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Original Article

The Association between Stress Levels and Food Consumption among Iranian Population

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Abstract

Background: Stress has been considered as a highly common disorder that has a complicated relation with dietary intake and has been linked with both increased and decreased dietary intake.

Objective: This study was conducted to assess the association between food consumption and stress levels in an Iranian adult population.

Methods: In this cross-sectional study, data from the third phase of Isfahan Healthy Heart Program (IHHP) that was conducted for cardiovascular diseases prevention and health promotion were used. Nine thousand five hundred forty-nine adults aged ≥ 18 years participated in the study. Dietary habits were assessed by a 49-item Food Frequency Questionnaire (FFQ). Stress levels were assessed by General Health Questionnaire-12 (GHQ-12). The participants were separated on the basis of their stress levels into two groups as the low- and high- stress groups.

Results: Individuals in the low- stress group were significantly younger and tended to have higher physical activity and education level, lower LDL cholesterol, and were less likely to be current smokers. Dietary intake of unsaturated oils, grains, fruits, vegetables, meat, and dairy products was significantly higher in the low- stress group whereas dietary intake of saturated oils was significantly lower; moreover, Global Dietary Index (GDI) was lower in the low- stress group. We found a significant positive association between stress level, GDI (OR: 1.24; 95% CI: 1.14 – 1.35), and saturated oils (OR: 1.17; 95% CI: 1.08 – 1.28) and inverse association between stress level and intake of unsaturated oils (OR: 0.84 ; 95% CI: 0.77 – 0.91), fruits and vegetables (OR: 0.83; 95% CI: 0.76 – 0.90), meat (OR:0.88; 95% CI:0.82 – 0.97),and dairy products (OR: 0.88 ; 95% CI: 0.81 – 0.96) after adjustments based on sex, age, smoking, and physical activity.

Conclusion: Our results showed a significant positive association between dietary intake and stress. We must have a special attention to dietary intake in stress management program of high- stress individuals, and in dietary recommendations, psychologic aspects should be considered. However, prospective longitudinal studies are needed to assess the causal relationship between stress and dietary factors.

Keywords: Diet and food groups, stress level

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Introduction

Anxiety, stress, and depression are highly common chronic diseases.¹ Stress, as a persistent factor in daily life, seriously influences the development and performance. Severe stress exposure or long time stress spoils mechanisms of homeostasis, affects body functions, and plays an important role in the pathogenesis of most of psychiatric disorders.² Growing evidence illustrated that stress influences health by its direct biologic effects and also by its indirect health behavior changes.^{3,4} One of the behavioral changes is food choice that affects health as a result

of changes in appetite and diet.⁵

Stress, at least temporarily, leads to biologic changes expected to decrease dietary intake and delay gastric emptying⁶ and consequently may lead to other behavioral changes such as, preference for high-energy foods like fat and sweet^{7,8} and hyperphagia.⁹ Nevertheless, stress has been linked with both increased or decreased dietary intake,¹⁰ but there are studies that couldn't find any differences in food consumption as a result of different levels of stress.¹¹ These controversial results may be related to the characteristic of the stressor; for instance, mild stress may lead to hyperphagia, whereas severe stress induces hypophagia.⁹ Individuals could use food for nourishment and also as a tool to manage temperament, tension, and stress.^{12,13} Albeit food choices and eating behaviors are related with a combination of factors including culture, education, age, gender, hormones, as well as individual intention and psychologic characteristics.^{12,14} A growing number of evidence has revealed that food consumption would affect our feeling.¹⁵ It has been demonstrated that consumption of carbohydrate- rich food is related with enhanced mood¹⁶ and may reduce the anger.¹⁷ On the contrary, there are studies that indicate food consumption could not affect stress level.¹⁸

The association between stress and diet is predominantly complex and the experimental results are inconsistent.⁸ Furthermore,

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most of the previous studies were accomplished on clinical or subclinical populations^{19,20} and there is little information about the association between stress and food consumption at the general population level specially in the region of the Middle East including Iran. Thus, this study was conducted to investigate the association between stress levels and consumption of different variety of food in central Iran.

