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Dietary patterns and irritable bowel syndrome risk

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ABSTRACT

Irritable bowel syndrome is a functional and non-histological disorder of the lower gastrointestinal tract that causes abdominal discomfort. Stress, dietary patterns, excessive use of laxatives, antibiotics and caffeine, other gastrointestinal disorders, sleep disorders and fluid intake are factors affecting this disease. The aim of the present study was to investigate the relationship between dietary patterns and irritable bowel syndrome in adults in Ahvaz. In this case-control study, the protocol of which was approved by the Vice-Chancellor of Research of Ahvaz Jundishapur University of Medical Sciences (Registration number RDC-9809) and the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (Registration number IR.AJUMS.REC.1398.908), a 147-item food frequency questionnaire (FFQ) was used to assess food intake. Extraction of the dominant dietary patterns was performed using principal component analysis (PCA) and finally the different tertiles of adherence to each dietary pattern with the risk of irritable bowel syndrome were examined using logistic regression and adjustment for confounders. Four dominant dietary patterns were extracted, which included traditional, unhealthy Western, and Mediterranean dietary patterns. After adjusting for confounders, the results showed that adherence to an unhealthy dietary pattern was associated with an increased risk of irritable bowel syndrome. Following a Mediterranean dietary pattern was associated with a reduced risk of IBS in the unadjusted model (OR=0.49, P=0.03). Although this association was not statistically significant in the adjusted models, there was a trend toward a reduced risk (P-trend=0.04). There was no significant association between adherence to traditional and Western dietary patterns with the risk of irritable bowel syndrome. There is an association between adherence to dominant dietary patterns and the risk of developing irritable bowel syndrome. The results of this study showed that adherence to an unhealthy dietary pattern was associated with an increased risk and adherence to a Mediterranean dietary pattern was associated with a reduced risk of developing the condition. Future studies could investigate the specific mechanisms through which diet influences IBS, taking into account the role of lifestyle and psychosocial factors.

1. Introduction

Irritable Bowel Syndrome (IBS) is functional disorder of lower gastrointestinal tract that characterized by altered bowel habits lead to recurrent or chronic abdominal pain (1). The prevalence of IBS in western countries is about 10-15%. This is reported that the prevalence of IBS in Asian countries is not so different from Westerners (2, 3). Approximately 0.25-1.1% of Iranian population have IBS (4). Numerous factors may exacerbate IBS; for example stress, dietary patterns, overuse of laxatives, antibiotics and caffeine, previous gastrointestinal disorders, sleep disorders and fluid intake (5, 6). Observational studies reported that patients with IBS have low quality of life (7). This is reported that high-carbohydrate diets may play a role in the symptoms of IBS, because of the incomplete absorption (8).

The results of a cross-sectional study of patients with IBS showed that lifestyle changes may reduce the symptoms.(9). Dietary pattern is one of the lifestyle factors that could affect the progression of IBS. Dietary patterns of individuals is affected by culture and race and many environmental factors (availability of food, ability of people to shop and advertise) (10). Although many studies have examined the association between foods or nutrients with IBS, there are few studies on the relationship between dietary patterns with IBS; for example Buscai., et al reported that the western dietary pattern was associated with IBS patients and more adherence to traditional dietary pattern was related to IBS in women (11). Determining the association between dietary pattern and risk of some disease in different countries is important because different cultures, religious beliefs and geography affect the dietary pattern (12).Given the synergistic effects of foods on each other and the wide variety of foods that can affect the risk of IBS or exacerbate its symptoms, evaluating dietary patterns seems to be an effective way to investigate the role of diet in IBS (13); so we designed and implemented the present study with the aim of survey the association between dietary patterns and IBS risk.

2.Materials and Methods

The present study had a case-control design. Our study protocol was approved by the research assistant of Ahvaz Jundishapur University of Medical Sciences (Registration No. RDC-9809)

2.1 *Definition and Selection the Cases and Controls*

About 83 adult patients with IBS referred to the office of a gastroenterologist of Ahvaz city were randomly selected. Cases were identified based on the ROME-III criteria. ROME-III criteria include recurrent abdominal discomfort (feeling uncomfortable without pain) or pain at least 3 days per month in last 3 months in addition to two or more of the following symptoms:

1. Improvement with defecation
2. Onset related to a change in frequency of stool
3. Onset related to a change in appearance of stool

*Criteria were set for the last 3 months and onset of symptoms at least 6 months prior to diagnosis (14).

