Original Article

The Relationship between Dietary Patterns with Blood Pressure in Iranian Army Staffs

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Abstract

Background: Hypertension is one of the most common noncommunicable diseases in the world. One of the most effective factors on blood pressure (BP) is nutrition. The aim of this study was to examine the relationship between dietary patterns and BP among military staffs. **Materials and Methods:** The study was carried out among 405 military staffs between 22 and 51 years old. Demographic, anthropometric information, and BP of participants were evaluated by standard methods. The dietary intakes were collected using a food frequency questionnaire (FFQ). Dietary patterns were identified using a posteriori method, factor analysis, and based on the FFQ. To check the relationship between BP and dietary patterns, we used multivariate linear regression in different models, relationship were adjusted for Age, sex, marital, smoking, income, body mass index, waist-to-hip ratio, family history of hypertension, energy intake, and physical activity level. **Results:** Two dominant dietary patterns were identified in the participants: Healthy and western pattern. The association of dietary patterns with systolic BP (SBP) and diastolic BP (DBP) was exhibited in different models. There was no relationship between SBP and DBP with healthy pattern (P = 0.269 and P = 0.638, respectively) and western pattern (P = 0.648 and P = 0.315, respectively) after adjustments. **Conclusion:** Our findings indicated that dietary patterns did not have any significant relationship with SBP and DBP after adjustment for confounders in the healthy military. To identify the dietary patterns associated with BP in healthy military, more strong design studies and more participants should be conducted in the future.

Keywords: *Blood pressure, dietary pattern, military staff*

Introduction

Proper nutrition is a very important factor in maintaining and promoting health and proved its role as a determining agent in chronic diseases.[1] Over the past half-century, most countries, especially developing countries, have been in nutritional transition and have moved toward a pattern of food and physical activity associated with chronic noncommunicable diseases.[2,3] For the more comprehensive understanding relationship between nutrition and diseases, it is better to nutrition be considered as a dietary pattern to take into account synergistic effects of foods and nutrients.[4]

Hypertension (HTN) is a public health problem around the world because it has a high prevalence and also increases the risk of other diseases especially cardiovascular and renal diseases.[5,6] The prevalence of HTN in people over 18-year-old has reported 22% (24% in males and 20% in females) in the world and 19.7% (20.4% in males and 18.9% in females) in Iran.[7] Studies in Iran have related high prevalence of HTN and prehypertension (pre-HTN) in military.[8,9]

Many studies have proven association between dietary pattern with HTN and pre-HTN especially dietary approaches to stop HTN style diet.[10-14] In a recent study, the relationship between the dietary pattern of higher fish, eggs, milk, nuts, vegetables, and fruits, and lower salt intake with prevalence, and control of HTN has evaluated and reported that the dietary pattern is inversely associated with the prevalence of HTN.[15] An inverse association has been represented between a healthy diet and HTN in urban residents of Arusha City;[16] Furthermore, Ndanuko *et al*. have suggested that a diet rich of nuts, seeds, fruits, and fish is related to blood pressure (BP), conversely.[17]

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Findings from a study on Cameroon defense forces have demonstrated that two major dietary patterns include fruit and vegetable pattern and meat pattern in these forces, and fruit and vegetable pattern is related to reduced risk of HTN; however, meat pattern is not associated with HTN.[18] In another study, was checked out the presence of metabolic syndrome and adherence to the Mediterranean dietary pattern in Greek navy, and it was concluded that compliance rate of the Mediterranean dietary pattern is low in forces with metabolic syndrome.[19]

Maintain the health of military for their proper function is necessary. Because in previous studies, there was a relationship between dietary pattern and BP in hypertensive patients, and there were few studies on the relationship between BP and dietary pattern among healthy people. Our aim of this study was to investigate the relationship between dietary patterns and BP in healthy people. It was also examined whether there was a relationship between unhealthy dietary pattern and BP in the patient people in healthy people. Few studies have examined dietary pattern in military forces, and as well as the high prevalence of HTN and pre-HTN has been reported in Iranian military. Therefore, we conducted a cross-sectional study to assay dietary pattern and its relationship with BP in 405 Iranian Army staffs.

