EVALUATION OF DIET QUALITY USING THE HEALTHY EATING INDEX IN COLLEGE ATHLETES

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ABSTRACT

Objective: The aim of this study is to examine the quality of dietary intake and related factors in college athletes.
Materials and Methods: One hundred twenty-seven athletes (n=127) participated in this cross-sectional study. Demographic characteristics, nutritional habits, and food consumption of the athletes were obtained with the help of the questionnaire. Food consumption was questioned with a 24-hour dietary recall method. The quality of dietary intake was assessed using the Healthy Eating Index-2015 (HEI-2015).
Results: The average age of the participants was 21.2±2.3 years. Diet quality scores ranged from 19.1 to 69.7. The mean HEI-2015 total score was 42.8±9.7. No athletes had a good diet, 75.6% had a poor diet, and 24.4% had a diet that needs improvement. Female athletes (n=42) had higher HEI-2015 scores than male athletes (n=85) in the following components: total vegetables, greens and beans, and seafood and plant proteins (p<0.05). The whole grains score was zero for both genders. There was a positive correlation between HEI-2015 total score and age, education duration, time spent in sports branch, and the number of meals and snacks (p<0.05). The mean HEI-2015 total score of the athletes in team sports were higher than those from individual sports (p<0.05). Also, the diet quality of the smoker athletes was lower than that of the non-smokers (p<0.05).
Conclusion: The diet quality of the majority of the college athletes was poor. The diet quality of the athletes needs modification. In order to improve the diet quality of athletes consumption of fruits, vegetables, whole grains and dairy products should be increased. Nutrition education should be provided to improve nutritional status, health and performance.
Anahtar Kelimeler: Healthy eating index, College athletes, Diet quality, Nutritional habits

ÜNİVERSİTE SPORCULARINDA SAĞLIKLI YEME İNDEKSİ KULLANILARAK DİYET KALİTESİNİN DEĞERLENDİRİLMESİ

ÖZ

Amaç: Bu çalışmanın amacı, üniversite sporcularında diyet kalitesini ve diyet kalitesi ile ilgili faktörleri incelemektir.
Gereç ve Yöntemler: Bu kesitsel çalışmaya yüz yirmi yedi sporcu (n=127) katılmıştır. Anket yardımıyla sporcuların demografik özellikleri, beslenme alışkanlıkları ve besin tüketimi elde edilmiştir. Besin tüketimi, 24 saatlik hatırlatma yöntemi ile sorgulanmıştır. Diyet kalitesi Sağlıklı Yeme İndeksi-2015 (HEI-2015) kullanılarak değerlendirilmiştir.
Bulgular: Katılımcıların ortalama yaşı 21.2±2.3 yıldır. Diyet kalite skorları 19.1 ile 69.7 arasında değişmektedir. Ortalama HEI-2015 toplam skoru 42.8±9.7 olarak bulunmuştur. Hiçbir sporcu iyi diyet kalitesine sahip değildir, sporcuların %75.6'sının diyet kalitesi kötüdür ve %24.4'ünün diyet kalitesinin iyileştirilmesi gerekmektedir. Kadın sporcuların (n=42), erkek sporculardan (n=85) daha yüksek skorlara sahip olduğu HEI-2015 bileşenleri: toplam sebzeler, yeşil yapraklı sebzeler ve kuru baklagiller, deniz ürünleri ve bitkisel proteinlerdir (p<0.05). HEI-2015 bileşenlerinden olan tam tahıl skoru her iki cinsiyet için de sıfırdır. HEI-2015 toplam skoru ile yaş, eğitim süresi, spor branşında geçirilen süre ile öğün ve ara öğün sayısı arasında pozitif korelasyon saptanmıştır (p<0.05). Takım sporlarındaki sporcuların ortalama HEI-2015 toplam skoru bireysel sporlardan daha yüksektir (p<0.05). Ayrıca sigara içen sporcuların diyet kalitesi sigara içmeyen sporculara göre daha düşüktür (p<0.05).
Sonuç: Üniversite sporcularının çoğunun diyet kalitesi kötüdür. Sporcuların diyet kalitesinin iyileştirilmesine ihtiyaç vardır. Sporcuların diyet kalitesini iyileştirmek için meyveler, sebzeler, tam tahıllar ve süt ürünleri tüketimi artırılmalıdır. Sporculara beslenme durumunu, sağlığı ve performansı iyileştirmek için beslenme eğitimi verilmelidir.
Key words: Sağlıklı yeme indeksi, Üniversite sporcuları, Diyet kalitesi, Beslenme alışkanlıkları

INTRODUCTION

Optimal nutrition is an important indicator for performance in athletes. Adequate and balanced nutrition does not only affect exercise capacity and performance, but also protects the immune function and health of the athletes (1, 2).

