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Assessment of Diet Quality and Nutrition Status of Turkish Elite Adolescent Male Soccer Players

Elit Adölesan Erkek Türk Futbolcularda Beslenme Durumu ve Diyet Kalitesinin Değerlendirilmesi

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ABSTRACT

This study aimed to assess the anthropometric characteristics, nutrient intake levels, nutritional status of elite adolescent soccer players, and the dietary quality of athletes. Elite male adolescent soccer players of the youth soccer team of a soccer club in the Turkish Super League were included in this study by categorizing them into three separate groups as U14/U15 (n=32), U16/U17 (n=44), and U19 (n=17). Anthropometric measurements of the athletes and food consumption records for three consecutive days were recorded during the competition season. Although the available energy value of the U14/U15 group was higher than the other groups, the available energy was determined to be at a suboptimal level in all groups. The U14/U15 group had the highest Health Eating Index-2015 score (43.7±5.57), while the score was 42.9±4.79 in the U19 group and 42.1±3.69 in the U16/U17 group (p>0.05), and 93.5% of the players were determined to be in the group with poor diet quality. The carbohydrate intake of adolescent soccer players was 5.3±1.16 g/kg body mass/day in the U14/U15 group, while it was 4.4 ± 0.87 g/kg body mass/day in the U16/U17 group, and 4.4±0.94 g/kg body mass/day in the U19 group. In this study, it was found out that adolescent football players had a poor diet quality, their carbohydrate consumption was inadequate, their fat intake level was high, and the protein intake was high in the U14/15 group whereas it was at the recommended levels in other groups. Providing recurrent nutritional training to adolescent football players and their families would assist athletes in gaining healthy eating habits as well as increasing their performance.

Keywords: *Adolescent, Soccer, Energy available, Healthy eating index-2015, Nutritional status*

ÖZ

Bu çalışmada elit erkek adölesan futbolcuların beslenme durumlarının, besin ögesi alımlarının, antropometrik ölçümlerinin ve diyet kalitelerinin değerlendirilmesi amaçlanmıştır. Türkiye Süper Liginde oynayan bir futbol takımında yer alan oyuncular U14/U15 (n=32), U16/U17 (n=44) ve U19 (n=17) şeklinde üç gruba ayrılarak çalışmaya dahil edilmişlerdir. Antropometrik ölçümler ve ardışık üç günlük besin tüketim kayıtları müsabaka sezon devam ederken alınmıştır. U14/U15 grubundaki oyuncuların kullanılabilir enerji düzeyi diğer gruplardan daha yüksek olmasına rağmen tüm gruplarda azalmış kullanılabilir enerji düzeyinin olduğu belirlenmiştir. En yüksek Sağlıklı Yeme İndeksi-2015 skoru U14/U15 grubunda (43.7±5.57) bulunurken, U19 grubunda 42.9±4.79 ve U16/U17 grubunda 42.1±3.69 olarak saptanmıştır (p>0.05). Tüm oyuncular değerlendirildiğinde sporcuların %93.5'i kötü diyet kalitesine sahiptir. U14/U15 grubunda yer alan sporcuların karbonhidrat alımı 5.3±1.16 g/kg beden ağırlığı/gün, U16/U17 grubunda 4.4±0.87 g/kg beden ağırlığı/gün ve U19 grubunda 4.4±0.94 g/kg beden ağırlığı/gün olarak belirlenmiştir. Bu çalışmada adölesan futbolcuların kötü bir diyet kalitesine sahip oldukları, karbonhidrat tüketimlerinin yetersiz, yağ alım düzeylerinin yüksek ve protein alımlarının U14/15 grubunda yüksek iken diğer gruplarda önerilen düzeylerde olduğu saptanmıştır. Adölesan futbolculara ve ailelerine tekrarlayan beslenme eğitimi verilmesi, sporcuların sağlıklı beslenme alışkanlıkları kazanmalarına ve performanslarını artırmalarına yardımcı olabilir.

Anahtar Kelimeler: *Adölesan, Futbol, Kullanılabilir enerji, Sağlıklı yeme indeksi-2015, Beslenme durumu*

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INTRODUCTION

Soccer is a team sport in which aerobic metabolism is used predominantly but requires explosive power, such as sprinting, jumping, shooting, and involves high-intensity activity periods when anaerobic metabolism is activated. Players run an average of 10-12 km throughout a 90-minute game (Granja et al., 2017; Hills and Russell, 2018). Soccer, played by adolescents in professional clubs, is characterized by the intensity of training and match playing that exceeds 70% of the players' maximal aerobic capacity. Technical and tactical training performed by adolescent soccer players generates a physiological load that surpasses 85% of the maximal heart rate (Unnithan et al., 2018).