Materials and Methods

Study population

We conducted a cross-sectional survey within a sample of Iran Army staffs during 2017; to assess the dietary pattern and its relationship with BP. Participants were selected by cluster random sampling method. In both sexes, military grade was considered as a cluster, and in each cluster, individuals were randomly selected. Four hundred and five males and females of military staffs aged between 22 and 51 years entered in the study, finally. Our inclusion criteria include healthy military staffs. We excluded those with have any type of diet, pregnant and lactating women, individuals who took any medication or supplements affecting BP or have not completed any of the required items. All study participants filled written informed consent forms before involved in the survey. The study was approved by the Ethics Committee of the AJA University of Medical Science, Tehran, Iran.

Demographic and measurements

Demographic and socioeconomic data included age, sex, education level, and income, marital; housing, smoking, alcohol and disease status, and family history of HTN were gathered by trained interviewers.

Anthropometric measurements were done by trained individuals in a certain hour of the day (8–10 am) for all participants. Weight (precision 0.05 kg, using Seca 700 scale, Hamburg, Germany) and height (Precision 0.5 cm, using wall-mounted height meter, Fazzini S208, Italy), were measured using standard protocols, and then, body mass index (BMI) were computed. The waist circumference was measured at the thinnest upper part of the navel with the least amount of clothing using a nonelastic strip (precision 0.1 cm). The hip circumference was measured in the most prominent part, and the waist-to-hip ratio (WHR) was calculated.

BP was measured twice with 15 min away by trained nurse based on the standard protocol,[20] and the average of two measurements of systolic BP (SBP) and diastolic BP (DBP) was used in the analysis. The sphygmomanometer used in this study was a calibrated sphygmomanometer and stethoscope (Accurtorr 1A; Datascope, Japan).

Dietary and physical activity assessment

Food intake information was collected by a 147 items self-completed validated semi-quantitative food frequency questionnaire (FFQ) that had been validated by previous studies.[21,22] Questionnaires were completed in the presence of skilled dietitians. Participants were asked to write details of foods in the considerations column. At first, reported portion size in FFQ was changed to grams/day using a household measurements book,[23] and then, food intake analysis and their consumed energy and nutrients estimated using NIV software (Nutritionist IV, diet analysis module, version 3.5.2). We identified under or over-reporting in our population and removed individuals with under or over-reporting energy intake (n = 18) because those reported an energy intake that was out of limits ± 3 standard deviation estimated energy requirements.[24]

Physical activity information was evaluated using the validated modifiable activity questionnaire that participants registered their last year's physical activity.[25] Frequency, duration, and intensity of physical activity were defined in this questionnaire. Physical activity level was estimated based on the metabolic equivalent task minutes per week (1 MET = 3.5 ml/kg/min of O_2 consumption).

Statistical analysis

Data were controlled for normal distribution using Kolmogorov–Smirnov test. Dietary patterns were assessed using a posteriori method, factor analysis, based on the FFQ. The 147 food items based on the resemblance of nutrient profiles and cooking application were divided into 34 groups. In some cases, one food item was considered as a food group due to a combination of special nutrients (e.g., egg or salt) or a specific baking method (e.g. French fries). Dietary patterns were acquired by essential component factor analysis with varimax rotation on the 34 food groups. Eigenvalues >1 were retained. The Kaiser-Meyer-Olkin (KMO) and Bartlett's tests demonstrated that the data were proper for this type of analysis (KMO: 0.70, Bartlett: $P < 0.001$). According to the

scree plot of eigenvalues was obtained two main dietary patterns as follows: Healthy and western pattern. The naming of dietary patterns was based on their components, propinquities with common dietary patterns in the world as well as former studies.[26,27]

To check the relationship between SBP and DBP with dietary patterns, we used multivariate linear regression in different models. In Model I, adjusted relationship for age, more adjustments were conducted for sex, marital, income, and smoking status in Model Π, and in Model Ш, in addition to the previous ones, the association was adjusted for energy intake, BMI, WHR physical activity, and family history of HTN. SPSS software v 19 was (SPSS V18 (SPSS Corp., version 18, Chicago, IL, USA) used for all statistical analysis. Statistically significant level was considered $P < 0.05$.