In recent years, the Healthy Eating Index (HEI) has been used in the evaluation of the diet quality in the general population (3-7). The HEI score has been originally designed to help individuals to consume a healthful and nutritionally adequate diet. The HEI was originally developed by the United States Department of Agriculture (USDA) in 1995 as a tool to evaluate the dietary recommendations and nutrition interventions. The HEI-2015 is the most current version of the HEI (8).

The HEI, which is frequently used in evaluating diet quality, assesses dietary intakes on density-based (amounts per 1.000 kcal) rather than on the basis of absolute amounts of foods consumed; thus, the HEI assesses the quality of the relative proportions of foods consumed rather than the quantity of foods consumed (8-10).

There are few studies in the literature evaluating the diet quality of the athletes. A high-quality diet can prevent nutrient deficiencies that may occur, ensuring the health and performance of the athletes (11, 12). Therefore, it is very important to evaluate the diet quality in this group.

Diet quality can be affected by various factors, such as age, gender, education level, and the consumption of main meals and snacks (12-14). College athletes have some unhealthy eating behaviors, such as meal skipping, inappropriate food choices, and high saturated fat, sugar, or sodium-containing diet that decrease their diet quality. Also, limited dietary intakes, lack of nutrition knowledge, and problems related to body image perception and weight management negatively affect dietary intake and diet quality in athletes (15-20).

There is no study examining the diet quality and related factors college athletes using the HEI in Turkey. For this reason, this study aimed to evaluate the quality of dietary intake and related factors in a sample of college athletes.

MATERIALS AND METHODS

Data Collection

A cross-sectional study was carried out at Trakya University, Edirne, Turkey. The study population consisted of athletes studying at Trakya University. Individuals who agreed to participate in the study with convenience sampling method were included. The study was completed with a total of 127 athletes from 15 sports (team and individual). The team sports were basketball, baseball, handball, volleyball, rugby, futsal, football, and softball, and the individual sports were wrestling, arm wrestling, badminton, karate, swimming, kickbox, and taekwondo. The inclusion criteria were 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. The study was approved by Faculty of Medicine Scientific Research Ethics Committee, Trakya University. Data were collected using a questionnaire prepared by the researchers. Demographic characteristics, nutritional habits, and dietary intakes of the athletes were obtained with the help of the questionnaire.

Diet Quality

Food consumption was assessed using a 24-hour dietary recall. Dietary data from the

food recall were entered into a food analysis software program: Nutrition Information System (BeBiS) to calculate the total daily intake of the nutrients and food groups (21). The quality of the dietary intake was assessed via the HEI-2015 using the data obtained from the BeBiS system. The HEI-2015 contains 13 dietary components. Nine adequacy components (those recommended for inclusion in a healthy diet) contain whole grains, dairy, total fruits, whole fruits, total protein foods, total vegetables, greens and beans, seafood and plant proteins, and fatty acids. Four moderation components (those that should be consumed sparingly) contain added sugars, refined grains, saturated fats and sodium. The HEI total score is the sum of the scores obtained from all the components. The total score is range 0 to 100. A score between 0 and 50 indicates a poor diet; 51 and 80, a moderate diet quality that needs improvement; and a score greater than 80 indicates a good diet (3, 22).

Statistical Analysis

The Statistical Package for the Social Sciences (version 22.0) software was used for all analyses. Descriptive statistics are given as mean, standard deviation, number, and percentages. The Chi-square test was performed to test for differences in the proportions of categorical variables. The mean differences among the independent three groups were evaluated by the one-way analysis of variance (ANOVA), and the mean differences between independent two groups were evaluated by Independent Samples T Test. The relationship between the variables was evaluated with the Pearson and Spearman correlation coefficient. A p-value of less than 0.05 was considered to be statistically significant.

