Nutrient Intakes among Jordanian Adolescents Based on Gender and Body Mass Index

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Abstract: *Background*: This study was conducted to examine the dietary intakes of macro- and micronutrients for a Jordanian adolescents based on gender and compare their intake to the Dietary Recommended Intakes (DRIs).

Methods: A sample of 398 male and female adolescents, aged 14-18 years, were recruited from private and public schools using convenience sampling. Socio-demographic questionnaire and 3-days food record were self-reported. Bodyweight and height were measured and body mass index (BMI) was calculated for all participants.

Results: There were no significant differences between male and female adolescents regarding the intake of micro and macronutrients except for protein, insoluble fibre, saturated fat, cholesterol, omega-6, vitamin E and calcium. The intake of insoluble fibre (g/day), omega-6(g/day), and vitamin E (mg/day) was significantly higher in female adolescents (3.1±0.1, 5.6±0.5, and 3.1±0.3, respectively, $P \leq 0.05$) compared to male adolescents (2.9±0.1, 5.1±0.4, and 2.5±0.2, respectively, $P \leq 0.05$). On the other hand, the intakes of protein (g/day), saturated fat (g/day), cholesterol (mg/day), calcium (mg/day) were significantly higher in male adolescents (90.1±2.3, 31.7±1.0, 339.2±18.3, and 651.5±27.8) as compared with female adolescents (79.2±2.1, 29.2±1.2, 263.6±14.9, and 555.2±21.7) ($P \leq 0.05$). Comparing of the adolescents' nutrients intake to the DRIs, many nutrients were found to be below or above the recommendations.

Conclusion: The study findings highlighted that there is an urgent need to establish a plan of action to combat malnutrition among adolescents in Jordan.

Keywords: Macronutrient, Micronutrient, Jordanian Adolescents.

INTRODUCTION

Adolescence is an intermediate duration between childhood and adulthood, which is considered as one of the most rapid phases of human development in which specific health and developmental needs should be provided [1]. Adolescence is a crucial and critical stage in the development of obesity as well as for developing risk factors for some metabolic and chronic diseases in adulthood [2]. Worldwide, malnutrition remains a pivotal nutritional problem for adolescents. Indeed, an increase in the global prevalence of obesity among adolescents has been reported in many surveys [3-5]. Most of the adolescents are not aware of the long-term complications and consequences of their current eating patterns and unhealthy dietary habits and behaviours [6]. During this period, the total fat intake of adolescents has increased and the intakes of raw fruit, non-starchy vegetables, and milk consumption have decreased. Additionally, many studies reported a decrease in fibre intake. These dietary patterns were found to be related to increases in the prevalence of obesity among adolescents [7]. This pre-adulthood period provides a chance to prepare for a healthful reproductive and productive life, and to avoid the onset of chronic disease associated with nutrition in adulthood. During this life stage, addressing adolescence-specific nutrition issues and possibly correcting some nutritional problems starting in the past could have great importance. Besides, adolescents usually do not receive attention in governmental nutrition programs. In spite of knowing that adolescents are tomorrow's adults and their health is crucial, the concern in adolescents' health is unsatisfactory [8]. The objectives of this study were to estimate the dietary intakes of macro- and micronutrients for Jordanian adolescents aged 14-18 years old their based on gender. Also, comparing adolescents' intake with the Dietary Recommended Intakes (DRIs) was performed. In addition, the nutrient intake of adolescents with normal body weight was compared with that of overweight and obese adolescents.

METHODS

Subject Enrollment

A cross-sectional study was used to determine the macro- and micronutrient intake. This study was conducted in Amman, the capital of Jordan from March to June 2018. A total of 398 adolescents were enrolled from large 16 schools in Amman: 8 public (4 East and 4 West of Amman) and 8 private (4 East and 4 West of Amman) schools from Amman. The sample size was calculated depending on the total population of 85,000

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adolescents at the selected age group [9], and a confidence level of 95% and a margin of error of 5%. The ratio of males: females was 1:1. Adolescents' recruitment was started after having the approval of the Directorate of Education and the interested parents of the siblings. All participants' parents/caregivers were asked to sign a written informed consent. The inclusion criteria for the adolescents were: age between 14 to 18 years old, Jordanian adolescents, and apparently and self-reported to be healthy. The exclusion criteria for both adolescents included: Age: <14 or >18 years old, participants suffering from chronic diseases or any disease that requires special diets, and adolescents who are not Jordanian.

