

# Adherence to Mediterranean dietary pattern and depression, anxiety and stress among high-school female adolescents

Asal Neshatbini Tehrani<sup>a</sup>, Amin Salehpour<sup>b</sup>, Bita Beyzai<sup>a</sup>, Hossein Farhadnejad<sup>a</sup>, Reza Moloodi<sup>c</sup>, Azita Hekmatdoost<sup>a</sup> and Bahram Rashidkhani<sup>a,\*</sup>

<sup>a</sup>National Nutrition and Food Technology Research Institute (WHO Collaborating Center), Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran

<sup>b</sup>Occupational Health Research Center, School of Public Health, Iran University of Medical Sciences, Tehran, Iran

<sup>c</sup>Department of Clinical Psychology, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

Received 14 November 2017

Accepted 7 January 2018

## Abstract.

**BACKGROUND:** Few studies have shown the protective effects of Mediterranean Dietary Pattern (MDP) in psychological disorders.

**OBJECTIVE:** This cross-sectional study was designed to determine the association between adherence to MDP and depression, anxiety and stress among female adolescents aged  $16.20 \pm 0.97$  in Tehran, Iran.

**METHODS:** Data from 263 participants were analyzed. Adherence to MDP was determined using Mediterranean-Style Dietary Pattern Score (MSDPS). Depression, anxiety and stress scores were characterized by DASS-21 (Depression Anxiety Stress Score-21 items) questionnaire.

**RESULTS:** Multivariable logistic regression was used to determine the prevalence of depression, anxiety, and stress across quintiles of MSDPS. After adjustment for age, the odds ratio (OR) for depression in the highest quintile of MSDPS was 0.44 (95% confidence interval [95%CI], 0.19–0.95), (P for trend = 0.009) compared to the lowest quintile. After additional adjustment for BMI, energy intake, physical activity, ethnicity, parents education level and total family income, subjects in the highest quintile had a 59% lower prevalence of depression compared to those in the lowest quintile of MSDPS (OR = 0.41; 95%CI, 0.17–0.97), (P for trend = 0.010). However, the MSDPS was not significantly associated with the presence of anxiety and stress.

**CONCLUSION:** Adherence to MDP is associated with a reduced presence of depressive symptoms in female adolescents.

Keywords: Mediterranean diet, depression, anxiety, stress, MSDPS, adolescents

## 1. Introduction

Adolescence is a critical period of life for development of psychological disorders [1]. Around 20% of children and adolescents are suffering from problems related to mental health worldwide [2]. Of those, depression with a high prevalence, has attracted much attention [3]. According to the World Health Organization (WHO) report,

---

\*Corresponding author: Bahram Rashidkhani, National Nutrition and Food Technology Research Institute (WHO Collaborating Center), Faculty of Nutrition Sciences and Food Technology, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Tel.: +989126548287; E-mail: Asalneshatbinitehrani@yahoo.com.

depression was the fourth explanation of inability in the world in 2000 and it would be the second reason in 2020 [4]. Furthermore, several studies show that there is a high coincidence of depression, stress and anxiety disorders in young people [5, 6]. In a review article in 2009, the global prevalence of depression among children and adolescents was reported from 0.6% in Britain to 3% in Puerto Rico and the average prevalence of anxiety was estimated 8% [7]. Moreover, two review articles have reported the high prevalence of depression and anxiety among Iranian children and adolescents [8, 9]. Overall, psychological disorders are more prevalent among girls rather than boys [10]. The comparative studies demonstrated the lower prevalence of mental disorders in Mediterranean countries than in Northern European countries so that, the suicide rates which may reflect the severe depression is the lowest in Mediterranean countries [11]. Thus, the theory of the protective role of Mediterranean Dietary Pattern (MDP) against mental disorders seems logical. MDP is characterized by a high fruits, nuts, vegetables, legumes, whole grains, olive oil and fish consumption, accompanied with a low meat and dairy products consumption and a moderate alcohol intake, [12, 13]. This dietary pattern has some beneficial effects on fat metabolism, blood pressure, body mass index (BMI), markers of coagulation and inflammation and the antioxidant capacity of plasma [14]. Evidence that supports the protective role of the MDP against depression has been reported in some studies [12, 15, 16]. A small trial [17] conducted on obese children and a cross-sectional study [18] that investigated a large sample of Spanish population reported that compliance with the MDP associated with a reduced risk of depression and improved mental health. Hence, considering the high prevalence of psychological disorders among female adolescents and prominence of the MDP as one of the probable protective factor, this study was designed to assess the association of adherence to the MDP with depression, anxiety and stress among high-school female adolescents aged 15–18 years in Tehran, Iran.

