are lack of nutrition knowledge and unhealthy nutritional habits (16). Inappropriate use of nutritional supplements among athletes is one of the common problems and may be harmful for the athlete's

health and/or performance. Most supplements are sold uncontrolled on the internet with no data about their safety and effectiveness. These products carry the risk of containing banned substances (doping agents, or anabolic/androgenic steroids) not listed on their labels. Unfortunately, these supplements are often used without a full understanding or evaluation of the potential benefits and risks associated with their use (17-22).

An adequate and balanced diet meets all nutrient requirements for the body. Meeting energy and nutrient requirements is very important for the athletes (6-9). A minimum of 5 g/kg of dietary carbohydrates is recommended for the athletes (23). Carbohydrate consumption prevents the blood glucose level from decreasing during exercise and provides support for muscle glycogen storage. Considering the activities according to their intensity, it is stated that carbohydrate requirement should be 3-5 g/kg in low intensity activities, 5-7 g/kg in medium intensity exercises, 6-10 g/kg in high intensity exercises, and 8-12 g/kg in very high intensity exercises (21). Protein recommendation for athletes is higher than that for healthy individuals in order to ensure the metabolic adaptation of the athletes to exercises. Daily protein recommendation for athletes is 1.2-1.7 g/kg and should provide 10%-35% of total calories (24-27). Furthermore, daily protein recommendation for athletes from different sources is 1.2-2.0 g/kg (24). Currently, there are no guidelines for athletes in terms of dietary fat intake. Thus, athletes are advised to follow the Acceptable Macronutrient Distribution Ranges (AMDRs) for dietary fat, ranging from 20% to 35% of their total energy intake. Meeting less than 20% of energy from fats is a risk factor for athletes in providing essential fatty acids and fat-soluble vitamins (28). It is important for athletes to intake micronutrients in recommended amounts. Micronutrients take part in energy production, hemoglobin synthesis, maintenance of bone health, immune function, and antioxidant system in the body. There are no Dietary Reference Intakes (DRIs) specially prepared for athletes; therefore, DRIs developed for healthy individuals are used to evaluate the intake of micronutrients (29,30). With increasing physical activity level, micronutrient requirements may increase in athletes. Therefore, athletes must meet the DRIs for micronutrients (31,32).

This study was aimed in our study to determine the dietary intakes, nutrition habits, and nutritional supplement use of collegiate athletes. It is thought that the study will provide important information to the literature on this subject.

Materials and methods

Data collection

This cross-sectional study was undertaken at Trakya University, Edirne, Turkey. A total of 127 athletes from 15 sports were included in the study. The inclusion criteria included being a member of an athletic team and being 18 or older. The participants were informed that their information would be kept confidential and used only for scientific purposes. All procedures were in line with the Helsinki Declaration.

Data were collected using a questionnaire survey prepared by the researchers. With the help of the questionnaire, demographic characteristics, health information, nutritional habits, supplements use and physical activity information of the individuals were obtained.

Assessment of dietary intakes

Dietary assessment was made using a 24-hour recall for 3 days. Dietary data from the food recall were entered into a food analysis software program: Nutrition Information Systems (BEBIS) to calculate the total daily intake of energy and nutrients. However, since there are no DRIs specially prepared for athletes, DRIs developed by Canadian and American scientists for healthy individuals by age groups and gender were compared with the data obtained from the BEBIS program. The AMDRs state that the acceptable proportion of daily energy intake from carbohydrates, protein, and fat is 45%–65%, 10%–35%, and 20%–35%, respectively, which were used for comparison purposes (28-33). The minimum recommendations for carbohydrate were assumed as ≥ 5 g/kg and ≥ 1.2 g/kg for protein (23-25). The resting metabolic rate (RMR) of the participants was estimated using the Harris-Benedict equation (30). The RMR was then multiplied by a

physical activity factor ranging from 1.8 to 2.3 for each subject and the total energy expenditure was calculated for each subject (4). The appropriate physical activity factor was established using the detailed physical activity record reported by each subject.

Statistical analysis

The Statistical Package for the Social Sciences (version 22.0) software was used for all analyses. All data are presented as frequency and percentage. The Chi-square test was performed to test for differences in the proportions of categorical variables. Mean differences between groups were assessed by the Independent t-test. A p-value of less than 0.05 was considered to be statistically significant.