Controls (N=182) were included in our study from the healthy (without IBS) patient's companions as well as those who refer to other wards of the clinic.

Inclusion Criteria

1: Willingness to do the interview and collaborate in our study
2: Age between 18 to 65 years
3: Body mass index in the normal range (18-25)

Exclusion Criteria

1: Any intestinal disease (diagnosis based on colonoscopy in the last 5 years) and intestinal infection (diagnosis based on fecal culture in suspected specimen)
2: Medical history of chronic gastrointestinal and colorectal disease
3: Any major bowel surgery
4: Regular use of laxatives or antidiarrheal drugs
5: Chronic use of antibiotics and corticosteroids and immunosuppressants
6: Use of drugs that alter gastrointestinal motility such as metoclopramide, cisapride, diphenoxylate, etc.
7: Taking drugs that increase bleeding from intestinal mucus such as aspirin, warfarin, heparin, etc.
8: Pregnancy or breastfeeding, being an athlete or hospitalized
9: Severe mental and behavioral disorders
10: Consumption of nicotine and its derivatives in the last 6 months
11: Taking non-steroidal anti-inflammatory drugs last week

2.2 Ethics

The whole protocol of our study was approved by the Ahvaz Jundishapur University of Medical Sciences Ethics Committee (Registration No. IR.AJUMS.REC.1398.908) and all the participants provided written informed consent.

2.3 Dietary Pattern

Dietary information of patients with IBS and control group were collected using a 147-item Food Frequency Questionnaire (FFQ) which was validated for Iranian adults (15). This questionnaire was completed by interview by a nutritionist.
This questionnaire evaluates food intake in 6 groups of bread and cereals, meat, dairy, vegetables, fruits and miscellaneous. During the interview, the average size of each food item in the FFQ explained to all individuals, and then the subjects asked to rate the consumption of each food item according to the standard serving size based on the option of load per day, week, month or year. 147 food items were aggregated into 25 food groups based on nutrient profiles and previous studies (Table1).

Table 1. Food groups using in the dietary pattern analysis

	Food groups	**Food Items**
1	Vegetable oils	Any types of vegetable oils
2	Red and processed meat	Beef and veal, mutton, minced meat, sausages, hamburgers
3	Spices	Pepper, turmeric and other spices
4	French fries	French fries
5	Tea and coffee	Tea, coffee and nescafe
6	Poultry	Chicken
7	Salt	salt
8	Eggs	Eggs
9	Solid fats	Solid vegetable oil, animal oil, animal butter, margarine
10	Whole grains	Barbari bread, stone bread, Tufton bread, whole grain bread, others
11	Organ meat	Heart, liver, kidneys, tongue, brain, head and legs, sirabi

12	High fat dairy products	Full-fat milk, full-fat yogurt, cream cheese, cream, ice cream, others
13	Boiled potato	Boiled potato
14	Beans	Lentils, peas, beans, soybeans, others
15	Fish	Any type of fish, canned fish
16	Snacks	Biscuits, puffs, chips, others
17	Refined grains	Lavash bread, baguette bread, rice, macaroni, others
18	Nuts	Almonds, peanuts, walnuts, pistachios, hazelnuts, seeds, others
19	Mayonnaise sauce	Mayonnaise sauce
20	Sweets and desserts	Dry sweets, sweeter sweets, chocolates, all kinds of cakes and cookies, honey, jam, sugar, sugar, candiesothers
21	Pickles	Pickles, salted vegetables, pickled cucumber
22	Vegetables	Cabbage, carrot, tomato and its products, spinach, lettuce, cucumber, eggplant, onion, green bean, pea, pumpkin, mushroom, bell pepper, turnip, corn, garlic and other vegetables.
23	fruits and fruit juices	Cantaloupe, watermelon, melon, green tomato, apple, apricot, yellow and red plum, Cherry, nectarine, peach, pear, fig, date, grape, kiwi, pomegranate, banana, persimmon, berries, pineapple, cirtus, dry fruit, various types of natural and industrial juices, other
24	Low fat dairy products	Low-fat milk, fat-free milk, low-fat yogurt, normal yogurt, white cheese, kashk, dogh, others
25	Olives and olive oil	Olives, olive oil

2.4 ***Physical Activity Assessment***

The Metabolic Equivalent (MET) Physical Activity Questionnaire was used to assess physical activity status of participants. Finally, individuals classified into three groups with low, medium and high activity levels. The validity and reliability of this questionnaire have been examined in Iran (16).

