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Research Article
Evaluation of Dietary Quality of Senior High School Students by Healthy Eating Index (HEI-2010)

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Abstract

Background and Objective: The adolescent period is one of the most important stages of life specially to growth and health aspect. The aim of this study was to evaluate diet quality of the senior students and to examine the relationship between the healthy eating index (HEI-2010) and their energy-nutrient intakes. The HEI was developed by the United States Department of Agriculture to provide a single summary of diet quality. **Materials and Methods:** The study was done with 177 volunteering senior high school students. The data were analyzed using Nutrition Information System (BeBiS) program. The HEI scores were classified into 3 categories as "good" (81 and above), "needs improvement" (51-80), "poor" (50 and below). **Results:** While 47.8% of the students with poor diet quality were females, 79% of the females had needs improvement in diet quality. While 52.2% of males had poor diet quality, 20.9% of the males had needs improvement diet quality. The educational level, the monthly income of the families had a significant effect on their HEI categories ($p<0.001$). **Conclusion:** Senior students had a mean total HEI score below 50 points. Students with poor and needs improvement diet quality received 52.6 and 44.4% of their energy needs from carbohydrates. Those with poor and needs improvement diet quality received 13.4 and 17.1% of their energy needs from proteins, respectively. Those with poor and needs improvement diet quality received 33.6 and 38.8% of their energy needs from fats, respectively. Senior students should therefore be educated about good nutritional habits and programs and policies should be developed for awareness.

Key words: Diet quality, healthy eating index, nutrition in adolescents, carbohydrates, family income

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

According to the World Health Organization (WHO), the adolescent period between the ages of 10-19, is one of the important stages of life which shows different alterations in terms of biological, psychological and social aspects[1]. The adolescent period is considered by WHO as a high-risk group in terms of nutritional status[2]. While in this period, when unhealthy foods are started to be consumed, foods with high sugar content and salty-fatty foods especially in fast food style diet are preferred, there is a significant decrease in consumption of healthy foods such as vegetables and fruits, milk and dairy products[3]. The effect of nutrition on the overall health status and disease incidence was researched and various indexes in different forms (global and synthetic) were developed by the researchers in order to evaluate diet quality[4]. Healthy eating index (HEI), one of these indexes, is a means of determining the nutritional status and it is used to evaluate the diet quality of individuals aged 2 years and older[5]. The 2010 version of the index, which was updated in 2013 and consisted of 12 components, was prepared according to the 2010 Dietary Guideline and food patterns of Americans[6]. The 2010 version of the index, which was updated in 2013 and consisted of 12 components, was prepared according to the 2010 Dietary Guideline and food patterns of Americans[7]. The HEI is a useful index for monitoring the nutrition of adolescents and evaluating diet quality successfully[8].

It is observed that the senior high school students in the adolescent period have decreased their physical activities and their eating habits and diet quality have deteriorated under the intensive examination and course program[9]. The aim of this study is to determine the nutritional status and healthy eating index of the senior students of a public and a foundation high school in the city center of Antalya.

MATERIALS AND METHODS

Research place, duration and sample selection: The sample of the study consists of 208 senior students from a public and a foundation high school located in the city center of Antalya and on the dates of the study and after the purpose of the study was announced, 177 students accepted to participate in the study voluntarily. The data were collected between March, 2018 and April, 2018 through a questionnaire. Ethics committee approval of the study was obtained from Akdeniz University Health Sciences Scientific Research and Publication Ethics Committee with the agenda numbered 02/1 on 19/12/2017.

General research plan: The information obtained from the study (information about the individual and family, health information, information on nutrition habits, information about physical activity, food consumption frequency form and 24 h dietary recall form) were obtained through the questions in the questionnaire form.

Calculation of healthy eating index-2010 (HEI-2010) score: Healthy eating index-2010 consists of 12 components in total. The first 9 (total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids) show the adequacy of diet, the last 3 (refined grains, sodium, empty calories) indicate the products which should be limited[10]. Healthy each component has its own standards. Scores show a proportional increase in consumption in the first 9 qualification components. In the limited consumption component, low consumption increases the score. Healthy eating index-2010 is evaluated maximum total score of 100 points. If the score is below 50, it is defined as "poor" diet quality. If it is in the range of 50 and 80, it is considered as "needs improvement" and if it is above 80 diet quality is "good"[11]. In the calculations, for the food consumption records of the individuals 24 h dietary recall form was used and the daily energy and nutrient intake of each individual was calculated with BeBiS.

Total fruit: The total fruit component is the fruit consumption/1000 calories of the energy taken/day. If there is a consumption of 192 g or more fruits "5" points are given and if there is no consumption "0" point is given[12].

Whole fruit: The whole fruit component is the consumption of fresh, canned, frozen and dried fruits/1000 calories/day of energy intake. Fresh fruit juice is outside this group. If there is a consumption of 96 g and above, "5" points are given and if there is no consumption "0" point is given[12].

Whole vegetable: The total vegetable component is the consumption of vegetables/1000 calories of the energy taken/day. If there is a consumption of 264 g or more "5" points are given and if there is no consumption "0" point is given[12].

Green and beans: The greens and beans component is the consumption of dark green vegetables, legumes and peas/1000 calories of the energy taken daily. The "5" points are given if there is a consumption of 48 g or more and if there is

no consumption "0" point is given. If the total protein food category score is not fully met, the amount to be met was transferred to the total protein food and seafood and plant proteins categories, when the total protein food category score is fully met, the remaining amount is included in this category (greens and beans) and the total vegetable component[12].

Whole grains: The whole grains component is the consumption of whole grains/1000 calories of daily energy. "10" points are given if there is a consumption of 42.52 g or more and "0" point is given if there is no consumption[12].