Data Collection

Data collection tools for participants were divided into 3 parts: the first one includes a socio-demographic questionnaire, the second part was performed to assess the dietary intake of adolescents using three days record after educating the adolescents about portion size using food models and household measurements. The third part included anthropometric assessment.

Assessments of Nutrient Intakes

Adolescents were asked to record all beverages and foods consumed at the time of eating (one day at the weekend and two random days) [10]. This record was performed for three non-consecutive days by writing the amount of consumed food and the preparation methods throughout the day. After that, data from food record were accurately analyzed using food processor nutrition analysis software (ESHA Food Processor SQL version 10.9.0; ESHA, Salem, OR) supplemented with additional data on traditional foods consumed in Jordan [11], focusing on micronutrient and macronutrient intakes.

Anthropometric Measurements

Bodyweight was measured for all the adolescents included in the study when the subjects were barefooted with light clothes using InBody 270 scale (InBody C., Ltd, Korea) to the nearest 0.1 kilograms (kg). Standing height of each adolescent was measured using stadiometer with the shoulder in a relaxed position and the arms hanging freely (to the nearest 0.1 cm). Body mass index (BMI) was calculated as prescribed by [10]. Body fat per cent was measured for the adolescents and they were classified to, normal body fat per cent when the per cent of body fat in males and females was below (25%, 30%) respectively and above these cutoff points were classified as obese [12]. The BMI was calculated as weight (kg)/ height (m^2). Overweight and obesity were categorized using Centers for Disease Control and Prevention (CDC) growth charts of BMI-for-age which defined obesity as ≥ 95^{th} percentile, overweight as ≥ 85^{th} percentile and < 95^{th} percentile and underweight as < 5^{th} percentile [13].

Statistical Analysis

The data were analyzed using the computer program statistical package for the social sciences (SPSS) version 23 (IBM SPSS Statistics for Windows, IBM Corporation). Group comparisons were performed using the t-test or analysis of variance (ANOVA). Descriptive statistics are presented as means and standard error of the mean (SE) or proportions. *P*-value was set at 0.05.

RESULTS

The results of this cross-sectional study highlighted the dietary nutrient intakes among Jordanian adolescents according to sex difference and BMI categories. Distribution of adolescents among different BMI categories according to their socio-demographic characteristics and anthropometric characteristics of adolescents are presented in Table **1**. The results of the study revealed that about half of the adolescents were from west Amman in Jordan. They were selected equally from private and public schools. On the other hand, the mean of fat per cent in males and females were 22.4% and 23.7%, respectively. About 55% of male and female adolescents showed a normal BMI, while 26.1% of the adolescents were overweight, and 10.1% were obese.

The mean daily intakes of total energy, macronutrients, and micronutrients according to gender are illustrated in Tables **2** and **3**. No significant differences were detected between male and female adolescents regarding the daily intake of energy (kcal/day) and most of the macronutrients except for protein, insoluble fibre, saturated fatty acids, cholesterol and omega-6. Protein, cholesterol and saturated fatty acid intakes were significantly higher in the male adolescents (90.1±2.3, 339.2±18.3 and 31.66±0.9 g/day, respectively, $p \leq 0.05$) compared to the female adolescents (79.2±2.1, 263.6±14.9, and 29.15±1.2 g/day, respectively, $p \leq 0.05$). On the other

