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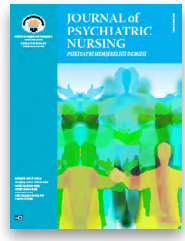

Original Article

The relationship between eating habits and mental development in adolescents

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Abstract

Objectives: Nutritional psychiatry is a new and rapidly gaining term in the field of nutrition and mental health. It is reported that unhealthy diets are a risk factor for the development of psychiatric symptoms such as depression and anxiety. In this study, it was aimed to determine the relationship between adolescents' eating habits and mental development.

Methods: The study was conducted in a public high school. The 24-h dietary recall was used to examine the nutritional habits of adolescents. "Adolescence Mental Development Scale" was used to determine the psychological development of adolescents.

Results: Of the 135 adolescents participating in the study, 59.3% are female. It was found that the consumption of carbohydrates, omega-6, riboflavin, folic acid, phosphorus, magnesium, dietary fiber, anthocyanin, etc., showed a statistically significant difference between individuals with positive and negative mental developments ($p<0.05$). Consumption of carbohydrates, omega-6, riboflavin, folic acid, phosphorus, magnesium, dietary fiber, anthocyanin, etc., was statistically significantly lower in individuals with negative mental developments ($p<0.05$).

Conclusion: As a result of our study, it was observed that adolescents' dietary contents had a significant effect on mental development.

Keywords: Adolescent; eating; mental health.

Adolescence, which is one of the most important periods of human development, is defined as the gradual transition period from childhood to adulthood, bringing along physiological, psychological, and social changes.[1] The World Health Organization states the age range of adolescence as 10–19.[2] In Türkiye, according to TUIK (Turkish Statistical Institute) 2019 data, 15.6% of the population was 12 million 955 thousand 672 young people in the age group of 15–24 years.[3] According to UNICEF, approximately 1.2 billion adolescents between the ages of 10–19 years constituted 16% of the world's population in 2019, and the rate of adolescents is expected to increase over time.[4] It is very important to protect and improve the health of adolescents, who constitute a significant part of the population, in terms of ensuring the health of future generations.

A rapid growth process develops both physically and mentally during adolescence. Proper nutrition in physical growth is an important factor in maintaining optimal health and a healthy growth-development process.[5] Due to the physical changes that occurred during this period, an increase in vitamin, mineral, energy, and protein requirements is observed.[6] Insufficient or unidirectional consumption of these essential nutrients can lead to the development of serious functional, structural, and mental disorders.[7] In addition, lifelong eating habits develop, changes in nutritional behavior and food se-

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lection,[6] and an increase in unhealthy eating attitudes/behaviors during adolescence.[8]

In a cross-sectional study conducted with a total of 500 adolescents, it was determined that 50% of the participants had breakfast every day, 47% consumed milk and dairy products daily, 31% consumed fruit daily, and 21% consumed vegetables daily. It is also reported that 44% of adolescents feel stressed, 35% feel tense, and 43% feel tired and sluggish. As a result, it has been seen that eating together, physical activity, and sleep patterns have positive effects on mental health, while consumption of fast food/snacks/soft drinks and alcoholic beverages/energy drinks has negative effects on mental health.[9] In the Korean National Health and Nutrition Examination Survey, which investigated the relationship between meal-skipping status and depressive mood, it was found that the risk of stress and depressed mood was higher in adolescents who skipped breakfast meals.[10] Lower intakes of vitamins B1, B2, B3, B5, B6, and folate were associated with higher externalizing behavior scores, according to the results of a cross-sectional analysis of the Western Australian Pregnancy Cohort (Raine) Study.[11]

Inadequate or excessive eating habits are among the risky behaviors in adolescence.[12] Since adolescents in the age group of 10–19 years are students, they meet their nutritional needs with at least one meal at school canteens, and as a result, the prevalence of eating disorders and obesity increases.[13] Eating disorders are an important cause of physical and psychosocial morbidity, especially in adolescent girls.[14] Therefore, it is thought that the psychological development of adolescents may be affected due to the change in nutritional disorders. Although the relationship between psychological development and nutrition has been proven by research, our study is very important as it reveals the detailed relationship between mental development and nutrient consumption in adolescents.

