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Comparison of Food Consumption and Nutritional Statuses of Athletic Adolescents

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ABSTRACT In this study, the researchers aimed to assess energy and nutrient consumptions and nutritional statuses of adolescents who participate in different branches of sports. The study group consisted of 138 athletes (108 boys and 30 girls) aged 10-17 years from five different branches of sports. Three-day food intake values and anthropometric measurements were recorded, and body analyses were performed. A high proportion of the athletes had BMIs in the 15-85 percentile, and there were body fat percentages of <15th percentile in all groups. Basketball players had significantly higher percentage of body fat and BMI compared to football players. All athletes obtained daily energy intake of 44.8±7.99 percent, 14.6±3.01 percent and 39.1±7.70 percent from carbohydrate, protein and fat respectively. In different sports branches, there were differences between the energy contributions of macro- and micronutrient intake ($p<0.05$). A high proportion of athletes failed to meet most micronutrient recommendations. Suboptimal nutritional status may negatively affect the athletes' performance, as well as physiological growth and development.

INTRODUCTION

Adequate and balanced nutrition is critically important to achieve optimal athletic performance for child and adolescent athletes, in addition to maintaining optimal body composition, physical and mental development (Galanti et al. 2015; Coutinho et al. 2016). The energy needs and macro- and micronutrients needs of physically active individuals are different from those of their sedentary counterparts (Daneshvar et al. 2013). Sports training could have negative effects on the nutritional status, health and physical performance of growing athletes if their dietary intake does not sufficiently address the increased dietary requirements of exercise (Coutinho et al. 2016). Despite the increased interest in healthy nutrition and use of dietary supplements to enhance performance, in general, the intake of certain quantities of energy and macro- and micronutrients by adolescent athletes is below recommendations (Askari et al. 2012; Galanti et al. 2015; Coutinho et al. 2016; Muia et al. 2016; Solheim et al. 2016). Many factors may affect an adolescent athlete's food intake, including socioeconomic status, the individual responsible for food purchase and preparation, access to sufficient calories, intentional weight loss and body image disturbance, peer pressure, and health problems (Spear 2005). In a study conducted with Turkish students of Physical Education and Sports, they showed tendency for substantial concern about body shape, which might affect eating behavior disorders. Therefore, it is important to understand the factors that might have an impact on the body size dissatisfaction to estimate the risk of eating disorders such as anorexia, bulimia or orthorexia nervosa (Nergiz-Unal 2014). Moreover, the vast majority of coaches have no formal education relevant to the nutritional needs of athletes, while misinformation (especially about protein intake) often causes coaches and parents to recommend unhealthy and potentially dangerous nutritional practices (Spear 2005; Eskici et al. 2016; Jacob et al. 2016). On the other hand, body composition is also an important factor for optimal physical fitness (Marinho et al. 2016). Body fat usually has negative effects on indicators of athletic performance such as agility, speed, stamina, running and jumping. On the other hand, the fat-free body mass is associated with and may be necessary for sports activities where physical strength is utilized, such as lifting, pushing, throwing, and blocking (Boileau and Horswill 2000). Few studies are available on the dietary intake, nutritional status and body composition of adolescent athletes who participate in different sports branches. Thus, there is an inadequate amount of information on the physical requirements of these athletes and the optimal nutritional habits needed to improve physical performance (Coutinho et al. 2016). Hence, investigations on food intake, nutritional statutes and body composition play an important role in the analysis of athletes' lifestyle (Galanti et al. 2015).

Objective of the Study

In this study the objective is to comprehensively evaluate the food consumption practices, nutritional statuses and anthropometric profiles of adolescents who participate in different sports branches, in comparison with available healthy nutrition recommendations for sports and general populations.

MATERIAL AND METHODS

Participants

The study group consisted of 138 athletes (108 boys and 30 girls) from the Kocaeli region aged 10-17 years (M±SD: 13.8±1.9 y) who were from sports clubs for five different branches (basketball n: 25; football n: 30; swimming n: 44; wrestling n: 23; tennis n: 16) and had practiced regularly for at least 3 hours per week during the previous 2 years or more. Athletes who had chronic diseases such as systemic hypertension, diabetes mellitus, chronic renal failure, chronic respiratory disease, or a history of anabolic steroid use were excluded. Age, gender, demographic characteristics, and typical exercise duration (weekly) were recorded for each athlete. The data was collected from self-reports recorded by the participants.

The individuals signed a voluntary participation form and filled in the questionnaires in accordance with the Declaration of Helsinki (World Medical Association). The research project was approved by the Ethics Committee of Kocaeli University, School of Medicine.