Results

Demographic, anthropometric and BP information, and physical activity level are presented in Table 1. Finally, 387 (74 females and 313 males) participants entered into the analysis.

Table 1: Characteristics of study population (*n*=387)

variables	Mean±SD or *n* (%)		*P*[a]
	Males (313)	Females (74)	
Age (years)	35.6±6.4	35.5±7.3	0.940
Sex, *n* (%)	313.0 (80.9)	74.0 (19.1)	-
BMI (kg/m2)	26.5±3.4	26.0±3.3	0.279
Weight (kg)	83.3±11.5	68.6±9.3	<0.001
Height (cm)	177.3±6.8	162.3±5.0	<0.001
WHR	0.93±0.05	0.86±0.05	<0.001
Energy intake (kcal/day)	3026.0±524.0	2652.0±323.0	<0.001
Metabolic equivalent task (h/day)	13.6±4.4	11.0±3.9	<0.001
SBP (mmHg)	118.0±7.7	108.2±9.5	<0.001
DBP (mmHg)	78.2±5.0	72.5±6.4	<0.001
Prevalence of pre-HTN and HTN, *n* (%)[b]	112 (35.8)	5 (6.8)	<0.001
Smoking, *n* (%) smoker	68.0 (21.7)	0	<0.001
Income status, *n* (%)			
Low	45.0 (14.4)	5.0 (6.7)	0.063
Moderate	161.0 (51.4)	32.0 (43.3)	
High	107.0 (34.2)	37.0 (50.0)	
Marital status, *n* (%) married	282.0 (90.0)	66.0 (89.2)	0.444
Education, *n* (%) college	171.0 (54.6)	57 (77.0)	0.002
Disease status, *n* (%) patient	37.0 (11.8)	7.0 (9.4)	<0.001
Family history of HTN	159 (50.8)	44 (59.5)	<0.001

[a]Obtained from independent samples *t*-test or Mann–Whitney U-test for continuous and categorical variables, respectively, according to sex, [b]HTN, pre-HTN, SBP ≥120 mmHg or DBP ≥80 mmHg. HTN: Hypertension, SD: Standard deviation, WHR: Waist-to-hip ratio, BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

Detected dominant dietary patterns are shown in Table 2. Two dominant dietary patterns were identified in the participants: healthy and western pattern. Healthy pattern was loaded for vegetables, fruits and fruit juice, dried fruits, low-fat dairy, fish, legumes, nuts, and olive oil, and components of western pattern was included red meat, processed meat, refrained grain, soda, salty and sweet snacks, sugar, salt, hydrogenated fats, vegetable oils, organ meats, eggs, poultry, high-fat dairy, and potato.

The association of dietary patterns with SBP and DBP was exhibited in crude and adjusted models in Table 3. In crude model, there was no relationship between SBP and DBP with healthy patterns ($P = 0.068$ and $P = 0.278$, respectively); however, after adjusting the relationship in different models, we found only a significant inverse relationship between SBP and healthy pattern in Model I ($P = 0.007$). We discovered a positive significant association between western pattern with SBP and DBP in the unadjusted model ($P = 0.048$ and $P = 0.024$, respectively) and Model I ($P = 0.008$ and $P = 0.004$, respectively). Further adjustments for confounders such as education level, disease, and housing status, there was no significant change in the reviewed association.

Discussion

From the results of our study were obtained two major dietary patterns included the healthy and western pattern in Iran army staffs. The most conducted studies in Iran have reported five dietary patterns included healthy or vegetable, western, Mediterranean, fast food, and traditional pattern[28-30] that two major identified dietary patterns in our study were similar to identified patterns in these studies.