RESULTS

The demographic characteristics of the college athletes are shown in Table 1. The mean age of the participants was 21.2 ± 2.3 years. No significant differences were observed between genders in terms of age (21.3 ± 2.5 years in males, 21.0 ± 2.0 years in females) ($p > 0.05$). It was found that 81% of the female athletes and 52.9% of the male athletes were in team sports ($p < 0.05$). There were no differences in male and female athletes in terms of the level of competition, alcohol consumption, smoking, and the place of living ($p > 0.05$).

Table 1: Demographic Characteristics of The College Athletes

Characteristic	Male (n=85)	Female (n=42)	p-value
Age (years), mean (SD)	21.3±2.5	21.0±2.0	0.456[a]
Sport			
Team	45 (52.9)	34 (81.0)	**0.002***
Individual	40 (47.1)	8 (19.0)	
Level of competition, n (%)			
National	58 (68.2)	32 (76.2)	0.353
International	27 (31.8)	10 (23.8)	
Living situation, n (%)			
With family	22 (25.9)	14 (33.3)	0.158
Alone	14 (16.5)	2 (4.8)	
With friends	49 (57.6)	26 (61.9)	
Smoking status, n (%)			
Yes	23 (27.1)	11 (26.2)	0.931
No	62 (72.9)	31 (73.8)	
Alcohol use, n (%)			
Yes	27 (31.8)	11 (26.2)	0.519
No	58 (68.2)	31 (73.8)	

[a]Independent Samples T Test, otherwise data expressed as Chi-square Test. *Significant at $p<0.05$.

The HEI-2015 total score and subscores between genders in college athletes are given in Table 2. Diet quality scores ranged from 19.1 to 69.7. The mean HEI-2015 total score was 42.8±9.7. No significant differences were observed between genders in terms of HEI-2015 total score ($p > 0.05$). No athletes had a good diet, 75.6% had a poor diet, and 24.4% had a diet that needs improvement. The worse consumption scores concerned the components of whole grains, total vegetables, fatty acids, and saturated fats. The whole grains score was zero for both genders. While the female athletes had higher scores from total vegetables, greens and beans, and seafood and plant proteins, the male athletes had higher scores from saturated fats ($p < 0.05$).

Frequencies of the minimum and maximum HEI-2015 scores by gender in college athletes are given in Table 3. The maximum consumption scores concerning the components of seafood and plant proteins and total protein foods were achieved by 42.4% and 54.8% and 81.2% and 66.7% in male and female athletes, respectively. The most achieved scores were total protein foods (81.2% and 66.7%), seafood and plant proteins (42.4% and 54.8%), and added sugars (31.8% and 45.2%) in male and female athletes, respectively. All athletes (100.0%) scored zero in whole grains.

The mean HEI-2015 total score and subscores according to demographic characteristics in college athletes are given in Table 4. The mean HEI-2015 total score of the athletes in team sports were higher than those from individual sports ($p < 0.05$). Also, the diet quality of the smoker athletes was lower than that of the non-smokers ($p < 0.05$).

The relationship of HEI-2015 total score with demographic characteristics and nutritional habits in college athletes is given Table 5. There was a positive correlation between HEI-2015 total score and the other parameters including age, education duration, time spent in sports branch, and the number of meals and snacks ($p < 0.05$).

Table 2: Comparison of The Hei-2015 Total Score And Subscores Between Genders In College Athletes