Anthropometric Measurements

All measurements were taken by trained dieticians and with participants wearing light clothes and no shoes. Height was measured to the nearest 0.1 cm with a wall-mounted stadiometer. Body weight, body fat percentage (%), fat weight (kg) and fat-free mass (kg) of the individuals were measured by using "TANITA-TBF 300". For the TANITA measurements, they were asked not to do heavy physical activity 24-48 hours before the test, not to have consumed much liquid (water, tea or coffee) and to have fasted for at least 4 hours prior to the test. Body mass index (BMI) (Neyzi et al. 2008) and percentage of body fat (Kurtoglu et al. 2010) were evaluated according to national standards. BMI percentage under the 5^{th}, between the 15^{th} and 85^{th}, above the 85^{th}, and above the 95^{th} percentile were defined as underweight, normal, overweight and obese, respectively (Onis et al. 2007). Body fat percentage under the 5^{th} percentile and between 85^{th} and 95^{th} percentile was considered low fat and excess fat, respectively (Kurtoglu et al. 2010).

Nutritional Assessment

To assess dietary intake, participants recorded information regarding all food and fluid consumed during the 3 days surveyed (2 weekdays and 1 weekend day), including the time of consumption, a brief description, and the quantity consumed. Food records were analyzed using the BEBIS software (Nutrition Information System), which is based on several international and national food composition tables, and supplemented with local data. Consumed portion size was assessed by utilizing the information such as item names, the location of food consumption, standard weights of foods or using the serving size that was determined from a picture booklet of 120 photographs of foods (Rakicioglu et al. 2009). Daily intake levels of energy, macronutrients and some micronutrients were assessed. The participants' energy and nutrient intakes were contrasted with the recommended dietary allowances (RDAs) for the population in Turkey (Besler et al. 2015). These Turkish RDAs were established according to age and sex.

Statistical Analysis

Descriptive data was reported as mean ± SD and percentage (%) when data were normally distributed (weight, height, BMI, total body fat (%), fat-free mass (kg), protein, carbohydrate, folate, magnesium, phosphorus intake), or when not (age, hours of training, exercise duration, energy and other nutrients intake).

The Shapiro-Wilk test was used to evaluate normality because the number of participants in each group was less than 50. Statistical analysis was performed between groups with no statistically significant difference in terms of age and sex (basketball-football-wrestling and swimming-tennis). The significance of the differences between two groups was analyzed with the Mann-Whitney U test for non-parametric variables, and Student's t-test for normally distributed data. All statistical analyses were performed using SPSS version 18 software (SPSS Inc., Chicago, IL, USA). Statistical significance was established at a p-value of 0.05.

RESULTS

Of those participating in the research, 18.1 percent played basketball, 21.7 percent played football, 31.9 percent were swimmers, 16.7 percent were wrestlers, and 11.6 percent played tennis. Comparing sports branches with no statistical difference in terms of age, the BMI of basketball players (22.1±2.8) was found to be higher by a significant degree than football players (20.5±1.4) ($p<0.05$). The body fat percentage of football players (10.6±3.3%) was lower than that of other groups, with a statistically significant difference compared to basketball players (14.7±5.8%) ($p<0.05$). The height of female swimmers (152.3±10.8 cm) was lower than that of female tennis players (159.4±5.0 cm), while the body fat percentage of male swimmers (17.3±6.1%) was higher than that of male tennis players (12.2±4.4%) ($p<0.05$) (Table 1).

The majority of children had BMI scores within the 15-85th percentiles (basketball: 76%, football: 100%, swimming: 70.5%, wrestling: 82.6% tennis: 81.2%). The majority of children participating in the study had a body fat percentage below the 15th percentile (basketball: 36%, football: 70%, swimming: 52.3%, wrestling: 65.2%, tennis: 68.8%) (Table 2).

There were significant differences in energy and nutrient intake between certain branches, especially between basketball players and wres-

Table 1: Anthropometric characteristics of athletes (M±SD)

	Basketball (n:25B)	*Football (n:30B)*	*Swimming (n:21B, 23G)[**]*	*Wrestling (n:23B)*	*Tennis (n:9B, 7G)[**]*
Age (year)[f]					
Boys	15.2±1.1[a]	14.6±1.4[b]	12.4± 1.5[a', b',c]	15.0± 1.6[c',d]	12.2± 1.2[a',b',d']
Girls	-	-	12.3± 1.7	-	11.5± 0.9
Body Weight (kg)[e]					
Boys	70.5±11.4[a]	58.7±7.3[a']	49.2± 9.4	58.7± 13.5[a']	45.8± 11.4
Girls	-	-	43.4± 11.3		46.1± 6.9
Height (cm)[e]					
Boys	178.1±9.5[a]	168.5±6.1[a]	156.4± 10.21	162.7± 10.4[a']	154.3± 12.2
Girls	-	-	152.3± 10.8[c]	-	159.4± 5.0[c']
BMI (kg/m^2)[e]					
Boys	22.1±2.8[a]	20.5±1.4[a']	20.0± 2.3	21.8± 3.2	19.0± 2.6
Girls	-	-	18.4± 2.5	-	18.1± 2.2
Total Body Fat (%)[e]					
Boys	14.7±5.8[a]	10.6±3.3[a']	17.3± 6.1[c]	11.9± 5.0	12.2± 4.4[c']
Girls	-	-	17.9± 6.7	-	17.0± 8.0
Fat-Free Mass (kg)[e]					
Boys	59.9±9.24[a]	52.3±6.1[a]	40.6± 8.2	51.3± 9.9[a']	40.1± 9.9
Girls	-	-	35.0± 6.4	-	37.9± 3.4
Training (hr/week)					
Boys	5.2±2.4	9.1±1.9[a',b]	16.2± 8.1[a',b',c]	12.1± 4.3[a',b',c',d]	-6.2± 2.3[,b',c',d',f]
Girls	-	-	13.8± 3.3	-	'6.2± 2.6
Exercise Duration (Years)					
Boys	5.2±2.8	5.7±2.4	6.4± 1.7	4.5± 1.9	5.8± 2.1
Girls	-	-	5.0± 2.0	-	5.2± 1.8

