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The Association between Diet Quality and Anxiety among Young Couples in Shiraz: A Cross-sectional Study

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ABSTRACT

***Background*:** Mental disorders impose a significant health and economic burden on both developed and developing countries. The relationship between nutrition and mental disorders has become an important topic of interest in recent years. Therefore, identification of modifiable risk factors for anxiety is a serious and critical research imperative. Thus, this study aimed to evaluate the relationship between the "diet quality index international" (DQI-I) and anxiety as a major subject. ***Methods*:** This cross-sectional study was conducted on 194 men and women, who were randomly selected to perform the routine examinations before marriage. In this research, socio-demographic and anthropometric indicators, such a dietary intake[1] and mental health were measured. To measure the former, a Food Frequency Questionnaire (FFQ) was applied and to determine the latter, a short version of the self-report depression, anxiety, and stress scale questionnaire (DASS-21) was used. ***Results*:** Univariate and multivariate linear regressions of anxiety and DQI score demonstrated significant association between DQI score and anxiety in all participants. A negative correlation was also seen between DQI score and anxiety in all participants. The anxiety scores reported for males and females did not introduce a significant difference. Adjustments for age, education, income, job, smoking, physical activity, and body mass index did not change the aforementioned associations. ***Conclusion*:** In this study, a significant association was observed between diet quality and the risk of mental disorders. The increase in DQI in participants caused a remarkable reduction in their level of anxiety. A healthy diet proved to be inversely associated with anxiety, while unhealthy dietary patterns were associated with increased risk of anxiety.

Keywords: *Mental disorders; Anxiety; Nutrient*

Introduction

Nowadays, mental disorders are known as a leading factor affecting health and economy in both developed and developing countries. The prevalence of mental disorders range from 3.3 to 21.4% (Mueller *et al.*, 1999), so that the global burden of anxiety is known as a major public health concern (Kessler *et al.*, 2005). Therefore, the identification of modifiable risk factors for anxiety is a serious and important research imperative (Ferrari *et al.*, 2013). Recent studies have highlighted role of the modifiable lifestyle behaviors, such as physical inactivity, smoking, and

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other lifestyle factors in the development of common mental disorders (Bonnet *et al.*, 2005). In addition, the relationship between nutrition and mental disorders was of great interest in recent years (Eyre *et al.*, 2013, Lopresti *et al.*, 2013). In both observational and clinical studies, the majority of previous studies focused on either the intake of individual nutrients or various food groups and their association with anxiety, or the effect of nutritional supplementation as a treatment strategy on depression. In this regard, studies identified the relationship of the intakes of dietary nutrients, such as zinc, magnesium-group vitamins, culinary fat (such as olive oil) and single food groups such as sea-food or fish consumption with respect to decreased risk of anxiety (Gómez-Pinilla, 2008, Tannenbaum *et al.*, 1997). However, given the complex combinations and interactions among nutrients in an individual's daily diet, considerable barriers exist to study individual nutrients and the diseases caused directly by dietary habits.

Diets are multidimensional; therefore, attribution of differential disease prevalence or symptomatology to a single nutrient or food group is difficult. Moreover, nutrient intake is associated with particular dietary patterns, which may act as a confounder regarding the diet-disease associations. In this regard, dietary patterns have been examined as predictors of disease outcomes more than ever. For example, according to a study among middle-aged women participating in the Nurses' Health Study, a prudent dietary pattern was found to be relevant to higher intakes of vegetables, fruits, legumes, fish, poultry, and whole grains. However, the western dietary pattern was characterized by higher intakes of red and processed meats, desserts, refined grains, and fried foods. These patterns were aligned with markers of systemic inflammation (Esmaillzadeh and Azadbakht, 2008, Schulze *et al.*, 2005).

In a study conducted over a group of adolescents, the dietary pattern of foods rich in animal foods had a direct relationship with anxiety (Weng *et al.*, 2012). In another study conducted on a group of adult women and men, a significant relationship was observed between dietary patterns including processed foods and anxiety (Bakhtiyari *et al.*, 2013).

