Association of the Alternative Healthy Eating Index (AHEI-2010) with depression, stress and anxiety among Iranian military personnel

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ABSTRACT

Introduction Psychological disorders have a major role in the incidence of chronic diseases and may result in reductions in the cost-effectiveness of the Armed Forces. Previous civilian studies have shown a protective association between healthy eating guidelines and mental disorders, but evidence to support this for a military population is limited. The aim of this study was to examine the association of Alternative Healthy Eating Index (AHEI-2010) with depression, stress and anxiety among Iranian military personnel.

Method A cross-sectional study was conducted on 246 male Army soldiers. Stress, anxiety, depression and dietary intakes were assessed. The association between variables was determined using multivariate logistic regression.

Results The prevalence of depression, stress and anxiety in study participants was 15.9%, 10.6% and 27.2% respectively. Participants with the highest adherence to the AHEI-2010 had an 80% lower odds of depression than those with the lowest adherence (OR: 0.20; 95% CI 0.04 to 0.78). Such an association was also found between adherences to the AHEI-2010 and anxiety (OR: 0.28; 95% CI 0.05 to 0.95). No significant association between adherence to the AHEI-2010 and stress was found.

Conclusion An inverse association between adherence to the AHEI-2010 and odds of depression and anxiety was found. Further studies are required to clarify this relationship.

Key messages

- ► Psychological disorders have a major role in the incidence of chronic diseases and may result in reductions in the cost-effectiveness of the Armed Forces.
- ► Previous civilian studies have shown a protective association between healthy eating guidelines and mental disorders.
- ► This study found an inverse association between adherence to the Alternative Healthy Eating Index and odds of depression and anxiety.

INTRODUCTION

The prevalence of psychological disorders, including depression, stress and anxiety are increasing worldwide.[1,2] The WHO has estimated depression will be the second biggest cause of mortality worldwide, by 2020.[3] It has previously been estimated that 21.0%, 17.1% and 20.8% of Iranians are suffering from depression, stress and anxiety, respectively.[4] These disorders are considered as potential risk factors for other chronic diseases, such as type 2 diabetes mellitus and cardiovascular disease. In addition, dangerous behaviours such as drug abuse or alcohol addiction are more prevalent among subjects with psychological disorders.[5,6] Previous studies have reported a high prevalence of psychological disorders among military organisations, which may result in self-harm.[7] Such studies have also shown that one-third of suicides among Army personnel were due to the history of psychological disorders before entry to army.[8]

Previous studies have linked poor diet to psychological disorders.[9] Observational studies have shown an association between psychological disorders and intake of some dietary groups, including vegetables, fish and fruits, as well as micronutrients, such as omega-3 fatty acids and vitamin D.[10,11] As the association of different diets with diseases may be affected by agonistic, antagonistic or synergistic reactions between diet components, it has been suggested that diet–disease associations should be examined through the whole diet rather than specific nutrients or food-oriented approaches.[12] The Healthy Eating Index-2010 (HEI-2010) is a new, valid and reliable measure of diet quality according to the 2010 Dietary Guidelines.[13] A study on 1118 African-American residents of Baltimore, USA, demonstrated an inverse association between adherence to the HEI-2010 and depression.[14] Another study reported a 49% and 45% reduced chance for anxiety and depression among subjects adhering to the Alternative Healthy Eating Index (AHEI-2010).[15] Other studies have also inversely linked adherence to a healthy diet with psychological disorders.[16] In the military environment, potential association of psychological disorders with diet is important. In 2014, it was first suggested that there may be an inverse association between essential fatty acids and symptoms of depression, aggression and risk of suicide ideation among the US military.[17] However, no studies have investigated the relationship between diet quality and mental health in the military environment.

Although previous studies have suggested an inverse relationship between healthy diets and psychological disorders in Western countries, there is very limited information about soldiers, particularly in Middle Eastern countries. Dietary intake among Middle Eastern populations are often different from more traditional western diets that have been rich in refined carbohydrates and

saturated fats. The aim of this study was to investigate potential associations of the AHEI-2010 with depression, stress and anxiety in a group of Iranian Army soldiers.

METHODS AND PARTICIPANTS
Participants
A cross-sectional study was performed on 246 Iranian Army Infantry soldiers in May 2016. Participants were randomly recruited from three groups of Army barracks. Inclusion criteria included only those subjects that were in good general health, did not follow a specific diet, did not suffer from food allergies and did not used any prescribed medicines, psychoactive substances, alcohol or nicotine. Demographic information included diet, degree of physical activity, psychological status and anthropometric measurements. All of study participants were recruited with signed informed consent. The current study was approved by the Ethics Committee of Tehran University of Medical Sciences.