Dairy: The dairy component is the consumption of milk, yoghurt, cheese and all other dairy products per 1000 calories per day of energy intake. If there is a consumption of 312 g and above, "10" points are given and if there is no consumption, "0" point is given[12].

Total protein foods: The total protein foods component is the consumption of seafood, lean red meat, poultry, eggs, legumes, peas and oilseeds/1000 calories of energy intake/day. The "5" points are given if there is a consumption of 70.87 g or more and "0" point is given if there is no consumption[12].

Seafood and plant proteins: The component of seafood and plant proteins is the consumption of seafood, plant-based proteins and oilseeds/1000 calories of energy taken/day. If there is a consumption of 22.68 g or more, "5" points are given and if there is no consumption "0" point is given[12].

Fatty acids: The fatty acids component is the ratio of (PUFA+MUFA)/saturated fatty acid. If this ratio is 2.5 or higher, "10" points is given and if it is 1.2 and below "0" point is given[12].

Refined grains: The refined grains component is the consumption of processed grains/1000 calories of the energy taken/day. If there is consumption of 51.03 g and below, "10" points are given, "0" point is given if there is consumption of 121.90 g and above[12].

Sodium: The sodium component is the consumption of sodium per 1000 calories of the energy taken/day. The "10" points are given if there is a consumption of 1.1 g or less and "0" point is given if there is a consumption of 2 g or more[12].

Empty calories: The component of empty calories include energy from solid fats, alcohol and added sugar. The "20" points are given if empty calories below 19% or less than the daily energy intake and "0" point is given if they are above 50% or more[12].

Statistical analyses: In the study, 24th version of SPSS analysis program was used. Chi-square test was used when two or more independent groups were compared in the categorical variables. In terms of comparing the mean value of the difference between groups with 2 categories (e.g., male and female) t-test was used. On the other hand, the statistical relationship between two continuous variables was measured by pearson correlation coefficient test. The results of the analysis are within the 95% confidence interval. In addition, the level of statistical significance was assumed to be significant at $p<0.05$.

RESULTS

A total of 177 senior high school students participated in the survey. The 98 (55.4%) of them were female and 79 (44.6%) were male students. The 48% of female students were 17 years old and 48.1% of male students were 17 years old. On the other hand, 52% of female students were 18 years old and 51.9% of male students were 18 years old. It was observed that the rate of female students (46.9%) in foundation high school was higher than male students (35.4%). While 53.1% of the females were studied in the public high school, 64.6% of the students were male. When the education level of the mothers of both male and female students was examined, 42.4% were university graduates (F = 42.9%, M = 41.8%). The 15.8% of the mothers of the students were primary school, 11.9% were secondary school and 29.9% were high school graduates. It was seen that the educational level of the fathers of the students was slightly higher than that of the mothers. Although these rates were quite balanced for female and male students, 10.2% of the fathers of the students were primary, 9% were secondary, 29.9% were high school and 50.8% were university graduates. The 15.3% of both male and female students (F = 15.3%, M = 15.2%) did not want to indicate the monthly income of their families. The ratio of students with monthly income of 1500 TL or less (n = 6) to all students was 3.4% (F = 5.1%, M = 1.3%). The proportion of students with monthly income of 1501-3000 TL was 27.1% (F = 26.5%, M = 27.8%), the proportion of students with monthly income of

Table 1: Anthropometric measurements of students by gender

	Female				Male				t-test	
Anthropometry	X	SD	Minimum	Maximum	X	SD	Minimum	Maximum	t-value	p-value
Height (cm)	164.54	6.07	151.0	182.0	180.18	6.73	160.0	198.0	-16.23	<0.001
Weight (kg)	59.54	8.55	42.6	84.1	76.33	12.97	54.1	119.2	-9.90	<0.001
BMI (kg m^{-2})	22.03	3.32	14.9	33.5	23.40	3.62	166.0	34.8	-2.63	<0.001

p<0.05 was accepted as statistically significance, X: Mean value

Table 2: Comparative statistics of students' BMI classification by gender

	Female		Male (n = 79)		Total (n = 177)			
BMI percentile	Number	Percentage	Number	Percentage	Number	Percentage	Chi-square	p-value
Weak (<3.p)	2	2.0	0	0.0	2	1.1		
Risk of weakness (3-15.p)	6	6.1	4	5.1	10	5.6		
Normal (15-85.p)	72	73.5	38	48.1	110	62.1	17.863	0.001
Mildly obese (85-97.p)	13	13.3	29	36.7	42	23.7		
Obese (>97.p)	5	5.1	8	10.1	13	7.3		

p<0.05 was accepted as statistically significance

3001-5000 TL was 19.8% (F = 16.3%, M = 24.1%) and 5001 TL and above was 34.5% (F = 36.7%, M = 31.6%). Table 1 shows the anthropometric measurements of the students by gender. When the height, weight and body mass index (BMI) of the students were examined, the measurement values of male students were higher than that of female students in all three units of measurement and the difference was statistically significant. In this respect, the average height of males (X = 180.18) was higher than the average height of females (X = 164.54), the average weight of males (X = 76.33) was higher than the average weight of females (X = 59.54) and the average of males' BMI (X = 23.40) was higher than that of females (X = 22.03). These mean differences were statistically significant (p<0.001 for all three).

Table 2 shows the comparative statistics of students' BMI percentile classification by gender. Accordingly, 1.1% of individuals were weak (F = 2%, M = 0), 5.6% were under the risk of weakness (F = 6.1%, M = 5.1%), 62.1% were normal (F = 73.5%, M = 48.7%), 23.7% were mildly obese (F = 13.3%, M = 36.7%), 7.3% were obese (F = 5.1%, M = 10.1%). It was understood that the ratio of male students in the mildly obese and obese categories was higher than female students.

As a result of the chi-square test, a statistically significant difference was found between gender and BMI percentile categories (p = 0.001).