Noticeable characteristics of a diet may be captured using a composite measure of dietary intake or dietary quality scores derived from the recommended dietary guidelines.

The evaluation of a diet quality is defined according to the level of adherence to the dietary guidelines and Food Guide Pyramid. Nowadays, eating habits are studied instead of reporting food or micronutrients. So, it can be more useful to consider the entire diet of such patterns and diet quality indicators.

According to the literature, different criteria exist for assessing the quality of the diet, such as healthy eating index (HEI), diet quality index International Version (DQI-I), and the Mediterranean diet scale (MDS). Among these factors, the most comprehensive and prestigious one is DQI-I, because the regimes quality in different countries can be affected by various stages of transition nutrition surveys for the chronic diseases to study malnutrition.

Therefore, the aim of this study was to investigate the relationship between DQI-I and anxiety.

Materials and Methods

Participants' characteristics: The ethics committee in Shiraz University of medical science approved this study. This cross-sectional study was carried out among the couples. They were asked to perform routine examinations before marriage in Shiraz city, Iran. All participants were required to sign the written informed consents.

Regarding anxiety, as one of the indicators examined in this study, the sample size was determined as 194 using the following formula (29).

$$N = \left(\frac{z_{\alpha} + z_{\beta}}{C(r)}\right)^2 + 3$$

Inclusion criteria: couples (men and women) who intended to get married and visited the reference laboratory for performing routine examination before the marriage.

Exclusion criteria involved:

1) People, who were under treatment with regard to each components of metabolic syndromes (drugs

affecting the metabolism of glucose, lipids, and blood pressure, such as steroids, non-steroidal anti-inflammatory drugs, thyroid hormones of male and female hormones) or were consuming supplements and vitamins in the last three months.

2) People having a history of chronic diseases in heart, lung, liver, kidney, and thyroid.

Initially, participants completed a series of demographic questions related to the following indicators:

1- Age
2- Gender
3- Occupation
4- Marital status
5- Education
6- Smoking (smoking time, average number of cigarettes smoked per day, week, and month, the number of leaves, etc.)
7- Using other drugs now and in the past
8- Types and dosage of used medications or supplements
9- Income level
10- Person's medical history and family disease background
11- Dietary changes
12- Physical activities in the past two months
13- Exposure to sunlight, consumption of alcoholic beverages (the amount and type) in the past year.

The participants' body weight and height were measured by a trained nutrition student using a regulated measuring station (Seca GmbH & Co. KG, Hamburg, Germany). The participants were wearing light clothes, but no shoes during the measurement. Body mass index (BMI) was calculated as weight/height^2 (kg/m^2). Physical activity was assessed using the short version of the International Physical Activity Questionnaire (IPAQ). The physical activity levels as well as continuous values of MET-minutes per week (MET = metabolic equivalent of task) were calculated according to the IPAQ scoring protocol.

The hip circumference was measured in standing position using muscle-bound meters over the most massive relief the hip in a horizontal plane. The blood pressure of the participants was measured by standard methods; 15 minutes after the participant was in a sitting position and leaning his/her arm on a hard surface. The blood pressure was measured twice within 15 minutes from the right hand (at the heart level) and the average of the two values was considered as the final blood pressure.

The participants were asked to avoid consuming tea, coffee, and decongestant drugs as well as smoking. Systolic blood pressure measurement was conducted based on auscultation of the first phase and diastolic blood pressure were auscultation of the second, phase five korotkoff.

Diet quality assessment: The dietary intakes were assessed by a self-administered optically readable food frequency questionnaire (FFQ), which its validity and reliability were tested, approved, and used in Iran. It was administered to obtain information about the usual food intake during the past year (Mirmiran *et al.*, 2010).