## 2. Methods and materials

### 2.1. Study population

This cross-sectional study was conducted on 280 female adolescents, which were selected using multistage stratified cluster sampling method. They were chosen randomly from high schools of three educative districts in Tehran, called affluent, middle class and disadvantaged (according to the definition of Ministry of Education). The participants who were smoker, chronic disease patients, anti depressant or sedative medication users, attendant who reported physician-diagnosed depression or anxiety disorders and participants who followed a distinct diet were excluded from the study. Data for 17 participants were ruled out from the analysis due to the fact that either their food frequency questionnaire (FFQ) data were missed or their reported total energy intake was excessively high (more than 4800 kcal/day<sup>-1</sup>). Finally data from 263 participants were available for analysis. A minimum sample size of 114 subjects required for this study was calculated according to an equation presented by Norman and Streiner [19]. In order to predict the exclusion of several subjects and for having higher precision and effect size calculation, the present study was conducted on 280 sample population.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Ethics Committee of the National Nutrition and Food Technology Research Institute (WHO Collaborating Center), Shahid Beheshti University of Medical Sciences, Tehran, Iran (ethics number 054577). Written informed consent was obtained from all participants.

### 2.2. Depression, stress and anxiety assessment

The Persian version of Depression, Anxiety, Stress Scale-21 (DASS-21), the short form of the primary scale (DASS-42), which was firstly introduced by Lovibond and Lovibond [20] has been used to determine the severity of depression, anxiety and stress in this study. Each of the three subscales of this questionnaire contains seven items. By summing the scores of relevant questions, the final score for each subscale is obtained. Evidence verified

the reliability and validity of the Persian form of DASS-21 [21, 22]. In the present study, regarding depression, anxiety and stress, we classified the participants in two groups according to Lovibond score classification [20]. Those within a normal range considered healthy and the rest described as unhealthy (e.g. in depression subscale, participants with a score of  $\leq 9$  considered healthy and subjects with a score of  $\geq 10$  marked as unhealthy).

### 2.3. Dietary intake assessment

Participant's food intake was assessed using a valid and reproducible semi-quantitative FFQ [23]. This FFQ consists of 168 food items with a standard serving size for each item, which is mostly consumed by Iranian individuals. Food consumption frequency for each person was determined on daily, weekly or monthly basis. The daily standard serving size for all food items was converted to daily grams of food intake using a manual for household measures [24]. The energy content of each food item was calculated using the United State Department of Agriculture (USDA) food composition data included in Nutritionist 4 software (First Databank; Hearst, San Bruno, CA, USA) due to this fact that Iranian food composition table (IFCT) [25] is not complete. Nevertheless, for Iranian food items, which do not exist in Nutritionist 4, (e.g., Kashk a dairy product) the IFCT was used. It should be noted that the energy and macronutrient content of many food items (e.g., bread and fruits) in IFCT are approximately similar to substitute food items in the USDA food composition table with a correlation of  $>0.9$  [26]. The Mediterranean-Style Dietary Pattern Score (MSDPS) has 13 dietary item scores according to the Mediterranean diet pyramid [27] namely, whole-grain cereals, fruits, vegetables, dairy products, wine, fish and other seafood, poultry, olives/legumes/nuts, potatoes and other starchy roots, eggs, sweets, meat and olive oil [28]. However, in this study only 12 scores were obtained, because the participants religious beliefs prohibited them responding the frequency of alcoholic beverages consumption [29]. For each food group, there is a recommendation by the food guide pyramid which individuals should aim to follow. Except olive oil, the other MSDPS components were scored continuously from 0 to 10 according to the degree of individual adherence to Mediterranean pyramid recommendation. A penalty designated for the overconsumption instances which was proportional to the number of consumed servings over the recommendations. Exerting the penalty can prevent obtaining higher scores merely by food overconsumption [28]. Zero score assigned for those who had a negative total MSDPS due to the overconsumption penalty. Olive oil was scored categorically based on the restrict use of olive oil (score 10), olive oil consumption along with other vegetable oils (score 5), or no olive oil (score 0). Finally, scores for each MSDPS component were summed and the total MSDPS which was standardized to a 0–100 scale calculated by the following equation.

$$\text{MSDPS} = \left[ \left( \frac{\sum_{i=1}^{12} s_i}{120} \right) \times 100 \right] \times p,$$

$s_i$  refers to the individual item score and  $p$ , is the proportion of total energy intake from Mediterranean diet pyramid.

### 2.4. Anthropometric measurement

Weight was measured using a digital scale (Seca 881, Germany) to the nearest 0.1 kg while the participants were minimally clothed with bare feet. Height was measured without shoes, using a portable non-stretch meter which was recorded to the nearest 0.5 cm. BMI was calculated as weight in kilograms divided by square of height in meter. Waist circumference and hip circumference were measured using a non-stretch meter tape. The former was measured at the slimmer part of the waist and the latter was measured at the widest part of the hip. Weight to Hip Ratio (WHR) was determined by dividing waist circumference in centimeter to hip circumference in centimeter.

### 2.5. Physical activity assessment

Physical activity data were acquired by a valid self-reported questionnaire [30] and described as metabolic equivalent hours per day (MET.h.d). This questionnaire was formerly used in a representative sample of Iranian women and demonstrated persistent outcomes [31].