HEI-2015 Components	Maximum HEI-2015 Score	Total (n=127) X±SD	Male (n=85) X±SD	Female (n=42) X±SD	p-value
Total Fruits	5	2.7±1.3	2.5±1.3	2.9±1.4	0.187
Whole Fruits	5	1.7±1.4	1.7±1.5	1.5±1.0	0.504
Total Vegetables	5	1.0±0.7	0.9±0.6	1.3±0.7	**0.003***
Greens and Beans	5	1.7±1.5	1.5±1.3	2.2±1.6	**0.006***
Whole Grains	10	-	-	-	-
Dairy	10	3.8±2.4	3.6±2.2	4.3±2.7	0.137
Total Protein Foods	5	4.7±0.8	4.7±0.7	4.5±0.9	0.125
Seafood and Plant Proteins	5	3.6±1.7	3.4±1.8	4.2±1.3	**0.004***
Fatty Acids	10	2.6±2.0	2.7±2.1	2.5±1.8	0.550
Refined Grains	10	6.0±3.6	5.9±3.7	6.1±3.5	0.751
Sodium	10	6.1±3.3	6.5±3.2	5.4±3.3	0.067
Added Sugars	10	6.4±3.9	6.1±3.9	7.1±3.8	0.194
Saturated Fats	10	2.5±2.6	2.9±2.7	1.8±2.3	**0.028***
HEI total score	100	42.8±9.7	42.4±9.5	43.7±10.2	0.477
Poor diet		96 (75.6)	65 (76.5)	31 (73.8)	

Needs improvement	31 (24.4)	20 (23.5)	11 (26.2)	0.743[a]
Good diet	-	-	-	

[a]Chi-square Test, otherwise data expressed as Independent Samples T Test, *Significant at p<0.05.

Table 3: Frequencies of The Minimum And Maximum HEI-2015 Scores By Gender In College Athletes

		Male		Female	
HEI-2015 Components	**Maximum HEI-2015 Score**	**Minimum score (%)**	**Maximum score (%)**	**Minimum score (%)**	**Maximum score (%)**
Total Fruits	5	-	11.8	-	14.3
Whole Fruits	5	-	9.4	2.4	2.4
Total Vegetables	5	3.5	-	-	-
Greens and Beans	5	7.1	3.5	-	14.3
Whole Grains	10	100	-	100	-
Dairy	10	-	1.2	-	4.8
Total Protein Foods	5	-	81.2	-	66.7
Seafood and Plant Proteins	5	2.4	42.4	-	54.8
Fatty Acids	10	10.6	1.2	4.8	-
Refined Grains	10	11.8	23.5	7.1	21.4

Sodium	10	8.2	20.0	9.5	19.0
Added Sugars	10	21.2	31.8	14.3	45.2
Saturated Fats	10	22.4	2.4	33.3	2.4
HEI total score	100	-	-	-	-

Minimum score is 0.

Table 4: The Mean HEI-2015 Total Score and Subscores According to Demographic Characteristics in College Athletes

HEI-2015 Components	Sport		Level of competition		Living situation*			Smoking status		Alcohol use	
	Team	Individual	National	International	With family	Alone	With friends	Yes	No	Yes	No
HEI total score	44.6±9.6[a]	40.0±9.4[b]	42.4±9.7	43.9±9.9	41.1±6.9	43.5±11.2	43.5±10.5	37.9±7.5[a]	44.7±9.9[b]	41.2±9.5	43.5±9.8
Total Fruits	2.8±1.3[a]	2.4±1.4[b]	2.7±1.3	2.6±1.5	2.4±1.0	2.7±1.6	2.9±1.4	2.3±1.2[a]	2.8±1.4[b]	2.5±1.3	2.7±1.3
Whole Fruits	1.7±1.3	1.6±1.4	1.6±1.3	1.7±1.4	1.3±1.1	1.5±1.4	1.8±1.5	1.5±1.2	1.8±1.4	1.5±1.3	1.7±1.4
Total Vegetables	1.0±0.6	1.0±0.7	1.0±0.6	1.1±0.7	1.0±0.5	1.1±0.7	1.0±0.7	0.7±0.5[a]	1.1±0.7[b]	1.0±0.7	1.0±0.7
Greens and Beans	1.8±1.5	1.5±1.4	1.6±1.4	1.9±1.6	1.5±1.1	1.9±1.7	1.7±1.6	1.2±1.3[a]	1.9±1.5[b]	1.6±1.5	1.7±1.4
Whole Grains	-	-	-	-	-	-	-	-	-	-	-
Dairy	4.1±2.4	3.4±2.4	3.8±2.3	4.0±2.6	3.4±2.1	3.6±2.5	4.1±2.5	3.7±2.6	3.9±2.4	3.7±2.6	3.9±2.4
Total Protein Foods	4.6±0.8	4.7±0.7	4.6±0.8	4.8±0.6	4.6±0.8	4.7±0.8	4.7±0.8	4.5±0.8	4.7±0.8	4.7±0.8	4.7±0.8