Table 1: Socio-Demographic and Anthropometric Characteristics of Adolescents

Variable	Males	Females	Total
Height (cm) [mean (SEM)]	173.77 (0.52)	158.66 (0.50)	166 (0.52)
Weight (kg) [mean (SEM)]	72.51 (0.95)	60.14 (0.71)	66.35 (0.67)
BMI (kg/m²) [mean (SEM)]	24.02 (0.30)	23.98 (0.30)	24.0 (0.21)
Underweight (%)(N)	5.5 (11)	11.1 (22)	8.3 (33)
Normal weight (%)	57.0 (114)	54.0 (107)	55.5 (221)
Overweight (%)	27.5 (55)	24.7 (49)	26.1 (104)
Obesity (%)	10.0 (20)	10.1 (20)	10.1 (40)
Fat percent (%)	22.4	23.7	23.05

*****BMI for age was obtained and categorized according to CDCs' cut off points.
+Underweight (BMI for age< 5th percentile), normal weight (5th percentile < BMI < 85th percentile), overweight (85th percentile <BMI < 95th percentile), obese (BMI≥ 95th percentile).

Table 2: Means of Macronutrients Intake among Adolescents Based on Gender

Energy and Macronutrients	Mean±SEM*			RDA/AI	P-value*
	Male	RDA/AI**	Female		
Energy (kcal/day)	2408.7 ± 64.6	-	2096.5 ± 61.0	-	0.210
Protein (g/day)	90.1 ± 2.3	52	79.2 ± 2.1	46	0.003
Fat (g/day)	99.1 ± 3.0	-	85.8 ± 2.9	-	0.064
Total Carbohydrate (g/day)	290.6 ± 7.9	130	254.2 ± 7.7	130	0.187
Fat Calories (kcal/day)	891.6 ± 26.9	-	771.4 ± 26.0	-	0.062
Saturated Fatty Acids Calories (kcal/day)	284.9 ± 8.9	-	262.4 ± 11.1	-	0.120
TFA Calories (kcal/day)	7.7 ± 0.9	-	6.8 ± 0.9	-	0.718
Sugar (g/day)	88.8 ± 2.9	-	77.9 ± 3.1	-	0.717
Starch(g/day)	0.2 ± 0.0	-	0.4 ± 0.1	-	0.220
Total Fiber (g/day)	19.0 ± 0.5	38	17.7 ± 0.5	26	0.304
Soluble Fiber (g/day)	1.3 ± 0.1	-	1.3 ± 0.1	-	0.849
Insoluble Fiber (g/day)	2.9 ± 0.1	-	3.1 ± 0.1	-	0.026
Saturated Fat (g/day)	31.7 ± 1.0	ND	29.2 ± 1.2	ND	0.012
Monounsaturated Fat (g/day)	13.5 ± 0.9	-	12.9 ± 0.8	-	0.189
Polyunsaturated Fat (g/day)	6.6 ± 0.5	-	7.2 ± 0.5	-	0.159
Trans Fatty Acids (g/day)	0.9 ± 0.1	ND	0.8 ± 0.1	ND	0.718
Cholesterol (mg/day)	339.2 ± 18.3	ND	263.6 ± 14.9	ND	0.001
Omega-3 (g/day)	0.5 ± 0.0	1.6	0.6 ± 0.0	1.1	0.726
Omega-6 (g/day)	5.1 ± 0.4	16	5.6 ± 0.5	11	0.047

*Data are presented as the mean ± SEM; and are considered statistically significant at $P \leq 0.05$.
**RDA: Recommended Dietary Allowances; AI: Adequate Intake.
ND = Not determinable.

hand, the daily insoluble fibre and omega-6 (g/day) intakes were significantly higher in the female adolescents (3.2±0.1, 5.63±0.5 g/day, respectively, $p \leq 0.05$) compared to the male adolescents (2.9±0.1, 5.1±0.4 g/day, respectively, $p \leq 0.05$). Most of dietary intake values of macronutrients were below dietary reference intake except protein and fat intake.