This comprehensive questionnaire consisted of 169 items and included frequency alternatives (from once per month to several times per day), the number of food units taken, and the portion sizes. After using the estimated portion sizes, the intake of each food was converted into daily equivalents (metrics were based on grams per day) for statistical analysis.

The DQI-I deals with four aspects of a high-quality diet consisting of variety, adequacy, moderation, and overall balance. Specific diet components are classified under each category. These categories help the users to identify diverse aspects of their diet that might be needed for improvement. The score for each category is calculated as the sum of the scores for each component in that category. The total DQI-I score (ranging from 0 to 100 points) is the sum of the scores for the four categories (**Table 1**) (Kim *et al.*, 2003).

- Variety

Variety was evaluated both as an overall variety and as a variety of protein sources. The maximum overall variety score can be achieved by intake of at least one meal from each of the food groups (meat, poultry, fish, egg, dairy, beans, grains, fruit, and

vegetables). The score for the variety of protein sources (meat, poultry, fish, dairy, beans and eggs) was based on consuming more than half of the serving size per day by taking into account the data gathered by the FFQ.

- Adequacy.

This feature evaluates the intake adequacy of those dietary elements required to protect the body against under-nutrition and deficiency disorders. The adequacy of fruits, vegetables, grains, and fibers' intake is dependent on the energy intake. So,, for an energy intake of 7118 kJ (1700 kcal), 9211 kJ (2200 kcal), and 11 304 kJ (2700 kcal), the maximum score was assigned to a diet containing two, three, and four portions of fruit and three, four, or five portions of vegetables, respectively. The protein intake was considered adequate when the proportion of the total energy from protein was 10%.

- Moderation

This element evaluates the intake of foods and nutrients related to chronic diseases, which may need limited. To emphasize on the intensity of moderation in fat intake, total fat intake in the DQI-I was evaluated using more stringent cut-off values than those found in other dietary indexes. The 'empty-calorie food' component measures how much a person's energy supply is dependent on low-nutrient density foods, which provide energy alone and supply deficient nutrients. The DQI-I states that table sugar, alcohol, oil, and similar foods are empty calorie foods (if the sum of nutrient densities considered across nutrients in a food is greater than one, the food is considered as an empty-calorie food).

- Overall balance

This category examines the overall balance of diet in terms of proportions of energy sources and fatty acid composition.

Anxiety assessment: Anxiety was assessed by a mental health questionnaire, that is a short version of the self-report depression, anxiety, and stress scale questionnaire. This is a 21-item self-administered questionnaire designed to measure the magnitude of three negative emotional states of depression, anxiety, and stress. The DASS-Depression focuses on reports of low mood, motivation, and self-esteem. DASS-anxiety deals with physiological arousal, perceived panic, and fear. DASS-stress assesses tension and irritability.

Data analysis: For quantitative variables, the Kolmogorov-Smirnov test was used to investigate the normal distribution and to compare different variables in different groups (gender, occupation, etc.). Afterwards, in the case that the data were normal, t-test and ANOVA were run and in case of significant results, a posteriori test was applied. In the case that data were not normal, some other tests were applied including the Kruskal-Wallis nonparametric test. Chi-square test was also used to determine the relationship between qualitative variables. Data were checked for normality using the Kolmogorov–Smirnov test. Multivariate linear regression was used to examine the association between scores of dietary patterns and DASS with adjustments for age, education, job, income, and smoking for model 1 and additionally for BMI and physical activity for model 2. The significance level was set at P-value < 0.05. All statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS version 16 (SPSS Inc., Chicago, USA)). In addition, mental health was assessed using a short version of the self-report depression, anxiety, and stress scale (DASS-21) questionnaire (with seven items per subscale) (Lovibond, 1996), which was validated for Iranian population (Sahebi et al., 2005).