Patients and Methods

Participants

Data from the third phase of Isfahan Healthy Heart Program (IHHP) were used for this cross-sectional study. The IHHP, as a community-based program, was conducted by Isfahan Cardiovascular Research Institute and Isfahan Provincial Health Office for Cardiovascular Prevention and Control and Healthy Lifestyle Promotion. Individuals from three provincial cities of Isfahan, Arak, and Najafabad were selected based on multistage cluster random sampling method. Further information about IHHP and sampling process are provided elsewhere.²¹ Inclusion criteria consisted of having dietary and anthropometric information, plasma glucose, lipid profiles, and other variables, and having previous history of chronic diseases and taking medications were considered as our excluding criteria. For each of the 9,549 adult participants who aged 18 years and above, a signed written informed consent was provided. This study was ethically approved by Isfahan University of Medical Sciences Ethics Committee and other related national organizations.

Measurements

Data regarding the socioeconomic, demographic, medical history, physical activity, as well as smoking habits were collected by trained interviewers using a pretested questionnaire.²¹ Weight and height were measured in bare foot and light clothing. Body mass index (BMI) was calculated as weight in kilogram divided by the square of height (kg/m^2). Blood pressure was taken twice after a five-minute rest in a seated position and the average was considered as final blood pressure. Physical activity was measured according to the duration of all types of physical activity per day as metabolic equivalents (mets).

Psychologic Stress

A 12-item General Health Questionnaire (GHQ-12) as a well-known diagnostic means was used to assess psychologic stress.²² On the basis of the existing evidence this questionnaire is consistent and reliable (Cronbach's alpha coefficient = 0.87) in general population screening.²³ A four-point scale including less than usual, no more than usual, rather more than usual, and much more than usual was used to evaluate each item and the scoring system in the current study was GHQ score (0-0-1-1) method. By this method each person would score from 0 to 12 points and individual, having score of 4 or higher, was categorized as high- stress level.

Dietary Habits

A 49- item Food Frequency Questionnaire (FFQ) was used by expert technicians to assess dietary intakes of the individuals. Medical Education Development Center confirmed the validity of this FFQ before being used.²⁴ Consumption frequency and the portion size of each food item during the previous year were individually asked and presented daily (e.g. bread), weekly (e.g.

meat), and monthly (e.g. fish) and then converted to daily intakes for current analysis. Quality of the diet was evaluated by Global Dietary Index (GDI), on the basis of average score for questions concerning dietary intake; lower GDI shows better dietary habits.

Biochemical Assessment

After an overnight fasting, biologic tests including fasting plasma glucose (FPG), serum total cholesterol, HDL and LDL cholesterol, and triglyceride levels were measured in Isfahan Cardiovascular Research Institute central laboratory.

Statistical Methods

We used Statistical Package for Social Science (SPSS Inc., Chicago IL. Version 15.0) for all statistical analyses. Independent sample Student's t-test was used to compare means of continuous variables between the low- and high- stress groups. We applied chi-square test for comparing categoric variables between the low- and high- stress groups. To explore the association between food intake and stress levels, we used logistic regression analysis in different models. In the first model, we adjusted for age and sex, and then further adjustments for physical activity and smoking were made. All models were done by treating the low- stress group as a reference.

Results

Characteristics of the study participants and cardiovascular risk factors separated by stress levels are shown in Table 1. Individuals in the low- stress group were younger ($P < 0.05$) and tended to have higher physical activity ($P < 0.0001$) and education level ($P < 0.05$), lower LDL cholesterol, and were less likely to be current smokers ($P < 0.05$) as compared to those in the high- stress group. No significant differences were found in the BMI, waist circumference, waist to hip ratio, and other biochemical parameters between the low- and high- stress groups. Dietary intake of the study participants separated by stress levels are provided in Table 2. Dietary intake of unsaturated oils, grains, fruits, vegetables, meat, and dairy products was higher in the low- stress group whereas dietary intake of saturated oils was lower; moreover, GDI was lower in the low- stress group as compared with the high- stress group (0.92 ± 0.31 vs 0.94 ± 0.31 , $p \leq 0.001$). The crude and multivariate adjusted odds ratio for dietary intake of the study participants separated by stress levels are shown in Table 3. Although we failed to find any association between dietary intake of carbohydrate- rich foods and grains, in crude models we reached a significant positive association between stress level and GDI and saturated oils (OR: 1.24; 95% CI: 1.14 – 1.35). On the contrary, we found inverse associations between stress level and intake of unsaturated oils (OR: 0.84; 95% CI: 0.77 – 0.91), fruits and vegetables (OR: 0.83; 95% CI: 0.76 – 0.90), meat (OR: 0.88; 95% CI: 0.82 – 0.97), and dairy products (OR: 0.88; 95% CI: 0.81 – 0.96) even after control for potential confounders such as age, sex, smoking, and physical activity.