DISCUSSION

In our study, the mean HEI-2015 total score was 42.8±9.7 and no significant differences were observed between genders. No athletes had a good diet, 75.6% had a poor diet, and 24.4% had a diet that needs improvement. Hill et al. reported that the HEI-2015 total score of the athletes was 71.0±11.2 (23). Joaquim et al. reported that the HEI score was classified as "needs to be improved" for all athletes (11). Compared to these studies, it is seen that the diet quality of the athletes is lower in our study. Also, contrary to our study, it was found that female athletes had a higher HEI score in these studies conducted by Hill et al. and Joaquim et al. (11, 23). In parallel with our study, in the study conducted by Zanella et al., the mean HEI-2015 total score was 43.3±8.2, the diet quality of 72.7% of the athletes was classified as poor, and no participant was found to have good diet quality (24). Differences in diet quality in studies may be due to the differences in athletes' nutritional habits and level of nutritional knowledge.

In our study, no difference was found between genders in terms of the HEI total score, but the female athletes had higher HEI-2015 scores than male athletes in the components of total vegetables, greens and beans, and seafood and plant proteins. In parallel with our study, in the study by Spronk et al., female athletes had higher score from the component of vegetables (12). Also, in our study, although female athletes had a higher plant proteins score, male athletes had a higher saturated fats score. This is probably due to the assessment of diet quality based on density (amounts per 1.000 kcal basis) in the calculation of the HEI score.

In the present study, the worse consumption scores concerned the components whole grains, total vegetables, fatty acids, and saturated fats. All athletes (100.0%) scored zero in whole grains. The intakes of many macro- and micronutrients can be improved with increased consumption of whole grains. Contrary to our study, it was found in the study of Joaquim et al. that the athletes had the maximum score for the components of whole fruits and total vegetables. However, their study also concluded that the improvement of the intake of whole grains, dairy products, vegetables, and whole fruits is needed (11). In general, the rate of achieving the expected HEI scores in components was found to be very low in our study. The most achieved scores were total protein foods (81.2% and 66.7%), seafood and plant proteins (42.4% and 54.8%), and added sugars (31.8% and 45.2%) in male and female athletes, respectively. The meal consumption of athletes has been found to be rich in saturated fats, and fewer intake of fruits, vegetables, dairy products, and whole grains has been reported (24-30). According to these results, it is seen that the college athletes in our study have unhealthy eating habits. In parallel with previous studies, the meal consumption of the college athletes was rich in saturated fats and had fewer intakes of fruits, vegetables, and dairy products. In addition, no whole grains consumption was observed. The diet quality of the majority of the college athletes in our study was poor. College athletes should be encouraged to consume vegetables, fruits, dairy products, and whole grains.

Diet quality can be affected by various factors. In our study, there was a positive correlation between HEI-2015 total score

and age, education duration, time spent in sports branch, and the number of meals and snacks. In the present study, the majority of the athletes (51.2%) skipped main meals and the average number of snacks they consumed was 1.9 per day. The energy requirement of the athletes is higher than sedentary individuals and varies depending on the intensity of the exercise. Inadequate energy intake can cause loss of muscle and increase the risk of fatigue, injury, and illness. Therefore, the energy requirement of the athletes can be provided with a sufficient number of meals and snacks (31-34). In our study, it is seen that, as the number of meals and snacks increases, the quality of diet increases. With the increase in age, both the education duration and the time spent in sports branch increase. In our study, it was found that the quality of the diet increased with the increase in age, education duration, and the time spent in sports branch. In addition, it was determined that the quality of the diet varies according to smoking status and sport type. Contrary to our study, it was found that age, level of education, and sport type did not affect the diet quality in the study of Spronk et al. (12). This result may be due to the differences in the characteristics of the individuals participating in the study. Further research is needed to determine the relationship between diet quality and demographic characteristics of the athletes.