According to the frequency of food consumption by students, the proportion of students who consumed pasteurized/UHT whole milk every day was found 20% for both male and female students. While 24.5% of female students never consumed pasteurized/UHT whole milk, this rate was 19% for males. The majority of students never consumed raw milk (M = 68.4%, F = 73.5%). Yoghurt (38.8%), full-fat cheese (33.7%) and pasteurized/UHT milk (21.4%) were found the most consumed products by female students in dairy products. In male students, the most consumed dairy products were full-fat cheese (34.2%), yoghurt (22.8%), pasteurized milk (19%) and kashar cheese (19%). Kefir (79.6%), raw milk (73.5%) and semi-skimmed milk (67.3%) were never consumed by female students in dairy products. In male students, dairy products that were never consumed were kefir (78.5%), raw milk (68.4%) and semi-skimmed milk (67.1%). In the meat-egg-legumes-oilseed group, the most consumed products by female students each day were oil seeds (33.7%) and eggs (25.5%). In male students, the most consumed products were eggs (35.4%), oilseeds (19%) and red meat (8.9%). The products that were never consumed by female students in meat-egg-leguminous-oilseed products were other poultry (69.4%), offal (66.3%) and salami/sausage (21.4%), respectively. In male students, meat-egg-legumes-oilseed products that never consumed were found other poultry (57%), offal (44.3%) and salami/sausage (7.6%). Fresh fruits (42.9%), green leafy vegetables (39.8%) and dried fruits (21.4%) were the most consumed products of female students in vegetable and fruit products every day. In male students, the most consumed vegetables and fruit products were found fresh fruits (36.7%), green leafy vegetables (27.8%) and other vegetables (21.5%). While 12.2% of female students never consumed dried fruits, this rate was 20.3% for male students. Among bread and cereal products, white bread was the most consumed product for both male and female students (72.2 and 51%, respectively). While 13.9% of male students stated that they consume brown bread every day, this rate was higher in female students (19.4%). The 38% of male students and 34.7% of female students did not consume breakfast cereals at all. The proportion of female students who never consumed white bread (24.5%) was about 3 times higher than that of male students who never consumed white bread (7.6%).

Table 3: Comparative statistics of energy and nutrient intake by gender

	Female		Male		Total		t-test	
Energy and nutrients	X	SD	X	SD	X	SD	t-value	p-value
Energy (kcal)	1753.4	362.7	2632.6	354.5	2145.8	566.0	-16.194	<0.001
Carbohydrate (g)	213.5	651.0	338.6	66.9	269.3	90.6	-12.551	<0.001
Protein (g)	61.6	17.9	90.3	20.5	74.4	23.8	-9.955	<0.001
Fat (g)	70.8	18.6	99.1	18.4	83.5	23.2	-10.121	<0.001
Saturated fatty acid (g)	29.5	8.5	41.7	9.4	35.0	10.7	-8.996	<0.001
MUFA (g)	25.4	7.7	35.4	8.7	29.9	9.5	-8.105	<0.001
PUFA (g)	11.6	5.5	I 5.4	6.4	13.3	6.2	-4.269	<0.001
Dietary fiber (g)	17.5	6.0	22.1	7.4	19.6	7.0	-4.547	<0.001

p<0.05 was accepted as statistically significance, X: Mean value

Looking at sugar and sweet products, 54.1% of the female students and 32.9% of the male students did not add any sugar in the tea. Chocolate/wafer (37.8%), biscuit (30.6%) and honey (14.3%) were the most preferred sugar and sweet products of the female students. The most preferred sugar and sweet products of male students were similar and chocolate/wafer (25.3%), biscuit (25.3%) and honey (13.9%) respectively. 38.8% of the female students did not consume molasses and candy. In males, this rate was 26.6 and 16.5%, respectively. Among the milk, fruit and pastry desserts, it was stated that both female and male students consume fruit desserts the less (F = 22.4%, M = 13.9%). Among the fats and oils, olive oil was the most consumed type of oil for both female and male students every day (F = 54.1%, M = 49.4%). Margarine was the least consumed for both female and male students (F = 53.1%, M = 32.9%). For both female and male students, the 2 most consumed beverages were tea and coffee each day (F = 61.2% and 59.2%, M = 65.8 and 54.4%). While 35.7% of female students never consumed carbonated soft beverages, this rate was 17.7% for males. Half of the females and 35% of the males stated that they never consumed fruit flavored soda. Finally, in the hamburger/pizza, pita/lahmacun and French fries categories, the rate of female students who never consume these products was found higher (9.2, 11.2 and 10.2%) than male students (5.1, 2.5 and 3.8%, respectively).

Energy and nutrient intake of students: Table 3 presents comparative statistics of students' energy and nutrient intake by gender. When the data in Table 3 were examined, it was observed that the mean values of males were higher than the mean values of female students in all of the energy, carbohydrate, protein, fat, saturated fatty acid, MUFA, PUFA and dietary fiber and the differences between the genders in all these items were found to be statistically significant (p<0.001) for all test results.

Table 4 shows the comparative statistics of vitamin and mineral intake by gender. According to the data, the mean values of vitamin K and Niacin for female students (X = 86.1 and X = 7.6, respectively) were found higher than the mean values of vitamin K and Niacin for males (X = 79.9 and X = 7.3, respectively). For vitamin C the mean value was found equal both for males and females (X = 82.7). It was observed that the mean value of males was higher than that of females in all items in Table 4 except these 3 items. In Table 4, there were vitamins and minerals in which the difference between the mean values of male and females were not found statistically significant. These were vitamin A (p>0.05), vitamin C (p>0.05), vitamin K (p>0.05) and niacin (p>0.05). In all vitamin and mineral intake except these four items, the mean value of males was higher than that of females and these differences were statistically significant. Table 4 shows adequate intake amounts for both female and male students for the 17 and 18 age groups according to TUBER-2015.

