

## Associations between Western and Mediterranean-type dietary patterns and depression in adults in Shiraz

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Received: 13/Nov/2015 Accepted: 21/Feb/2016

### ABSTRACT

**Background and aims:** Depression is a growing public health problem in the world. In this study we investigated the relationship between dietary patterns and depression in adults aged 20-50 years living in Shiraz, Iran.

**Methods:** In a cross-sectional study, 416 subjects (180 men and 236 women) aged 20 to 50 years were selected by stratified multistage random sampling. Dietary intakes were assessed using a semi-quantitative food frequency questionnaire. Depression information was collected by Depression, Anxiety and Stress Scale (DASS) questionnaire. Three major dietary patterns were extracted by factor analysis: vegetable, Western, and Mediterranean-type dietary patterns. Regression analysis was used for association between dietary pattern and depression.

**Results:** A strong positive significant association was observed between Western dietary pattern and depression. Also there was a negative significant association between Mediterranean-type dietary pattern and depression. These associations remained statistically significant even after adjustments for demographic characteristics, physical activity, smoking, body mass index, and energy intake. No association was found between vegetable dietary pattern and depression.

**Conclusion:** The results showed that there was a relationship between dietary patterns and depression. However, clinical trials are needed to clarify whether a causal relationship between diet and mood disorders can be established.

**Keywords:** Dietary pattern, Depression, Adults.

Original article

### INTRODUCTION

Psychiatric distresses are a growing global public health problem.<sup>1</sup> According to recent statistics, approximately half to one-fifth of the world's population experience at least one type of these disorders during their life.<sup>2</sup> In a study in

Iran, the prevalence of psychiatric disorders was 10.8%, with depression (3.3%), being the most common.<sup>3</sup>

The effects of psychiatric distress such as depression appear over the lifespan of all the individuals in different ethnic, racial,

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cultural, and socioeconomic groups.<sup>4</sup> Epidemiological studies suggest that depression can be categorized as risk factors of cardiovascular diseases, type 2 diabetes, osteoporosis, decreased cognitive function, and even death.<sup>5</sup> Although pharmacological interventions and psychotherapy are usual strategies for the treatment of psychiatric disorders, recent notions pose lifestyle changes including dietary modifications can be considered as a safe and effective strategy for individuals at risk of such disorder.<sup>6</sup>

Some studies have investigated the relationships between dietary pattern and depression, but the relationship with some patterns, such as the association between depression and Western dietary pattern are still controversial and need further investigations.<sup>7</sup> Also studies in Middle Eastern countries such as Iran, which have different dietary patterns from other countries, are scarce. The results of such studies may provide nutritionists, dieticians, physicians, and other health-care professionals with information on appropriate dietary advice against such mood disorders. In the current study, we investigated the relationship between dietary patterns and depression in adults in Shiraz.

## METHODS

This cross-sectional study was conducted from November 2013 to March 2014 on 438 adults aged 20-50 years in Shiraz, Iran. Participants were selected by stratified multistage random sampling from households living in 9 municipal districts of Shiraz. Pregnant and lactating women, subjects with severe illnesses, such as cancer and organ failure, a history of cardiovascular diseases and cancer, individuals with special diets, diseases, or medications that affect

appetite, those on medications for diabetes, dyslipidemia and hypertension, individuals with a history of major psychological disorders and/ or taking antipsychotic medications were not included. Some of the aforementioned inclusion criteria were used because they are states or conditions that may affect lifestyle or psychological status. An informed written consent was obtained from all participants.

Data on demographics, family affluence scale (FAS), physical activity, and smoking were collected by trained interviewers using a questionnaire.<sup>8</sup>

Weight was measured with minimal clothing to the nearest 0.1 kg using a digital scale (Glamor BS-801, Hitachi, China) and height was measured to the nearest 0.1 cm by using a non-stretchable tape fixed on a wall while the person was standing without shoes with heels, buttocks, and shoulders touching the wall. Body mass index (BMI) was calculated by dividing weight in kilograms by the square of height in meters. Physical activity was assessed by the international physical activity questionnaire (IPAQ) and expressed as metabolic equivalent in minutes per week (MET-min/wk).<sup>9</sup>