2.*5 Anthropometric Measurements*

Participants' body weight was measured with minimally clothed and without shoes. Height was measured without shoes, in a standing position, while shoulders were in a normal position. Body Mass Index (BMI) was obtained by dividing weight (Kg) by height (m) squared. Waist circumference (WC) was measured using a tape measure in the standing position in the area between the lowest gear and the iliac crest. Hip circumference (HC) measured in the largest area of the hip and the waist to hip circumference (WHR) ratio was calculated.

2.6 Assessment of sleep status

The sleep status of participants was evaluated and scored based on the Petersburg Sleep Quality Questionnaire (PSQI).

2.7 Statistical Analysis

The data are entered in SPSS software version 16 and then according to the obtained data, we use the appropriate statistical method. Factor analysis method was used to identify the major dietary patterns in this study. In this method, food

items are first categorized into predefined groups (based on the knowledge of the researcher and previous studies) and based on the correlation between these food groups using SPSS software, food patterns are determined. PCA (Principal Component Analysis) used to identify major dietary patterns (17).

To examine if the distribution of the different foods allows the use of principal component analysis, the Kaiser–Meyer–Olkin (KMO) test was used. Values greater than 0.5 are acceptable for this test. Obtained factors were retained for further analysis based on Eigen values > 2.5, Scree plot and natural interpretation. Only the food groups with the communalities > 0.4 were considered in each extracted factor. The extracted patterns were named based on the loaded groups and considering the former literatures. The positive factor load in each pattern indicates a direct relationship with that pattern and the negative factor load indicates an inverse relationship with that pattern. Each person surveyed received a score based on adherence to extracted dietary patterns. All the cases and controls were categorized by tertiles of dietary pattern scores and used in the final analysis. Logistic regression test (OR: Odds Ratio) used to assess the relationship between dietary patterns and the risk of IBS with and without control of confounders. Crude relationship between patterns and IBS risk was reported in model 1. The relationship with adjustment for age and sex confounders were named model 2. Moreover, further adjustment for body mass index and energy intake category was done in model 3. The significance level considered 0.05. The control method of confounding variables did by ANCOVA method.

3. Results

3.1 Study population

A total of 270 (187 healthy and 83 IBS) participants were included in the present case-control study, which was done in Ahvaz city, Khuzestan province, in the south west of Iran. The anthropometric and demographic characteristics of case and control participants are presented in Table 2. The mean age of control group was significantly lower than case group (P< 0.001). As shown, there was also a significant difference between IBS and healthy participants about smoking status and the cases were more smoker than controls (P = 0.02). Other demographic characteristics had no significant differences between patients and control groups.

Table 2. Anthropometric and demographic characteristics of participants based on the IBS status (n =271)

Characteristics	**Controls N= 187 (69.26%)**	**Cases N= 83 (30.74%)**	p-value[a]
Contentious variables	Mean ± SD		
Age (Year)	29.42±7.08	34.53±10.47	< 0.001
BMI (Kg/m^2)	23.59±3.56	24.41±3.72	0.77
WHR	0.49±0.05	0.51±0.05	0.81
BP (mmHg)	115.07±8.59	121.14±9.89	0.63

Physical activity (MET/min/week)	2920.81±794.81	1729.91±800.36	0.55
Energy intake (Kcal/day)	2730.97±1399.49	2868.27±1304.31	0.35
Categorical variables	Frequency (percent)		p-value[β]
Gender			
Female	92 (49.2)	41 (49.4)	0.97
Male	95 (50.8)	42 (50.6)	
Sleep quality (PSQI)			
No sleep disorders	73 (38.8)	32 (38.6)	0.88
Moderate sleep disorders	70 (37.2)	33 (39.8)	
Serious sleep disorders	17 (9)	8 (9.6)	
Very serious sleep disorders	2 (1.1)	0 (0)	
Alcohol consumption			
Yes	6 (3.2)	6 (7.2)	0.12
No	182 (96.8)	77 (92.8)	
Psychiatric Disease			
Yes	22 (12)	16 (21.3)	0.05
No	162 (88)	59 (78.7)	
Smoking status			
Yes	5.34	13.50	0.02
No	94.65	86.40	