In this context, the study was conducted as a descriptive study to determine whether there is a relationship between adolescents' eating habits and their mental development. In this study, nutrient consumption differences between positive and negative mental development groups in male and female adolescents were investigated.

- Nutritional behaviors are at the forefront of many individual and environmental factors that affect physical and mental development
- Nutritional content had a significant effect on mental development
- The consumption of carbohydrates, omega-6, riboflavin, biotin, folic acid, phosphorus, magnesium, calcium, dietary fiber, unsaturated fatty acids, and anthocyanins are lower in individuals with negative mental development
- Consumption of cholesterol, pantothenic acid, iron, caffeine, and flavon_3_ol differs between individuals with positive and negative mental development
- While cholesterol, pantothenic acid, caffeine, and flavon_3_ol consumption are lower in individuals with negative moods, iron consumption is higher.

Materials and Method

Participants

Our research was conducted with students studying at a high school selected by lot from among the public high schools located in the provincial center of Isparta. The population of the study was 208 students studying at … (blinded) High School, and the sample consisted of 135 students calculated with the sampling method whose universe was known at a 90% power and 95% confidence interval by power analysis. One hundred and thirty-five students who volunteered to participate and obtained consent from their families were included in the study. One hundred and thirty-five students were randomly selected from the total population.

The inclusion criteria were to be under 18 years old and to be a volunteer. Individuals with conditions that interfere with body analysis, such as the presence of a pacemaker or platinum in their bodies, were excluded from the study. The main hypotheses of the research are; Consumption of micro and macro nutrients in adolescents is associated with mental health status, total energy, fat, saturated fat, and cholesterol consumption negatively affects mental health status, consumption of riboflavin, thiamine, and folate positively affects mental health. The study was carried out between March 05, 2019, and May 23, 2019. The main research questions are:

• Does energy consumption in adolescents affect mental development?

• Does the consumption of different nutrients affect mental development in adolescents?

Before the application, the necessary explanations were made to the participants by the researchers, and the questionnaires were administered in the classroom under the researcher's observation. The students filled out the questionnaires in about 10 min, and the anthropometric measurements of each student were made by the researchers whereas each student was in a separate room one by one. In the study, sociodemographic variables and food consumption records were taken as independent variables, and the Psychological Development Scale in adolescence was the dependent variable.

Data Collection Tools

Descriptive ınformation questionnaire

The descriptive information form created by the researcher, consisting of 47 questions in total, consists of two parts. In the first part, there are 30 questions asking about sociodemographic information, general health information such as the presence of chronic disease and long-term drug use, total number of main and snacks, and nutritional habits such as skipping meals. In the second part, there are 17 questions that evaluate the behavioral characteristics of individuals, their adaptation to adolescence, and their psychological development.

Anthropometric measurement and 24-h dietary recall

Anthropometric measurements of the students were made by the researchers. Body analysis measurements of all students were made on the same day, within 2 h, with the Tanita BC 545 N InnerScan devices while the students were wearing the least amount of clothing. A 24-h dietary recall record was requested from each student to determine their eating habits. The 24-h dietary recall was obtained by recording the hours, contents, and meal contents of all consumed meals throughout the day before the survey was administered. In the analysis of dietary data, the data obtained from the 24-h dietary recall were evaluated with the full version of BeBiS 8.1. However, since some nutrients (flavon_3_ol, flavone, flavonol, flavonone, anthocyanidin, and isoflavone) are not included in the BeBis database, a new database originating from USDA was created and integrated into BeBiS 8.1 and nutritional record analysis was performed.