### 2.6. Other variables assessment

Face-to-face interviews conducted to collect information on age (years), ethnicity (Fars, Turk, Gilak, Others), father/mother's employment status (employed/unemployed), father/mother's education level (high school and diploma, university education), parent Marital status (married, unmarried), total family income, and supplement intake (yes, no), through structured questionnaires.

## 3. Statistical analysis

All analyses were conducted using the Statistical Package for the Social Sciences, version 21 (SPSS) and a  $P$  value of  $<0.05$  was considered statistically significant. MSDPS was divided in quintiles. Distribution of qualitative variables across MSDPS quintiles were compared by Chi-square or Fisher's exact test. The normality of quantitative variables was checked by Kolmogorov smirnov test. Since the distribution of all quantitative variables was abnormal, they converted to normal distribution by logarithmic conversion. To determine the odds ratio (OR) and 95% confidence interval (95%CI) of depression, anxiety, and stress across quintiles of MSDPS, multivariable logistic regression models were conducted with the lowest MSDPS quintile considered as the reference category. Logistic regression models were adjusted for age, BMI, energy intake, physical activity, ethnicity, mother/father's education level and total family income. To assess the overall trends of OR across quintiles of MSDPS, we used the median of each quintile as a continuous variable in the logistic regression models.

## 4. Results

The mean MSDPS in this study was  $15.99 \pm 5.64$  out of a maximum possible score of 100. The mean depression, anxiety and stress scores were 9.89, 8.43 and 14.00 respectively. Among serving per day Mediterranean food groups, median intake distribution was the highest for fruit consumption that resulted in the lowest median component score for the mentioned group due to overconsumption (penalty principle). In contrast, the lowest median intake distribution was observed for the whole grain group. Furthermore, median component scores were the highest for dairy products (Table 1). Compared to the participants in the lowest quintile, (Table 2) those in the highest quintile of MSDPS were more likely to be Fars and Gilak (84% vs 75% in Fars category and 3.80% vs 0 in Gilak category,  $P < 0.05$ ) and had more highly educated mothers (26.90% vs 15.40%,  $P = 0.05$ ). Moreover, energy intake was significantly higher in the highest quintile of MSDPS compared to the lowest quintile ( $P < 0.001$ ). Table 3 shows the crude and adjusted ORs and 95% CIs of depression, anxiety and stress scores across the quintiles of MSDPS. In crude model, a significant lower prevalence of depression was observed in the highest compared to the lowest quintile of MSDPS (OR=0.44; 95% CI, 0.19 – 0.95). In the 2nd model, after adjustment for age, the odds ratio of depression in the 5th quintile of MSDPS was 0.42 (95% CI, 0.18 – 0.94). Also, after additional adjustment for BMI, energy intake, physical activity, ethnicity, mother/father's education level and total family income, subjects in the highest quintile had a 59% lower prevalence of depression compared with those in the lowest quintile of MSDPS (OR=0.41; 95% CI, 0.17–0.97). Furthermore, there was a significant trend in risk of depression across increasing quintiles of MSDPS

Table 1  
Dietary intakes, score distribution and spearman rank correlation of the Mediterranean-style dietary pattern score (MSDPS) in Tehranian high-school female adolescents

Food groups	Intake distribution <sup>1</sup>	Score distribution <sup>1</sup>	Spearman rank correlation to total MSDPS <sup>2</sup>
Serving/day			
Whole grain	0.16 (0.00–1.88)	0.21 (0.00–2.35)	0.26
Fruits	7.74 (2.52–21.37)	0.00 (0.00–8.54)	0.10
Vegetables	3.33 (0.89–8.94)	5.06 (1.10–9.30)	0.44
Dairy	1.08 (0.13–2.95)	5.11 (0.44–9.37)	0.52
Serving/week			
Fish and other seafood	0.66 (0.00–3.30)	0.15 (0.00–0.78)	0.31
Poultry	2.40 (0.48–6.70)	0.85 (0.17–2.39)	0.28
Olives, legumes and nuts	11.96 (2.1–50.77)	3.47 (0.57–9.07)	0.31
Potatoes and other starchy roots	2.70 (0.60–10.23)	1.28 (0.28–4.86)	0.12
Eggs	2.00 (0.23–7.00)	0.95 (0.11–3.33)	0.31
Sweets	14.49 (4.03–44.26)	5.34 (0.00–9.40)	0.17
Meat	3.09 (0.22–12.24)	3.77 (0.03–9.21)	0.41
Olive oil	—	—	0.45

<sup>1</sup>Data are median (5th, 95th percentile). <sup>2</sup>Total MSDPS was calculated by summation of 12 components of MSDPS which was standardized to a 0–100 scale and weighted to the proportion of total energy intake from Mediterranean diet pyramid.