Although talent and daily training play a crucial role in the success of the athlete, nutrition is one of the primary elements in promoting physical performance and experiencing a rapid recovery process after exercise (Zeng et al., 2020). Because adequate and balanced nutrition is critical for reaching and maintaining optimal body weight and physical condition, achieving the highest performance during training and competition, ensuring a rapid recovery, and minimizing the risk of disease and injury (Oliveira et al., 2017). Adolescence is a period when dramatic changes are experienced in body composition, physical growth, and development, and the need for energy, macro, and micronutrients of individuals increase substantially. The intense training performed by adolescent soccer players regularly causes these needs to increase even more. Thus, considerable attention should be paid to nutrition to ensure the desired performance and body development in these athletes and protect the individuals' health in the short and long term (Das et al., 2017; Noronha et al., 2020).

Although the advantages of optimal nutrition in adolescent athletes are well-known, a limited number of studies demonstrate that players have a negative energy balance (Briggs et al., 2015; Caccialanza et al., 2007). The deficiency of carbohydrate consumption, which is the dominant energy source for football players during exercise and ensures the highest level of performance and the delay of fatigue, is a considerable problem for adolescent athletes in these studies (Naughton et al., 2016; Ruiz et al., 2005). On the other hand, it has been revealed that the consumption of fat and saturated fat is higher in their diets (Iglesias-Gutiérrez et al., 2012; Ruiz et al., 2005; Russell and Pennock, 2011), whereas regarding micronutrients, deficiencies were detected in vitamin [vitamin A, vitamin E, vitamin D, folic acid, vitamin B6], minerals [potassium, zinc, calcium, magnesium], and fiber consumption (Boisseau et al., 2002; Briggs et al., 2015). In a study assessing the quality of diet among adolescent athletes, the findings showed that 72.7% of the players had a poor diet quality (Zanella et al. , 2019).

Adolescence is very crucial since it is the period when eating habits are acquired. The nutritional habits that are acquired in this period are transferred to adulthood and have a significant impact on individuals' living a healthy life (Wojtyła-Buciora et al., 2013). This study was designed and performed to assess the anthropometric characteristics, nutrient intake levels, nutritional status of adolescent football players, and the diet quality of athletes.

METHODS

Participants: In this study, 93 adolescent soccer players who are in the Elite U14-U19 professional soccer teams (except the U18 team) playing in the Turkish Super League, and the Development League of Turkish Football Federation were included. The players of all teams participate in physical [sprinting, intermittent endurance], technical and tactical training for an average of 90-120 minutes 4 days a week, and a league match one day a week. In this study, the players were divided into three groups as follows: U14/U15 (n=32), U16/U17 (n=44), and U19 (n=17), and they were assessed. All athletes and their families were informed about this study; written informed consent was obtained from them stating that they volunteered to participate in this study. The ethical approval was obtained from the Ege University Faculty of Medicine Medical Research Ethics Committee (dated July 22, 2020, with the decision number of 20-7.1T/3).

Food Consumption Assessment: To assess the nutritional status of the individuals included in the research, they were asked to note down their food consumption for three consecutive days (Tuesday, Wednesday, Thursday) within a week during the competition season. Prior to this process, all athletes in the groups were instructed on how to keep the records. The "Food and Nutrition Photo Catalog: Measurements and Quantities" guideline was distributed to every athlete; hence, they can interpret the amount of nutrients they consume accurately. To prevent missing or inaccurate data, the records were looked over daily by dieticians together with the athlete. Upon the amount of consumed nutrients was identified, the energy, macro, and micronutrients taken in the daily diet were determined using the software of Nutrition Information Systems [BEBİS 7.0]. The amount of nutrients taken by the athletes was compared with the values of age and gender-specific Dietary Reference Intake (DRI) and recommendations were made for the athletes (Boisseau et al., 2002; Burke et al., 2018; Desbrow et al., 2014; Hargreaves, 1994; Institute of Medicine Subcommittee on, Uses of Dietary Reference, and Institute of Medicine Standing Committee on the Scientific Evaluation of Dietary Reference, 2000).

Energy Availability: Energy availability (EA) is operationally defined as energy intake minus training or exercise energy expenditure of an athlete. It is represented in terms of $kcal.kg^{-1}$ fat-free mass (FFM). In this study, low EA was considered at <30 $kcal.kg^{-1}$ FFM, 30<EA<45 $kcal.kg^{-1}$ suboptimal EA and ≥45 $kcal.kg^{-1}$ FFM as adequate EA. The clinical outcomes associated with these cut-offs were explored only among female athletes, and there is a need for further research on male athletes. However, these cut-offs are considered useful for male and female athletes in managing their diets, in place of EB (Burke et al., 2018).