Table **3** shows the means of micronutrient intakes male and female adolescents'. There were no significant differences among male and female adolescents for the intake of almost all micronutrients except for calcium and vitamin E. While calcium daily intake was significantly higher in the male adolescents (651.5±27.8 mg/day) as compared with female

Table 3: Means of Male and Female Adolescents' Micronutrients Intake

Micronutrients Intake/day	Gender				P-value*
	Male		Female		
	Mean* ± SEM	RDA/AI**	Mean ± SEM	RDA/AI	
Vitamin A (IU/day)	2704.9 ± 176.0	3000	2801.8 ± 216.6	3000	0.136
Vitamin B1 (mg/day)	0.8 ± 0.0	1.2	0.7 ± 0.0	1.0	0.398
Vitamin B2 (mg/day)	0.6 ± 0.0	1.3	0.7 ± 0.0	1.0	0.063
Vitamin B3 (mg/day)	13.0 ± 0.5	16	10.9 ± 0.6	14	0.471
Vitamin B6 (mg/day)	0.6 ± 0.0	1.3	0.6 ± 0.0	1.2	0.263
Vitamin B12 (µg/day)	2.9 ± 0.3	2.4	3.3 ± 0.4	2.4	0.160
Vitamin C (mg/day)	77.3 ± 4.8	75	76.1 ± 4.2	65	0.147
Vitamin D (µg/day)	0.4 ± 0.0	15	0.6 ± 0.0	15	0.596
Vitamin E (mg/day)	2.5 ± 0.2	15	3.1 ± 0.3	15	0.021
Vitamin K (µg/day)	19.4 ± 1.5	75	21.9 ± 1.6	75	0.700
Calcium (mg/day)	651.5 ± 27.8	1300	555.2 ± 21.7	1300	0.027
Iron (mg/day)	12.35 ± 0.4	11	11.5 ± 0.4	15	0.841
Folate (µg/day)	147.2 ± 5.9	400	165.9 ± 6.1	400	0.200
Selenium (µg/day)	54.18 ± 2.6	55	50.0 ± 2.5	55	0.551
Sodium (mg/day)	3786.8 ± 124.6	1500	3238.8 ± 119.2	1500	0.098
Phosphorus (mg/day)	453.8 ± 16.8	1250	454.8 ± 18.3	1250	0.411
Iodine (µg/day)	8.3 ± 0.8	150	9.5 ± 0.8	150	0.661
Potassium (µg/day)	1002.3 ± 40.11	4700	971.8 ± 42.1	4700	0.921
Zinc (mg/day)	3.53 ± 0.1	11	3.7 ± 0.2	9	0.302

*Data are presented as the mean ± SEM; and are considered statistically significant at $P \leq 0.05$.
**RDA: Recommended Dietary Allowances; AI: Adequate Intake.

adolescents (555.2±21.7 mg/day) (*p≤0.05*), vitamin E daily intakes were significantly higher in female adolescents (3.1±0.3 mg/day, *p≤0.05*) compared to the male adolescents (2.5±0.2, mg/day *p≤0.05*). Most of the dietary intakes of micro nutrients were below the dietary reference intakes except for vitamin C and sodium.

Tables **4** and **5** present means of macro- and micronutrients intakes of underweight, normal, overweight and obese adolescents. Macro- and micronutrient daily intakes were not significantly different among underweight, normal, overweight and obese adolescents except for zinc and phosphorus.

DISCUSSION

The findings of this study showed that about half of the participants had normal body mass indices (55.5%); while 104 (26.1%) of them were overweight, 40 (10.1%) were obese, and only 33 (8.3%) were underweight. This result might be explained as described by Abu-Mweis *et al*. (2014) who stated that the majority of the Jordanian adolescents followed unhealthful lifestyle behaviours regarding skipping breakfast, low intake of vegetables, fruits and milk, high intake of foods rich in fat and sugar, and low levels of physical activity and had high sedentary lifestyle practices [14]. Being inactive is a vital contributor to overweight and obesity [15]. Our results agree with those of [16] who found that overweight and obesity were more common among school students around the period of puberty. Also, our results are in agreement with a study conducted in a neighbouring Arab country [17]. The authors revealed that 10.1% of the secondary school students in Dubai were underweight, 51.0% were within a healthy weight, 26.7% of students were overweight and 12.2% were obese [17]. Besides, El- Hazmi and Warsy (2002) revealed that the prevalence of overweight and obesity were 20% and 11%, respectively in primary and intermediate schools in Al-Khobar city, Kingdom of Saudi Arabia [18]. Al-Nakeeb *et al*. (2012) reported that the prevalence of overweight and obesity among adolescents (14–18 years) was 38.3% [19]. Regarding gender differences,