Results

A total of 127 (33.1% women, 66.9% men) collegiate athletes between the ages of 18 and 30 participated in the study. The average age of the participants was 21.2 ± 2.3 years. The athletes trained 4.7±1.3 days/week on average and their mean training duration was 93.3±27.8 minutes/day. It was found that 26.8% of the athletes were smokers, and 29.9% consumed alcohol. The demographic characteristics of the athletes are shown in Table 1.

The main meal skipping status and the reason for skipping meals are given in Table 2. It was found that 51.2% of the athletes skipped meals and there was a significant difference in terms of meal skipping by gender ($p<0.05$). The most skipped meal in women was lunch, while in man, it was breakfast. The most important reason for skipping meals in men and women was not having sufficient time (58.3% and 53.7%, respectively).

Nutritional habits of the athletes are given in Table 3. Most athletes paid attention to diet and fluid consumption before and after training (73.2% and 81.9%, respectively). Fifty-four percent of the athletes stated that they consume main meals less than two hours before training. While the athletes mostly preferred carbohydrate-rich foods (57.5%) before training, they preferred protein-rich foods after training (59.1%).

Table 1. Demographic characteristics of the collegiate athletes.

Variables	n (127)	%
Gender		
Woman	42	33.1
Man	85	66.9
Marital status		
Married	1	0.8
Unmarried	126	99.2
Living …		
With Family	36	28.3
Alone	16	12.6
With friends	75	59.1
Smoking status		
Yes	34	26.8
No	93	73.2
Alcohol use		
Yes	38	29.9
No	89	70.1
Chronic illness diagnosis		
Yes	5	3.9
No	122	96.1

The athletes' nutritional supplement use is given in Table 4. It was found that 49.6% of the athletes used nutritional supplements (≥2 days/week over the past year) and there was a significant difference in the use of supplements between genders ($p<0.05$). The supplements used most were sports drinks (33.1%), multivitamin/mineral supplements (26.0%), and protein powder (21.3%). More men (57.6%) stated that they had information about supplements than women (21.4%) ($p<0.05$). The athletes stated that they learned the information about supplements mostly from coaches (31.5%), internet (28.3%), and friends (21.3%). Sixty-three percent of the athletes believed that these products improve performance.

Energy and nutrient intakes of the athletes are given in Table 5. The energy intake was 3084.3±1564.0 kcal in women and 3981.9±1531.7 kcal in men. The mean proportions of the total energy coming from carbohydrates, protein, and fat were 41%, 18%, and 41% in women and 42%, 20%, and 38% in man, respectively. The average carbohydrate (g/kg) and protein (g/kg) intakes of the athletes were above the recommended levels (5.7 g/kg,5.3 g/kg; 2.3 g/kg,

Table 2. Main meal skipping status of the collegiate athletes and the reasons for meal skipping.

	Total (n=127) n %		Woman (n=42) n %		Man (n=85) n %		p-value
Main meal skipping							
Yes	65	51.2	24	57.1	41	48.2	**0.036***
No	62	48.8	18	42.9	44	51.8	
Which main meal is skipped							
Breakfast	29	44.6	6	25.0	23	56.1	
Lunch	30	46.2	17	70.8	13	31.7	
Dinner	6	9.2	1	4.2	5	12.2	
The reason for skipping meals							
Not having sufficient time	36	55.4	14	58.3	22	53.7	
Nausea	1	1.5	0	0.0	1	2.4	
No appetite	16	24.7	6	25	10	24.4	
Not wanting to gain weight	2	3.0	1	4.2	1	2.4	
Habit	9	13.9	3	12.5	6	14.7	
Financial	1	1.5	0	0.0	1	2.4	

Chi-square test *p<0.05

Table 3. Nutritional habits of the collegiate athletes.

	n	%
Do you pay attention to your diet before and after training?		
Yes	93	73.2
No	8	6.3
Sometimes	26	20.5
Do you pay attention to fluid consumption before and after training?		
Yes	104	81.9
No	7	5.5
Sometimes	16	12.6
How long before training do you consume main meals?		
<2 hours	64	50.4
2-4 hours	56	44.1
> 4 hours	3	2.4
I don't pay attention	4	3.1
What foods do you prefer before training?		
Carbohydrate-rich content	73	57.5
Protein-rich content	47	37.0
Fat-rich content	1	0.8
Fiber-rich content	2	1.6
I don't pay attention	4	3.1
What foods do you prefer after training?		
Carbohydrate-rich content	42	33.1
Protein-rich content	75	59.1
Fat-rich content	0	0
Fiber-rich content	4	3.1
I don't pay attention	6	4.7

Table 4. The use of nutritional supplements of the collegiate athletes.