Dietary patterns were assessed using a 168-item semi-quantitative Food Frequency Questionnaire (FFQ), which was evaluated for validity and reliability in previous studies.<sup>10</sup> The FFQ consisted of a list of foods with serving sizes commonly consumed by Iranians. Participants were asked to report frequency of consuming each food item during the previous year on a daily (e.g. bread), weekly (e.g. rice, meat), or monthly (e.g. fish) basis. Portion sizes were then converted to grams by using

household measures.<sup>11</sup> Participants with 70 blank items on the FFQ and those who reported a total daily energy intake outside 800–4200 kcal were excluded.<sup>12</sup> The final analysis was performed on 416 subjects (180 males and 236 females). The nutrient composition of the consumed foods was determined by Nutritionist IV version 3.5.2, which modified Nutritionist IV software is based on the US Department of Agriculture food composition database with some additions for Iranian foods.

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), which has been validated for Iranian population.<sup>13,14</sup> The depression scale assesses dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia, and inertia.<sup>13</sup>

The participants were asked to rate each symptom by its severity during the previous week. Each item was ranked on a 4-point scale ranging from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). Score would range from 0 to 21, with higher score indicating greater depression. This score was doubled for the scoring instructions and the scale was referred to as the DASS throughout.

Data were analyzed by SPSS software version 19.0. Dietary patterns were identified using a posteriori method, factor analysis, and based on the FFQ. The 168 food items were divided into 34 groups based on similarity of nutrient profiles and culinary usage. In some cases, due to a specific nutrient composition (e.g., egg) or a specific cooking procedure (e.g., fried

potato) one food item was selected as a food group. Dietary patterns were obtained by principal component factor analysis with varimax rotation on the 34 food groups. Eigen values greater than 1 were retained. The Kaiser-Meyer-Olkin (KMO) and Bartlett's tests showed that the data were suitable for such analysis (KMO: 0.70, Bartlett:  $P < 0.001$ ). The Curve for the scree plot of eigenvalues indicated that there were three major dietary patterns: Vegetable, Western, and Mediterranean-type dietary pattern. The labeling of dietary patterns was based on the interpretation of foods with high factor loadings for each dietary pattern.<sup>15</sup> Food groups and their factor loadings were illustrated in Table 1. The Bart factor of dietary pattern was used for the statistical analysis. Higher Bart scores indicated a greater and lower Bart scores demonstrated lower diet consumption.

Data were checked for normality using the Kolmogorov-Smirnov test. Tertiles of dietary patterns were compared with qualitative variables, such as sex, marital status, educational level, and FAS using Chi-square, with age using one-way analysis of variance (ANOVA), with BMI and score of depression using simple linear regression.  $P < 0.05$  was considered statistically significant. Multiple linear regression was used to examine the association between dependent variable (depression score) and independent variable (scores of dietary patterns) with adjustments for age, sex, marital status, education, job, family affluence scale, location, and smoking for model 1 and additionally for daily energy intake, BMI, and physical activity for model 2.

**Table 1:** Food groups used in the factor analysis and factor loadings

Food groups	Food items	Dietary patterns		
		Vegetable pattern	Western pattern	Mediterranean -type pattern
Green leafy vegetables	Spinach, lettuce	0.71	-	-
Yellow vegetables	Carrot	0.53	-	-
Cabbage	Cabbages	0.44	-	-
Tomatoes	Tomato, tomato paste	0.70	-	-
Garlic	Garlic	0.65	-	-
Other vegetables	Cucumber, eggplant, onion, green beans and peas, squash, mushroom, pepper, corn, turnip	0.72	-	-
Legumes	Lentils, split peas, beans, chick peas, soy	0.57	-	-
Potatoes	Potatoes	0.31	-	-
Pickles	Pickles, sauerkraut.	-	-	-
Processed meats	Sausages	-	0.57	-
Soda	Soda	-	0.57	-
Refined grains	Iranian refined breads, baguette bread, rice, pasta	-	0.51	-
Salt	Salt	-	0.46	-
Red meats	Beef, lamb, minced meat, hamburger	-	0.45	-
Hydrogenated oil	Hydrogenated oils, grease, butter, margarine	-	0.38	-
Sugar	Chocolate, honey, jam, sugar, sugar cubes, candies	-	0.36	-
Organ meats	Heart, kidney, liver, tongue, brain	-	0.34	-
Eggs	Eggs	-	0.31	-
Mayonnaise	Mayonnaise	-	0.30	-
High-fat dairy	High-fat milk, high-fat yogurt, cream cheese, cream, dairy fat, ice cream	-	-	-
Fried potato	French fries	-	-	-
Salty snacks	Biscuits, popcorn, crackers, potato chips	-	-	-
Coffee- tea	Tea and coffee	-	-	-
Canned fruit	All types of canned fruit	-	-	0.56
Nuts	Almond, peanut, walnut, pistachio, hazelnut, seeds	-	-	0.55
Fruit	All fresh fruit	-	-	0.52
Fruit juice	All natural juices	-	-	0.52
Low fat dairy	Low-fat milk, skim milk, low-fat yogurt, cheese, Kashk, yogurt drink	-	-	0.42
Fish	All fish types, canned fish	-	-	0.35
Olive	Olives, olive oil	-	-	0.34
Poultry	Chicken, turkey, ostrich	-	-	-
Sweets	Cookies, cakes, muffins, pies	-	-	-
Whole grains	Iranian whole-wheat breads, barely, barely bread	-	-	-
Vegetable oil	All vegetable oils except olive oil	-	-	-
Explained variance (%)		9.3	7.7	7.0