Adolescence mental development scale

The scale was developed by Uzun[15] and covers individuals between the ages of 12 and 20. The scale consists of 15 items and two sub-dimensions. High scores in each sub-dimension indicate that the feature belonging to that sub-dimension is also high. The scale is in 5-point Likert type, and the options are numbered from 1 to 5 as "not suitable at all," "somewhat suitable," "undecided," "suitable," and "completely suitable." 1 corresponds to "not at all appropriate" and 5 to "completely suitable." The high score obtained from the scale gives the "Psychological Development of Adolescents" scores. Although there is no cutoff score in the scale scoring, the high score obtained from the scale is considered to be negative. ort he reason, the median value of the scale score obtained from our study, 41 points, was considered the cutoff point; 41 points and above are considered negative mental development, 41 points below positive mental development. The reliability coefficients of the factors (Cronbach Alpha) were found 0.825 for the personal uncontrollability sub-dimension and 0.761 for the timidity sub-dimension.[15]

Data Evaluation

The analysis of the data was made with the SPSS 20.0 package program. Normal distribution was evaluated with Shapiro-Wilk and Kolmogorov-Smirnov tests and Skewness and Kurtosis values. Descriptive statistics such as frequency distribution, mean, median, standard deviation, and interquartile range to define the characteristics of the sample; Independent sample t-test for variables with normal distribution to evaluate the difference between variables; Mann–Whitney U Test and 95% significance level (or α=0.05 margin of error) were used for variables that did not show normal distribution.

Ethics of Research

Ethics Committee Approval of the study was obtained from … (blinded) Ethics Committee Presidency Health Sciences Ethics Committee (Decision number: 35910). Institutional permission was obtained from the … (blinded) Provincial Directorate of National Education, and written and verbal consent was obtained from the students and their families who agreed to participate in the study. There is no support for our research.

Results

Of the 135 adolescents participating in the study, 59.3% are female. The average age of the participants was 15.4±0.66; the average BMI was 20.2±8.27 kg/m^2; The average body fat percentage was 21.7±6.55% in male and 27.9±7.31% in female. When BMI according to height was examined, 54.8% of the adolescents were normal, and 20.7% were overweight; when the height according to age was examined, 82.2% of them were normal and 8.9% were short (Table 1).

When the adolescents participating in the study evaluated themselves in terms of psychological well-being, it was found that 40.7% evaluated themselves as good, 49.6% as moderate, and 9.6% as bad. In addition, 73.3% of them reported that they experienced psychological changes during adolescence and 36.3% reported that they had difficulty in adapting to these changes. 2.9% of these adaptation problems were due to family relations, 2.9% to friendships, 1.4% to school, 0.7% to body weight, 8.9% to social environment, and 1.4% to shyness. Adolescents' Mental Development Scale Score average is 42.1±10.61, and 53.3% of the adolescents have been found to have negative mental development (Table 2).

When the health information of adolescents was examined,

Table 1. General characteristics of adolescents[1]

Variables	Study Group
Age	15.4±0.66
Gender	
Male	55 (40.7%)
Female	80 (59.3%)
BMI (kg/m2)	20.2±8.27
BMI for Age (n, %)	
Severe Thinness	2 (1.5%)
Thinness	14 (10.4%)
Normal	75 (55.5%)
Overweight	28 (20.7%)
Obese	16 (11.9%)
Height For Age (n,%)	
Severe Short	3 (2.2%)
Short	12 (8.9%)
Normal	111 (82.2%)
Tall	7 (5.2%)
Severe Tall	2 (1.5%)
Body Fat Percentage %	
Male	21.7±6.55
Female	27.9±7.31

Table 2. Answers are given by adolescents to questions about their emotional stetament[2]