IBS, Irritable bowel syndrome; SD, Standard Deviation; BMI, Body Mass Index; WHR, Waist to Hip Ratio; BP, Blood Pressure; PSQI, Pittsburgh Sleep Quality Index.
[a] p-values based on Student tests.
β p-values based on Chi square tests.

3.2. Dietary Patterns

The Kaiser–Meyer–Olkin (KMO) test was done for assessing the sufficiency of sample size for principal component analysis. The KMO test result was 0.70. Principal component analysis extracted four major dietary patterns using Eigen value >2 .5 and scree plot (figure1). These four patterns explained 40.47% of the total variance. All the patterns and foods groups loaded on them are shown in table3 including **western dietary pattern** characterized by "high consumption of Vegetable oils, Red and processed meat, Spices, French fries, Tea and coffee, Poultry, Sweets and desserts and Boiled potato", **traditional dietary pattern** characterized by "high consumption of Solid fats, Whole grains, Organ meat, High fat dairy products, Boiled potato, Beans and Fish", **unhealthy dietary pattern** characterized by "high consumption of Chips and puffs, Refined grains, Nuts, Mayonnaise sauce, Sweets and desserts and Pickles" and **Mediterranean dietary pattern** characterized by "high consumption of Vegetables, fruits and fruit juices, Low fat dairy products, olive and olive oil" (Table 3).

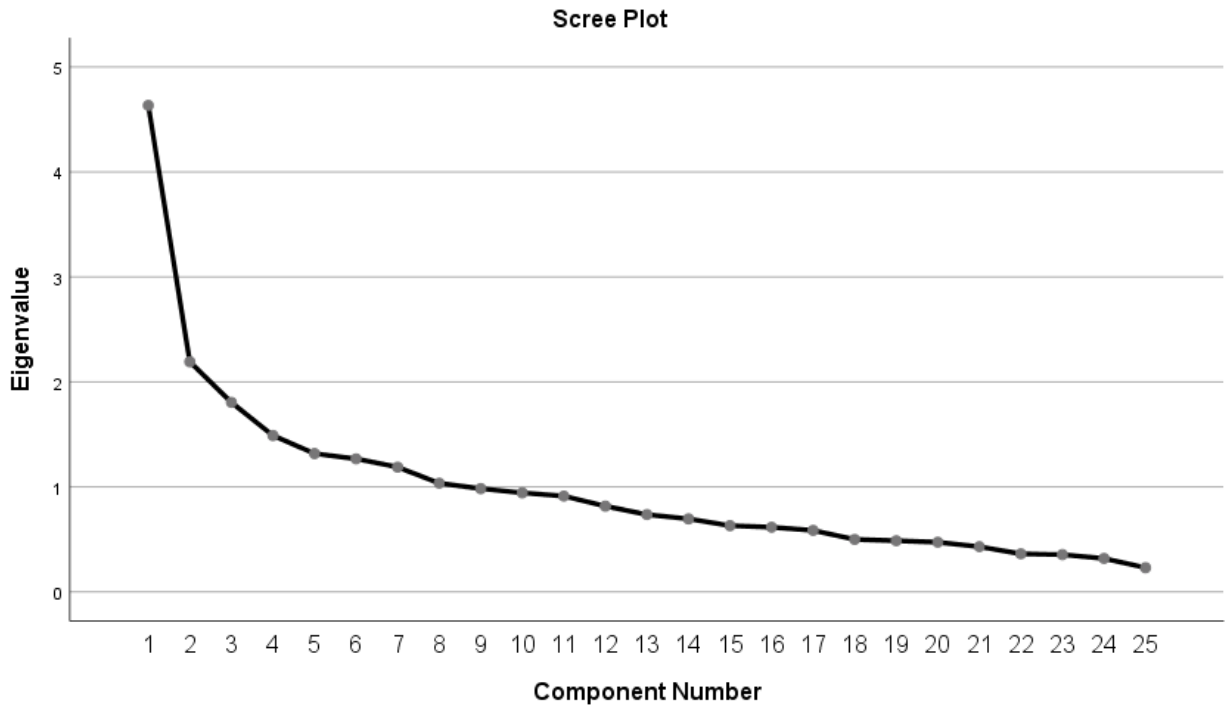

Figure1: The major extracted factors based on fracture on the scree plot.