CONCLUSION

In accordance with the results of this study, the diet quality of the majority of the college athletes was poor and no athletes had a good diet. The female athletes had higher scores than the male athletes from the HEI-2015 components of total vegetables, greens and

beans, and seafood and plant proteins. All athletes scored zero in the component of whole grains. The rates of achieving the desired levels in HEI components was found to be very low. A positive correlation was found between the HEI-2015 total score and age, education duration, time spent in sports branch, and the number of meals and snacks. The mean HEI-2015 total score of the athletes in team sports were higher than those from individual sports. Also, the diet quality of the smoker athletes was lower than that of the non-smokers. Dietary interventions are needed in college athletes because the overall diet quality of the athletes needs modification. Dietary interventions may improve dietary patterns and diet quality leading to the optimal nutritional status, health, and performance. In order to improve the diet quality of athletes consumption of fruits, vegetables, whole grains and dairy products should be increased. Fats consumption should be limited. Consumption of refined grains and added sugars should be reduced. The lack of nutritional knowledge of college athletes can result in wrong dietary and nutritional practices; therefore, nutrition education should be given to college athletes.

Ethical Approval

The study was approved by Faculty of Medicine Scientific Research Ethics Committee, Trakya University (Numbered 2016/45).

Authors' Contributions

HND designed the study and wrote the manuscript.

OMC designed the study, collected data, performed the statistical analyses, wrote the manuscript and submitted the manuscript.

KAYNAKLAR

1. Devlin BL, Belski R. Exploring General and Sports Nutrition and Food Knowledge in Elite Male Australian Athletes. Int J Sport Nutr Exerc Metab 2015;25(3):225-32.
2. IOC consensus statement on sports nutrition 2010. J Sports Sci 2011;29(1):3-4.
3. Shiao SPK, Grayson J, Lie A, Yu CH. Predictors of the Healthy Eating Index and Glycemic Index in Multi-Ethnic Colorectal Cancer Families. Nutrients 2018;10(6).
4. Van Duong T, Tseng IH, Wong TC, Chen HH, Chen TH, Hsu YH, et al. Adaptation and Validation of Alternative Healthy Eating Index in Hemodialysis Patients (AHEI-HD) and Its Association with all-Cause Mortality: A Multi-Center Follow-Up Study. Nutrients 2019;11(6).
5. Mathias MG, Coelho-Landell CA, Salomao RG, Almada M, Camarneiro JM, Barros TT, et al. Validation of the Brazilian Healthy Eating Index-Revised Using Biomarkers in Children and Adolescents. Nutrients 2018;10(2):154.
6. Ye X, Scott T, Gao X, Maras JE, Bakun PJ, Tucker KL. Mediterranean diet, healthy eating index 2005, and cognitive function in middle-aged and older Puerto Rican adults. J Acad Nutr Diet 2013;113(2):276-81.
7. Rashidipour-Fard N, Karimi M, Saraf-Bank S, Baghaei MH, Haghighatdoost F, Azadbakht L. Healthy eating index and cardiovascular risk factors among Iranian elderly individuals. ARYA Atheroscler 2017;13(2):56-65.
8. Krebs-Smith SM, Pannucci TE, Subar AF, Kirkpatrick SI, Lerman JL, Tooze JA, et al. Update of the Healthy Eating Index: HEI-2015. J Acad Nutr Diet 2018;118(9):1591-602.
9. Guenther PM, Casavale KO, Reedy J, Kirkpatrick SI, Hiza HA, Kuczynski KJ, et al. Update of the Healthy Eating Index: HEI-2010. J Acad Nutr Diet 2013;113(4):569-80.
10. Schap T, Kuczynski K, Hiza H. Healthy Eating Index-Beyond the Score. J Acad Nutr Diet 2017;117(4):519-21.
11. Joaquim DP, Juzwiak CR, Winckler C. Diet Quality Profile of Track-and-Field Paralympic Athletes. Int J Sport Nutr Exerc Metab 2019:1-7.
12. Spronk I, Heaney SE, Prvan T, O'Connor HT. Relationship Between General Nutrition Knowledge and Dietary Quality in Elite Athletes. Int J Sport Nutr Exerc Metab 2015;25(3):243-51.
13. Woodruff SJ, Hanning RM, Lambraki I, Storey KE, McCargar L. Healthy Eating Index-C is compromised among adolescents with body weight concerns, weight loss dieting, and meal skipping. Body image 2008;5(4):404-8.
14. Koksal E, Karacil Ermumcu MS, Mortas H. Description of the healthy eating indices-based diet quality in Turkish adults: a cross-sectional study. Environ Health Prev Med 2017;22(1):12.
15. Valliant MW, Emplaincourt HP, Wenzel RK, Garner BH. Nutrition education by a registered dietitian improves dietary intake and nutrition knowledge of a NCAA female volleyball team. Nutrients 2012;4(6):506-16.
16. Shriver LH, Betts NM, Wollenberg G. Dietary intakes and eating habits of college athletes: are female college athletes following the current sports nutrition standards? Journal