[*] [a,a'], [b,b'], [c,c'], [d,d'] $p<0.05$
[*]Statistical analysis was performed (excludes training and exercise duration) between groups with no statistical difference in terms of age and sex (basketball-football-wrestling/swimming-tennis).
[**]B: Boys, G: Girls
[e] *t* tests
[f] Mann-Whitney U test

Table 2: Distribution of BMI and body fat percentage of participants

	Basketball (n:25B)	*Football (n:30B)*	*Swimming (n:21B, 23G)*[**]	*Wrestling (n:23B)*	*Tennis (n:9B, 7G)*[**]
BMI Percentile					
<15. percentile	12.0	-	18.2	4.3	18.8
15-85. percentile	76.0	100.0	70.5	82.6	81.2
>85-<95. percentile	8.0	-	11.4	4.3	-
>95 percentile	4.0	-	-	8.7	-
Body Fat (%)					
<15. percentile	36.0	70.0	52.3	65.2	68.8
15-85. percentile	48.0	30.0	29.5	26.1	31.2
>85-<95. percentile	12.0	-	18.2	8.7	-
>95. percentile	4.0	-	-	-	-

tlers (fat, carbohydrate, vitamin A, vitamin B_1, vitamin B_2, vitamin B_{12}, vitamin C, Ca, Mg, P, Fe, Zn) and between swimmers and tennis players (carbohydrate, vitamin A, vitamin B_1, vitamin B_2, vitamin B_{12}, vitamin C, Ca, Mg, P, Fe, Zn) ($p<0.05$). The contribution of carbohydrates to total energy intake was low in all groups, while the contribution from fats was found to be high (Table 3).

Table 4 describes the athletes' energy and micronutrient intake compared to applicable Turkish RDA values. The deficiency observed in the energy consumption of wrestlers (30.4%) was greater than that of other groups. The protein intake of athletes in all groups was significantly high compared to the Turkish RDA recommendations. The ratio of athletes with insufficient fiber intake was noticeable especially among wrestlers and tennis players (60.9%, 75%, respectively). Similarly, insufficient intake amounts of vitamin B_1 (wrestling: 47.8%; tennis: 31.2%), vitamin B_3 (basketball: 36%; football: 43.3%; swim-