Table3: Factor loading matrix for major dietary patterns

Food groups	**Western pattern**	**Traditional pattern**	**Unhealthy pattern**	**Mediterranean pattern**
Vegetable oils	0.77	-	-	-
Red and processed meat	0.61	-	-	-
Spices	0.55	-	-	-
French fries	0.54	-	-	-
Tea and coffee	0.52	-	-	-
Poultry	0.49	-	-	-
Salt	-	-	-	-
Eggs	-	-	-	-
Solid fats	-	0.63	-	-
Whole grains	-	0.62	-	-
Organ meat	-	0.62	-	-
High fat dairy products	-	0.55	-	-
Boiled potato	0.42	0.52	-	-
Beans	-	0.47	-	-
Fish	-	0.42	-	-
Chips and puffs	-	-	0.60	-
Refined grains	-	-	0.55	-
Nuts	-	-	0.53	-
Mayonnaise sauce	-	-	0.51	-
Sweets and desserts	0.47	-	0.50	-
Pickles	-	-	0.49	-
Vegetables	-	-	-	0.77
fruits and fruit juices	-	-	-	0.73
Low fat dairy products	-	-	-	0.59

Olives and olive oil	-	-	-	0.72
Percentage of variance explained	13.23	9.76	7.13	6.35

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Values > 0.4 were retained for simplicity.

3.3. The association of dietary patterns adherence with IBS risk

The association of IBS risk with tertiles of dietary patterns adherence scores was assed using logistic regression in three models and the results were reported in table 4. There was no significant association between western pattern and IBS risk (P-value and P-trend > 0.05). The participants in tertile 2 of traditional pattern score had significantly higher odds for IBS risk in model1 (P= 0.04); but this relationship was faded after adjustment for age, sex, body mass index and energy intake category (P > 0.05). Also, there was no ordered relationship across the tertiles of traditional pattern (P-trend> 0.05). The participants with higher scores for unhealthy patterns had higher odds for IBS risk than reference tertile (P< 0.001). Also, there was an ordered relationship across the tertiles of unhealthy pattern in all the three models (P< 0.001). The participants in tertile 3 of Mediterranean pattern score had significantly higher odds for IBS risk in model1(P= 0.03); but this relationship was faded after adjustment for age, sex, body mass index and energy intake category (P > 0.05). Moreover, there was an ordered relationship between tertiles of Mediterranean score in all three models (P< 0.05).

Table4: Multivariate adjusted odds ratio (95%CIs) for IBS across tertile of dietary patterns of participants

Models	**Tretile1** OR (95%CIs) p-value	**Tretile2** OR (95%CIs) p-value	**Tretile3** OR (95%CIs) p-value	**P-trend**
Western pattern				
Model 1	reference	1.07 (0.57 - 2) p = 0.83	1.17 (0.62 – 2.21) P= 0.63	0.63
Model 2	reference	1.12 (0.51 – 2.47) P= 0.77	0.8 (0.37 – 1.76) P= 0.59	0.63
Model 3	reference	1.21 (0.53 – 2.76) P= 0.65	0.92 (0.38 – 2.22) P= 0.85	0.66
Traditional pattern				
Model 1	reference	0.51 (0.27 – 0.98) P= 0.04	0.67 (0.35 – 1.31) P= 0.24	0.26
Model 2	reference	0.53 (0.25 – 1.15) P= 0.12	1.19 (0.52 – 2.71) P= 0.68	0.30
Model 3	reference	0.59 (0.27 – 1.31) P= 0.19	1.39 (0.56 – 3.43) P= 0.48	0.28
Unhealthy pattern				
Model 1	reference	6.33 (3.17 – 12.66) P< 0.001	5 (2.58 – 9.70) P< 0.001	< 0.001
Model 2	reference	4.74 (2.1 – 10.69) P< 0.001	4.94 (2.37 – 10.66) P< 0.001	< 0.001
Model 3	reference	4.62 (1.98 – 10.74) P< 0.001	5.11 (2.44 – 11.65) P< 0.001	< 0.001
Mediterranean pattern				