Vitamins and minerals that higher than adequate intake in female students were sodium, phosphorus, vitamin a, copper, riboflavin, vitamin K and niacin. In the other vitamins and minerals in the table, the current values of female students were lower than the required values. In males, vitamins and minerals that exceed the expected value were sodium, phosphorus, copper, biotin, vitamin B12, vitamin A, iron, riboflavin, pantothenic acid, vitamin E, iodine, niacin, vitamin B6 and magnesium. In the other vitamins and minerals in the table, the present values of male students were found lower than the required values.

Table 5 shows the comparative statistics of the distribution of the daily energy intake by the students according to gender. Accordingly, the percentage of female students' daily energy intake from carbohydrates was X = 49.17, while male students' was X = 52.52. This ratio difference was statistically significant (p = 0.003).

Table 4: Comparative statistics of student' vitamin and mineral intake by gender

	Female				Male				t-test	
	Intake		DRI		Intake		DRI			
Vitamins and minerals	X	SD	TUBER (17 years)	TUBER (18 years)	X	SD	TUBER (17 years)	TUBER (18 years)	t-value	p-value
Vit A (mcg)	832.7	512.5	650.0	650.0	878.7	421.5	750.0	750.0	-0.642	0.522
Vit B6 (mcg)	1.0	0.4	1.2	1.2	1.4	0.7	1.3	1.3	-4.512	<0.001
Vit B12 (mcg)	3.0	2.8	4.0	4.0	4.8	2.4	4.0	4.0	-4.544	<0.001
Vit C (mg)	82.7	45.3	90.0	95.0	82.7	52.0	100.0	110.0	0.001	0.999
Vit E (mg)	10.9	4.5	11.0	11.0	14.7	6.1	13.0	13.0	-4.585	<0.001
Vit K (mcg)	86.1	79.0	75.0	75.0	79.9	57.3	75.0	75.0	0.587	0.558
Mate (mcg)	235.7	86.6	330.0	330.0	287.7	102.0	330.0	330.0	-3.668	<0.001
Niacin (mg/1000 kcal)	7.6	3.7	6.7	6.7	7.3	2.8	6.7	6.7	0.762	0.447
Thiamine (mg)	0.8	0.2	1.0	1.0	1.1	0.3	1.2	1.2	-7.560	<0.001
Riboflavin (mg)	1.1	0.3	1.0	1.0	1.5	0.4	1.3	1.3	-6.675	<0.001
Biotin (mcg)	33.3	12.1	35.0	40.0	45.8	15.5	35.0	40.0	-6.053	<0.001
Pantothenic acid (mg)	4.2	1.0	5.0	5.0	5.8	1.4	5.0	5.0	-8.526	<0.001
Calcium (mg)	749.8	238.7	1150.0	1000.0	897.6	336.1	1150.0	1000.0	-3.295	0.001
Iron (mg)	9.3	2.9	13.0	11-16.0	13.1	3.4	11.0	11.0	-7.847	<0.001
Copper (mg)	1.4	0.4	1.1	1.3	2.0	0.4	1.3	1.6	-9.957	<0.001
Magnesium (mg)	255.7	80.5	250.0	300.0	329.5	100.4	300.0	350.0	-5.429	<0.001
Phosphorus (mg)	997.0	266.4	640.0	550.0	1306.8	278.9	640.0	550.0	-7.533	<0.001
Sodium (g)	2.8	1.1	1.5	1.5	4.2	1.2	1.5	1.5	-8.293	<0.001
Potassium (g)	2.2	0.7	4.7	4.7	2.6	0.9	4.7	4,7.0	-4.110	<0.001
Zinc (mg)	7.4	2.2	11.9	7.5-12.7	11.6	3.1	14.2	9.4-16.3	-10.220	<0.001
Iodine (mcg)	117.7	53.1	130.0	150.0	157.6	50.6	130.0	150.0	-5.066	<0.001

p<0.05 was accepted as statistically significance, X: Mean value

Table 5: Comparative statistics of the distribution of daily energy intake by students according to gender

	Female		Male		Total		t-test	
Energy distribution (%)	X	SD	X	SD	X	SD	t-value	p-value
Carbohydrate	49.17	8.56	52.52	6.33	50.67	7.80	-2.987	0.003
Protein	14.70	4.66	13.91	2.78	14.35	3.94	1.402	0.163
Fat	36.12	6.99	33.51	5.78	34.95	6.59	2.725	0.007

p<0.05 was accepted as statistically significance, X: Mean value

On the other hand, the difference between the percentage of female students' daily energy intake from protein (X = 14.70) and the percentage of male students' daily energy intake from protein (X = 13.91) were not found to be statistically significant (p>0.05). Finally, the percentage of female students' daily energy intake from fat was X = 36.12, while male students' was X = 33.51. This ratio difference was found to be statistically significant (p = 0.007).

Findings of healthy eating index 2010 (HEI-2010) of students: Table 6 presents the comparative statistics of the students' total scores and components of healthy eating index-2010 (HEI-2010) by gender. According to these data, the mean total HEI score (X = 43.9) of female students was found higher than the mean total HEI score of female students (X = 37.6) and this difference was statistically significant (p = 0.001). On the other hand, the mean total HEI score of both female and male students was <50 points (X = 41.1). In this regard, it was understood that the healthy eating index of senior high school students participating in the survey was low in both male and female students. In terms of the components of the HEI, it was seen that the component scores of the female students were higher in the total fruit, total vegetables, greens and beans, whole grains, dairy and refined grains component scores than the male students and the difference was statistically significant (p = 0.019, p<0.001, p<0.001, p = 0.001, p = 0.02, p<0.001 respectively).