Table 3: Daily energy and nutrient intakes of athletes

	Basketball (n:25B)	*Football (n:30B)*	*Swimming (n:21B, 23G)*[**]	*Wrestling (n:23B)*	*Tennis (n:9B, 7G)*[**]
Energy (kcal) [f]	2968.8 ±723.3[a]	2768.0±788.0[b]	2588.3±734.9[c]	2118.5±380.3[a', b']	2185.2± 550.3[c']
Protein (g) [e]	99.5± 33.1	90.5± 28.9	90.6± 25.8	91.6± 25.5	90.2± 25.9
Protein (g/kg/d) [e]	1.4± 0.5[a]	1.5± 0.5[b]	2.0± 0.7[a', b',c]	1.6± 0.4[c',d]	2.0± 0.5[a', b',d']
Fat (g) [f]	130.1± 38.2[a]	110.3± 3.4[a']	113.0± 38.1	98.5± 30.8[a']	100.2± 34.7
Fat (E%) [e]	39.8± 8.3	35.6± 7.6[b]	39.2± 5.7[b']	41.8± 8.9[b']	41.2± 8.3[b']
Saturated fat (E%) [f]	16.1± 5.0	14.9± 4.7[b]	16.9± 3.8[b',c]	16.6± 5.3	14.3± 4.0[c']
Carbohydrate (g) [e]	334.9±107.2[a]	342.8±106.2[b]	294.6± 90.5[c]	213.4± 51.6[a', b']	222.4± 73.1[c']
Carbohydrate (E%) [e]	44.8± 7.7[a]	49.8± 7.7[a', b]	45.5± 5.9[b', c]	40.3± 7.9[b', c']	40.7± 9.2[b']
Fiber (g) [f]	23.5± 9.2	24.6± 10.6	24.6± 11.6	20.7± 11.2	16.9± 10.2
Vitamin A (ìg) [f]	1256.2±449.3[a]	1146.2±644.0	1420.9±687.4[c]	976.2±475.9[a']	982.7± 579.1[c']
Vitamin E (mg) [f]	19.2± 9.1	14.1± 9.7	15.5± 11.2	12.4± 6.2	17.3± 8.3
Vitamin B_1 (mg) [f]	1.1± 0.3[a]	0.9± 0.4	1.0± 0.3[c]	0.8± 0.2[a']	0.8± 0.3[c']
Vitamin B_2 (mg) [f]	1.9± 0.6[a]	1.6± 0.6[a']	1.8± 0.6[c]	1.4± 0.5[a']	1.6± 0.6[c']
Vitamin B_3 (mg) [f]	16.3± 13.5	13.3± 7.3	12.7± 5.8	14.4± 7.3	15.4± 6.0
Vitamin B_6 (mg) [f]	1.78± 1.0	1.5± 0.7	1.5± 0.5	1.4± 0.4	1.5± 0.5
Folate (ìg) [e]	328.5± 76.7	355.7±116.5	312.5±112.9	295.5± 92.6	211.0± 74.9
Vitamin B_{12} (ìg) [f]	3.9± 2.2[a]	3.1± 2.2	4.3± 2.6[c]	2.6± 1.9[a']	3.8± 2.7[c']
Vitamin C (mg) [f]	134.3± 92.3[a]	114.6± 95.5	125.6± 60.6[c]	64.3± 32.7[a']	84.2± 41.7[c']
Calcium (mg) [f]	1094.9±413.7[a]	753.4±395.2[a']	1018.8±376.5[c]	637.2±400.2[a']	734.5± 386.9[c']
Magnesium (mg) [e]	347.4±115.7[a]	307.5±114.6	338.1±108.5[c]	262.6± 91.4[a']	265.2± 89.1[c']
Phosphorus (mg) [e]	1575.6±401.9[a]	1363.9±446.4	1487.6±396.9[c]	1264.4±397.6[a']	1272.4± 413.3[c']
Iron (mg) [f]	13.8± 3.5[a]	12.7± 4.3	13.9± 4.6[c]	10.9± 3.5[a']	11.2± 3.5[c']
Zinc (mg) [f]	13.1± 3.1[a]	11.4± 3.4[a', b]	12.9± 3.9[c]	9.6± 3.1[a', b']	10.9± 5.4[c']

[*] [a,a'], [b,b'], [c,c'], [d,d'] $p<0.05$

E%= Percentage in total energy intake.

[*] Statistical analysis was performed (excludes protein g/kg/d, fat E%, saturated fat E%, carbohydrate E%) between groups with no statistical difference in terms of age and sex (basketball-football-wresting/swimming-tennis).

[e] *t* tests

[f] Mann-Whitney U test

Table 4: Energy and nutrient intake of athletes compared to Turkish RDA

Energy and Nutrient	*Basketball (n:25)*			*Football (n:30)*			*Swimming (n:44)*		
	<67	*133<*	*Intake,% RDA M(SD)*	*<67*	*133<*	*Intake,% RDA M(SD)*	*<67*	*133<*	*Intake,% RDA M(SD)*
Energy (kcal) ^{e}	-	12.0	105.1±25.3	6.7	16.7	101.7±29.6^{b}	6.8	11.4	108.4±28.9^{c}
Protein (g) ^{e}	-	84.0	202.6±66.0*	-	80.0	186.0±61.0*	-	86.4	184.8±52.6*
Fiber(g) ^{f}	36.0	8.0	81.0±31.5^{a}	33.3	6.7	84.7±36.7^{b}	29.5	15.9	89.5±40.6 ^{c}
Vitamin A (ìg) ^{f}	4.0	40.0	144.2±51.1^{a}	13.3	46.7	145.7±82.0^{b}	2.3	77.3	220.5±112.5$^{a',b',c,*}$
Vitamin E (mg) ^{f}	24.0	48.0	134.2±68.5	46.7	26.7	106.1±78.1^{b}	27.3	34.1	132.0±100.1
Vitamin B_1 (mg) ^{f}	24.0	8.0	87.8±25.3 ^{a}	33.3	16.7	86.7±36.8^{b}	13.6	22.7	106.6±33.6 $^{a',b',c}$
Vitamin B_2 (mg) ^{f}	4.0	68.0	156.0±61.6^{a}	-	40.0	135.7±52.8^{b}	-	81.8	191.2±56.4 $^{a',b',c,*}$
Vitamin B_3 (mg) ^{f}	36.0	20.0	104.8±84.9^{a}	43.3	16.7	89.9±47.8^{b}	22.7	20.5	99.5±46.3
Folate (ìg) ^{e}	12.0	4.0	84.1±20.3 ^{a}	20.0	13.3	98.3±36.1^{b}	36.4	13.6	87.9±39.8^{c}
Vitamin B_{12} (ìg) ^{f}	12.0	64.0	169.2±96.0	23.3	50.0	152.1±103.6^{b}	6.8	63.6	222.4±139.9$^{b',c,*}$
Vitamin C (mg) ^{f}	8.0	56.0	178.8±123.2	26.7	46.7	156.2±124.5	9.1	68.2	167.5±80.7^{c,*}
Calcium ^{f}	24.0	8.0	84.1±31.8^{a}	73.3	6.7	58.1±30.4$^{a',b}$	40.9	4.5	78.3±28.9$^{b',c}$
Magnesium ^{e}	28.0	8.0	89.1±31.8^{a}	33.3	16.7	91.7±47.3^{b}	6.8	38.6	125.7±43.0 $^{a',b',c}$
Phosphorus ^{e}	-	44.0	125.8±31.7^{a}	13.3	23.3	109.9±37.0	2.3	29.5	119.0±31.7^{c}
Iron ^{e}	-	44.0	137.8±34.8^{a}	6.7	40.0	127.8±45.2	2.3	43.2	133.3±48.7^{c}
Zinc ^{f}	4.0	28.0	118.7±27.5^{a}	16.7	16.7	104.1±31.4^{b}	-	34.1	123.3±38.1^{c}