(*P* for trend < 0.05). However, the higher MSDPS were not associated significantly with presence of anxiety and stress.

## 5. Discussion

According to the findings of the present study, individuals with higher adherence to the MDP had lower risk of depression after controlling for potential confounders. However, no significant association was observed in regard to risk of anxiety and stress prevalence. Similar results related to protective role of the MDP against depressive disorders have been reported in several studies [12, 15, 17, 18, 32]. Although the specific mechanisms of the MDP role in depression prevention are not well known, here we suggest some hypothesized that may justify this association. Mediterranean diet adherence guarantees adequate intake of vitamins B6, B9 and B12 [33]. Some previous studies [34–36] have demonstrated the beneficial role of these vitamins in depression. Vitamins B6, B9 and B12 are participating in Methionine-Homocysteine cycle [15, 37]. Methionine is a precursor of S-adenosylmethionine which has prominent role in monoamines (i.e. Serotonin) production. Serotonin acts as an antidepressant. Besides participating in Methionine-Homocysteine cycle, folate has a main role in bipterin-dependent neurotransmitters synthesis. Tetrahydrobiopterin is an essential cofactor for biogenic amines formation whose Tyrosine and Tryptophan are precursors of them. Therefore, folate deficiency may decrease the serotonin, dopamine or norepinephrine synthesis. MDP leads to an increased intake of omega-3 fatty acids (from fish), which is another reason for its protective role against depression [15]. Several studies have shown the beneficial role of omega-3 fatty acids intake in depression prevention and treatment [38–40]. MDP and its depression protective characteristic may be partly due to high olive oil consumption. Olive oil is the main source of fat (mostly MUFAs

Table 2  
 Characteristics of participants across the Mediterranean-Style Dietary Pattern Score (MSDPS)  
 Quintiles in Tehranian high-school female adolescents

	MSDPS Quintiles			P-value
	Q1	Q3	Q5	
Age, y	15.92 ± 0.85	16.11 ± 0.99	16.34 ± 0.98	0.07
Duration of residence in Tehran, y	15.80 ± 1.18	15.83 ± 1.32	16.11 ± 1.38	0.42
Total family income/mo (US)	86.28 ± 76.25	77.48 ± 48.49	75.12 ± 54.20	0.83
Ethnicity n(%)				0.02
Fars	39 (75.0)	39 (73.60)	44 (84.60)	
Turk	10 (19.20)	11 (20.80)	3 (5.80)	
Gilak	0 (0)	0 (0)	2 (3.80)	
Others	3 (5.80)	3 (5.70)	3 (5.80)	
Mother's education level n(%)				0.05
High school and diploma	44 (84.60)	31 (58.50)	38 (73.10)	
University degree	8 (15.40)	22 (41.50)	14 (26.90)	
Father's education level n(%)				
High school and diploma	39 (75.0)	31 (58.50)	33 (63.50)	
University degree	13 (25.0)	22 (41.50)	19 (36.50)	
Mother's employment status n(%)				0.10
Employed	13 (25.0)	11 (20.80)	13 (25.0)	
Unemployed	39 (75.0)	42 (79.20)	39 (75.0)	
Father's employment status n(%)				0.41
Employed	52 (100.0)	53 (100.0)	52 (100.0)	
Unemployed	0 (0)	0 (0)	0 (0)	
Parent marital status n(%)				0.40
Married	50 (96.20)	50 (94.30)	51 (98.10)	
Unmarried	2 (3.80)	3 (5.70)	1 (1.90)	
Energy intake (Kcal/day)	2372.82 ± 939.13	2734.78 ± 883.98	2824.03 ± 744.58	<0.001
Physical activity (MET.h.d)	35.52 ± 6.56	35.72 ± 5.47	37.14 ± 6.53	0.55
Supplement intake n(%)	14 (26.90)	11 (20.80)	23 (44.20)	0.06
Body mass index (kg/m <sup>2</sup> )	22.03 ± 4.24	22.10 ± 4.25	22.79 ± 4.49	0.78
Depression score	11.57 ± 9.49	12.75 ± 10.48	7.50 ± 8.16	0.07
Anxiety score	8.34 ± 7.51	9.88 ± 8.41	7.46 ± 6.56	0.87
Stress score	14.46 ± 10.11	17.13 ± 10.04	12.23 ± 8.91	0.43

Data are presented as mean ± SD for continuous variables and n (percent) for categorically distributed variables. The P-value was determined using Chi-square test (Fisher's exact) for quantitative variables and one-way analysis of variance (ANOVA) for qualitative variables.