## RESULTS

The average age of participants was 35±8.9 years. Most of the subjects in our study were, women, married and have college education, low family affluence and

low physical activity. Demographic characteristics, lifestyle information, and depression score of the study subjects are presented in Table 2.

**Table 2:** Characteristics of the study subjects (n=416)

Characteristics	Mean (SD) or n (%)
Age (y)	35.2(8.9)
Sex, n(%)	Male 180(43.3)
	Female 236(56.7)
Marital status, n(%)	Married 299(71.9)
Education, n(%)	College 253(60.3)
Job	Employed 344(82.7)
Family affluence scale, n(%)	Low 205(49.4)
	Moderate 170(41.0)
	High 40(9.6)
Smoking, n(%)	Smokers 43(10.4)
Physical activity, n(%)	Low(<600 Met-min/wk) 245(59.2)
	Moderate(600-2999 Met-min/wk) 132(31.9)
	High(≥3000 Met-min/wk) 37(8.9)
	BMI(kg/m <sup>2</sup> ) 26.3(4.4)
	Energy intake(kcal/d) 2250(646)
	Depression score* 9.3±7.3

\*Depression score has a possible range of 0-42, with higher score indicating greater depression.

Subjects with higher scores of vegetable dietary pattern were older and had higher BMI but no significant association was

observed between this dietary pattern and other characteristics of the study subjects (Table 3).

**Table 3:** Characteristics and dietary intakes of the study subjects across tertiles of dietary patterns<sup>1</sup>

Characteristics	Vegetable pattern			Western pattern			Mediterranean-type pattern		
	Q1	Q3	p <sup>2</sup>	Q1	Q3	p	Q1	Q3	p
Age(y)	33.4(8.6)	36.5(8.9)	0.02	37.7(8.0)	32.8(9.2)	<0.001	35.2(8.9)	33.6(8.8)	0.01
Female, n(%)	75(54.0)	79(56.8)	0.7	106(76.3)	50(36.0)	<0.001	89(64.0)	67(48)	0.02
Single/divorced, n(%)	49(35.3)	35(25.2)	0.09	26(18.7)	52(37.4)	0.002	37(26.6)	51(36.7)	0.01
Academic education, n(%)	58(41.7)	54(38.8)	0.9	48(34.5)	62(44.6)	0.7	39(28.1)	74(53.2)	<0.001
Employed, n(%)	111(80.4)	118(84.5)	0.6	121(87.1)	110(79)	0.2	118(84.9)	106(76.3)	0.04
High FAS, n(%)	12(8.6)	13(9.4)	0.2	9(6.5)	16(11.5)	0.2	4(2.9)	17(12.3)	0.004
Low physical activity <sup>3</sup> , n(%)	82(59)	78(57.0)	0.6	81(58.3)	84(61.3)	0.1	97(70.3)	74(53.2)	0.01
Current smokers, n(%)	17(12.3)	12(8.6)	0.5	2(1.4)	29(21.0)	<0.001	17(12.3)	12(8.6)	0.6
BMI (kg/m <sup>2</sup> )	25.5(4.3)	27.0(4.6)	0.05	27.0(4.5)	25.9(4.2)	0.3	26.5(4.8)	25.9(4.5)	0.08
Total energy, (kcal/d)	2071(615)	2458(651)	<0.001	1855(516)	2756(612)	<0.001	1925(573)	2706(644)	<0.001
Depression score	9.7(7.6)	9.2(7.6)	0.5	8(6.9)	10(7.5)	0.03	10.4(7.6)	9.1(7.5)	0.1

\*Values are either Mean (SD) or n(%), as indicated n=83 in each quintile. \*\*P was computed by ANOVA for age, by Chi-square for qualitative variables, by simple linear regression for BMI and scores of depression. \*\*\*Low physical activity was defined as <600 Met-min/wk. Abbreviations: BMI, body mass index; FAS, family affluence scale.