Emotional questions	Study Group (n:135)
How do you consider your mental well-being?	
Good	55 (40.7%)
Moderate	67 (49.6%)
Bad	13 (9.6%)
Do you think you have experienced a mental-psychological change during your adolescence period?	
Yes	99 (73.3%)
No	35 (25.9%)
Have you had difficulty adjusting during your adolescence?	
Yes	49 (36.3%)
No	86 (63.7%)
Compliance Problem Type	
Social Environment	12 (8.9%)
Family relations	4 (2.9%)
Friendships	4 (2.9%)
School	2 (1.4%)
Shyness	2 (1.4%)
Body Weight Problems	1 (0.7%)
Mental Development Scale Score	42.1±10.61
Mental Development	
Positive	63 (46.7%)
Negative	72 (53.3%)

[2]Data are given as mean±standard deviation or percentage (n, %).

it was found that 12.6% had a chronic disease, 34.1% had a vitamin–mineral deficiency, and 13.3% used any vitamin–mineral supplement. The most common chronic disease was eye disease (4.4%), and the most common vitamin–mineral deficiency was Vitamin D deficiency (25.2%). It has been determined that 7.3% of the supplement users use a Vitamin D supplement (Table 3).

Nutrients with normal distribution in both male and female adolescents were analyzed with the t-test, and nutrients not normally distributed were analyzed with the Mann–Whitney U Test, and the test used in the table descriptions was specified. When the consumption of energy and nutrients in adolescents female was examined, it was found that the consumption of carbohydrates, omega-6, riboflavin, biotin, folic acid, phosphorus, magnesium, calcium, dietary fiber, unsaturated fatty acid, and anthocyanin showed a statistical significant difference between individuals with positive and negative mental developments ($p<0.05$). Consumption of carbohydrates, omega-6, riboflavin, biotin, folic acid, phosphorus, magnesium, calcium, dietary fiber, unsaturated fatty acid, and anthocyanin was statistically significantly lower in individuals with negative mental developments ($p<0.05$) (Tables 4 and 5).

When the consumption of energy and nutrients in adolescents male was examined, it was found that the consumption of cholesterol, pantothenic acid, iron, caffeine, and falvon_3_ol showed a statistically significant difference between individuals with positive and negative mental developments. Cholesterol, pantothenic acid, caffeine, and falvon_3_ol consumption was found to be statistically significantly lower in individuals with negative mood, whereas iron consumption was higher ($p<0.05$) (Tables 4 and 5).

Discussion

Adolescence term is a period characterized by significant biological, psychological, and social changes.[16] Adolescents' mental and physical development[5] continues in this period. Furthermore, the changes that occur in this period can trigger conflicts in adolescents with their environment and negatively affect mental health by causing problems related to family relationships, friendship relations, and social environment.[17] Adolescents are at risk for developing mental disorders due to their developmental characteristics. Negative effects on mental development during this period increase the risk of developing mental illness in later ages.[18] ort he reason, it is an important requirement for adolescents to maintain and improve their mental health in a healthy way and to increase their mental resilience.[19]

Family and friendship are one of the factors affecting mental health during adolescence. Social support from friends has important and positive effects on psychological well-being such as life satisfaction, happiness, self-esteem, and coping with stress.[17] It is emphasized that friendless adolescents are

Table 3. Evaluation of adolescents' health status[3]

Health information	Study group (n:135)
Chronic disease	
Yes	17(12.6%)
No	118(87.4%)
Chronic disease type	
Asthma	4 (2.9%)
Diabetes	1 (0.7%)
Eye diseases	6 (4.4%)
Migraine	1 (0.7%)
Psychiatric Diseases	1 (0.7%)
Thyroid	2 (1.5%)
Vitamin-mineral deficiency	
Yes	46 (34.1%)
No	89 (65.9%)
Vitamin-mineral deficiency type	
Iron deficiency	12 (8.9%)
Vitamin D Deficiency	34 (25.2%)
Vitamin B12 Deficiency	16 (11.9%)
Other	1 (0.7%)
Supplement usage	
Yes	18 (13.3%)
No	117 (86.7%)
Supplement type	
Vitamin B12	4 (2.8%)
Vitamin D	10 (7.3%)
Iron	1 (0.7%)
Omega3	1 (0.7%)
Multivitamin	3 (2.2%)

[3]Data are given as percentage (n, %).

vulnerable to loneliness, depression, and anxiety.[20] Consistent with the ort he e, in our study, most of the adolescents reported psychological changes during adolescence, and some reported that they had difficulty in adapting to these changes. Most of these adaptation problems are social environment, family relations, and friendships.