Healthy Eating Index-2015 (HEI-2015): The HEI-2015 score is based on thirteen parts measuring both adequacy and moderation food groups. Adequacy components are dietary elements that are encouraged, and higher scores reflect higher intake. Moderation components represent dietary elements recommended to be limited, and higher scores reflect lower intake. Adequacy components include total fruit (0–5 points), whole fruits (0–5 points), total vegetables (0–5 points), greens and beans (0–5 points), whole grains (0–10 points), dairy (0–10 points), total protein foods (0–5 points), seafood and plant proteins (0–5 points) and fatty acids (0–10 points). Moderation components include refined grains (0–10 points), sodium (0–10 points), added sugars (0–10 points), and saturated fats (0–10 points). Each part is scored, and then component scores are summed to generate a total HEI-2015 score. Total HEI-2015 score ranges from 0 to 100, with 100 being the best and high scores indicating better diet quality. The scores are classified as follows: a low-quality diet, <51%; a diet requiring improvement, 51% to 79%; and a good-quality diet, ≥80% (Jürgensen et al., 2015; Wolfson et al., 2020).

Anthropometric Measurements: The measurements of the participants were taken by the experienced authors at the facilities of Göztepe Football Team. The heights of the participants were measured using a stadiometer (Seca 240, Germany) with an error margin of ± 0.1 cm. Bodyweight, body fat percentage, fat mass (kg), lean body mass (kg), muscle mass (kg), and phase angle measurements were performed using a bioelectrical impedance device (Tanita MC-780MA, Japan). Bioelectrical impedance analysis (BIA) was conducted on the morning of the day when the athletes did not have training and competitions (between 09.00-10.30) by meeting the necessary conditions for BIA, including conditions such as fasting for 10-12 hours and not exercising intensely in the last 24 hours (Pekcan, 2013).

Determining the Physical Level: All kinds of physical activity types, levels, and duration of the participants were asked, and their 24-hour physical activity status was noted down during the same three days when they kept their food consumption records, and their total energy expenditure (TEE) was calculated. Basal metabolic rates (BMR) of individuals were found using the Harris-Benedict equation. The physical activity level (PAL) of the participants was calculated with the formula of TEE/BMR (Pekcan, 2013).

Statistical Analysis: The software of SPSS, version 25.0, (SPSS Inc., Chicago, IL, USA) was used to analyze the data. Descriptive statistics were presented as percentages and mean ± standard deviation (SD). One-way analysis of variance (ANOVA) and Bonferroni correction as a post-hoc test were used to compare the teams based on age. The results were considered statistically significant at p<0.05.

RESULTS

Physical and Anthropometric Characteristics of Elite Adolescent Soccer Players: The physical and anthropometric characteristics of the athletes by age are presented in Table 1. A significant difference was determined between the teams regarding height, body weight, lean mass, and muscle mass (p<0.017). The findings showed that there was a significant difference between the BMI measurements of U14/U15 and U19 teams, phase angle value and lean mass of U14/U15 and U16/U17 teams, and body fat percentage values of U16/U17 and U19 teams (p<0.017); whereas, regarding body fat mass, no significant difference was determined between the teams.

Table 1

Physical and Anthropometric Characteristics of Elite Adolescent Soccer Players ($\tilde{x}$ ± SD)

	U14/U15 (n=32)	U16/U17 (n=44)	U19 (n=17)	p
Age (years)	13.9±0.57	15.8±0.61	18.3±0.46	0.001*
Height (cm)	171.9±7.79^{x,y}	178.6±5.36	180.3±7.01	0.001*
Weight (kg)	56.6±8.19^{x,y}	66.3±6.68	69.4±7.79	0.001*
BMI (kg/m^2)	19.2±1.43^{y}	20.5±2.20	21.3±1.89	0.001*
Body Fat (%)	13.7±1.83	13.9±2.01^{t}	11.8±4.10	0.012*
Body Fat (kg)	7.9±1.99	9.4±2.02	8.7±3.94	0.059
Fat-Free Mass (kg)	48.4±6.58^{x,y}	56.8±5.14	60.8±5.66	0.001*
Muscle Mass (kg)	46.1±6.26^{x,y}	56.8±5.14	57.9±5.25	0.001*
Phase Angle	-6.4±0.48^{x}	-6.8±0,49	-6.6±0.55	0.001*

Bold indicates a significant difference. Bonferroni correction: ^{x}p<0.017 for differences between U14/15 and U16/17; ^{y}p<0.017 for differences between U14/U15 and U19; ^{t}p<0.017 for differences between U16/17 and U19.