Oleic acid) in this dietary pattern [41, 42]. Along with antioxidant properties olive oil increases  $\delta$ -9 desaturase enzyme activity and preserves the physiochemical properties of neuronal membranes [42]. However, there are limited studies that investigate the association between olive oil intake and depression [43–45]. Depression is associated with elevation in proinflammatory cytokines such as interleukins 1, 6 and C-reactive proteins. These cytokines can decrease the neuronal growth factors such as brain derived neurotrophic factor (BDNF). BDNF is synthesized by endothelial cells [46]; this peptide is essential for synaptic elasticity, neuronal endurance and axonal growth [47]. According to some evidence, patients with depression have lower levels of BDNF and antidepressants can upregulate BDNF and other neuronal growth factors [48]. Besides its anti inflammatory effect

Table 3  
Crude and adjusted odds ratios (OR) and 95% confidence intervals (95% CIs) of depression, anxiety, and stress across quintiles of the MSDPS in Tehranian high-school female adolescents

	Quintiles of MSDPS			P for trend*
	Q1	Q3	Q5	
Depression				
Model 1	1.00 (Ref)	1.20 (0.56 – 2.60)	0.44 (0.19 – 0.95)	0.014
Model 2	1.00 (Ref)	1.18 (0.54 – 2.54)	0.42 (0.18 – 0.94)	0.009
Model 3	1.00 (Ref)	1.38 (0.60 – 3.16)	0.41 (0.17 – 0.97)	0.010
Anxiety				
Model 1	1.00 (Ref)	1.03 (0.48 – 2.23)	0.92 (0.43 – 1.99)	0.888
Model 2	1.00 (Ref)	1.01 (0.47 – 2.19)	0.88 (0.40 – 1.93)	0.984
Model 3	1.00 (Ref)	1.14 (0.51 – 2.55)	0.87 (0.38 – 1.97)	0.936
Stress				
Model 1	1.00 (Ref)	1.41 (0.65 – 3.04)	0.72 (0.33 – 1.59)	0.548
Model 2	1.00 (Ref)	1.36 (0.63 – 2.96)	0.67 (0.30 – 1.49)	0.434
Model 3	1.00 (Ref)	1.47 (0.65 – 3.35)	0.60 (0.25 – 1.40)	0.250

\*Based on logistic regression model using median MSDPS in each quintile as a continuous variable. Model 1: Crude model. Model 2: Adjusted for age. Model 3: Additionally adjusted for BMI, energy intake, physical activity, ethnicity, mother/father's education level, total family income.

[49], MDP improves BDNF production through advantageous effects on endothelial cells [50, 51]. Moreover, MDP has high sociocultural food profit. according to the acknowledgment of the United Nations Educational, Scientific and Cultural Organization, Mediterranean diet is considered as an Intangible Cultural Heritage of Humanity with the emphasize on eating together, geniality and hospitality [52]. In culture of the Mediterranean regions, family and conjoint meals are encouraged for bringing fun and enjoyment [53]. Traditional food nature of MDP besides its concept that involves diversity, quality, continuity and amiability [54, 55] are other possible mechanisms by which, MDP prevents depression. The most previous studies have observed an inverse relationship between diet quality and anxiety and stress. Vriendt et al. demonstrated a converse association between diet quality and stress levels in a sample of European students aged 12–17 years [56]. A cross-sectional study conducted on a sample of Norwegian adults reported that women with better diet quality had lower anxiety scores [57]. Bakhtiari et al. found a positive relationship between processed foods consumption and anxiety levels among Tehranian adults [58]. Consistent with our findings, Khodabakhshi et al. reported no significant relationship between healthy dietary pattern and anxiety among male adolescents living in Baharestan province, Iran [59]. There are strengths related to this study. To our knowledge, this is the first study in Middle Eastern countries to examine the association of compliance with the Mediterranean dietary pattern with depression, anxiety and stress. Moreover, considering general diet quality rather than personal dietary factors could be an encouraging substitute for demonstrating the multidimensional characteristics of individual's diet and may be useful in assessment of diet regard to depression prevalence [60]. There are some limitations, first, due to the cross-sectional design of the study, causality determination between MDP adherence and depression, anxiety and stress is impossible. Second, relatively small sample size makes it difficult to find significant associations and the third; we excluded alcohol consumption due to some barriers regarding cultural and religious beliefs in participants. Because of prohibition issues on the import of alcoholic beverages in Iran, the alcohol content of beverages consumed by Iranian people is significantly different compared to the other countries and are usually reported in Food Content Tables (FCTs) and the Iranian FCT has no information on content of different types of alcohol [61]. Several confounding factors may exist which are not considered in this study such as increasing stress and anxiety levels among students with the rise of grades due to pressure of getting acceptance in university entrance exams which

is mostly attributed to Iran educational system. Family structures and parent's psychological status are two main factors which may affect these subscale scores. The non-only child have higher anxiety score than only child because of this fact that they may don't receive enough spiritual support and have more economic burden [62]. Furthermore, in the present study, the variance of stress and anxiety scores was low. It may be another reason for absence of significant association of adherence to the MDP with anxiety and stress.

## 6. Conclusion

The results of this study show an inverse relationship between adherence to MDP and the presence of depression symptoms. We acknowledge that the results of the present study should be confirmed by more prospective studies with considering a large number of confounding factors. In order to create preventive strategies to reduce such disorders, the concentration should be on overall dietary pattern.