	Total (n=127) n %		Woman (n=42) n %		Man (n=85) n %		p-value
Use of supplements							
Yes	63	49.6	14	33.3	49	57.6	**0.010***
No	64	50.4	28	66.7	36	42.4	
Which supplements do you use?							
Sports drinks	42	33.1	12	28.6	30	35.3	0.449
Multivitamin/mineral supplements	33	26.0	12	28.6	21	24.7	0.640
Protein/AAs							
Protein powder	27	21.3	2	4.8	25	29.4	**0.001***
Creatine	3	2.4	1	2.4	2	2.4	0.992
BCAAs	17	13.4	1	2.4	16	18.8	**0.010***
Amino acids	9	7.1	0	0.0	9	10.6	**0.029***
Glutamine	9	7.1	0	0.0	9	10.6	**0.029***
L-carnitine	1	0.8	0	0.0	1	1.2	0.480
L-arginine	1	0.8	0	0.0	1	1.2	0.480
Carbohydrate							
Carbohydrate powder	4	3.2	0	0.0	4	4.7	0.153
Fatty acid							
CLA	1	0.8	1	2.4	0	0.0	0.153
Do you have information about supplements?							
Yes	58	45.7	9	21.4	49	57.6	**<0.001***
No	10	7.9	8	19.1	2	2.4	
I have little information	59	46.5	25	59.5	34	40.0	
The source of the information							
Physician	4	3.1	0	0.0	4	4.8	
Dietitian	7	5.5	3	8.8	4	4.8	
Friends	27	21.3	9	26.5	18	21.7	0.367
Coach	40	31.5	12	35.3	28	33.7	
Internet	36	28.3	8	23.5	28	33.7	
School elective course	3	2.4	2	5.9	1	1.2	
Do you think that supplements improve your performance?	80	63.0	26	61.9	54	63.5	0.760
Yes	18	14.2	5	11.9	13	15.3	
No	29	22.8	11	26.2	18	21.2	
No idea							

Chi-square test *p<0.05 AAs: Amino acids, BCAA: Branched-chain amino acids, CLA: Conjugated linoleic acid

2.5 g/kg, by gender, respectively). Also, the average vitamin and mineral intakes were above the recommended levels.

Discussion

This study will provide important information about the dietary intakes, nutritional habits, and nutritional supplement use of Turkish collegiate athletes actively competing in any sports branch. In our study, it was found that 51.2% of the athletes skipped meals and meal skipping was higher in female athletes than in male athletes. This difference may be due to the different aspects of women's and men's concerns about body image. The most skipped meal in women was lunch, and it was breakfast in men. Breakfast consumption positively affects the performance by providing regeneration of muscle and liver glycogen storages after night-long starvation, and regular consumption of meals provides

Table 5. Energy and nutrient intakes of the collegiate athletes.

	Woman (n=42) X±SD	Recommended	Man (n=85) X±SD	Recommended
Energy (kcal)	3084.3±1564.0	2582	3981.9±1531.7	3455
Energy (kcal/kg)	53.9±29.5	43.3	50.9±19.7	43.5
Protein (% kcal)	18.1±5.5	10-35	20.5±7.0	10-35
Protein (g/kg)	2.3±1.1	≥ 1.2 g/kg	2.5±1.2	≥ 1.2 g/kg
Carbohydrates (% kcal)	41.2±9.4	45-65	41.8±9.7	45-65
Carbohydrates (g/kg)	5.7±3.9	≥ 5 g/kg	5.3±2.7	≥ 5 g/kg
Fat (% kcal)	40.8±5.7	20-35	37.8±6.6	20-35
Vitamin A (mcg)	2367.9±3138.1	700	5079.7±8804.6	900
Vitamin B6 (mg)	2.6±1.3	1.3	3.9±2.5	1.3
Vitamin B12 (mcg)	10.4±12.7	2.4	22.4±33.3	2.4
Vitamin C (mg)	109.9±58.1	75	126.7±81.4	90
Calcium (mg)	1221.2±549.4	1000°	1543.6±645.1	1000°
Iron (mg)	19.8±9.9	18	26.8±11.3	8
Zinc(mg)	15.7±7.2	8	22.1±9.5	11