Daily Energy and Macronutrient Intakes of Elite Adolescent Soccer Players: Daily energy and macronutrient intakes of the players, based on age, are shown in Table 2. When the energy taken per body weight (kcal/kg) was assessed, no difference was determined between the groups in terms of the average daily energy intake; while the adolescent soccer players in the U14/U15 team received significantly more energy than the other team players (p<0.01). When the available energy values were analyzed, the findings revealed that the average available energy values of the athletes in the three groups were at the suboptimal level, although the highest value was determined in the U14/U15 team.

No difference was detected between the carbohydrate intake of the groups, while the carbohydrate intake of all groups did not meet the recommended levels. The highest rate was detected in the U19 team, with 46.3% ± 6.51. Regarding the amount of carbohydrate taken per body weight, the findings showed that only the U14/U15 team (5.3 ± 1.16 g/kg body mass) reached the recommended levels, and there was a significant difference between the values of this group and the players of the other teams. The use of added sugar was at reference values in all groups; however, their fiber consumption was insufficient. The findings showed that the portion of daily energy taken from protein was at the recommended levels in U16/U17 and U19 teams, whereas this ratio was above the recommended levels in the U14/U15 (16.5 ± 2.36%) team. The amount of protein taken by the athletes in the U14/U15 team per body weight was above the recommended values for adolescent soccer players. The consumption of the other team players was at normal levels, and the U14/U15 team players consumed significantly more protein per body weight compared to the other teams. The energy ratios from the daily diet and saturated fat consumption of the individuals in all groups were above the reference values. The athletes in the U19 team had the highest consumption of saturated fat and monounsaturated fatty acids.

Table 2

Energy and Macronutrient Intake Levels of Elite Adolescent Soccer Players ($\tilde{x}$ ± SD)

	RV	U14/U15 (n=32)	U16/U17 (n=44)	U19 (n=17)	p
Energy Intake (kcal/day)		2607.3±318.36	2625.9±360.89	2763.4±444.13	0.426
Energy Intake/Body Mass ($kkal.kg^{-1}.day^{-1}$)		47.8±10.23^{x,y}	40.3±6.67	40.1±6.29	0.001**
Energy Availability ($kcal.kg^{-1}$ $FFM.day^{-1}$)	=~45	38.6±7.15	33.7±7.37	33.7±6.36	0.034*
Carbohydrate					
Total (g)		290.5±44.98	284.8±55.11	305.6±76.15	0.522
g/kg body mass/day	5-7	5.3±1.16^{x,y}	4.4±0.87	4.4±0.94	0.001**
Energy Ratio (%)	>55	45.8±6.45	44.8±9.34	46.3±6.51	0.791
Sugar					
Total (g)		43.5±29.6	45.1±27.79	45.9±22.96	0.950
Energy Ratio (%)	<10	6.7±4.63	7.5±4.81	7.2±4.78	0.799
Dietary Fiber (g/day)	25-30	22.6±7.17	22.6±8.63	24.2±9.5	0.784
Protein					
Total (g)		104.1±16.6	95.8±19.35	96.5±21.3	0.166
g/kg body mass/day	1.4-1.7	1.9±0.45^{x,y}	1.5±0.35	1.4±0.36	0.001**
Energy Ratio (%)	12-15	16.5±2.36	14.9±2.81	14.5±2.31	0.023*
Fat					
Total (g)		110.8±26.08	119.6±34.29	121.6±23.39	0.403
$g.kg^{-1}$ $body\ mass.day^{-1}$		2.1±0.64	1.8±0.57	1.8±0.42	0.258
Energy Ratio (%)	<30	37.6±6.04	39.5±3.75	39.3±4.21	0.514
SFA, Energy Ratio (%)	*<10*	13.8±3.74	14.7±3.81	16.6±4.72	0.103
MUFA, Enerji Ratio (%)		13.4±3.14^{x}	14.6±3.96	17.9±4.92	0.005**
PUFA, Energy Ratio (%)		7.4±3.36	6.9±2.95	8.1±3.63	0.538

Bold indicates a significant difference. Bonferroni correction: $^{x}p<0.017$ for differences between U14/15 and U16/17; $^{y}p<0.017$ for differences between U14/U15 ve U19; Reference Values (RV) taken from Boisseau et al. (2002), Burke et al. (2018), Desbrow et al. (2014), Hargraves (1994), and Institute of Medicine (2000).