Table 4: Contd..

Energy and Nutrient	*Wrestling (n:23)*			*Tennis (n:16)*		
	<67	*133<*	*Intake,% RDA M(SD)*	*<67*	*133<*	*Intake,% RDA M(SD)*
Energy (kcal) ^{e}	30.4	-	75.6± 16.1$^{b',c',d}$	6.2	6.2	90.4± 20.6$^{c',d'}$
Protein (g) ^{e}	4.3	78.3	186.3± 57.2*	-	87.5	183.0± 54.9*
Fiber(g) ^{f}	60.9	8.7	69.9± 39.7 $^{b', c'}$	75.0	6.2	59.9± 34.7 $^{a', c'}$
Vitamin A (ìg) ^{f}	13.0	26.1	115.5± 60.2 $^{a', c'}$	12.5	56.2	147.2± 66.4 $^{c'}$
Vitamin E (mg) ^{f}	34.8	13.0	87.4± 42.1^{d}	12.5	56.2	152.8± 77.4 $^{b',d'}$
Vitamin B_1 (mg) ^{f}	47.8	4.3	79.3± 52.6 $^{a', c'}$	31.2	-	82.6± 22.5 $^{c'}$
Vitamin B_2 (mg) ^{f}	4.3	30.4	120.4± 52.9 $^{a', c',d}$	-	68.8	164.6± 52.6$^{c',d',*}$
Vitamin B_3 (mg) ^{f}	26.1	21.7	95.8± 50.3	12.5	43.8	123.8± 51.1 $^{a', b'}$
Folate (ìg) ^{e}	43.5	-	77.3± 23.7 $^{b'}$	50.0	-	60.9± 24.6 $^{a',b',c'}$
Vitamin B_{12} (ìg) ^{f}	34.8	34.8	115.0± 86.9$^{c',d}$	6.2	68.8	202.2± 147.2$^{d'}$
Vitamin C (mg) ^{f}	34.8	8.7	84.8± 44.6 $^{c'}$	18.8	37.5	112.1± 55.6$^{c'}$
Calcium ^{f}	82.6	4.3	50.1± 37.2 $^{c',**}$	81.2	-	55.8± 29.7 $^{a',c'}$
Magnesium ^{e}	52.2	-	70.3± 24.6 $^{a', c', d}$	6.2	12.5	100.5± 24.5 $^{c',d'}$
Phosphorus ^{e}	17.4	17.4	99.6± 33.2 $^{c'}$	6.2	12.5	101.0± 33.9 $^{a,c'}$
Iron ^{e}	8.7	26.1	108.5± 38.0 $^{c'}$	6.2	31.2	111.8± 35.6 $^{a'}$
Zinc ^{f}	26.1	8.7	85.6± 30.3 $^{b', c'}$	25.0	12.5	101.5± 48.4 $^{a',b',c'}$

$^{a,a'}$, $^{b,b'}$, $^{c,c'}$, $^{d,d'}$p<0.05

*Mean intake significantly higher than Turkish RDA, p<0.05, **Mean intake significantly lower than Turkish RDA, p<0.05

^{e} *t* tests

^{f} Mann-Whitney U test

ming: 22.7%; wrestling: 26.1%), folate (swimming: 36.4%; wrestling: 43.5%; tennis: 50%), and Mg (basketball: 28%; football: 33.3%; wrestling: 52.2%) are also prevalent. Insufficient calcium intake was widespread in all groups, with the mean calcium intake of wrestlers (50.1±37.2%), especially being significantly lower than the Turkish RDA (p<0.05).