Nutritional psychiatry is an area that examines the relationship between nutrition and mental health and is rapidly gaining importance. It is reported that unhealthy diets are a risk factor ort he development of psychiatric disorders such as depression and anxiety. Therefore, healthy nutrition is an important lifestyle factor that has various effects on mental well-being.[21] In a study conducted with the ort he e review, while chronically refined carbohydrate consumption was associated with neurocognitive deficits; the effects of acute carbohydrate administration have been mixed, as they have both beneficial effects and neutral or negative effects.[22] Consumption of a meal rich in carbohydrates triggers insulin release in the human body. Insulin helps blood glucose enter cells where it can be used for energy and also triggers the entry of tryptophan into the brain. Tryptophan also contributes to mental well-being by affecting the neurotransmitter level in the brain. Because foods rich in healthy carbohydrates with low glycemic index trigger the release of serotonin and tryptophan, diets low in carbohydrates tend to trigger depression.[23] In this study, carbohydrate consumption was found to be effective on mental development in adolescent girls, which supports the findings of the ort he e. Carbohydrate consumption was found to be statistically significantly lower in adolescent girls with negative mental development ($p<0.05$).

Various nutritional factors positively affect mental health and well-being. Some of these are omega-3 fatty acids, phospholipids, cholesterol, niacin, folate, Vitamin B6, and Vitamin B12.[24] In a study investigating the effects of vitamin supplementation on mood, 129 healthy young adults received nine vitamin supplements for 12 months, and it was reported that supplementation improved mental health as a result of the study. It has been stated that the main reason ort he positive change in mood is related to the increase in riboflavin and pyridoxine levels.[25] It is also reported that riboflavin has a possible role in the treatment and protection of mental illnesses.[26] In a study, it was found that riboflavin and pyridoxine also stimulate dopamine and serotonin metabolism by increasing the antioxidant capacity in the brain.[27] In our study, omega-6 fatty acid consumption in adolescent girls was found to be statistically significantly lower in individuals with negative mental development ($p<0.05$). It is thought that this situation may be due to the limited study sample. However, the dietary omega-6/omega-3 ratio was not found to be statistically associated with mental development in both adolescent boys and adolescent girls ($p>0.05$). In our study, while no statistically significant relationship was found between pyridoxine consumption and mental development, it was found that riboflavin consumption was statistically significantly lower in adolescent girls with negative mental development ($p<0.05$) and riboflavin consumption had a positive effect on mental development.

Since serotonin cannot pass the blood–brain barrier, L-tryptophan is synthesized in the brain from the amino acid taken from food.[28] Tryptophan undergoes two reactions in the body. Approximately 1–5% of it is synthesized as serotonin, whereas 95–99% is metabolized by the kynurenine pathway.[29] The kynurenine pathway and its metabolites can, directly and indirectly, affect various classical neurotransmitters such as serotonin and affect mental well-being.[30] It has been reported that serotonin deficiency, which occurs in negative mood states such as depressive mood, is caused by the metabolism of tryptophan via kynurenine.[31] Kynurenine pathway; many vitamins and minerals play a critical role as cofactors and coenzymes in the de novo synthesis of the NAD coenzyme, magnesium, etc. affect the activity of kynurenine and magnesium quinolinate

Table 4. Distribution of adolescents' energy and nutrient consumption by positive and negative mental development[4]