Results

Demographic characteristics, lifestyle information, and DASS scores of the study participants are presented in **Table 2**. The mean age of 180 studied participants was 27.1 years. The age means of 90 men and 90 women were 29.13 and 25.06 years, respectively. The mean BMI for the total participants was 23.82 (kg/m^2). The results showed that 98% of participants had an academic degree. The mean anxiety score of participants was 4.9 and the anxiety score was not different between men and women participating in the study. **Table 3** shows the score of the dietary quality index and its components for all participants. As shown in **Table 3**, no difference was

observed between men and women with regard to the score of the DQI and its components.

Univariate and multivariate linear regressions of anxiety and DQI score showed a significant relation between DQI score and anxiety in all participants, including both males and females (**Table 4**). Diet quality index score had a negative association with anxiety in all participants. In addition, adjustments for age, education, income, job, smoking, physical activity, and BMI did not change the aforementioned associations.

Table 1. Diet quality index-international scores and components

Components	Score ranges (points)
DQI-I, total	0-100
Variety	0-20
Overall food group variety	0-15
Within-group variety for protein sources	0-5
Adequacy	0-40
Vegetable group	0-5
Fruit group	0-5
Grain group	0-5
Fiber	0-5
Protein	0-5
Iron	0-5
Calcium	0-5
Vitamin C	0-5
Moderation	0-30
Total fat	0-6
Saturated fat	0-6
Cholesterol	0-6
Sodium	0-6
Empty calorie foods	0-6
Overall balance	0-10
Macronutrient ratio	0-6
Fatty acid ratio	0-4

Table 2. Characteristics of the study participants (n = 180)

Quantitative variables	Total	Males	Females	P-value[a]
Age (year)	27.10 ± 7.27[c]	29.13 ± 7.31	25.06 ± 6.66	0.001
Body mass index (kg/m^2)	23.82 ± 4.20	24.53 ± 4.41	23.11 ± 3.95	0.024
Systolic blood pressure (mmHg)	119.87 ± 13.19	121.34 ± 13.98	118.40 ± 12.25	0.13
Diastolic blood pressure (mmHg)	75.25 ± 8.86	76.32 ± 9.11	74.17 ± 8.52	0.10
Total physical activity in week (Met-min/week)	504.70 ± 74.23	651.41 ± 86.77	357.98 ± 51.49	< 0.001
Anxiety score	4.90 ± 4.47	5.10 ± 4.50	4.70 ± 4.30	0.56
Qualitative variables	**Total, N (%)**	**Males, N (%)**	**Females, N (%)**	**P-value[b]**
Job				
Employed	111 (61)	80 (88)	31 (34)	< 0.001
Education				
College	70 (38)	30 (33)	40 (45)	0.25
Smokers	12 (6.6)	11 (12.2)	1 (1.1)	< 0.001
Income				
No income	58 (32.2)	1 (1.1)	57 (63.3)	< 0.001
Below the poverty line	74 (41.1)	51 (56.7)	23 (25.6)	< 0.001
Above the poverty line	48 (26.7)	38 (42.2)	10 (11.1)	< 0.001

[a]: ANOVA test; [b]: chi-square test; [c]: Mean ± SD

Table 3. Diet Quality Index-International scores and component

Components	Total	Males	Females	P-value [a]
Total diet quality	48.48 ± 6.40 [b]	48.76 ± 6.37	48.21 ± 6.44	0.56
Variety	10.43 ± 3.04	10.50 ± 3.25	10.37 ± 2.85	0.77
Adequacy	29.81 ± 3.50	29.82 ± 3.57	29.79 ± 3.44	0.94
Moderation	6.98 ± 3.58	7.07 ± 3.71	6.90 ± 4.00	0.77
Overall Balance	1.43 ± 1.83	1.58 ± 1.97	1.29 ± 1.67	0.29

[a]: Student test; [b]: Mean ± SD

Tables 4. Univariate and multivariate linear regressions of Diet Quality Index and anxiety score.