DISCUSSION

Food consumption and nutritional statuses have been of particular interest in sports, especially given their effects on athletic performance (Purcell and Section 2013; Galanti et al. 2015; Coutinho et al. 2016). General recommendations need to be modified by sports nutrition experts to accommodate the unique concerns of individual athletes health, sports activities, nutrient requirements, food preferences, and goals on body weight and body composition (Rodriguez 2009). This study is the first comprehensive assessment of the food consumptions, nutrition statuses and anthropometric profiles of Turkish adolescents participating in the five selected sports branches.

It was observed in this study that body fat percentages of most athletes, especially footballers (70%) and tennis players (68.8%), were under the 15th percentile. The amount of data on fat percentage regarding various sports reported in numerous studies, some of which featured hundreds of athletes for some sports, is limited (Juzwiak et al. 2008; Dassanayake et al. 2016). The athletic population is generally lean, having some of the lowest fat percentage values found in the body mass (Kalnina et al. 2015; Dassanayake et al. 2016). It is worth noting that adolescent athletes and adult athletes have different compositions in their body masses. Furthermore, rapid variations in fat and fat-free mass components, which evolve in a sex-specific way, are characteristics of adolescent growth. Therefore, while assessing body composition in adolescents, biological maturation, as well as sex-specific observation should be taken into account (Aerenhouts et al. 2015). Age-adjusted BMI and body fat percentiles have not yet been investigated in adolescent populations for different sports as direct or potential confounders of body components, as there are differences in growth rates (Thralls et al. 2016). In fact, the fat percentages of most athletic groups are about 1 SD lower than their nonathletic counterparts (Boileau and Horswill 2000).

As physique is very important in athletic performance, it is expected that different athletic groups have different sport-specific body composition profiles (Kalnina et al. 2015). The results of this study indicated significant differences in percentages of body fat among the groups of players. Basketball players demonstrated significantly higher percentages of body fat compared to football players, and this higher weight of basketball players compared to footballers and wrestlers may be linked to lower training hours each week. However, though the training hours for swimmers (boys-girls: 13.8-16.2 hour/week) are significantly longer than for tennis players (boys-girls: 6.2 hour/week) swimmers had significantly higher percentage body fat than tennis players (Table 1). This result proves that nutritional habits have a significant effect on body composition. Apart from this, the proportion of body fat (BF %) in athletes is known to vary depending on the gender of the athlete and the sports branch (Oladunni and Sanusi 2014; Kalnina et al. 2015). Boileau and Horswill (2000) stated that the body fat percentage of adolescent wrestlers should be between ten to sixteen percent. For tennis players, this percentage should be within the range of six to seventeen percent, while for male and female swimmers, it should be within the ranges of ten to fourteen percent and fifteen to twenty-three percent, respectively. Although it was not possible to determine the critical body fat percentage for various sports based on empirical data, it has recently been suggested that twelve percent and five percent body fat should be considered the minimum level of body fat percentage for female and male athletes, respectively (Kalnina et al. 2015). In this study, however, the mean fat percentage of 10.6-17.3 for male athletes and 17.0-17.9 for female athletes appears to be above the risk limits, and it was found that a high proportion of participants had a percentage body fat value below the 15th percentile in all groups (Table 2). Furthermore, in this study, 2 boys (1 wrestling, 1 football), and 5 girls (2 tennis, 3 swimming) had body fat percentages below the recommended minimum levels (this is not shown in the table). Kalnina et al. (2015) found that about eight percent of boys and seven percent of girls had a body fat percentage value below the minimum level recommended for continued participation in sport. The consequences of low body fat percentage for adolescent athletes are relatively well known, for example, imbalance in bone remodeling is serious for adolescent athletes of both genders, because that imbalance hinders the achievement of a high peak bone mass and thus an optimal stature. Additionally, there is risk of fractures, illness, decline in physical growth, and cognitive deficiencies influencing school and learning, and loss of reproductive function (Kalnina et al. 2015). Considering that adipose tissue is a vital endocrine organ for normal physical development in children (Ackland et al. 2012), findings in this study suggest that there is a need to assess body fat levels in these populations of children as an aid to primary prevention of the effects on growth and on medical complications. In parallel, field methods for body fat percentage measurement would need to be validated in the sporting population to which they are to be applied.

While low levels of body fat seem to be related to improved performance, body fat levels alone are not a great predictor of success in sports (Siders et al. 1991). For ideal performance, BMI levels should be in the range of 10^{th}-85^{th} percentiles. On the other hand, a large, lean body mass caused by physical activity, and high muscularity or frame size may provide high BMI values for some adolescents (Spear 2005). In the current study, although a high proportion of participants had a body fat percentage value below the 15^{th} percentage, the researchers found that a high proportion of participants had a BMI between the 15-85 percentiles in all groups (Table 2). This situation means that athletes had high levels of muscle mass, and this being evidence that BMI does not distinguish between fat and lean mass (Thralls et al. 2016; Marinho et al. 2016).