Assessment of dietary intake
Data on dietary intakes of participants was obtained using a semiquantitative food frequency questionnaire (FFQ), which has been previously validated for the Iranian population.[18] It evaluates frequency of intake of each food item during the past year. Amounts of each nutrients and food groups (in grams) were then calculated using the Nutritionist IV software (N-Squared Computing, Tehran), modified for the Iranian population.

Assessment of exposure
Adherence to the AHEI-2010 was determined using recommended guidelines.[19] The AHEI-2010 contains 11 different food groups. Six components for which the highest intakes were supposed to be ideal, including: (1) vegetables, (2) fruit, (3) whole grains, (4) nuts and legumes, (5) long-chain omega-3 fatty acids (docosahexaenoic acid and eicosapentaenoic acid) and (6) polyunsaturated fatty acids; one component for which moderate intake was supposed to be ideal (alcohol); and four components for which avoidance or lowest intake were supposed to be ideal, including: (1) sugar-sweetened beverages and fruit juices, (2) red and processed meat, (3) trans fatty acids and (4) sodium. A score

of 0–10 was given to each food group. Finally, these scores were summated, and the AHEI-2010 score was obtained.

Assessment of outcome
Participants' depression, anxiety and stress were assessed using the Depression, Anxiety, and Stress Score questionnaire. This tool has been previously validated for the Iranian population.[20] Each subject provides a score of 0–42 as a baseline for the severity of their depression, anxiety and stress. Higher scores indicate more severe psychological distress. Scores higher than 21, 15 and 26 were considered as having severe depression, anxiety and stress, respectively.

Assessment of other variables
Weight was determined using a digital scale (Seca, Hamburg, Germany) with light clothes and without shoes to the nearest of 0.1 kg. Height was also measured in steady state without shoes using a stadiometer (Seca) to the nearest of 0.1 cm. Body mass index (BMI) was calculated using weight (kg) divided by height (m^2). Socioeconomic status (SES) of participants was assessed by a questionnaire. Assessment of participants' physical activity was based on the International Physical Activity Questionnaire.

Statistical analysis
AHEI-2010 scores were converted to quartiles. Distribution of quantitative and qualitative variables through the quartiles was assessed using one-way analysis of variance and q-square tests, respectively. Dietary intakes were compared through the quartiles using analysis of covariance test, after controlling for age and energy intake. The association between AHEI-2010 scores and depression, anxiety and stress was examined by multivariate logistic regression in crude status and by different models. In model 1, results were adjusted for age (year), energy intake (kcal/day) and BMI (kg/m^2). Further adjustments for physical activity (low, moderate and high), education (≤bachelor or <bachelor), marriage status (single or married), smoking (yes or no), SES (poor, moderate and high) and family size (≤4 or >4) were done in the second model. First quartile was considered as the reference in analyses. p Values of <0.05 were considered as statistically significant. All analyses were done using SPSS software, V.23.

Table 1 General characteristics of study participants across quartiles (Q) of Alternative Healthy Eating Index-2010 (AHEI-2010) (mean values and SD)

		Quartiles of AHEI-2010				
		Q1	Q2	Q3	Q4	p Value†
n		62	61	62	61	–
Age (years)		24.2±1.4	24.0±1.2	24.3±1.4	24.0±1.8	0.62
Weight (kg)		71.3±9.9	79.0±12.5	77.3±15.9	79.9±18.1	0.01*
BMI (kg/m^2)		22.4±3.1	24.5±3.5	24.3±4.3	24.3±4.1	0.01*
Unmarried (%)		79.0	85.2	93.5	93.4	0.03*
Economic status (%)	Low	43.6	42.7	38.7	24.6	0.01*
	Middle	54.8	55.7	50.0	55.7	
	High	1.6	1.6	11.3	19.7	
Physical activity (%)	Low	22.6	42.6	27.4	6.6	0.01*
	Middle	32.3	42.6	41.9	59.0	
	High	45.1	14.8	30.7	34.4	
Education (%) (≤bachelor)		88.7	88.5	88.7	86.9	0.98
Family size (%) (≤4)		30.6	27.9	19.4	16.4	0.19

*p<0.05 was considered statistically significant.
†Obtained from analysis of variance for continuous variables and χ^2 test for categorical variables.
BMI, body mass index.