	β (95% Confides interval I for β)	P-value [a]
Total		
Unadjusted	-0.36 (-0.45, -0.276)	< 0.001
Model 1	-0.35 (-0.44, -0.26)	< 0.001
Model 2	-0.35 (-0.44, -0.27)	< 0.001
Males		
Unadjusted	-0.37 (-0.50, -0.24)	< 0.001
Model 1	-0.35 (-0.48, -0.22)	< 0.001
Model 2	-0.35 (-0.48, -0.22)	< 0.001
Females		
Unadjusted	-0.37 (-0.50, -0.24)	< 0.001
Model 1	-0.36 (-0.48, -0.23)	< 0.001
Model 2	-0.36 (-0.23, -0.48)	< 0.001

[a]: The model was adjusted for age, education, job, income, and smoking. Model 2 was also adjusted for BMI and physical activity.

Discussion

The purpose of this study was to investigate the association between anxiety and DQI score. This research is the first study on the relationship between diet quality and mental disorders in Iran. With respect to the importance of the global burden of anxiety, as a known major public health concern with an increasing prevalence, this study was designed. The results showed that anxiety and DQI scores of 90 couples had significant association. The relationship remained significant after adjusting for the covariates. According to the literature, it seems that no study has ever investigated the relationship between DQI and anxiety status.

The other studies had discovered the correlation between diet quality and chronic diseases. In the Nurses' Health Study and the Health Professionals Follow-Up Study, the risk of chronic diseases, such as cardiovascular disease and cancer was 25% lesser in individuals, who were in the top quintile of diet quality scores over eight years of follow-up compared to the lowest quintile (Weng *et al.*, 2012). Diet quality measured by dietary pattern analysis showed the risk of cardiovascular diseases in studies (Bakhtiyari *et al.*, 2013, Mirmiran *et al.*, 2010). Diet quality index was also inversely related to cancer mortality in participants (McCullough *et al.*, 2002). Recent results from the INTERHEART study over 52 countries demonstrated that the risk for acute myocardial infarction was 30% higher in individuals with higher scores on a measure of dietary "risk" (Fung *et al.*, 2001).

These results are largely concordant with previous studies revealing an inverse relationship between measures of diet quality indices and anxiety (Hu *et al.*, 2000, Mai *et al.*, 2005). Healthy diet was found to have an inverse association with anxiety, while the unhealthy and western dietary patterns increased the risk of anxiety. Higher scores of healthy diet (greater intake of fruits, vegetables, whole grains and low-fat meat) were associated with better mental health and lower

anxiety (Mai *et al.*, 2005). On the other hand, higher intake of processed foods, sweets, beverage, as well as red meat and its products were found to have a positive association with mental disorders (Jacka *et al.*, 2010b). Previous studies reported that micronutrients, such as vitamins (vitamins B, vitamin C, vitamin D, and vitamin E), minerals (calcium, chromium, iron, magnesium, zinc and selenium), and other bioactive substances (phenolic compounds and plant sterols) could reduce the risk of mental diseases (Jacka *et al.*, 2010a). These nutrients and substances are found in many food groups. For example, fruits and vegetables are good sources of B vitamins, vitamin C, vitamin E, iron, calcium, magnesium, and bioactive substances (Munoz *et al.*, 2008), dairy products are good sources of calcium, zinc, vitamin B2, vitaminB12, selenium, and magnesium, and finally, legumes are known to contain vitamin B9, iron, zinc, and calcium (Bakhtiyari *et al.*, 2013).