Males, young and single subjects, higher smoking habits, and higher depression score (P=0.03) possessed significantly higher scores of Western dietary pattern. Males, young and single subjects also had significantly higher

scores of Mediterranean-type dietary pattern. Also, education and family affluence scale were positively, and job and physical activity were negatively associated with scores of Mediterranean-type dietary pattern. The intake

of energy increased across tertiles of all dietary patterns.

Univariate and multiple linear regression of depression and the three dietary patterns showed no significant association for vegetable dietary pattern (Table 4), but Western dietary pattern was

positively and contrarily Mediterranean-type dietary pattern was negatively significant associated with depression. Adjustments for age, sex, marital status, location, education, family affluence scale, job, smoking, energy intake, physical activity, and BMI did not change the aforementioned associations.

**Tables 4:** Univariate and multiple linear regressions of dietary patterns and depression

Tittle	Vegetable pattern		Western pattern		Mediterranean type pattern	
	$\beta$ (95% CI)	P	$\beta$ (95% CI)	P	$\beta$ (95% CI)	P
Depression						
Unadjusted	-0.48(-1.18, 0.22)	0.18	0.80(0.01, 1.50)	0.026	-0.94(-1.64, -0.24)	0.009
Model 1	-0.42(-1.12, 0.28)	0.24	1.01(0.23, 1.80)	0.011	-0.60(-1.33, 0.12)	0.10
Model 2	-0.55(-1.29, 0.18)	0.14	1.64 (0.66, 2.62)	0.001	-0.90(-1.75, -0.06)	0.03

Model 1 was adjusted for age, sex, marital status, education, job, family affluence scale, location, and smoking. Model 2 was additionally adjusted for energy intake, BMI, and physical activity. CI, confidence interval.

## DISCUSSION

Significant associations were found between dietary patterns and depression in this study. There was a significant positive association between Western dietary pattern and a significant negative association between Mediterranean-type dietary pattern and depression. The associations remained significant even after adjusting for potential confounders including age, sex, marital status, education, job, family affluence scale, location, smoking, physical activity, calorie intake, and BMI. No significant association was found between vegetable dietary pattern and depression.

Some of the previous investigators have also reported the negative association between depression and Western-type dietary pattern. For instance, dietary patterns containing fast-food and commercial pastries or containing sweetened desserts, fried foods, processed meat, refined grains, and high-fat dairy products were associated with a higher risk of depression in cohort studies.<sup>16,17</sup> Similarly, in a cross-sectional study lower consumption of fast-foods, ready-to-eat foods like instant noodle, frozen, canned or microwave foods, and potato chips were associated with lower

odds of depression in Chinese college students.<sup>18</sup> The positive relationship between Western dietary pattern and depression may be because of increased preference for palatable, i.e. high-sucrose and high-fat, foods during periods of depression probably because of improvement in mood following consumption of such kinds of foods.<sup>19</sup> An emergent idea is that the increased risk of depression by Western dietary patterns is associated with increased levels of inflammatory markers, C-reactive protein and interleukin-6.<sup>20</sup>

Also, there are similarities between our results for the Mediterranean-type pattern with results of other studies. For example, a traditional dietary pattern characterized by fish and fruit consumption was associated with a lower incidence of depressive syndrome in a longitudinal cohort conducted on adults aged between 40-65 years in France.<sup>21</sup> Similarly, a lower consumption of fruit was associated with higher score of depression in a cross-sectional study on college students.<sup>18</sup> Likewise, a traditional healthy dietary pattern characterized by vegetables, fruit, meat, fish, and whole grains was associated with lower

odds for depression in a cross-sectional study of women aged between 20-93 years in Australia.<sup>22</sup> Also, a Mediterranean dietary pattern and especially consumption of fruit, nuts, and legumes, and a higher monounsaturated- to saturated-fatty acids ratio was associated with lower incidence of depression in Spanish university graduates.<sup>23</sup>