In related literature the studies have not found data comparing anthropometric profiles of athletes from different branches. As a result, comparisons were made separately. In this study, the body fat percentage of male basketball players (14.7%) was higher than those observed in studies by Gerodimos et al. (2005) (BF: 11.1%) and Siders et al. (1991) (BF: 10.5%), while BMI (22.1) was lower. The mean BMI of adolescent footballers in a study by Iglesias-Gutierrez et al. (2008) was 20 while their body fat percentage was nine percent, and these results are broadly similar to this study results (BMI: 20.5, BF: 10.6%). In this study, the body fat percentage of male swimmers (Boys: 17.3%, Girls: 17.9%) was higher than in the study by Dassanayake et al. (2016) (Boys: 9.3%, Girls: 18.2%), while the values for girls were similar. Again, the mean body fat percentage of female tennis players in this study (17.0%) was higher than that in the study by Olculu et al. (2012) (13.8%). Differences in age, playing category and sample size may account for the differences in percentage body fat and BMI among the studies mentioned above.

To enhance performance, athletes should reduce the proportion of body fat and increase lean mass through an adequate and balanced diet and increase in physical activity. Adequate energy intake is also required to support normal growth and development as well as physical activity (Spear 2005). The results of this study reveal mean daily energy intake (2119 to 2969 kcal, Table 3) of the athletes to be consistent with findings from other research (Rankinen et al. 1995; Garcin et al. 2009; Baker et al. 2014) while also meeting Turkish RDAs (Table 4). With less than fifty percent of energy derived from carbohydrates (40.3%-49.8%) and a similar proportion from fat (35.6%-41.8%), the macronutrient content of the athletes' diets was imbalanced according to the Turkish RDA, which suggests intakes of fifty to sixty percent carbohydrates and twenty-five to thirty-five percent fat as daily recommendations (Besler et al. 2015). Additionally, the energy percentage from saturated fats in all groups was higher than the recommended value of ten percent (Purcell and Section 2013) (Table 3). This proportion of CHO in the diet should be increased, and fat should be reduced for better performance based on the current theory of the connection between athletic performance and CHO intake (Purcell and Section 2013). When the protein intake of young athletes is examined, individuals in all groups consumed significantly more protein than the Turkish RDA (Table 4), with the amount of protein consumed per weight being very high (especially for swimmers and tennis players) (Table 3). This is explained by the high consumption frequency of protein-rich food, such as chicken, beef, cheese and eggs. Many athletes are not aware of the fact that the excess protein is either burned for energy or converted to fat. Consuming high protein diets does not necessarily enhance muscular mass, and it can also lead to dehydration, weight gain, gout, gastrointestinal upset, hepatotoxicity, renal toxicity, hypercalciuria, and impaired essential amino acid absorption (Almeida and Soares 2003; Rodriguez et al. 2009). While the suggestions above are applicable for the general pediatric population, numerous other factors affect protein requirements. In any case, protein recommendations should never be higher than 1.5g/kg/d (ideally 0.9-1.3 g/kg/d) (Almeida and Soares 2003; Spear 2005).

In comparison to the athletes in other studies, athletes in this study appeared to derive more energy from fat, saturated fat and/or protein, but less from carbohydrates (Mullinix et al. 2003; Garcin et al. 2009; Gibson et al. 2011). However, compared to the athletes in the study by Almeida and Soares (2003), athletes in their study appear to derive less energy from fat, protein and carbohydrate. In the study by Ziegler et al. (2001), the athletes appeared to derive less energy from fat and protein and more from carbohydrates than athletes in this study. Finally, energy derived from fats, proteins and carbohydrates were similar to the values found by Rankinen et al. (1995), Iglesias-Gutie´rrez et al. (2008) and Martinez et al. (2011). These various results may be dependent on sex, age, socio-economic status, cuisine culture, branches of sports and/or exercise duration, and level of the subjects.

An important finding of this study was that the vitamin and mineral intake of footballers was better than wrestlers, and that of swimmers was better than tennis players. A comparison of food consumption in this study by athletes who participate in different sports branches showed that energy and nutrient intake of wrestlers was generally low (Table 3).

While various vitamins and minerals are required for good health, ensuring that athletes consume proper amounts of calcium and iron requires particular attention. Calcium is significant for bone health, normal enzyme activity and muscle contraction. The suggested intake of calcium is 1300 mg/day for 10 to 18-year-olds (Hellwig et al. 2006; IOM 2011; Besler et al. 2015). Although various foods and beverages contain calcium (Purcell and Section 2013), a high ratio of all athletes had calcium intake levels below Turkey's RDA recommendations. The rate of wrestlers, especially those who met the mean calcium requirements was very low (50.1±37.2%) and statistically significant ($p<0.05$). Low calcium intake is common among athletes (Rankinen et al. 1995; Almeida and Soares 2003; Martínez et al. 2011, Coutinho et al. 2016). Inadequate intake could place these athletes at risk of lower bone-mineral density, stress fractures and osteoporosis (Spear 2005; Rodriguez et al. 2009). Hence, diet recommendations should include consumption of foods and beverages that have high calcium contents.