Table 4: Macronutrients Intake Based on BMI among Study Participants

Macronutrients Intake/Day	BMI Categories*				P-value*
	Underweight**	Normal	Overweight	Obesity	
	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	
Calories (kcal/day)	2006.2 ± 158.7	2308.1 ± 61.9	2204 ± 85.8	2282.4 ± 128.5	0.301
Protein(g/day)	72.9 ± 5.2	87.9 ± 2.1	81.5 ± 3.1	84.9 ± 4.4	0.480
Carbohydrate (g/day)	249.4 ± 19.8	276.9 ± 7.7	269.8 ± 10.8	274.1 ± 16.3	0.612
Fiber (g/day)	17.6 ± 1.1	18.6 ± 0.5	18.1 ± 0.7	18.4 ± 1.1	0.832
Soluble Fiber (g/day)	1.3 ± 0.1	1.3 ± 0.1	1.3 ± 0.1	1.2 ± 0.1	0.924
Insoluble Fiber(g/day)	3.1 ± 0.3	3.1 ± 0.1	2.9 ± 0.2	3.1 ± 0.3	0.924
Fat (g/day)	80.5 ± 7.1	95.1 ± 2.9	89.9 ± 3.9	94.8 ± 6.7	0.255
Saturated fat (g/day)	24.3 ± 2.5	30.6 ± 1.0	30.6 ± 1.32	33.7 ± 3.2	0.780
MUFAs (g/day)	11.2 ± 1.9	13.4 ± 0.8	12.7 ± 1.1	15.4 ± 1.6	0.459
PUFAs (g/day)	5.7 ± 1.1	7.2 ± 0.5	6.2 ± 0.6	7.9 ± 1.0	0.344
Fat Calories (Kcal/day)	723.9 ± 64.2	855.3 ± 26.0	808.1 ± 35.0	852.8 ± 60.3	0.301
Sat Calories (kcal/day)	218.6 ± 22.5	275.8 ± 9.6	275.3 ± 9.6	275.3 ± 11.9	0.078
TFA Calories (kcal/day)	3.5 ± 0.9	7.5 ± 0.9	7.5 ± 4.1	7.8 ± 1.9	0.347
Sugar (g/day)	76.7 ± 7.7	83.1 ± 2.9	84.9 ± 2.9	86.5 ± 6.5	0.762
Cholesterol (mg/day)	280.4 ± 44.1	306.9 ± 16.7	307.2 ± 22.7	275.1 ± 28.5	0.820
Omega-3 (g/day)	0.4 ± 0.1	0.6 ± 0.0	0.5 ± 0.0	0.7 ± 0.1	0.056
Omega-6 (g/day)	4.7 ± 1.1	5.6 ± 0.4	4.9 ± 0.5	5.9 ± 0.9	0.612

*BMI for age was obtained and categorized according to CDCs' cut off points.
**Underweight (BMI for age< 5th percentile), normal weight (5th percentile < BMI < 85th percentile), overweight (85th percentile <BMI < 95th percentile), obese (BMI≥ 95th percentile).