Table 2 Multivariable-adjusted intakes of selected nutrients and food groups of study participants across quartiles (Q) of Alternative Healthy Eating Index-2010 (AHEI-2010)† (mean values and SD)

| | Quartiles of AHEI-2010 | | | | | | | | |
| | Q1 n=62 | | Q2 n=61 | | Q3 n=62 | | Q4 n=61 | | |
	Mean	SD	Mean	SD	Mean	D	Mean	SD	p Value‡
Energy (kcal/d)	2027.59	444.24	2342.31	455.09	2245.35	556.07	2315.77	504.16	0.01*
Carbohydrates (g/d)	243.51	51.63	288.11	64.36	277.51	77.67	287.67	63.75	0.01*
Proteins (g/d)	96.03	16.43	104.94	19.36	102.19	20.84	114.61	22.61	0.01*
Fats (g/d)	73.75	24.92	82.96	23.26	72.72	27.40	70.46	24.48	0.03*
n-3 Fatty acids (g/d)	1.19	0.21	1.35	0.24	1.38	0.27	1.73	0.31	0.01*
Red meat (g/d)	77.27	13.71	83.55	15.03	82.79	15.10	96.28	19.52	0.01*
Whole grains (g/d)	22.32	3.86	27.04	4.69	27.42	6.35	30.44	5.92	0.01*
Fruit (g/d)	222.19	38.27	242.62	44.85	236.29	48.08	265.10	52.48	0.01*
Vegetables (g/d)	203.18	47.91	257.37	43.38	268.51	69.20	299.24	66.69	0.01*
Nuts and legumes (g/d)	17.29	1.49	18.98	3.68	22.23	4.47	27.98	2.70	0.01*
Trans fat (% of energy)	3.20	0.48	3.14	0.42	2.84	0.48	2.69	0.47	0.01*
PUFA (% of energy)	2.53	0.22	2.58	0.19	2.83	0.22	2.92	0.29	0.01*

*p<0.05 was considered statistically significant.
†Energy intake is adjusted for age and sex; all other values are adjusted for age, sex and energy intake.
‡Obtained from analysis of covariance.

RESULTS

Subject response rate was 100% for providing completed questionnaires. In total 246 soldiers (mean 24 years old±1.5 years) completed the study. Baseline characteristics of participants among quartiles of AHEI-2010 are shown in Table 1. Participants with higher scores of AHEI-2010 were single, had a better economic status and smaller family size than those with lower scores. Dietary intakes of food groups and micronutrients across quartiles of AHEI-2010 are shown in Table 2.

Subjects with higher scores of AHEI-2010 reported higher intakes of omega-3 fatty acids, whole grains, vegetables, fruits, nuts and polyunsaturated fatty acids (PUFAs) compared with those with lower scores. The prevalence of depression, stress and anxiety in participants was 15.9%, 10.6% and 27.2%, respectively (Figure 1).

The prevalence of depression and anxiety was lower in those subjects with increased AHEI-2010 scores. No association was found between AHEI-2010 and stress.

Participants with the highest adherence to the AHEI-2010 had an 80% lower odds of depression than those with the lowest adherence (OR: 0.20; 95% CI 0.04 to 0.78) (Table 3).
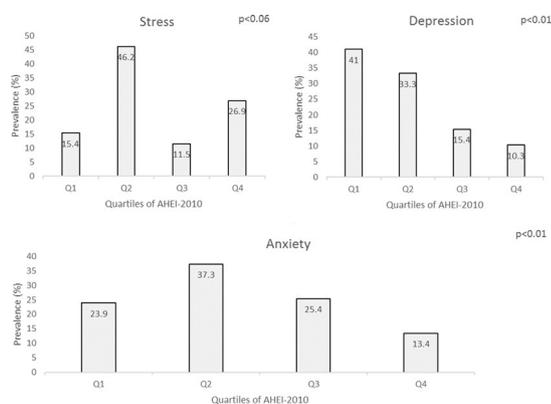
This association remained significant, even after controlling for the potential confounders (OR: 0.12; 95% CI 0.02 to 0.58). Such an association was also found between adherences to the AHEI-2010 and anxiety. After controlling for the potential confounders, participants with the highest adherence to the AHEI-2010 had a 72% lower odds of anxiety than those with the lowest adherence (OR: 0.28; 95% CI 0.05 to 0.95). In addition, the OR of depression and anxiety decreased by the increase in adherence to the AHEI-2010 (P_{trend} <0.02). No significant association was found between adherence to the AHEI-2010 and stress, and it remained non-significant after adjustment for potential confounders (OR: 0.13; 95% CI 0.16 to 2.24).