	Female			Male		
Energy and Nutrients	**Positive Mental Development M±SS (Min-Max)**	**Negative Mental Development M±SS (Min-Max)**	**p-value**	**Positive Mental Development M±SS (Min-Max)**	**Negative Mental Development M±SS (Min-Max)**	**p-value**
Energy	1578.79±512.86 (527.80–2328.10)	1406.82±581.11 (191.80–2669.80)	0.813	1736.58±684.09 (762.00–3238.30)	1636.03±619.70 (743.20–2912.60)	0.582
Carbohydrate	180.27±65.57 (57.60–299.40)	144.25±63.55 (29.00–298.10)	0.020*	181.00±84.71 (72.40–352.10)	195.80±86.55 (72.80–367.50)	0.996
Protein	24.55±19.77 (15.50–90.50)	48.70±23.30 (6.70–103.60)	0.240	57.70±24.71 (24.00–114.00)	48.35±19.80 (27.90–101.60)	0.159
Fat	72.50±28.34 (22.60–137.70)	64.76±27.45 (5.20–136.70)	0.231	69.90±36.81 (17.40–152.60)	64.65±29.92 (25.80–142.90)	0.635
Omega-3 Fatty Acid	1.42±0.65 (0.40–2.90)	1.23±0.59 (0.10–2.80)	0.197	1.10±0.68 (0.40–2.80)	1.35±0.60 (0.40–2.40)	0.715
Omega-6 Fatty Acid	12.34±7.57 (1.10–33.40)	9.12±4.93 (0.30–22.00)	0.040*	9.10±8.98 (1.60–30.90)	9.10±3.89 (2.30–15.60)	0.097
Vitamin A	767.04±398.92 (14.80–1672.50)	623.91±126.38 (347.40–893.50)	0.055	689.41±366.01 (23.00–1244.70)	556.05±199.42 (176.10–948.40)	0.123
Thiamine	0.74±0.26 (0.20–1.20)	0.67±0.32 (0.10–1.50)	0.263	0.69± 0.32 (0.30–1.40)	0.72±0.34 (0.30–1.60)	0.733
Riboflavin	0.98±0.36 (0.40–1.80)	0.79±0.29 (0.20–1.30)	0.020*	1.27±0.69 (0.40–2.40)	1.32±1.11 (0.40–2.20)	0.453
Niacin	10.30±4.80 (2.30–21.20)	9.51±5.62 (0.40–23.40)	0.516	11.44±5.23 (2.90–22.00)	10.60±6.35 (3.20–20.30)	0.245
Pantothenic Acid	3.82±1.14 (1.00–6.40)	3.55±1.63 (0.30–6.90)	0.422	4.40±1.97 (1.30–8.30)	3.46±1.19 (1.90–6.10)	0.047*
Pyridoxine	1.08±0.48 (0.10–2.20)	1.00±0.48 (0.00–2.10)	0.495	1.05±0.52 (0.30–2.30)	0.91±0.31 (0.40–1.70)	0.251
Biotin	36.13±16.64 (5.80–72.50)	28.21±13.73 (2.70–60.80)	0.026*	39.81±22.24 (6.90–75.10)	41.16±36.77 (6.40–79.10)	0.705
Folic acid	285.62±122.42 (88.90–5889.30)	198.46±80.53 (17.60–357.70)	0.001*	243.39±119.67 (63.50–511.20)	212.29±97.74 (82.40–463.70)	0.318
Iron	9.03±3.62 (1.90–16.40)	7.59±3.41 (1.10–14.70)	0.081	7.40±2.24 (3.30–12.00)	9.74±4.26 (3.70–17.80)	0.019*
Phosphorus	878.15±318.38 (210.20–1610.70)	655.43±256.82 (79.20–1179.00)	0.002*	1011.58±459.64 (368.50–1318.90)	964.05±452.96 (441.10–2162.90)	0.456
Magnesium	222.43±91.14 (44.70–403.80)	171.47±79.34 (13.80–360.80)	0.012*	190.52±93.44 (67.20–364.60)	213.40±97.31 (88.40–486.10)	0.224
Zinc	8.65±3.69 (2.70–16.00)	7.26±3.62 (0.70–15.10)	0.100	7.95±2.72 (3.80–14.60)	8.90±4.01 (4.10–18.30)	0.357
Calcium	500.41±211.21 (182.10–995.70)	310.82±131.12 (55.30–596.80)	0.000*	442.01±212.07 (107.80–869.80)	545.44±361.45 (129.50–1406.80)	0.227
Dietary Fiber	16.77±6.12 (5.50–28.60)	13.42±6.51 (1.50–28.00)	0.027*	12.20±4.95 (3.10–21.50)	13.15±4.62 (4.80–20.80)	0.500
Monounsaturated Fatty Acids	28.57±13.85 (7.60–65.10)	25.27±6.24 (13.80–38.00)	0.198	26.83±12.17 (6.90–52.80)	27.24±11.56 (7.90–53.10)	0.901
Saturated Fatty Acids	23.42±8.47 (8.30–43.60)	22.68±11.23 (2.50–52.90)	0.751	25.51±9.43 (6.90–47.70)	26.94±11.60 (7.30–49.00)	0.636
Flavonol	9.91±6.39 (0.00–24.70)	9.43±5.91 (0.10–23.00)	0.738	11.48±13.73 (0.00–21.30)	8.01±6.77 (0.00–24.60)	0.589