## Acknowledgments

We are thankful to all staff and participants of the present study.

## Financial support

Conduction of the study was financially supported by the National Nutrition and Food Technology Research Institute (WHO Collaborating Center), Shahid Beheshti University of Medical Sciences, Tehran, Iran. (Grant number 450109)

## Conflicts of interest

"None."

## Authorship

A. NT., B. R. and R. M. contributed in conception and design, H. F. contributed in statistical analysis.

A. NT. And B. B. contributed in generation, collection and assembly, A. NT., H. F. and A. S. contributed in data interpretation and manuscript drafting. A. NT., A. S., A. H. and H. F. contributed in manuscript revision. All authors approved the final version of the manuscript.

## References

- [1] Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry*. 2005;62(6):593-602.
- [2] Patel V, Flisher AJ, Hetrick S, McGorry P. Mental health of young people: A global public-health challenge. *Lancet*. 2007;369(9569):1302-13.
- [3] Rice F, Rawal A. Can basic risk research help in the prevention of childhood and adolescent depression? Examining a cognitive and emotional regulation approach. *Depression Research and Treatment*. 2010;2011.



- [4] World Health Organisation (WHO). The world health report 2001 – Mental Health: New Understanding, New Hope. Geneva, WHO; 2001 ([http://www.who.int/whr/2001/en/whr01\\_en.pdf](http://www.who.int/whr/2001/en/whr01_en.pdf)). (Accessed September 17, 2012).
- [5] Kessler RC, DuPont RL, Berglund P, Wittchen H-U. Impairment in pure and comorbid generalized anxiety disorder and major depression at 12 months in two national surveys. *American Journal of Psychiatry*. 1999;156(12):1915-23.
- [6] Pittenger C, Duman RS. Stress, depression, and neuroplasticity: A convergence of mechanisms. *Neuropsychopharmacology*. 2008;33(1):88-109.
- [7] Merikangas KR, Nakamura EF, Kessler RC. Epidemiology of mental disorders in children and adolescents. *Dialogues Clin Neurosci*. 2009;11(1):7-20.
- [8] Sajjadi H, Mohaqeqi Kamal SH, Rafiey H, Vameghi M, Forouzan AS, Rezaei M. A systematic review of the prevalence and risk factors of depression among iranian adolescents. *Glob J Health Sci*. 2013;5(3):16-27.
- [9] Zarafshan H, Mohammadi MR, Salmanian M. Prevalence of Anxiety Disorders among Children and Adolescents in Iran: A Systematic Review. *Iran J Psychiatry*. 2015;10(1):1-7.
- [10] Emami H, Ghazinour M, Rezaeishiraz H, Richter J. Mental health of adolescents in Tehran, Iran. *J Adolesc Health*. 2007;41(6):571-6.
- [11] Birt C, Bille-Brahe U, Cabecadas M, Chishti P, Corcoran P, Elgie R, et al. Suicide mortality in the European Union. *The European Journal of Public Health*. 2003;13(2):108-14.
- [12] Sanchez-Villegas A, Delgado-Rodriguez M, Alonso A, Schlatter J, Lahortiga F, Serra Majem L, et al. Association of the Mediterranean dietary pattern with the incidence of depression: the Seguimiento Universidad de Navarra/University of Navarra follow-up (SUN) cohort. *Arch Gen Psychiatry*. 2009;66(10):1090-8.
- [13] Willett WC, Sacks F, Trichopoulos A, Drescher G, Ferro-Luzzi A, Helsing E, et al. Mediterranean diet pyramid: A cultural model for healthy eating. *Am J Clin Nutr*. 1995;61(6 Suppl):1402S-6S.
- [14] Fragopoulou E, Panagiotakos DB, Pitsavos C, Tampourlou M, Chrysohoou C, Nomikos T, et al. The association between adherence to the Mediterranean diet and adiponectin levels among healthy adults: The ATTICA study. *The Journal of Nutritional Biochemistry*. 2010;21(4):285-9.
- [15] Sanchez-Villegas A, Henriquez P, Bes-Rastrollo M, Doreste J. Mediterranean diet and depression. *Public Health Nutr*. 2006;9(8A):1104-9.
- [16] Skarupski KA, Tangney CC, Li H, Evans DA, Morris MC. Mediterranean diet and depressive symptoms among older adults over time. *J Nutr Health Aging*. 2013;17(5):441-5.
- [17] Gussinyer S, Garcia-Reyna NI, Carrascosa A, Gussinyer M, Yeste D, Clemente M, et al. Anthropometric, dietetic and psychological changes after application of the “Nin@ s en movimiento” program in childhood obesity. *Medicina Clinica*. 2008;131(7):245-9.
- [18] Munoz M-A, Fito M, Marrugat J, Covas M-I, Schröder H. Adherence to the Mediterranean diet is associated with better mental and physical health. *British Journal of Nutrition*. 2008;101(12):1821-7.
- [19] Norman G, Streiner D. *Biostatistics: The Bare Essentials*. 1994:106.
- [20] Lovibond SH, P.F L. *Manual for the depression anxiety psychology Foundation*. 1995.
- [21] Bayani AA. Reliability and preliminary evidence of validity of a Farsi version of the depression anxiety stress scales. *Percept Mot Skills*. 2010;111(1):107-14.
- [22] Samani S, Jekar B. The reliability and validity of the short form of depression, anxiety and stress. *Journal of Humanities and Social Sciences university of Shiraz [in persian]*. 2007;26(3).
- [23] Esfahani FH, Asghari G, Mirmiran P, Azizi F. Reproducibility and relative validity of food group intake in a food frequency questionnaire developed for the Tehran Lipid and Glucose Study. *Journal of epidemiology/Japan Epidemiological Association*. 2009;20(2):150-8.
- [24] Ghaffarpour M, Houshiar-Rad A, Kianfar H. *The manual for household measures, cooking yields factors and edible portion of foods*. Tehran: Nashre Olume Keshavarzy. 1999:1-40.
- [25] Azar M, Sarkisian E. *Food composition table of Iran*. Tehran: National Nutrition and Food Research Institute, Shaheed Beheshti University. 1980:65.
- [26] Mirmiran P, Esfahani FH, Mehrabi Y, Hedayati M, Azizi F. Reliability and relative validity of an FFQ for nutrients in the Tehran lipid and glucose study. *Public Health Nutr*. 2010;13(5):654-62.
- [27] Altomare R, Cacciabauda F, Damiano G, Palumbo VD, Gioviale MC, Bellavia M, et al. The mediterranean diet: A history of health. *Iranian Journal of Public Health*. 2013;42(5):449.
- [28] Rumawas ME, Dwyer JT, McKeown NM, Meigs JB, Rogers G, Jacques PF. The development of the Mediterranean-style dietary pattern score and its application to the American diet in the Framingham Offspring Cohort. *J Nutr*. 2009;139(6):1150-6.
- [29] Hosseini-Esfahani F, Jessri M, Mirmiran P, Bastan S, Azizi F. Adherence to dietary recommendations and risk of metabolic syndrome: Tehran Lipid and Glucose Study. *Metabolism*. 2010;59(12):1833-42.