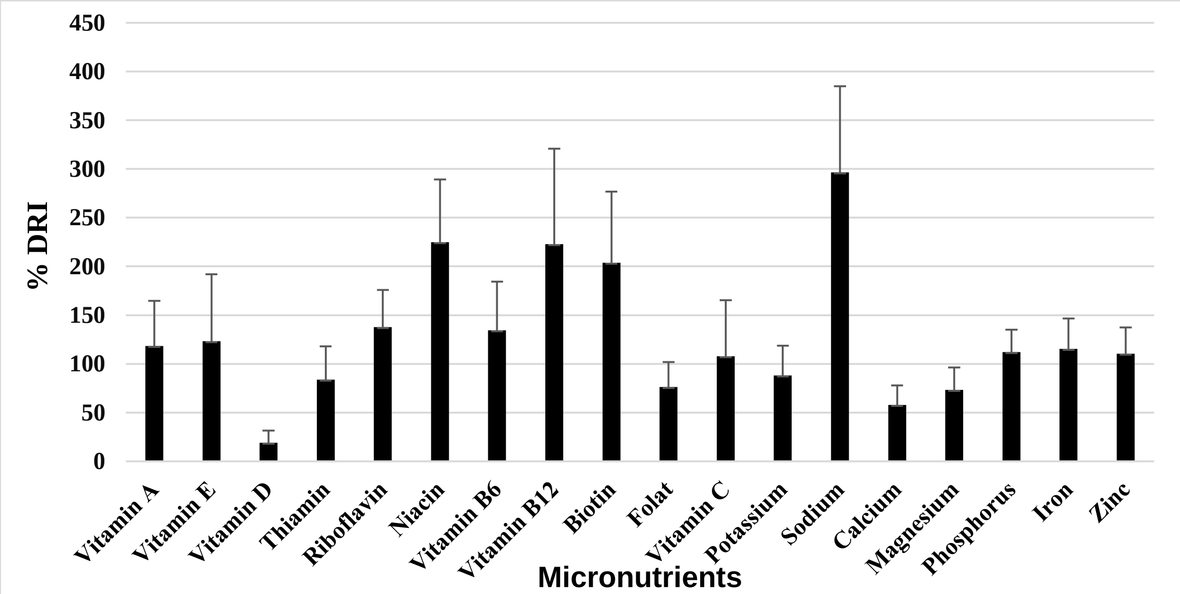
No difference was detected between the carbohydrate intake of the groups, while the carbohydrate intake of all groups did not meet the recommended levels. The highest rate was detected in the U19 team, with 46.3% ± 6.51. Regarding the amount of carbohydrate taken per body weight, the findings showed that only the U14/U15 team (5.3 ± 1.16 g/kg body mass) reached the recommended levels, and there was a significant difference between the values of this group and the players of the other teams. The use of added sugar was at reference values in all groups; however, their fiber consumption was insufficient. The findings showed that the portion of daily energy taken from protein was at the recommended levels in U16/U17 and U19 teams, whereas this ratio was above the recommended levels in the U14/U15 (16.5 ± 2.36%) team. The amount of protein taken by the athletes in the U14/U15 team per body weight was above the recommended values for adolescent soccer players. The consumption of the other team players was at normal levels, and the U14/U15 team players consumed significantly more protein per body weight compared to the other teams. The energy ratios from the

daily diet and saturated fat consumption of the individuals in all groups were above the reference values. The athletes in the U19 team had the highest consumption of saturated fat and monounsaturated fatty acids.

Daily Energy and Macronutrient Intakes of Elite Adolescent Soccer Players: The average daily vitamin and mineral intake of adolescent soccer players according to DRI (%DRI) is shown in Figure 1. The findings showed that vitamin D, thiamine, folate, potassium, calcium, and magnesium intakes of the athletes did not meet the recommended levels for adolescents. Vitamin A, vitamin E, iron, and zinc intakes of the individuals were above the recommended levels; particularly niacin, vitamin B12, biotin, and sodium intake rates were the micronutrients that reached the highest level.

Figure 1

Average Daily Vitamin and Mineral Intake of Elite Adolescent Soccer Players According to the DRI (%DRI)



Assessment of the Diet Quality of Elite Adolescent Soccer Players:

Table 3.