[4]*p<0.05 t-test.

Table 5. Distribution of other nutrient consumption in adolescents by positive and negative mental development[5]

Energy and Nutrients	Female			Male		
	Positive Mental Development Median; IQR (Min-Max)	Negative Mental Development Median; IQR (Min-Max)	p-value	Positive Mental Development Median; IQR (Min-Max)	Negative Mental Development Median; IQR (Min-Max)	p-value
Cholesterol	152.40;205.60 (28.70–513.20)	144.45;239.83 (0.60–559.50)	0.736	2.30;3.90 (0.00–8.60)	1.50;0.90 (0.20–3.30)	0.141
Vitamin B12	3.40;2.73 (0.40–7.10)	2.60;2.21 (0.00–7.90)	0.661	5.40;5.40 (0.60–13.30)	4.45;3.38 (0.80–9.30)	0.099
Vitamin C	67.75;11.63 (11.90–193.00)	71.15;43.75 (0.50–137.60)	0.410	44.80;65.70 (0.00–153.30)	37.50;26.22 (9.20–81.80)	0.393
Vitamin D	1.25;1.78 (0.10–5.20)	1.10;1.70 (0.00–3.70)	0.181	2.30;3.90 (0.00–8.60)	1.50;0.90 (0.20–3.30)	0.141
Vitamin E	10.45;8.60 (0.60–34.40)	7.20;5.25 (0.40–23.20)	0.118	7.80;11.60 (1.00–26.00)	8.70;9.85 (1.90–19.10)	0.868
Sodium	1390.35;1234.20 (127.60–3075.40)	1229.75;1264.67 (321.80–3586.50)	0.386	1698.40;1496.30 (176.90–4000.10)	1623.55;1405.58 (442.50–3124.90)	0.553
Potassium	2008.07±783.01 (477.10–3445.30)	1878.63±555.00 (1104.00–3014.90)	0.265	2001.20;1488.60 (624.90–3710.20)	1930.45;1272.98 (863.10–3964.10)	0.764
Polyunsaturated Fatty Acids	12.15;11.17 (3.00–34.60)	9.85;7.65 (0.40–20.30)	0.029*	11.30;16.10 (2.10–37.10)	12.30;7.48 (2.70–17.40)	0.089
Caffeine	0.00;16.00 (0.00–40.00)	16.00;32.00 (0.00–80.00)	0.051	28.00;48.00 (0.00–80.00)	0.00;16.00 (0.00–32.00)	0.005*
Flavon_3_ol	9.60;91.40 (0.00–191.40)	91.40;91.60 (0.00–195.50)	0.614	91.40;240.02 (0.00–457.20)	0.10;91.40 (0.00–183.50)	0.033*
Flavon	5.60;11.65 (0.00–23.50)	5.60;10.23 (0.00–22.20)	0.809	1.60;5.70 (0.00–11.70)	5.60;11.02 (0.00–27.40)	0.149
Flavonon	0.40;0.52 (0.00–1.40)	0.60;0.53 (0.00–1.40)	0.226	0.30;0.70 (0.00–1.70)	0.35;1.05 (0.00–1.70)	0.993
Isoflavon	0.20;0.30 (0.00–0.80)	0.30;0.40 (0.00–0.90)	0.171	0.20;0.40 (0.00–1.00)	0.30;0.52 (0.00–1.30)	0.530
Antioxidant	2.40;2.85 (0.20–13.10)	1.90;1.92 (0.00–111.20)	0.219	2.85;3.02 (0.00–6.60)	1.80;2.15 (0.30–5.40)	0.726