Discussion

The influence of different dietary intake on stress levels is an attractive issue in health-related behavior investigations. In the current cross-sectional study, we found significant associations between stress and consumption of some food groups such as

Table 1. Characteristics of the study participants and cardiovascular risk factors based on stress levels*

Variables	Stress levels		P**
	Low stress	High stress	
Age (years)	38.41 ± 15.19	39.51 ± 16.24	0.001
BMI(kg/m ²)	25.70 ± 4.51	25.59 ± 4.78	0.29
Waist (cm)	90.21 ± 12.71	89.67 ± 12.88	0.07
Waist to hip ratio	0.89 ± 0.08	0.89 ± 0.08	0.47
Physical activity (mets)	813.92 ± 594.42	758.90 ± 572.06	≤ 0.0001
Smoking (%)	12.9	14.5	0.01
Education (%)			0.001
0–5 years	42.6	79.7	
6–12 years	43.0	39.2	
> 12 years	14.4	11.1	
Fasting blood sugar (mg/dL)	88.6 ± 23.3	89.6 ± 25.6	0.08
Glucose (2hpp) (mg/dL)	105.2 ± 36.4	104.5 ± 36.7	0.39
Cholesterol (mg/dL)	191.5 ± 41.3	193.1 ± 42.3	0.06
Triglycerides (mg/dL)	151.9 ± 104.1	147.6 ± 100.8	0.05
LDL-cholesterol(mg/dL)	117.4 ± 33.5	119.2 ± 34.1	0.02

* Data are means ± standard deviation unless indicated; **P- values are related to Student's t- test and chi-square test show the difference between the two categories of stress levels.

Table 2. Dietary intake of the study participants based on stress levels*

Dietary intake	Stress level		P**
	Low stress	High stress	
Global Dietary Index	0.92 ± 0.31	0.94 ± 0.31	0.001
Saturated oils (time/week)	6.2 ± 5.8	6.8 ± 6.2	0.000
Unsaturated oils (time/week)	5.8 ± 5.1	5.3 ± 5.1	0.000
Grains (time/week)	20.6 ± 6.9	20.3 ± 7.0	0.051
Fruits (time/week)	6.8 ± 4.4	7.3 ± 4.1	0.000
Vegetables(time/week)	7.7 ± 4.2	7.4 ± 4.6	0.02
Meat*** (time/week)	6.3 ± 3.3	6.1 ± 3.5	0.03
Dairy products (time/week)	16.1 ± 6.2	15.6 ± 6.7	0.000
Carbohydrate- rich foods (time/week)	25.5 ± 8.3	24.9 ± 8.5	0.08

*Data are means ± standard deviation unless indicated; **P- values are related to Student's t- test and show difference between two categories of stress levels; *** Including red meat, chicken, and fish.

Table 3. Multivariate adjusted odds ratio for dietary intake of the study participants according to stress levels*

Dietary intake	Stress	Crude	Model 1 (age and sex adjusted)	Model 2 (full adjusted)**
Global Dietary Index	Low	1.00	1.00	1.00
	High	1.20 (1.10–1.31)	1.25 (1.15–1.37)	1.24 (1.14–1.35)
Saturated oils (time/week)	Low	1.00	1.00	1.00
	High	1.18 (1.08–1.28)	1.19 (1.09–1.29)	1.17 (1.08–1.28)
Unsaturated oils (time/week)	Low	1.00	1.00	1.00
	High	0.82 (0.75–0.89)	0.82 (0.76–0.90)	0.84 (0.77–0.91)
Grains (time/week)	Low	1.00	1.00	1.00
	High	1.08 (0.99–1.18)	1.08 (0.99–1.17)	1.03 (0.95–1.12)
Fruits and vegetables (time/week)	Low	1.00	1.00	1.00
	High	0.83 (0.76–0.90)	0.81 (0.75–0.89)	0.83 (0.76–0.90)
Meat (time/week)	Low	1.00	1.00	1.00
	High	0.89 (0.82–0.97)	0.88 (0.82–0.97)	0.88 (0.82–0.97)
Dairy products (time/week)	Low	1.00	1.00	1.00
	High	0.86 (0.79–0.93)	0.86 (0.79–0.94)	0.88 (0.81–0.96)
Carbohydrate- rich foods (time/week)	Low	1.00	1.00	1.00
	High	0.99 (0.99–1.00)	0.99 (0.99–1.00)	1.00 (0.99–1.00)