- [30] Aadahl M, Jorgensen T. Validation of a new self-report instrument for measuring physical activity. *Med Sci Sports Exerc.* 2003;35(7):1196-202.
- [31] Rezazadeh A, Rashidkhani B, Omidvar N. Association of major dietary patterns with socioeconomic and lifestyle factors of adult women living in Tehran, Iran. *Nutrition.* 2010;26(3):337-41.
- [32] Crichton GE, Bryan J, Hodgson JM, Murphy KJ. Mediterranean diet adherence and self-reported psychological functioning in an Australian sample. *Appetite.* 2013;70:53-9.
- [33] Castro-Quezada I, Román-Viñas B, Serra-Majem L. The Mediterranean diet and nutritional adequacy: A review. *Nutrients.* 2014;6(1):231-48.
- [34] Almeida OP, Ford AH, Flicker L. Systematic review and meta-analysis of randomized placebo-controlled trials of folate and vitamin B12 for depression. *Int Psychogeriatr.* 2015;27(5):727-37.
- [35] Sachdev PS, Parslow RA, Lux O, Salonikas C, Wen W, Naidoo D, et al. Relationship of homocysteine, folic acid and vitamin B12 with depression in a middle-aged community sample. *Psychol Med.* 2005;35(4):529-38.
- [36] Williams AL, Cotter A, Sabina A, Girard C, Goodman J, Katz DL. The role for vitamin B-6 as treatment for depression: A systematic review. *Fam Pract.* 2005;22(5):532-7.
- [37] Bottiglieri T. Folate, vitamin B12, and neuropsychiatric disorders. *Nutr Rev.* 1996;54(12):382-90.
- [38] Hibbeln JR. Fish consumption and major depression. *Lancet.* 1998;351(9110):1213.
- [39] Hibbeln JR. Seafood consumption, the DHA content of mothers' milk and prevalence rates of postpartum depression: A cross-national, ecological analysis. *J Affect Disord.* 2002;69(1-3):15-29.
- [40] Frasure-Smith N, Lesperance F, Julien P. Major depression is associated with lower omega-3 fatty acid levels in patients with recent acute coronary syndromes. *Biol Psychiatry.* 2004;55(9):891-6.
- [41] Logan AC. Omega-3 and depression research: Hold the olive oil. *Prostaglandins, leukotrienes and essential fatty acids.* 2005;72(6):441.
- [42] Sarris J, Schoendorfer N, Kavanagh DJ. Major depressive disorder and nutritional medicine: A review of monotherapies and adjuvant treatments. *Nutrition Reviews.* 2009;67(3):125-31.
- [43] Kyrozis A, Psaltopoulou T, Stathopoulos P, Trichopoulos D, Vassilopoulos D, Trichopoulou A. Dietary lipids and geriatric depression scale score among elders: The EPIC-Greece cohort. *Journal of Psychiatric Research.* 2009;43(8):763-9.
- [44] Assies J, Lok A, Bockting C, Weverling G, Lieverse R, Visser I, et al. Fatty acids and homocysteine levels in patients with recurrent depression: An explorative pilot study. *Prostaglandins, Leukotrienes and Essential Fatty Acids.* 2004;70(4):349-56.
- [45] Irmisch G, Schläfke D, Gierow W, Herpertz S, Richter J. Fatty acids and sleep in depressed inpatients. *Prostaglandins, Leukotrienes and Essential Fatty Acids.* 2007;76(1):1-7.
- [46] Guo S, Kim WJ, Lok J, Lee S-R, Besancon E, Luo B-H, et al. Neuroprotection via matrix-trophic coupling between cerebral endothelial cells and neurons. *Proceedings of the National Academy of Sciences.* 2008;105(21):7582-7.
- [47] Belmaker R, Agam G. Major depressive disorder. *N Engl J Med.* 2008;2008(358):55-68.