[5]*p<0.05 Mann–Whitney U.

regulates phosphoribosyl transferase. Iron, on the other hand, is responsible for the proper functioning of both indolamine 2,3-dioxygenase and 3-hydroxy-anthranilic acid dioxygenase.[32] Furthermore, biotin deficiency has been associated with irritability and depressed mood; pantothenic acid deficiency has been associated with irritability and restlessness.[33] In a study investigating the antidepressant effects of magnesium, it was reported that magnesium has an antidepressant-like effect and interacts with the serotonergic system.[34] Coppen and Bolander–Gouaille reported that low folate levels are related to an inadequate response to antidepressants, and supplementation with folic acid is shown to advance response to antidepressants.[35] According to studies, nutritional factors have great importance in the protection and development of mental health. For this reason, it is important to make sure that the nutritional recommendations of adolescents include adequate amounts of nutrients. Thi Thu Nguyen et al.[36] reported that potassium, calcium, magnesium, phosphorus, iron, zinc, and copper intake were negatively associated with negative moods among female individuals. Anthocyanin and flavon_3_ol are important antioxidants. Khalid et al.[37] reported that the observed effect of flavonoids such as anthocyanin is of potential practical value in improving mental health. Dietary fiber is a crucial component of a healthy diet, with benefits that may be associated with processes in the microbiota and the resulting byproducts. The reduction in inflammatory compounds resulting from dietary fiber consumption can alter neurotransmitter concentrations to reduce symptoms of depression.[38] In our study, it was found that biotin, folic acid, phosphorus, magnesium, calcium, dietary fiber, unsaturated fatty acid, and anthocyanin consumption was statistically significantly lower in adolescents with negative mental development (p<0.05).

It was determined that cholesterol, pantothenic acid, and flavon_3_ol consumption was statistically lower in adolescent men with negative mental development, and iron consumption was higher ($p<0.05$). Although our study reveals the relationship between mental development and nutritional status in adolescents, the limitations of our study are the limited study population and the inability to record long-term food consumption due to age group.

Conclusion

Adolescence is a developmental period in which physical, psychological, and social changes are together, and there are specific needs for each field. In this period, spiritual development is observed as well as physical development. There are many individual and environmental factors that affect physical and spiritual development. Nutritional and nutritional behaviors come first among these factors. Consumption of carbohydrates, omega-6, riboflavin, folic acid, phosphorus, magnesium, dietary fiber, anthocyanin, etc., was statistically significantly lower in individuals with negative mental developments. In this direction, it is recommended to organize educational programs for healthy nutrition, including families, to encourage healthy nutrition in adolescents' environments (school canteen, etc.), and to increase studies examining nutrition and mental development in terms of different variables to ensure healthy mental development in adolescents.

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