Table 5: Micronutrient Intakes Based on BMI among Study Participants

Micronutrients Intake/Day	BMI Categories*				P-value
	Underweight**	Normal	Overweight	Obesity	
	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	
Vitamin A (IU/day)	2266.8 ± 404.5	2815.0 ± 195.0	2899.2 ± 272.1	2432.6 ± 387.6	0.586
Vitamin B1 (mg/day)	0.7 ± 0.9	0.8 ± 0.0	0.7 ± 0.0	0.8 ± 0.1	0.545
Vitamin B2 (mg/day)	0.6 ± 0.1	0.6 ± 0.0	0.6 ± 0.0	0.7 ± 0.1	0.790
Vitamin B3 (mg/day)	9.4 ± 1.3	12.3 ± 0.5	11.4 ± 0.8	13.2 ± 1.3	0.150
Vitamin B6 (mg/day)	0.5 ± 0.1	0.7 ± 0.0	0.6 ± 0.0	0.7 ± 0.1	0.070
Vitamin B12 (µg/day)	2.1 ± 0.7	3.3 ± 0.3	2.9 ± 0.4	3.4 ± 0.7	0.539
Vitamin C (mg/day)	74.7 ± 8.4	80.6 ± 4.6	76.4 ± 6.1	57.8 ± 6.6	0.219
Vitamin K (µg/day)	15.6 ± 3.1	22.2 ± 1.5	18.9 ± 2.1	20.7 ± 3.6	0.328
Vitamin D (µg/day)	0.5 ± 0.2	0.5 ± 0.1	0.4 ± 0.1	0.4 ± 0.1	0.874
Vitamin E (mg/day)	2.0 ± 0.3	2.9 ± 0.2	2.4 ± 0.3	2.9 ± 0.6	0.334
Phosphorus (mg/day)	350.2 ± 34.2	468.3 ± 17.4	436.6 ± 22.5	508.7 ± 38.8	0.028
Potassium (mg/day)	847.6 ± 103.1	1018.2 ± 40.4	960.9 ± 56.3	998.6 ± 70.3	0.428
Iodine (µg/day)	7.3 ± 1.8	8.9 ± 0.7	9.2 ± 1.4	8.7 ± 1.2	0.862
Zinc (mg/day)	2.8 ± 0.3	3.7 ± 0.1	3.4 ± 0.2	4.2 ± 0.4	0.033
Selenium (µg/day)	41.9 ± 5.7	54.6 ± 2.6	49.4 ± 3.3	53.8 ± 5.4	0.222
Folate (µg/day)	161.3 ± 15.7	174.9 ± 5.8	161.9 ± 7.6	171.6 ± 13.9	0.559
Calcium (mg/day)	564.7 ± 63.8	595.5 ± 23.3	606.8 ± 33.5	672.2 ± 67.2	0.572
Iron (mg/day)	10.8 ± 0.9	12.2 ± 0.4	11.6 ± 0.46	12.2 ± 0.67	0.507
Sodium (mg/day)	3154.5 ± 257.2	3627.5 ± 120.4	3384.2 ± 170.0	3522.5 ± 263.4	0.404

*BMI for age was obtained and categorized according to CDCs' cut off points.
**Underweight (BMI for age< 5th percentile), normal weight (5th percentile < BMI < 85th percentile), overweight (85th percentile <BMI < 95th percentile), obese (BMI≥ 95th percentile).

our results showed that there was no difference between males and females. This finding agrees with the results of Jiwane and Wadhva (2014) who found no significant difference between males and females aged 5–19 years regarding their BMI [20]. Moreover, Gunter *et al.,* (2015) recorded no significant difference in obesity between males and females among rural elementary school children [21].

In the present study male adolescents tended to have low intake of fibre, omega-3, omega-6, vitamins B1, B2, B3 and B6, biotin, vitamins D, E, K, and A, calcium, iodine, folate, phosphorus and zinc, while their intake of protein and carbohydrates was higher as compared to the DRI. On the other hand, female adolescents tend to have low intake of fibre, omega-3, omega-6, vitamins B1, B2, B3 and B6, biotin, vitamins A, D, C, E, and K, calcium, iodine, folate, phosphorus iron, and zinc, while they tended to have high intake of protein and carbohydrates as compared to the DRI. Many studies reported high consumption of carbohydrates and fat, and inadequate consumption of micronutrients such as iron, zinc, calcium and potassium, as well as vitamins C, A, and D and folic acid among male and female adolescents [22-24].