Healthy Eating Index-2015 Score of Elite Adolescent Soccer Players ($\tilde{x}$ ± SD)

HEI-2015 Component	Range	U14/U15 (n=32)	U16/U17 (n=44)	U19 (n=17)	p
Total HEI Score	0-100	43.7±5.57	42.1±3.69	42.9±4.79	0.428
Adequacy					
Total Fruit	0-5	4.0±1.23	3.5±1.42	3.6±1.43	0.370
Whole Fruit	0-5	4.3±1.06	4.2±1.14	4.1±0.92	0.914
Total Vegetables	0-5	1.8±0.79	1.5±0.87	1.7±1.09	0.549
Greens and Beans	0-5	2.3±1.69	2.4±1.66	1.5±1.48	0.220
Whole Grains	0-5	0.3±0.46	0.5±0.62	0.7±1.28	0.390
Dairy	0-10	4.1±1.94	3.9±1.72	3.5±2.00	0.628
Total Protein Foods	0-5	3.2±0.96	3.2±1.07	3.0±0.76	0.757
Seafood and Plant Proteins	0-5	2.7±1.13	3.2±1.30	2.8±0.94	0.364
Fatty Acids	0-10	2.7±1.99	3.5±2.06	3.3±2.82	0.395
Moderation					
Refined Grains	0-10	0.9±0.99	0.9±1.23	0.8±1.28	0.944
Sodium	0-10	5.3±3.08	4.2±2.91	5.2±2.64	0.292
Added Sugars	0-10	8.1±1.36	7.4±2.30	8.3±0.99	0.181
Saturated Fats	0-10	4.1±3.27	3.9±3.23	4.1±3.21	0.845

*One-way ANOVA

The results of the assessment of individuals according to the Healthy Eating Index-2015 are presented in Table 3. The findings demonstrated that the mean HEI-2015 score of all teams is lower, and the dietary quality of the individuals is in the group that considered as "poor (≤50 points)", whereas the lowest HEI-2015 score was determined in the U16/U17 group, and this group was followed by the U19 team; plus, the U14/U15 team had the highest score. None of the athletes were in the group, for which diet quality was considered as "good (80 points)", while only six people (6.5%) were in the group, for which the diet quality is considered as "should be improved (51-80 points)". No significant difference was detected between the teams concerning the HEI-2015 score and scores of its sub-items ($p>0.05$). When the sub-items of HEI-2015 were analyzed, the players' mean scores of total fruits, whole fruit, and added sugars consumption were close to the maximal score, and the lowest scores were obtained from total vegetables, whole grains, refined grains, and dairy consumption.

DISCUSSION

This study aimed to assess the nutritional status and dietary quality of elite adolescent male athletes playing soccer in the youth soccer team of a professional soccer club. The findings demonstrate that the daily energy intake of the athletes in all groups is inadequate, and the available energy level does not reach the recommended level. The players did not take carbohydrates at the level specified for adolescent soccer players; however, the ratio of the energy taken from fat was higher. Moreover, individuals had also inadequate intake of micronutrients, such as thiamine, folate, vitamin D, calcium, and magnesium, which have very crucial functions in metabolic processes. Besides, in this study, 93.5% of the participants were in the group with poor diet quality.

Previous studies performed on adolescent soccer players have revealed that the energy intake of athletes ranges between 2500-3100 kcal/day. It can be noticed that the daily average energy intake of the athletes participating in this study is within the range of values revealed by Garcia-Roves et al. (2015) (2607.3 kcal-2763.4 kcal). The amounts of energy taken by athletes are higher than the values revealed by Naughton et al. (2016) and Bousseu et al. (2002) while they are similar to the values that have been revealed by Caccialanza et al. (2007), Murphy and Jeanes (2006) and Russel and Pennock (2011). On average, they get 22.3% less energy than rival athletes in the same league (Ersoy et al., 2019).

In this study, the energy balance has been assessed based on the energy availability level. A suboptimal level of energy availability is considered as the level that can be tolerated by the body but should be followed for short periods, while a low level of energy availability is considered as the level that leads to Relative Energy Deficiency Syndrome (RED-S) (Mountjoy et al., 2018). Although the energy availability level of the U14/U15 team players was significantly higher than the U16/U17 and U19 teams, all teams had suboptimal levels of energy availability (see Table 2). While 29.6% of the athletes had a low, and 53.5% of them had a suboptimal level of energy availability, 16.9% of them reached the optimal level [data is not presented in the table]. Similarly, a study performed on professional female football players showed that 23% of the athletes had a low level of energy, and 60% of them had a suboptimal level of energy availability (Moss et al., 2020). Several studies in the literature found the presence of negative energy balance in adolescent football players. Russel and Pennock (2011) determined that footballers take less energy than they spend on average 788 cal/day, while Caccialanza et al. (2007) determined they take less energy than they spend on average 890 cal/day. Based on the results of this study, there is a significant group of players at the risk of RED-S. Athletes who are at risk or have experienced RED-S have decreased training/competition athletic performance and/or an increased risk of injury. In addition to these adverse effects, it has also been revealed that RED-S increases the risk of adverse health effects that might arise in the later stages of the athlete's life (Lane et al., 2019). It is of great importance to take sufficient energy and nutrients in a period, such as the adolescent period, when dramatic changes occur in body composition, physical growth, and development.