- [48] Karege F, Vaudan G, Schwald M, Perroud N, La Harpe R. Neurotrophin levels in postmortem brains of suicide victims and the effects of antemortem diagnosis and psychotropic drugs. *Molecular Brain Research.* 2005;136(1):29-37.
- [49] Casas R, Sacanella E, Estruch R. The immune protective effect of the Mediterranean diet against chronic low-grade inflammatory diseases. *Endocr Metab Immune Disord Drug Targets.* 2014;14(4):245-54.
- [50] Esposito K, Marfella R, Ciotola M, Di Palo C, Giugliano F, Giugliano G, et al. Effect of a Mediterranean-style diet on endothelial dysfunction and markers of vascular inflammation in the metabolic syndrome: A randomized trial. *JAMA.* 2004;292(12):1440-6.
- [51] Fuentes F, Lopez-Miranda J, Perez-Martinez P, Jimenez Y, Marin C, Gomez P, et al. Chronic effects of a high-fat diet enriched with virgin olive oil and a low-fat diet enriched with  $\alpha$ -linolenic acid on postprandial endothelial function in healthy men. *British Journal of Nutrition.* 2008;100(1):159-65.
- [52] Lixinski L. *Intangible cultural heritage in international law*: OUP Oxford; 2013.
- [53] Dernini SB, EM. Historical and behavioral perspectives of the Mediterranean Diet. In *Mediterranean Diet in Health and Disease*, pp. 29-41 [DF Romagnolo and OI Selmin, editors]. New York: Humana Press/Springer. 2016.
- [54] Turmo IG. *The Mediterranean Diet: Consumption, cuisine and food habits*. MediTERRA 2012 (english): Presses de Sciences Po (PFNSP); 2012. pp. 115-32.
- [55] Medina FX. Food consumption and civil society: Mediterranean diet as a sustainable resource for the Mediterranean area. *Public Health Nutrition.* 2011;14(12A):2346.
- [56] De Vriendt T, Clays E, Huybrechts I, De Bourdeaudhuij I, Moreno LA, Patterson E, et al. European adolescents' level of perceived stress is inversely related to their diet quality: The Healthy Lifestyle in Europe by Nutrition in Adolescence study. *Br J Nutr.* 2012;108(2):371-80.
- [57] Jacka FN, Mykletun A, Berk M, Bjelland I, Tell GS. The association between habitual diet quality and the common mental disorders in community-dwelling adults: The Hordaland Health study. *Psychosom Med.* 2011;73(6):483-90.

- [58] Bakhtiyari M, Ehrampoush E, Enayati N, Joodi G, Sadr S, Delpisheh A, et al. Anxiety as a consequence of modern dietary pattern in adults in Tehran–Iran. *Eat Behav.* 2013;14(2):107-12.
- [59] Khodabakhshi A, Rastak H, Rashidkhani B. the association of dietary pattern with body image and anxiety among adolescents [in persian]. *Psychonursing Journal.* 2015.
- [60] Grau MV, Baron JA, Sandler RS, Haile RW, Beach ML, Church TR, et al. Vitamin D, calcium supplementation, and colorectal adenomas: Results of a randomized trial. *Journal of the National Cancer Institute.* 2003;95(23):1765-71.
- [61] Azar M, Sarkisian E. Food composition table of Iran: National Nutrition and Food Research Institute. Shaheed Beheshti University, Tehran. 1980.
- [62] Jin Y, He L, Kang Y, Chen Y, Lu W, Ren X, et al. Prevalence and risk factors of anxiety status among students aged 13–26 years. *International Journal of Clinical and Experimental Medicine.* 2014;7(11):4420.