On the other hand, the only component in Table 6 where the male score is high and the score difference is statistically significant was total protein foods. The mean total HEI score (X = 4.21) of male students was higher than the mean score of female students (X = 3.4) and the difference was found statistically significant (p = 0.006). There was no statistically significant difference between gender in terms of total fruit, seafood and plant proteins, fatty acids, sodium and empty calories, which are the components of the HEI in Table 6 (p>0.05).

Table 6: Comparative statistics of students' HEI total scores and components by gender

	Female		Male		Total			
HEI total score and components	X	SD	X	SD	X	SD	t-value	p-value
Total HEI-2010 score (100)	43.9	16.0	37.60	10.0	41.10	14.0	3.240	0.001
Total fruit (5)	1.21	1.4	0.78	1.0	1.02	1.3	2.376	0.019
Whole fruit (5)	1.90	2.2	1.47	1.9	1.71	2.0	1.417	0.158
Total vegetables (5)	1.78	1.2	0.92	0.7	1.40	1.1	5.853	<0.001
Greens and beans (5)	2.07	2.0	1.04	1.4	1.61	1.8	4.039	<0.001
Whole grains (10)	2.50	3.8	0.95	2.4	1.81	3.3	3.316	0.001
Dairy (10)	4.03	2.8	2.91	2.0	3.53	2.5	3.094	0.002
Total protein foods (5)	3.40	2.1	4.21	1.8	3.76	2.0	-2.801	0.006
Seafood and plant proteins (5)	1.28	1.9	1.49	2.2	1.37	2.0	-0.69	0.491
Fatty acids (10)	1.54	2.6	1.14	1.9	1.36	2.3	1.180	0.24
Refined grains (10)	3.62	3.8	1.44	2.8	2.65	3.6	4.398	<0.001
Sodium (10)	4.74	4.0	4.64	3.5	4.69	3.8	0.181	0.857
Empty calories (20)	15.9	4.3	16.70	2.6	16.20	3.6	-1.527	0.129

p<0.05 was accepted as statistically significance, X: Mean value

Table 7: Comparative statistics of the general characteristics of the students according to HEI categories

	Poor		Need improvements			
General characteristics	Number	Percentage	Number	Percentage	Chi-square	p-value
Age						
17	65	48.5	20	46.5	-0.227	0.821
18	69	51.5	23	53.5		
Gender						
Female	64	47.8	34	79.1	4.105	<0.001
Male	70	52.2	9	20.9		
School						
Public high school	82	61.2	21	48.8	-1.43	0.155
Foundation high school	52	38.8	22	51.2		
Education level of mother						
Primary	25	18.7	3	7.0	-2.307	0.023
Secondary	18	13.4	3	7.0		
High school	37	27.6	16	37.2		
Collage/University	54	40.3	21	48.8		
Education level of father						
Primary	15	11.2	3	7.0	-1.571	0.118
Secondary	13	9.7	3	7.0		
High school	43	32.1	10	23.3		
Collage/University	63	47.0	27	62.8		
Monthly income						
Does not know/want to share	22	16.4	5	11.6	-2.224	0.027
1500 TL and below	6	4.5	0	0.0		
1501-3000 TL	40	29.9	8	18.6		
3001-5000 TL	26	19.4	9	20.9		
5001 TL and above	40	29.9	21	48.8		

p<0.05 was accepted as statistically significance

In Table 7, the general characteristics of the students are compared according to the diet quality categories of "poor" and "needs improvement". Those with a total score of 0-50 according to HEI were included in the "poor" diet quality and those with a score of 51-80 were included in the "needs improvement". Since there were no students with good diet quality in the sample group, so there was no good diet quality group in the analyzes.

Looking at the age groups, 48.5% of the students in the 17 years old had "poor" diet quality, while this ratio was 51.5% in the 18 years old. No significant difference was found between age and HEI categories (p>0.05). While 47.8% of the students with poor diet quality were females, 79% of the females had needs improvement diet quality. While 52.2% of males had poor diet quality, 20.9% of the males had needs improvement diet quality. A statistically significant difference was found between gender and HEI categories (p<0.001). While 48.8% of the students had needs improvement diet quality in public high schools, 51.2% of students in foundation high school. No statistically significant difference was found between studying in public or foundation high school and HEI categories (p>0.05).

Table 8: Comparative statistics of the students' BMI percentile classification according to the HEI categories

	Poor		Need improvements			
BMI percentile	Number	Percentage	Number	Percentage	Chi-square	p-value
Weak (<3.p)	1	0.7	1	2.3	2.775	0.007
Risk of weakness (3-15.p)	8	6.0	2	4.7		
Normal (15-85.p)	76	56.7	34	79.1		
Mildly obese (85-97.p)	37	27.6	5	11.6		
Obese (>97.p)	12	9.0	1	2.3		

p<0.05 was accepted as statistically significance

Table 9: Comparative statistics of students' energy and nutrient values according to HEI categories

	Poor		Need improvements		t-test	
Energy and nutrients	X	SD	X	SD	t-value	p-value
Energy (kcal)	2262.06	559.61	1783.48	416.16	5.999	<0.001
Carbohydrate (g)	293.74	85.01	193.17	60.68	8.513	<0.001
Protein (g)	75.14	24.38	72.08	22.03	0.733	0.465
Fat (g)	85.32	23.87	77.65	20.18	1.900	0.059
Saturated fatty acid (g)	36.76	10.80	29.35	8.50	4.644	<0.001
MUFA (g)	29.94	9.68	29.71	9.08	0.137	0.891
PUFA (g)	13.14	6.24	13.69	6.24	-0.498	0.619
Dietary fiber (g)	19.16	6.75	20.88	7.62	-1.404	0.162

p<0.05 was accepted as statistically significance, X: Mean value

While 67.9% of the mothers of the students with poor diet quality were high school or university graduates, 86% of the mothers of the students with poor diet quality were high school or university graduates. The educational level of the mothers of the students had a significant effect on their HEI categories (p = 0.023). The educational level of the fathers did not have a significant effect on their diet quality (p>0.05).