Although the sort of the methodology used in this study does not permit to conclude the causal relationship between consumption of the Mediterranean-type dietary pattern and prevention of depression, the biological properties of some of the components of this pattern may suggest the observed relationship. Depression has been found to be associated with increased production of pro-inflammatory cytokines and omega-3 fatty acids have proved to inhibit the synthesis of such cytokines.<sup>24</sup> Long-chain omega-3 fatty acids present in fish of the Mediterranean-type dietary pattern may be involved in the negative association of this pattern and depression.<sup>25</sup> Olive oil, another component of the Mediterranean-type dietary pattern may also contribute to the negative association of this pattern with depression. Olive oil produces psychoactive lipid oleamide which induces sleep and modulates serotonin receptor-mediated signaling.<sup>26</sup> Olive oil has been also potential to decrease inflammation and oxidative stress, both of which are known as key components of depression.<sup>27,28</sup> Moreover, antioxidants and polyphenols in fruits of the Mediterranean-type dietary pattern may be efficacious in prevention of depression.<sup>29</sup> We did not find significant association between vegetable dietary pattern and depression; other investigators, however, have found a negative association between consumption of vegetables and depression. For instance, Tsai and coworkers reported that vegetables, but not fruit, were protective against depressive syndrome in older Taiwanese people.<sup>30</sup> Also, in a cross-sectional study conducted on a Chinese elderly

population, higher consumption of dietary patterns containing “vegetable-fruit” and “snacks-drinks-milk products” was associated with a lower depression score.<sup>31</sup> In clinical trials also, vegan diets have improved mental health and decreased depression.<sup>32,33</sup> The reason that we did not find an association between vegetable dietary pattern and depression may be the method of cooking vegetables. Frying is a common procedure of cooking vegetables in Shiraz. So, a higher consumption of vegetables may result in a higher intake of fat. Fats are components of the Western dietary pattern. So, the higher consumption of vegetables may propel the subjects towards Western dietary pattern which had a positive association with depression, resulting in weakening of the negative association between vegetables and this mental health disorder.

There are studies with results contrary to the findings of this study. For example, the negative association between Western dietary pattern and depression has not been found in some investigations.<sup>16,22,34-39</sup> Similarly, in one study no significant association was observed between consumption of fish or omega-3 fatty acids and depression.<sup>40</sup> Likewise, in a study on women 20-93 years no association was found between consumption of a Mediterranean-type diet, containing fruits, salads, fish, tofu, beans, nuts, yogurt, and red wine, and depression.<sup>22</sup> The reason of discrepancy in the results of studies could be the cohort or cross-sectional nature of the studies. Difference in the method of assessing depression, difference in the study population (one sex or both, educational level, healthy subjects versus patients), the use of principal component analysis for extraction of dietary patterns, difference in statistical methods, and the type of covariates used.

The strengths of this study were the method of sampling, stratified multi-stage random sampling, by which a good representative sample of adults 20-50 years living in Shiraz was selected. However, our



study also had limitations. Although many confounding factors were controlled in the analysis, factors such as family history of depression were not controlled. Moreover, with a cross-sectional design we could not conclude whether an unhealthy dietary pattern preceded development of depression or if depression caused inappropriate and unhealthy dietary choices.

## CONCLUSION

Our study showed that the dietary pattern has an important relationship with depression in a representative sample of adults 20-50 years in Shiraz. Regression analysis after adjustments for demographic and lifestyle characteristics suggested that the Western dietary pattern has a great associations with depression, while a Mediterranean-type dietary pattern containing good quantities of fruit, nuts, fish, and olive oil has a good negative relationship with depression. Clinical trials are required to examine the preventive effect of the Mediterranean-type diet on depression.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interests.

## ACKNOWLEDGMENT

We are thankful to the subjects who kindly participated in this study. We also thank Mr. Mohsen Karamati and Mohammad Aqaei Nezhad for his kind help in data analysis. The present article was extracted from the thesis written by Majid Kamali and was financially supported by Shiraz University of Medical Sciences, Grant No. 92-6865.

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**How to cite the article:** Kamali M, Dastsouz F, Amanat S, Sadeghi F, Akhlaghi M. Associations between Western and Mediterranean-type dietary patterns and depression in adults in Shiraz. *Int J Epidemiol Res.* 2016; 3(2): 128-137.