Energy was calculated using the Harris-Benedict equation and the physical activity factor.
Acceptable Macronutrient Distribution Ranges (AMDRs) were taken into account for energy intake from carbohydrates, protein, and fat.
°: Adequate Intake (AI), Calcium was evaluated according to AI, other vitamins and minerals were evaluated according to the Recommended Dietary Allowances (RDAs).
The minimum recommendations for carbohydrate were assumed as ≥ 5 g/kg and for protein as ≥ 1.2 g/kg.

the necessary carbohydrate and energy intake (25). In the study of Cakar et al. (13), it was determined that 80.9% of pharmacy students regularly consume breakfast. In contrast, Shriver et al. (3), Oladunni et al. (34) and Waly et al. (35) reported that 29%, 72%, and 55% of the athletes skipped meals. The fact that meal skipping is common among athletes may be due to the insufficient nutritional information of the athletes.

The misuse of nutritional supplements is quite common among athletes (36). For example, vitamin and mineral supplements should be used only in cases where the vitamin and mineral requirements cannot be provided with diet provided that a deficiency in blood analysis is detected (19,37). In our study, it was found that 26.0% of the athletes used multivitamin/mineral supplements without any vitamin/mineral deficiency. Dascombe et al. (38) reported that 45.8% of the athletes used mineral supplements and 43.1% used vitamin supplements. In another study conducted by Lieberman et al. (39), 42% of the athletes used vitamin/mineral supplements. The widespread use of vitamin and mineral supplements among athletes may be due to the nutritional deficiencies and the desire to improve performance. In our study, it was found that 49.6% of the athletes used nutritional supplements (≥2 days/week over the past year) and the use of supplements was higher in male athletes than in that in women athletes. In parallel with our study, supplement use was higher in men (90.9%) than women (77.8%) in the study of Madden et al. (40). When we look at the studies conducted, it is seen that the rate of using nutritional supplements is higher than the result we obtained. In the study by Dascombe et al. (38), Lieberman et al. (39), Lun et al. (41), Aljoloud et al. (36), Heikkinen et al. (42), and Burns et al. (43) have reported that 87.5%, 66%, 87%, 93.3%, 73%, and 88% of the athletes used nutritional supplements, respectively. Also, parallel to our study, sports drinks, multivitamin/mineral supplements, and protein/amino acids supplements are among the most preferred supplements in these studies (36,38,39,41,44-47).

In our study, 45.7% of the athletes stated that they had information about nutritional supplements and this rate was higher in men (57.6%) than women (21.4%). The athletes stated that they learned the information about supplements mostly from coaches (31.5%), the internet (28.3%), and friends (21.3%). Health professionals, pharmacists and physicians have to be main source for information regarding proper usage of dietary supplements. The recommendation of using nutritional supplements by non-professionals in this regard is an important health risk because some products can disrupt the body's metabolic and endocrine balance and cause health problems (48). In our study, coaches are seen as the most common information source about nutritional supplements. However, the extent of the accuracy of this information is unclear. In our study more men stated that they had information about supplements than women; however, the use of supplements was more in men and most of the men stated that they obtained this information from coaches. In studies conducted by Toni et al. (8) and Zinn et al. (49), it was concluded that coaches had insufficient nutritional knowledge. It is believed that not only the athletes but also the coaches who have the opportunity to communicate with the athletes should be informed about this subject. In parallel with our study, in the studies of Burn et al. (43) and Abbey et. al. (44), coaches (39.8% and 27%, respectively) were the most common information resource about supplements. Contrary to our study, physicians (45.9%) and dietitians (28.5%) were the main source of information about nutritional supplements in the study of Aljoloud et al. (36). In our study, health professionals were at the end as the source of information. It is thought that this is due to the fact that the athletes were closer to the coaches as a source of information rather than the health professionals. The evidence that supplements increase performance is insufficient. However, as seen in our study, most of the athletes (63.0%) believe that these products increase performance. In a study conducted by Dascombe et al. (38), in parallel with our study, 65.3% of the athletes believed that supplements improve performance. It is thought that classes for the athletes taught experts at universities may eliminate the lack of knowledge of the athletes on this subject.