The monthly income of the families of the students with needs improvement diet quality was higher than the monthly income of the families of the students with poor diet quality and having different levels of monthly income had a significant effect on the HEI categories (p = 0.027).

Table 8 presents the comparative statistics of the BMI classification of the participants according to the HEI categories. While 56.7% of the students with normal BMI percentile had poor diet quality, this rate was 79.1% for the needs improvement diet quality. While 36.6% of the students with poor diet quality were mildly obese and obese, 13.9% of the students with poor diet quality were mildly obese and obese. As a result of the chi-square test, it was seen that the HEI categories had a significant effect on the students' BMI percentile classification (p = 0.007).

Table 9 presents the comparative statistics of the energy and nutrient values of the students according to the HEI categories. According to these data, the mean energy value of the students with poor diet quality (X = 2262.06) was higher than the mean energy value of the students with needs improvement diet quality (X = 1783.48) and the difference was found to be statistically significant (p<0.001).The mean carbohydrate value of the students with poor diet quality (X = 293.74) was higher than the mean carbohydrate value of the students with needs improvement diet quality (X = 193.17) and the difference was statistically significant (p<0.001). The difference between the mean protein value of the students with poor diet quality (X = 75.14) and the mean protein value of the students with needs improvement diet quality (X = 72.08) was not found to be statistically significant (p>0.05).

The difference between the mean fat value of the students with poor diet quality (X = 85.32) and the mean fat value (X = 77.65) of the students with needs improvement diet quality was not found to be statistically significant (p>0.05). The mean saturated fatty acid value of the students with poor diet quality (X = 36.76) was higher than the mean saturated fatty acid value of the students with needs improvement diet quality (X = 29.35) and the difference was statistically significant (p<0.001).

The difference between the mean MUFA value of the students with poor diet quality (X = 29.94) and the mean MUFA value of the students with needs improvement diet quality (X = 29.71) was not found to be statistically significant (p>0.05).

The difference between the mean PUFA value of the students with poor diet quality (X = 13.14) and the mean PUFA value of the students with needs improvement diet quality (X = 13.69) was not found to be statistically significant (p>0.05). Finally, the difference between the mean value of dietary fiber (X = 19.16) of students with poor dietary quality and the mean value of dietary fiber (X = 20.88) of students with needs improvement diet quality (X = 19.16) was not found to be statistically significant (p>0.05).

Table 10: Comparative statistics of the percentages of the nutrients that meet daily energy requirements of students according to HEI categories

Nutrients (%)	X	SD	X	SD	t-value	p-value
Carbohydrate	52.66	6.68	44.47	7.87	6.69	<0.001
Protein	13.46	2.92	17.12	5.28	-4.33	<0.001
Fat	33.69	6.21	38.88	6.24	-4.76	<0.001

p<0.05 was accepted as statistically significance, X: Mean value

Table 11: Correlation between energy, macronutrients, dietary fiber values and HEI scores of students

	Females		Males		Total	
Healthy eating index	r-value	p-value	r-value	p-value	r-value	p-value
Energy (kcal)	-0.274**	0.006	-0.156	0.17	-0.318**	0.00
Protein (g)	0.291**	0.004	0.224*	0.047	0.062	0.411
Carbohydrate (g)	-0.494**	0.000	-0.385**	0.00	-0.471**	0.00
Fat (g)	0.037	0.718	0.127	0.267	-0.088	0.246
Dietary fiber (r)	0.268**	0.008	0.442**	0.00	0.220**	0.003

Pearson correlation coefficient test was used for calculations of p-values, *p<0.01, **p<0.01

Table 10 shows the comparative statistics of the percentages of the nutrients that meet daily energy requirements of the surveyed students according to their diet quality. When the data in Table 10 are analyzed, the students with poor diet quality received an average of 52.66% of their energy needs from carbohydrate, while students with needs improvement diet quality received 44.47% of their energy needs from carbohydrate and this difference was statistically significant (p<0.001). On the other hand, students with poor diet quality received an average of 13.46% of their energy needs from proteins, while students with needs improvement diet quality received an average of 17.12% of their energy needs from protein and this difference was statistically significant (p<0.001).

Finally, students with poor diet quality received 33.69% of their energy needs from fats, while students with needs improvement received 38.88% of their energy needs from fats and this difference was statistically significant (p<0.001). As a result; while carbohydrates had a higher proportion among the students who had poor diet quality than the students with needs improvement diet quality in terms of meeting their daily energy needs, proteins and fats had a higher proportion among the students with needs improvement than the ones who had poor diet quality.

Table 11 presents the correlation coefficients between the energy, macronutrients, dietary fiber intake values and the HEI scores of the students and the statistical significance levels of these coefficients. In terms of all students, no correlation was found between the protein and fat values of the students and their healthy eating index scores (r (175) = 0.062, p>0.05, r (175) = -0.088, p>0.05, respectively). There was a statistically significant, positive correlation between HEI and dietary fiber values (r (175) = 0.220, p = 0.003). In this respect, as the dietary fiber values of the students increased, the total scores of the HEI increased in the same direction. On the other hand, there was a statistically significant, negative correlation between HEI scores and both energy and carbohydrate values (r (175) = -0.318, p<0.001, r (175) = -0.471, p<0.001). In this respect, as the energy and carbohydrate values of the students increased, the total scores of the HEI decreased.

When the relationship between female and male students' HEI values and energy, protein, carbohydrate, fat and dietary fiber values were examined separately, the correlation between HEI and protein, which was found to be statistically insignificant in all students' correlation analysis, had positive in female students and statistically significant (r (96) = 0.291, p = 0.004). The relationship between HEI and protein was found to be positive and statistically significant in males (r (77) = 0.224, p = 0.047). In this respect, as the protein values of both male and female students increased, the total scores of the HEI showed a positive increase.