Carbohydrates are the most important source of energy in a soccer player's diet. Burke et al. suggest that athletes should take 5-7 $g.kg^{-1}$ $BM.day^{-1}$ for medium-intensity training and competition, 6-10 $g.kg^{-1}$ $BM.day^{-1}$ for medium-intensive training or maximal glycogen loading (Burke et al., 2011). In this study, only the athletes playing in the U14/U15 team (5.3 ± 1.16 g/kg BM/day) took carbohydrates at the recommended level, and the consumption of the players in other teams (4.4 g/kg BM/day) was inadequate. It was revealed in various studies that adolescent soccer players consumed insufficient carbohydrates levels of 4.3 $g.kg^{-1}$ $BM.day^{-1}$ (Murphy and Jeanes, 2006) and 4.7 ± 1.1 $g.kg^{-1}$ $BM.day^{-1}$ (Iglesias-Gutiérrez et al., 2012). A similar situation is seen in professional soccer players as well. It was determined in a study performed on a group of professional soccer players in the Dutch Premier League (Eredivisie) that the players took an average of 4.0 ± 1.2 g/kg BM/day carbohydrate (Brinkmans et al., 2019). Remarkably, players decrease their carbohydrate consumption with the advancing age. It can be noticed in this study that as the U14/U15 team advances towards the U19 team, the players reduce their carbohydrate consumption. Ruiz et al. determined in their study that carbohydrate consumption, which was 6.68 g/kg BM/day in the U14 group, decreased to 4.57 g/kg BM/day in the 20-age group (Ruiz et al., 2005). Hargraves (Hargreaves, 1994) stated that at least 55% of football players' daily energy should be taken from carbohydrates. Previous studies performed on adolescent athletes typically show that the carbohydrate consumptions of individuals are below this rate (Boisseau et al., 2002; Iglesias-Gutiérrez et al., 2012). The part of the energy acquired from carbohydrates ranged between 44.8% and 46.3% among the athletes included in this study, and the consumption was inadequate. The cruciality of dietary carbohydrates for football players due to the fact that it is used in the synthesis of glycogen, which is the dominant energy source of this sport branch. Taking adequate carbohydrate levels before, during, or after training/competition assists in maintaining the performance and delaying fatigue through protecting and replacing glycogen stores (Aucouturier et al., 2008). It has been shown that depletion of glycogen stores in a football match is one of the most remarkable causes of fatigue, and especially, beginning the match with decreased glycogen storage leads to a significant decrease in the high intensity running performance and the distance paced in the second half of the match (Saltin, 1973).

It has been revealed that the conventional daily protein intake recommendation [0.8-1.0 g/kg/day] in adolescent athletes does not meet the protein requirement adequate for growth and high-intensity activity, and protein intake should be higher for adolescent soccer players than for sedentary male adolescents (Boisseau et al., 2002). The general view is that adolescent athletes should take 1.4-1.7 g/kg/day of protein. Previous studies have demonstrated that unlike the lower intake observed in carbohydrate intake, the protein intake of adolescent athletes is at the recommended levels and/or that this level is surpassed (García-Rovés et al. , 2014). Similarly, it was determined in this study that the U14/15 team had protein intakes above the recommended levels and the other team players had protein intakes at the recommended levels (see Table 2) and they received their needs mainly from high-quality protein sources such as chicken meat, eggs, beef, and cheese. Adequate protein intake in adolescents is of great importance for maintaining growth, increasing lean muscle mass, repairing exercise-induced muscle fiber damage, and promoting recovery and immune functions (Petrie et al., 2004).

It has been reported that the daily fat need of adolescent soccer players can be meet by the levels recommended for adults and that 30% of the daily energy should be taken from fat while saturated fat intake should be of <10% (Desbrow et al., 2014). In this study, the daily energy of the athletes acquired from fat exceeded the recommended levels and ranged between 37% to 39%, and similarly, the rate of saturated fat consumption was higher in all groups, particularly in the U19 group [14-16%]. Previous studies have revealed that adolescent athletes consume above the recommended levels of fat and saturated fat (Ersoy et al., 2019; Ruiz et al., 2005). To protect the health of athletes in the long term, it should be aimed to reduce the total fat and saturated fat intake. Adjusting the fatty acid profile of their diets and reducing the consumption of unsaturated fat-containing protein foods [e.g., fish and oilseeds] containing MUFA and PUFA to the recommended levels would contribute to the protein and energy requirement as well as providing additional anti-inflammatory benefits in training and recovery (Jenner et al., 2019).