* Grouping was based on median cut-off; **Adjusted for age, sex, smoking, and physical activity.

vegetable oils, fruits and vegetables, meat, and dairy products.

Psychologic stress has been known as a considerable risk factor for cardiovascular diseases among adults.²⁵ On the other hand, diet and nutrition could affect cardiovascular risk factors²⁶ and may adjust biologic procedures behind the stress response system.⁸ In this study, we not only found an increase in LDL-cholesterol concentration in the high- stress individuals, but also the consumption of saturated oils was higher while the consumption of unsaturated oils was lower in this group that shows a higher risk for cardiovascular disease in the high- stress people. In the same way, in other studies, the consumption of unsaturated fatty acids had protective effects against stress,^{27,28} however, there were some contradictions.²⁹ There are evidences supporting the association between psychologic stress and obesity,³⁰ mainly central obesity.³¹ Stress has been assumed to increase abdominal fat throughout the consequence of neuro-endocrine system.³² Although we couldn't find any significant relationship between stress levels and obesity indices, but there was a marginal association (P = 0.07) between

the waist circumference and stress. Our results are partially in line with other study that showed BMI was not associated with stress.³³

In a cross-sectional study, comparing western (including meat pies, processed meats, pizza, chips, hamburgers, white bread, sugar, flavored milk drinks, and beer) and traditional diet (including vegetables, fruits, beef, lamb, fish, and whole-grain foods), showed that the western diet was associated with higher stress level; however, the traditional diet was related with lower risk of anxiety.²² This result is similar to our results on GDI, in which individuals with low level of stress had better diet compared with individuals who had higher stress. Moreover, another investigation revealed that during stressful period, some meals such as meat, fish, fruits, and vegetables were eaten less.³⁴ These studies support our results about the association between stress and some food groups that we have found in this study. Although a naturalistic study showed that stress didn't have any effect on food intake,³⁵ this may be related to surgical stress that has been studied. Previous studies showed that in stress- prone individuals, a high

carbohydrate diet protected them from negative mood,³⁶ but there is a debate about carbohydrate consumption and stress.²⁰

Dietary factors such as antioxidants affect the oxidative processes that is concerned with the pathophysiology of mental illnesses;³⁷ thus, diet may modify the risk of cognitive and neurostructural changes in the brain which influence psychologic symptoms throughout the life.³⁷ The probable effect of diet on mental disorders may mix with the impact of different mood on appetite and self-care; therefore, nutrient inadequacy and mental illness aggravation could be related in a vicious circle.²² In this study, we found an inverse relationship between the consumption of fruits and vegetables as a main source of anti-oxidant and stress level that was supported with previous investigations.²⁰ It has been declared that physiologically active amines in common fruits and vegetables may improve the physiological diseases.³⁸ Several limitations can be considered in our study. First of all, this study was a cross-sectional study; therefore, we couldn't reach a conclusion about the casualty on the basis of our results. Prospective studies can provide further explanation. Another limitation is that, we used FFQ and as prior investigations explained, FFQ could lead to underestimating dietary consumptions.²³ Furthermore, we adjusted the effects of sex, age, and other indicators of lifestyle including smoking and physical activity; however, other unmeasured confounders may affect our results.

Due to our results in association between stress levels and food intake, we must have special attention to dietary intake in stress management program of the high- stress individuals, and otherwise in dietary recommendations, psychologic aspects should be considered. But, the causal relation between stress and food consumption is complicated to interpret and it has remained indistinguishable whether stress changes the food consumption or diverse consumption of foods conduct to unpleasant emotion. Therefore, longitudinal investigations are required to find out the cause-effect relation between stress and dietary factors.

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