The current study found no significant differences in energy intake (kcal/day) between male and female adolescents. This result might be explained by the same dietary habits for both males and females of this age group in school and at home. These findings are in agreement with data obtained from previous studies [25-27]. These authors revealed that no significant differences in the percentage contribution of macronutrients from total daily energy intake between males and females. However, the daily mean intake of protein was significantly higher in male adolescents than females. Kenmogne-Domguia *et al*., (2016) showed that the daily intakes of proteins were higher for male than for female adolescents aged from 14 to 18 years [28]. This difference in protein intake might be due to the high consumption of meat and processed meat among male adolescents. It is worth mentioning that protein intake among male and female adolescents in the present study was adequate compared to dietary guidelines established by the American Heart Association. In agreement with our findings, protein intake contribution to energy recall for one day in public schools adolescents in the eastern part of France was found to be high in male and female adolescents in term of percentage of the daily energy and as absolute value [29]. Furthermore, the present study showed that the mean daily intake of omega-6 was significantly higher among female adolescents than male adolescents. This might be explained by a higher intake of polyunsaturated fatty acid by a female in comparison with a male which are the main sources of omega-6. This finding is in disagreement with data obtained from O'Sullivan *et al*., (2011) who reported that boys had a higher daily mean intake of omega-6 than girls [30].

Besides, our findings did not show any significant differences in micronutrient intakes between males and females, except for calcium intake which was significantly higher in male adolescents and for vitamin D and vitamin E intakes which were significantly higher in female adolescents. In agreement with our study, Sjöberg *et al.,* (2003) reported satisfactory calcium intake among male adolescents, but insufficiency among female adolescents [29]. The intake of calcium was lower than 600 mg/day in 29% of females and 8% of males in France. The higher intake of calcium among males than females in the current study might be due to their high consumption of dairy products. In agreement with our findings, male and female Slovenian adolescents had a low intake of vitamin D [31]. In the absence of endogenous synthesis, this quantity of dietary vitamin D is insufficient to cover the estimated adequate value of vitamin D intake required to ensure 25(OH) D serum concentrations [32].

STUDY LIMITATIONS

The present study had several limitations. Firstly; the high burden of the self-reported 3-day food records on the students, which depends on cognitive processes and perception of serving sizes. Secondly; cultural shame associated with declaring the economic status and affordability of adequate food. However, we tried to overcome this issue by asking the adolescents to complete the questionnaire and food records in privacy. Nonetheless, other confounders were present. Third, there was a lack of information about the physical activity of students. Finally, using (ESHA), an international food database, that tracks the general international market availability of different food types, but not the bioavailable consumption in our country is another limitation in this study.

CONCLUSION

In conclusion, there were no differences among male and female adolescents in the intake of carbohydrate, energy, fibre and fat. Protein intake was significantly higher in male than in female adolescents.

There were no significant differences among male and female adolescents ' intake of micronutrients except for calcium intake which was significantly higher in male adolescents and for vitamin D and E intakes which were significantly higher in female adolescents. Furthermore, micro and macronutrient intakes did not differ among underweight, normal, overweight and obese adolescents except for phosphorus and zinc.

COMPETING INTERESTS

The authors declare that they have no competing or conflict of interest.

AUTHOR CONTRIBUTIONS

RT and HT conceived, designed and supervised the study. TJ collected the data. RT, HT, and TJ were responsible for curation, analysis, and interpretation of the data. RT, TJ, and HT drafted the manuscript. All authors critically reviewed the manuscript and approved the final draft.

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ETHICS POLICIES

The study was conducted following the ethical standards of the responsible committee on human experimentation and with the Helsinki declaration of 1975. The proposal was approved by the Institutional Review Board of the Ministry of Education (3/10/7734).

LIST OF ABBREVIATIONS

% = Percentage

µg = Microgram

ANOVA = Analysis of variance

BMI = Body mass index

CDC = Centres for Disease Control and Prevention

CI = Confidence Interval

G = Gram

I.D = Identity

IU = International unit

Kcal = Kilocalories

Kg = Kilogram

Mg = Milligrams

MOE = Ministry of education

N = Number

RAE = Retinol Activity Equivalent

RE = Retinol Equivalent

SEM = Standard Error of Mean

TFA Calories = Calories from Trans Fatty Acid

SPSS = Statistical package for social science

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