In a study, a sample of 1046 adult women were asked to consume a dietary pattern including vegetables, fruit, beef, lamb, fish, and whole-grains. Later, the results showed that this dietary pattern decreased the odds ratio of clinically diagnosed anxiety. However, a dietary pattern including processed and western diets was related to an increased odds ratio of psychological symptoms. Augmented a priori diet quality scores were also related to reduce psychological symptoms (Fung *et al.*, 2001). In another study, a lesser adherence to consumption of foods including a healthy diet as well as an augmented intake of unhealthy foods were related to increased odds for anxiety in participants (Hu *et al.*, 2000). These associations confirmed the dose-response patterns and remained significant after adjustment for a wide range of potential confounding factors. Emotional eating means the tendency to preferably consume energy-dense sweet and high-fat foods in response to stress. Several studies confirmed that the manifestation of anxiety symptoms was related to emotional eating (Kaur and Kapoor, 2001, Lampe, 1999, Messina, 1999), but evidence is lacked regarding the role of specific anxiety profiles on emotional eating. Parker and Crawford observed that craving for comfort foods, such as chocolate or cake, increased with increased number of atypical anxiety symptoms and identified rejection sensitivity as one important predictor of such craving (Konttinen *et al.*, 2010, Ouwens *et al.*, 2009, Parker and Crawford, 2007, Whitaker *et al.*, 2014).

The level of income, education, age, and smoking affects the person's depression and anxiety status. In the literature, lower education levels and higher age had a direct relationship with anxiety in individuals. A direct relationship was also reported between smoking and anxiety disorders (Yousefi *et al.*, 2010). In this study, after adjusting these factors, a positive relationship was found between dietary quality and anxiety, which suggests that DQI has an impact on the level of anxiety beyond the other factors.

Inflammatory procedures are thought to play an etiological role in the initiation and maintenance of mental disorders (Smith, 1991). They are also of central importance in the high-prevalence of chronic disease, such as coronary heart diseases and diabetes (Shah *et al.*, 2008, Spranger *et al.*, 2003). Inflammation may describe the relationship among medical illnesses, mental disorders, and mortality, in addition to its associations with diet. Adaptation of a Mediterranean diet, high in vegetables, fruits, legumes, whole grains, fish, olive oil, and low-fat dairy products, is associated with lower levels of inflammation (Chrysohoou *et al.*, 2004). However, western diets and diets high in refined carbohydrates are related to higher levels of C-reactive protein, as a marker of low-grade inflammation (Liu *et al.*, 2002). A western dietary pattern decreased brain-derived neurotrophic factor (BDNF) levels during a short period and this result was independent of obesity or nutritional deficits (Molteni *et al.*, 2002). This factor protects neurons from oxidative stress and stimulates neurogenesis (Duman *et al.*, 1997). It also plays a central role in depressive illness (Hashimoto *et al.*, 2004, Mariscal-Arcas *et al.*, 2007). Thus, by moderating the expression of BDNF, diet can influence mental disorders.

This study had a number of limitations. The first limitation was that the study was cross-sectional and cross-sectional studies cannot confirm the cause-and-effect relationship between variables. Mental disorders affect appetite and food intake. Therefore, prospective studies should be conducted to confirm this relationship. In addition to diet, several other risk factors also can increase the risk of mental illnesses, including smoking, alcohol consumption and reduced physical activity. In addition to these risk factors, socio-economic status should be monitored carefully because it also can affect dietary intake and the risk of mental disorders people. So, in future studies, these factors should be monitored carefully. Another limitation of this study was the small number of participants. Future studies should have a greater number of participants.

Conclusions

This study is the first study on the relationship between diet quality and mental disorders in Iran. In this study, a significant correlation was observed between diet quality and risk of mental disorders. The increase in the index of dietary quality in humans caused a significant reduction in their level of anxiety.

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Authors' Contributions

Study concept and design: Mahoor Salehi; Acquisition of data Mahoor Salehi; Analysis and interpretation of data: Mahoor Salehi; Drafting of the manuscript: Mahoor Salehi; Critical revision of the manuscript for important intellectual content: Mohammad Hassan Eftekhari, Statistical analysis: Mahoor Salehi; Administrative, technical, and material support: Mohammad Hassan Eftekhari, Study supervision: Mohammad Hassan Eftekhari.

Conflict of Interest

Authors have no conflict of interests.

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