of American college health : J Am Coll Health 2013;61(1):10-6.

17. Torres-McGehee TM, Pritchett KL, Zippel D, Minton DM, Cellamare A, Sibilia M. Sports nutrition knowledge among collegiate athletes, coaches, athletic trainers, and strength and conditioning specialists. J Athl Train 2012;47(2):205-11.

18. Spronk I, Kullen C, Burdon C, O'Connor H. Relationship between nutrition knowledge and dietary intake. Br J Nutr 2014;111(10):1713-26.

19. Rash CL, Malinauskas BM, Duffrin MW, Barber-Heidal K, Overton RF. Nutrition-related knowledge, attitude, and dietary intake of college track athletes. Sport J 2008;11(1):48-55.

20. Spendlove JK, Heaney SE, Gifford JA, Prvan T, Denyer GS, O'Connor HT. Evaluation of general nutrition knowledge in elite Australian athletes. Br J Nutr 2012;107(12):1871-80.

21. Dehne LI, Klemm C, Henseler G, Hermann-Kunz E. The German food code and nutrient data base (BLS II. 2). European journal of epidemiology 1999;15(4):355-8.

22. Reedy J, Lerman JL, Krebs-Smith SM, Kirkpatrick SI, Pannucci TE, Wilson MM, et al. Evaluation of the Healthy Eating Index-2015. J Acad Nutr Diet 2018;118(9):1622-33.

23. Hill E, Jontony N, Taylor C, Boucher L, O'Brien V, Spees C. Diet Quality, Body Composition, and Carotenoid Status in NCAA Division 1 Athletes. J Acad Nutr Diet 2019;119(10):A142.

24. Zanella PB, August PM, Alves FD, Matté C, de Souza CG. Association of Healthy Eating Index and oxidative stress in adolescent volleyball athletes and non-athletes. Nutrition 2019;60:230-4.

25. Waly MI, Kilani HA, Al-Busafi MS. Nutritional practices of athletes in oman: a descriptive study. Oman Med J 2013;28(5):360-4.

26. Burkhart SJ, Pelly FE. Dietary intake of athletes seeking nutrition advice at a major international competition. Nutrients 2016;8(10):638.

27. Hinton PS, Sanford TC, Davidson MM, Yakushko OF, Beck NC. Nutrient intakes and dietary behaviors of male and female collegiate athletes. Int J Sport Nutr Exerc Metab 2004;14(4):389-405.

28. Clark M, Reed DB, Crouse SF, Armstrong RB. Pre-and post-season dietary intake, body composition, and performance indices of NCAA division I female soccer players. Int J Sport Nutr Exerc Metab 2003;13(3):303-19.

29. Jenner SL, Trakman G, Coutts A, Kempton T, Ryan S, Forsyth A, et al. Dietary intake of professional Australian football athletes surrounding body composition assessment. J Int Soc Sports Nutr 2018;15(1):43.

30. Pelly FE, Thurecht R. Evaluation of Athletes' Food Choices during Competition with Use of Digital Images. Nutrients 2019;11(7).

31. PANEL E. Selected Issues for Nutrition and the Athlete: A Team Physician Consensus Statement. Med Sci Sports Exerc 2013;45(12):2378-86.

32. Thomas DT, Erdman KA, Burke LM. Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: nutrition and athletic performance. J Acad Nutr Diet 2016;116(3):501-28.

33. Manore MM. Weight management for athletes and active individuals: a brief review. Sports Medicine 2015;45(1):83-92.

34. Ray TR, Fowler R. Current issues in sports nutrition in athletes. Southern medical journal 2004;97(9):863-7.