DISCUSSION

Psychological disorders are among major causes of the diseases' burden and may result in morbidity and mortality.[21] Furthermore, psychological distress has linked to the other chronic diseases, therefore putting a burden on the health system. However, based on the best of our knowledge, there is no study available investigating the association of adherences to the AHEI-2010 with psychological disorders in military populations. Therefore, changes in nutritional behaviours to a healthy diet may improve psychological status and reduce chronic diseases.[11] This study has demonstrated an inverse association between adherence to the AHEI-2010 and the odds of developing depression and anxiety. This association remained unchanged after controlling for the confounders including total energy intake, BMI, age, marriage status, smoking, economic status, physical activity, family size and education. The prevalence of depression, stress and anxiety in our study (15.9%, 10.6% and 27.2%, respectively) was similar to that found in healthy non-military personnel.[22]

Previous civilian studies have demonstrated a direct relationship between adherence to western diets and risk of psychological disorders.[23] Increased consumption of fruits, vegetables and whole grains has been linked to the reduced risk of anxiety. In contrast, consumption of a diet rich in refined grains and sweetened or fried foods has been associated with the elevation in anxiety incidence,[24] and this was found in our study.

Figure 1 The prevalence of anxiety, stress and depression in study participants across quartiles of Alternative Healthy Eating Index-2010 (AHEI-2010).

Table 3 Anxiety and depression across quartiles of Alternative Healthy Eating Index-2010 (AHEI-2010) (multivariable-adjusted ORs and 95% CIs)

| | Quartiles of AHEI-2010 | | | | | | | |
| | Q1 | Q2 | | Q3 | | Q4 | | |
	OR	OR	95% CI	OR	95% CI	OR	95% CI	P_{trend}†
Depression								
Crude	1.00	0.63	0.16 to 2.45	0.26	0.07 to 0.91	0.20	0.04 to 0.78	0.01*
Model 1	1.00	0.61	0.15 to 2.41	0.25	0.07 to 0.88	0.17	0.04 to 0.72	0.01*
Model 2	1.00	0.65	0.16 to 2.65	0.21	0.05 to 0.80	0.12	0.02 to 0.58	0.01*
Stress								
Crude	1.00	2.92	0.56 to 5.30	0.50	0.18 to 1.37	1.54	0.04 to 3.56	0.78
Model 1	1.00	2.01	0.45 to 4.92	0.39	0.12 to 1.26	0.94	0.17 to 2.97	0.23
Model 2	1.00	2.19	0.47 to 4.09	0.34	0.10 to 1.01	0.76	0.13 to 2.24	0.16
Anxiety								
Crude	1.00	0.40	0.16 to 1.00	0.24	0.10 to 0.57	0.39	0.15 to 0.98	0.02*
Model 1	1.00	0.38	0.14 to 0.98	0.21	0.08 to 0.55	0.30	0.09 to 0.98	0.01*
Model 2	1.00	0.43	0.16 to 1.16	0.22	0.08 to 0.58	0.28	0.08 to 0.95	0.02*

Model 1: adjusted for age, energy intake and BMI. Model 2: further adjustment for physical activity, smoking, marital status, education, family size and economic status.
*p<0.05 was considered statistically significant.
†Obtained by the use of categories of AHEI-2010 as an ordinal variable in the model.
BMI, body mass index.

An inverse association was also seen between adherences to the AHEI-2010 and depression, similar to civilian studies.[25] Authors have demonstrated an association between a diet rich in fruits, vegetables, fish, whole grains and olive oil and moderate in red and processed meat with a reduction in depression symptoms.[14 16 26] Our study did not find a significant association between adherences to the AHEI-2010 and stress. Stress can increase a subject's appetite for sweetened or fatty foods.[27] An association between stress and the rate of fat, fibre, fruit and vegetables consumption has not been found,[28] as was the case in our study.

Potential mechanisms to explain this inverse association of adherence to the AHEI-2010 with odds of depression and anxiety have been suggested. High concentrations of antioxidants such as folate and vitamin E in the AHEI-2010 can protect neurones from the degenerative effects of inflammation and oxidative stress.[29] Moreover, the AHEI-2010 has also consists of high amounts of omega-3 and polyunsaturated fatty acids that are potentially neuroprotective.[30] In addition, the Iranian dietary pattern is full of refined grains, rice and hydrogenated oils.[31]

We recognise that potential limitations of this study include its cross-sectional design which makes determining causative effects difficult. Furthermore, using the FFQ as a tool to measuring dietary intakes deeply depends on the memory of participants and may cause some errors such as recall bias.

CONCLUSION

An inverse association was found between adherence to the AHEI-2010 and the odds of depression and anxiety, but no association was found with stress. This association remained unchanged after controlling for the confounders such as total energy intake, BMI, age, marriage status, smoking, economic status, physical activity, family size and education. Further epidemiological research is recommended to fully qualify such associations, with prospective cohort studies to potentially determine causality.

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