In order to maintain adequate hemoglobin concentrations as well as total iron stores during growth, iron has important roles. During adolescence, because of growth, increase in red blood cell volume and the additional lean body mass, there is an increased need. As iron deficiency anemia can cause poor stamina, lowered performance and learning difficulties, prevention should be focused on regular consumption of adequate sources of iron that are acceptable to teenagers (Spear 2005). While the iron requirement for girls and boys at 10-13 years is 10 mg, more iron is required for those aged from 14 to 18 years, that is, up to 10 mg/day for males and 18 mg/day for females (Besler et al. 2015). Therefore, the daily mean iron intake of basketball players (13.8±3.5) was significantly higher than wrestlers (10.9±3.5), while that of swimmers (13.9±4.6) was significantly higher than tennis players (11.2±3.5) and the mean iron intake in all groups was sufficient (Table 3). This result is similar to other studies on athletes (Resina et al. 1991; Leblanc et al. 2002; Daneshvar et al. 2013), though some studies have found the iron intake of sportspeople to be insufficient (Hawley and Williams 1991; Martínez et al. 2011).

The B group vitamins should be consumed in proportion to the total energy content of the diet (Almeida and Soares 2003; Rodriguez et al. 2009). The results show that the type of sports has an effect on the athlete's requirements for B group vitamins (B_1, B_2, B_3, B_6, B_{12}), due to quantity of energy consumption (Tables 3 and 4). A high proportion of athletes (with the exception of wrestlers) had vitamin B_2 and vitamin B_{12} vitamin intake above Turkish RDA recommendations. However, this high intake was not statistically significant ($p>0.05$) and the amount was not sufficient to cause any side effects (>300% RDA) (Spear 2005). Comparing the B_2 and B_{12} vitamin intake of swimmers with tennis players, the B_2 vitamin intake was high compared to RDA and this was statistically significant ($p<0.05$) (Table 4). In contrast, the amount of wrestlers (47.8%), tennis players (31.2%), basketball players (24.0%), and swimmers (22.7%) with deficient B_1 vitamin intake was worrying. Similarly, deficient vitamin B_3 intake was very widespread, especially among basketball players (36%) and footballers (43.3%) (Table 4). This result is in parallel with the study by Hawley and Williams (1991), however, it is not similar to studies by Rankinen et al. (1995), Almeida and Soares (2003) and Juzwiak et al. (2008). While consumption of some B group vitamins was high, some were deficient indicating that sportspeople did not pay enough attention to nutritional variety and balanced nutrition.

Another important finding of this study is that a high proportion of basketball players, football players, swimmers and tennis players had vitamin A and vitamin C intake above the Turkish RDA. However, amongst wrestlers, 43.5 percent consumed insufficient amounts of folate, and 34.8 percent consumed insufficient levels of vitamin C, while fifty percent of tennis players consumed insufficient amounts of folate (Table 4). Similar deficiencies in vitamin and mineral intake have been reported in adolescent tennis players (Juzwiak et al. 2008). Deficiencies in folate have been associated with reductions in endurance performance and anemia (Rodriguez et al. 2009). Vitamin C is involved in a number of metabolic reactions, acts on the synthesis of collagen, is related to immunologic function, increases the absorption of non-heme iron (thus preventing iron-deficiency anemia), and is an effective antioxidant (Almeida and Soares 2003, Smith et al. 2015). Intake of vitamin C and folate may be inadequate because children and adolescents involved in wrestling and tennis often avoid fresh fruits and vegetables, which are primary sources of these nutrients and fiber. The insufficient fiber intake of the majority of all athletes supports this situation (Table 4).

CONCLUSION

In conclusion, adolescent athletes participating in the present study displayed differences depending on the type of sport engaged in. Based on the current dietary recommendations, the results of the present study demonstrated that the majority of athletes have an inadequate and imbalanced nutritional status due to both under-nutrition and over-nutrition, as found among some athletes. Adolescent wrestlers had low average total energy intake, and all branches had excessive protein and fat intake, as well as lower intakes of carbohydrate and several micronutrients, especially calcium. Although a high proportion of athletes had mean BMI values within normal ranges, body fat percentage was low in all branches.

RECOMMENDATIONS

It is suggested that nutritional and anthropometrical screening and monitoring is essential for adolescent athletes. Targeted nutritional monitoring could lead to maintenance of optimal growth, enhanced training adaptations and performance. Therefore, the importance and benefits of a proper diet and adequate and balanced nutrition should be explained to athletes, coaches and family members. It is suggested to establish individualized goals and use a range of body-composition values in developing weight targets for athletes in individual sports rather than attempting to reach a singular goal for all athletes.

LIMITATIONS

The initial limitation of the study was its relatively small sample size. Also, the lack of a control group comprising sedentary adolescents with which to make comparison has limited the interpretation of the study results. In addition, blood samples could be used to evaluate more clearly the nutritional status of adolescents. Therefore, future research in this field needs to be designed with larger sample sizes including both adolescent athletes and sedentary adolescents, and be conducted incorporating blood samples.

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