On the other hand, there was a statistically significant relationship between HEI and energy (r (175) = -0.318, p<0.001) in the correlation analysis of all students, there was no found statistically significant in male students (r (77) = -0.156, p>0.05). Finally, in the correlation analysis of all students, the relationship between the HEI and dietary fiber (r = 0.220), which was found to be statistically significant, was found to be statistically significant in male students, too (r (77) = 0.442, p<0.001). Compared to the correlation coefficient of female students (r = 0.268), the strength of the relationship between male students' HEI values and dietary fiber values is about twice as strong as that of female students.

DISCUSSION

Adolescent period is a period in which physiological energy and nutrient requirements increase. In the studies conducted in our country, it was observed that the Daily energy intake by adolescents was below the recommendations[13]. Kılınç and Çağdaş[14] in a study conducted with adolescents found that the energy intake of female students was 1927 kcal. Turkey Nutrition and Health Survey (TBSA-2010) states that the daily energy intake for females at 15-18 age group is 1701 kcal/day and for males 2288 kcal/day[15]. In this study, daily energy intake was 1753.4±362.7 kcal/day for females students and 2632.6±354.5 kcal/day for male students.

According to TBSA-2010 data, 15-18 age group female and male adolescents received 221 g, 300 g carbohydrate, respectively and the contribution of carbohydrate to daily energy was found to vary[15] between 53.6 and 54.7%. In this study, similar results were found with TBSA-2010 in daily carbohydrate intake and contribution to energy. According to this, daily carbohydrate intake of female and male students was 213±65.1 and 338.6±66.9 g respectively and the percentage of contribution of CHO to energy was 49.17±8.56 and 52.52±6.33, respectively.

In studies conducted on the nutritional status of adolescents, it is determined that protein is usually sufficient and even slightly above the recommended level[16]. According to TBSA-2010 data, it was observed that female and male adolescents received 48.8 and 68 g protein daily in the 15-18 age group and the percentage of protein contribution to daily energy ranged[15] between 12.1 and 12.5%. In this study, it was found that the daily protein intake of male and female students was slightly above the recommended. Protein intake for female and male students was 61.6±17.9 and 90.3±20.5 g, respectively and the percent of the contribution of protein to energy was 14.7±4.66 and 13.91±2.78, respectively.

The contribution of fat to daily energy according to TBSA-2010 for female and male adolescents in the 15-18 age groups ranged between 32.7 and 34.8%, respectively[15]. In this study, the percentage of fat contribution to daily energy was found to be 36.12±6.99 and 33.51±5.78 in female and male students, respectively. The type of fat consumed in healthy nutrition is important. While saturated fat consumption is associated with the risk of cardiovascular disease and certain types of cancer, it is reported that unsaturated fatty acids such as omega-3 and olive oil reduce this risk[17]. In this study, more saturated fat consumption was found in students with poor diet quality. No significant difference was found between MUFA and PUFA intake and diet quality categories ($p>0.05$).

Dietary fiber has a significant place in the prevention of obesity, cardiovascular disease, constipation and diabetes[18]. Farvid *et al.*[19] examined the relationship between breast cancer and fiber intake during adolescence and early adulthood and reported that breast cancer risk was lower in women fed with fiber-rich in foods. In a study conducted in the United States between 2001 and 2010, it was reported that adolescents consumed 13.2 g of dietary fiber per day in their diet, which was not sufficient for normal body functions[20]. According to TBSA-2010 data, dietary fiber intake in males aged 15-18 is 23.2 g and in females is 18.9 g[15]. In this study, dietary fiber intake of males was found to be 22.1±7.4 and 17.5±6.0 g for female students.

Iron is a micronutrient necessary for the maintenance and functioning of vital functions that have important functions in the body. In the studies, it was observed that the daily iron intake of male students was high and the female students were insufficient. Iron malnutrition during adolescence, due to menstrual losses for girls may lead to iron deficiency or iron deficiency anemia[21]. The prevalence of anemia in adolescents in our country varies by region between[22] 30-78%. According to TBSA-2010, daily iron intake was found to be 12.1 mg in males and 9.7 mg in females aged[15] 15-18. In this study, similar results were obtained with TBSA-2010, daily iron intake was 13.1±3.4 mg for males and 9.3±2.9 mg for female students.

Camhi *et al.*[23] in a study evaluating the diet quality by HEI of adolescents found a total score of 51.5±9.07. Koc and Yardimci[24] in a study with adolescents found a total score of 50.2±9.4. No gender differences were observed in either study. In this study, the total HEI score was found to be 41.1±14 and the females' HEI score (43.9±16) was higher than that of the males' HEI score (37.6±10) and the difference was statistically significant ($p = 0.001$). The diet quality of adolescents in a study is the ones having poor and needs improvement categories. Energy intake showed similar results for both categories and protein intake was found to be higher in needs improvement diet quality. In the other study, more fiber intake was found in individuals with needs improvement diet quality compared to poor diet quality[24]. In this study, energy and carbohydrate intake were higher in the poor diet quality compared to needs improvement diet quality. Protein intake and dietary fiber were similar in both diet quality categories. In a study conducted by Tande *et al.*[25] with the data obtained from NHANES III in order to determine the relationship between HEI and abdominal obesity, HEI component scores were found to be associated with abdominal obesity. In the present study, the proportion of students in the poor diet quality who are mildly obese and obese was higher compared to needs improvement diet

quality[26]. In a study by Singh *et al.*[27], the prevalence of obesity was found to be 2.7 times higher in children of low-income families compared to children of high-income families. In this study, the monthly income of the families of the students in poor diet quality was found to be low compared to needs improvement diet quality.