Model 1	reference	1.02 (0.52 – 1.98) P= 0.97	0.49 (0.26 – 0.93) P= 0.03	0.03
Model 2	reference	1.54 (0.71 – 3.36) P= 0.28	0.71 (0.32 – 1.56) P= 0.39	0.04
Model 3	reference	1.68 (0.73 – 3.83) P= 0.22	0.74 (0.26 – 2.1) P= 0.57	0.04

OR (95%CI) and P-values were determined based on logistic regression.
Model1: unadjusted.
Model2: adjusted for age and sex.
Model3: adjusted for age, sex, body mass index and energy intake category.

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کلمات کلیدی:

سندرم روده تحریک پذیر،
الگوی غذایی غربی،
الگوی غذایی مدیترانه ای،
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چکیده

سندرم روده تحریک پذیر یک اختلال عملکردی و غیر هیستولوژیک در دستگاه گوارش تحتانی است که منجر به ناراحتی شکمی می شود. استرس، الگوهای غذایی دریافتی، استفاده بیش از حد از ملین ها، آنتی بیوتیک ها و کافئین، سایر اختلالات دستگاه گوارش، اختلالات خواب و مصرف مایعات عوامل تاثیرگذار بر این بیماری هستند. هدف مطالعه حاضر، بررسی ارتباط بین الگوهای غذایی دریافتی با طر سندرم روده تحریک پذیر در بزرگسالان شهر اهواز می باشد. در این مطالعه مورد-شاهدی که پروتکل آن مورد تایید معاونت پژوهشی دانشگاه علوم پزشکی جندی شاپور اهواز (شماره ثبت RDC-9809) و کمیته اخلاق دانشگاه علوم پزشکی جندی شاپور اهواز (شماره ثبت IR.AJUMS.REC.1398.908) قرار گرفت، از پرسشنامه بسامد خوراک (FFQ) ۱۴۷ آیتمی جهت بررسی دریافت های غذایی استفاده شد. استخراج الگوهای غذایی غالب دریافتی با استفاده از روش تحلیل مولفه های اصلی (PCA) انجام شد و در نهایت سهک های مختلف پیروی از هر الگوی غذایی با خطر سندرم روده تحریک پذیر با استفاده از رگرسیون لجستیک و تعدیل عوامل مخدوشگر، مورد بررسی قرار گرفت. ٤ الگوی غذایی غالب استخراج شد که شامل الگوهای غذایی سنتی، غربیف ناسالم و مدیترانه ای بودند. پس از تعدیل عوامل مخدوشگر نتایج نشان داد که پیروی از الگوی غذایی ناسالم با افزایش خطر سندرم روده تحریک پذیر مرتبط بود. پیروی از الگوی رژیم غذایی مدیترانه ای، با کاهش خطر ابتلا به IBS در مدل تعدیل نشده همراه بود (P=0.03 ،OR=0.49). اگرچه این ارتباط در مدل های تعدیل شده از نظر آماری معنی دار نبود، اما روندی به سمت کاهش ریسک وجود داشت (P-trend۰/۰٤=). بین پیروی از الگوی غذایی سنتی و غربی با خطر سندرم روده تحریک پذیر، ارتباط معنی داری وجود نداشت. بین پیروی از الگوهای غذایی دریافتی غالب با خطر ابتلا به سندرم روده تحریک پذیر ارتباط وجود دارد. نتایج این مطالعه نشان داد که پیروی از الگوی غذایی ناسالم با افزایش خطر و پیروی از الگوی غذایی مدیترانه ای با کاهش خطر ابتلا به این بیماری مرتبط بودند. مطالعات آینده می توانند مکانیسم‌های خاصی را که از طریق آنها رژیم غذایی بر IBS تأثیر می‌گذارد، با در نظر گرفتن نقش سبک زندگی و عوامل روانی-اجتماعی بررسی کنند.