Micronutrients play a crucial role in energy production, hemoglobin synthesis, protection of bone health, ensuring the activeness of immune functions, and protection of the body against oxidative damage. Exercise stresses the activity of many metabolic pathways that require micronutrients and leads to an increase in their turnover and loss from the body. Hence, adequate intake of micronutrients by athletes is important (Rodriguez et al., 2009). The findings obtained in this study showed that the average intake of thiamine, folate, vitamin D, potassium, calcium, and magnesium of the individuals did not meet the reference levels. Similarly, previous studies showed that athletes take some vitamins and minerals insufficiently. We should note that particularly the inadequate intake of antioxidant vitamins, folate, calcium, magnesium, potassium, and zinc come to the forefront, although it varies among the studies (Ersoy et al., 2019; Russell and Pennock, 2011). Previous studies assessing the nutritional status of athletes have explained the intake levels of nutrients with quantitative methods in accordance with the recommendations of the relevant authorities. However, the number of studies assessing all aspects of the diet quality of athletes is limited. This study suggests that the diet quality of athletes is remarkably poor. The HEI-2015 scores of the athletes have ranged between 42.1-43.7 points and only 6.5% of the individuals scored at the level that should be improved, but none of the athletes has a diet quality at the "good" level. It was found in a study performed on adolescent volleyball players that the HEI-2010 score of the athletes was 43.3 ± 8.2 points, and 72.7% of the players were in the group with "low dietary quality," whereas no athlete had a "good dietary quality," and the individuals' consumption of dairy products, vegetables and fruits was insufficient (Zanella et al., 2019). While Jürgensen et al. (2015) found the diet quality score as 52.4 ± 10.0 points in male athletes engaged in team sports in different branches, 45.6% of the athletes were in the group with low diet quality. Athletes consumed vegetables, whole grains, and dairy products inadequately, as in our study. It has been revealed in a study conducted on elite basketball players that athletes receiving daily counseling by certified sports dietitians have an HEI score at the good diet quality, and the total score of the individuals is over 90 points (Tsoufi et al., 2017). We think that diet quality indexes, such as HEI-2015, would be helpful in assessing the nutritional status of the athlete as they assess the adequacy, diversity, and proportionality of the diet together. Poor diet quality is associated with abdominal obesity, hypertension, cardiovascular diseases, and cancer. Thus, having an adequate dietary quality of the athlete could contribute to the improvement of the nutritional behavior and physical performance of the individual and could also assist in protecting his health in the long term (Moss et al., 2020).

Taking food consumption with the 24-hour dietary recall method has disadvantages such that it may not reflect the habitual intake of the individuals, being dependent on the individual's recall capacity, the participants may be selective about the foods they choose to report during the interview, there may be a recall bias, it relies on the participant's literacy and ability to describe food and estimate portion size and tends to generally underestimate their food intake (Castell et al., 2015). To reduce this bias, a 24-hour food consumption record was taken for three consecutive days, which is recognized as a valid method (Jones and Barlett, 2020). Moreover, the Food and Nutrition Photo Catalog, which is reported to be an efficient method for determining food consumption, was utilized to further reduce the margin of error (Rodon and Livingstone, 2000).

CONCLUSION

The data obtained in this study group suggest that the diet quality of elite adolescent football players is poor, they do not meet the basic nutritional requirements recommended by the authorities for athletes, and they have a negative energy balance. They need to increase their consumption of vegetables, fruits, whole grains, and dairy products and reduce their consumption of refined and fat-rich foods. Their carbohydrate intake level is lower, and their fat and saturated fat consumption are higher than the recommended levels. Furthermore, they take specific micronutrients inadequately, which have crucial roles in many metabolic processes in the body. Providing nutritional training not only to athletes but also to trainers and their families by athlete dieticians for athletes to receive the nutrients required for increasing their performance, growing, and developing healthily and living a healthy life in the long term, refreshing these training routinely and making them permanent would ensure that the desired optimal nutritional habits are acquired by athletes.

Author contributions:

1. **Murat URHAN:** Idea, Design, Supervision, Data Collection and Processing, Analysis/Comment, Writing, Critical Review
2. **Hasan YILDIZ:** Design, Data Collection and Processing, Analysis/Comment, Writing, Critical Review

Information about Ethical Approval

Ethical Committee: Ege University Faculty of Medicine Medical Research Ethics Committee

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