Inadequate consumption of dairy products may cause nutrients such as calcium, protein and B12 not to reach the recommended levels. In the last TBSA-2010 report, dairy products consumption was found to be low in all age groups. According to TBSA-2010, it is reported that consumption of dairy products is 176.2 g for females and 130.8 g for males in 15-18 age group[15]. In a study by Rodrigues *et al.*[28], one of the lowest diet quality components was found to be the dairy. In this study, the total component score of the dairy (3.53±2.5) was found to be low, similar to the results of other studies.

In adequate consumption of vegetables and fruits has a very high prevalence in various age groups in Europe and America. Especially in adolescents, it is reported that Daily vegetable-fruit consumption is low and they consume less than 1 serving of fruit and vegetable daily[29]. According to TUBER-2015, daily vegetable consumption should be 3.5-4 servings for males and 3.5 servings for female adolescents in 15-18 age group. Daily fruit consumption should be 2.5-3 servings in males and 2.5 servings in female students in 15-18 age group[13]. In this study, daily fruit and vegetable consumption was not sufficient. When the frequency of food consumption is examined, daily green leafy vegetable consumption was 39.8% for females and 27.8% for males, other vegetable consumption was 20.4% for females and 21.5% for males, fresh fruit consumption was 42.9% for females and 36.7% for males. According to HEI components, total fruit score was found to be 1.02±1.3, whole fruit score was 1.71±2 and total vegetable score was 1.4±1.1. Cereals are the main nutrient group of the society and because they contain many nutrients, they are an important part of healthy nutrition. Whole grains are rich in B-group vitamins other than B12 and whole grain products should be consumed in a healthy diet[30].

According to TUBER-2015, daily bread and cereal consumption is 7- 8 servings for males and 4-5 servings for females in the 15-18 age group[13]. Bruening *et al.*[31] in a study conducted with 2043 adolescents found that daily whole grain consumption is less than 1 serving. In a study conducted by Koc and Yardimci[24], daily whole grain consumption in adolescents was found to be 30.3±63.1 g for females and 22.4±52.8 g for males. In this study, the rate of female students consuming brown bread every day was 19.4%, while the rate of male students was 13.9%. According to HEI components, whole grains component scores were also lower in both female and male students (F = 2.5±3.8, M = 0.95±2.4).

Today, the Mediterranean diet model, which is shown as an example of healthy nutrition, is an ideal form of nutrition. Mediterranean diet, rich in unsaturated fatty acids like fish, olives, olive oil and antioxidant-rich in vegetables and fruits and legumes and whole grain products are available[32]. In a study by Koc and Yardimci[24], it was found that intake of seafood and plant protein among adolescents was similar for female and male adolescents and stated that consumption of seafood was well below the recommended amounts. In this study, seafood and plant proteins' component scores were found to be low (F = 1.28±1.9, M = 2.2±1.37). Some salt is needed for body health. According to WHO[33], daily salt intake should be less than 5 g with the amount of salt added to foods. For adolescents, 4 g salt and 1.5 g of Na are recommended daily[13,34]. In the study conducted by Koc and Yardimci[24], sodium consumption was found to be 3.7±2.1 g for female and 3.6±1.7 g for male adolescents. In this study, sodium consumption was found to be 2.8±1.1 g in female and 4.2±1.2 g in male students. Adolescents' pizza, hamburger, salami, sausage, processed meats, chips, biscuits, popcorn with salt, processed foods and sauces are known to be consuming more than necessary salt. This consumption on the one hand increases the burden on the kidney, on the other hand poses a risk factor for hypertension that may develop in the future[35]. Sugar added beverages generally include fruit flavored drinks, sports and energy drinks, 100% fruit juices, carbonated soft drinks and tea/coffee. Such beverages cause the total sugar consumption to be exceeded in adolescent nutrition[36]. In 2011, the Ministry of Education prohibited the sale of high-energy, low-nutrient soft carbonated drinks in school canteens[37]. High consumption of beverages with high sugar content is associated with obesity, metabolic syndrome and type-2 diabetes with increased energy intake[38,39]. According to TBSA-2010 data, daily carbonated soft drinks consumption was reported to be 560 mL in male and 453.4 mL in female adolescents in the 15-18 age group[15]. In this study, the rate of males consuming carbonated soft drinks was 17.7 and 7.1% in female students.

In order to monitor the change of nutrition over time and evaluate the quality of diet, indices specific to our country such as Healthy Eating Index can be developed. Such indices will guide the formation and development of nutritional policies.

CONCLUSION

This study indicated that according to the HEI-2010 assessment, the diet quality of the majority of senior students needs to be improved. Methods are needed to improve the nutritional habits of senior students. For this purpose, measures in the family, school and adulthood, covering the period of training programs, should be initiated by the government via advertisements and campaigns. Habits formed senior students will likely be continued into older adulthood. A cure for life style-related disorders is unlikely in the near future, therefore, the preeminent solution continues to be encouraging positive life style changes associated with physical activity and dietary habits. In conclusion, percentage of having poor diet is high among in our study group. Senior students should therefore, be educated about good nutritional habits and programs and policies should be developed for awareness.

SIGNIFICANCE STATEMENT

The HEI-2010 is more concerned with the amount of diet than diet quality and gives each standard per energy. Potential uses include population monitoring, evaluation of interventions and research. The individual component scores provide essential information in addition to that provided by the total score. The educational level, the monthly income of the families had a significant effect on their HEI categories. Their results showed that there is a significant association between the age of the adolescents and healthy diet. Overweight adolescents are more likely to develop eating disorders. Therefore, the development of dietary quality indices specific to the nutrient consumption and dietary habits of HEI in my country adaptable to my country and the use of HEI as a screening tool may be more effective in showing the factors affecting diet quality and diet quality.

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