The timing and content of the meal consumed before exercise is important for metabolism and performance (50). Foods and liquids consumed before training should be rich in carbohydrate content. Foods and liquids with high carbohydrate content ensure the maintenance of blood glucose and muscle and liver glycogen levels during training. Foods with moderate protein, and low fat and fiber content minimize gastrointestinal problems. Food intake with high fat and fiber content may cause gastrointestinal problems before and during training. Consumption of meals 3-4 hours before training is the most ideal timing so that the time required for digestion and absorption of nutrients is provided (51). Fifty four percent of the athletes stated in our study that they consumed main meals in less than two hours before training. Furthermore, the athletes also stated that they prefer carbohydrate-rich foods (57.5%) before training, and that they prefer protein-rich foods (59.1%) after training. In our study, how much athletes knew about nutritional groups and macro nutrients was investigated. In addition, fat-rich foods and fiber-rich foods were reported as pre- and post-training food preference by the athletes in our study. This is thought to be due to the lack of nutritional information of athletes. It would be beneficial to provide education for athletes on food nutrients, food groups, and pre- and post-training nutrition.

Most athletes paid attention to diet and fluid consumption before and after training (73.2% and 81.9%, respectively). However, these rates were not at the desired level. In trainings taking longer than one hour, carbohydrate-added fluids help maintain hydration and performance; however, sodium-added fluids should be consumed for trainings taking more than a few hours. Especially, for trainings lasting longer than one hour, sports drinks positively affecting performance are recommended (24,51). In our study, 33.1% of the athletes consumed sports drinks. Considering the training durations of the athletes (93.3 ± 27.8 minutes/day), it is thought that the importance of consuming sports drinks is not fully known by the athletes. In the study conducted by Aljaloud et al. (36), sports drinks consumption was found to be 88.7%. In our study, the use of sports drinks was not at the desired level.

Athletes can meet all nutritional needs for performance, hydration, post-training regeneration, and

their health with a balanced diet (36). In our study, the intake of energy above their total energy needs was observed in both genders. A minimum of 5 g/kg of dietary carbohydrates and 1.2 g/kg dietary protein are recommended for athletes and it is seen that the recommended levels were met in the athletes. However, the protein intake was well above the recommended level (>2 g/kg). Recommended vitamin and mineral levels are met in athletes from the diet. The mean proportions of total energy coming from carbohydrates, protein, and fat were 41%, 18%, and 41% in women and 42%, 20%, and 38% in men, respectively. Accordingly, the percentage of energy coming from carbohydrates was below the desired level and the percentage of energy coming from fats was above the desired level. Based on this information, the dietary patterns of the athletes in our study were unbalanced: it was seen that their diets had high energy, protein, and fat content. It is considered that to provide education for athletes to meet their energy and nutrient requirements is necessary. In parallel with our study, studies of Farajian et al. (32) and Ghloum et al. (52) have found that energy, protein, and fat intake of the athletes were above the recommended level. In addition, it was concluded in the study of Knez et al. (53) that the athletes met all vitamin and mineral needs from the diet.

As a result, it was observed that the athletes met the energy and all nutrient requirements from the diet. However, about half of the athletes used supplements and their information resources were inappropriate. Coaches were the most important source of information about nutritional supplements. It is unclear how accurate the information they provided about proper nutrition. For this reason, it was concluded that nutritional information should be evaluated not only in athletes but also in trainers with advanced studies. The fact that meal skipping was common among the athletes may be due to insufficient nutritional information of the athletes. Athletes' attention to diet and fluid consumption before and after training was not at the desired level. It should be ensured that athletes acquire nutritional information from dietitians and other health professionals who are experts in nutrition. In addition, it is envisaged that courses taught by lecturers in relevant departments of the universities may be useful in this regard.

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