Our findings indicated that healthy pattern did not have any significant relationship with SBP and DBP after adjustment for confounders ($P = 0.269$ and $P = 0.638$, respectively). Based on our reviews, few studies have evaluated the relationship between dietary patterns with BP in military staffs. HTN is one of the most common chronic diseases in the world that it increases risk of other diseases especially cardiovascular and renal diseases.[5,6] Proper nutrition and lifestyle are one of the most important effective factors on BP.[1,5] Two longitudinal studies have reported dietary patterns were not associated with BP in Chinese people;[31,32] Furthermore, in a sample of 4304 Pakistani adults, a diet rich of fruit and vegetable was not related to HTN.[33]

In contrast to our study, Nkondjock and Bizome evaluated the dietary patterns that are effective on the incidence of HTN in Cameroonian military and reported a significant association between fruit and vegetable pattern with a reduced risk of HTN.[18] It has also been reported a significant relationship between a healthy diet with HTN in two cross-sectional surveys.[16,17]

In the unadjusted model, we did observe a significant association between western pattern with SBP

Table 2: Food groups used in the factor analysis and factor loadings and dominant identified dietary patterns

Food groups	Food items	Healthy pattern	Western pattern
Green leafy vegetables	Spinach, lettuce	0.752	-
Yellow vegetables	Carrot	0.706	-
Tomatoes	Tomato	0.750	-
Cruciferous vegetables	Different types of cabbage	0.563	-
Garlic	Garlic	0.468	-
Other vegetables	Cucumber, eggplant, onion, green beans and peas, squash, pepper, mushroom, corn, turnip	0.787	-
Fruits and fruit juices	All fresh fruits and natural juices	0.632	-
Dried fruit	All dried fruits	0.348	-
Legumes	Lentils, split peas, beans, chickpeas, mung bean, soya	0.373	-
Fish	All fish types, canned fish	0.409	-
Low-fat dairy	Low-fat milk, low-fat yogurt, cheese, Kashk, yogurt drink	0.552	-
Olive	Olives, olive oil	0.502	-
Nuts	Almond, peanut, walnut, seeds pistachio, hazelnut	0.466	-
Salt	Salt	-	0.675
Sugar	Chocolate, honey, jam, sugar, sugar cubes, candies	-	0.634
Salty snacks	crackers, potato chips, cheese puffs	-	0.625
Soda	Soda	-	0.522
Processed meats	Sausages, lunch meat	-	0.500
Refined grains	refined breads, baguette bread, rice, pasta, vermicelli	-	0.489
Sweet snacks	Biscuits, cookies, cakes, gaz, sohan, creamy sweets	-	0.484
Vegetable oils	All vegetable oils except olive oil	-	0.448
Eggs	Eggs	-	0.412
High-fat dairy	High-fat milk, high-fat yogurt, cream cheese, cream, dairy fat, ice cream	-	0.387
Potatoes	Potatoes	-	0.380
Organ meats	Heart, kidney, liver, tongue, tripe, brain, sheep's head and trotters	-	0.370
Hydrogenated oil	Hydrogenated oils, butter, margarine	-	0.342
Red meats	Beef, lamb, minced meat, hamburger	-	0.312
Poultry	Chicken, turkey	-	0.304
Mayonnaise	Mayonnaise	-	-
Sugar-sweetened fruit juice	Sugar-sweetened fruit juices	-	-
Fried potato	French fries	-	-
Canned fruits	All types of canned fruit	-	-
Coffee-tea	Coffee, tea	-	-
Pickles	Pickles, salted vegetables	-	-

Factors loading lower than ±0.30 are not presented for simplicity

and DBP (P = 0.048 and P = 0.024, respectively), but after adjustment was not seen any significant association (P = 0.648 and P = 0.315, respectively). Like our study, a cross-sectional study in Cameroonian defense forces showed that a dietary pattern rich in bushmeat, poultry, and red meat did not have any relationship with HTN.[18] Castro *et al*. assessed the association of dietary patterns and cardiovascular diseases risk factors included BP in Brazilian adults and indicated that there is no any significant correlation between modern pattern (similar to our Western pattern) and BP;[34] in addition, in another study, was not observed a significant relationship between fat and sweet pattern and HTN.[33]

Although the results of some studies were similar to our study, a number of studies have reported different results from our survey. One study in Australian adults has investigated the association between dietary patterns with obesity and HTN and showed that a dietary pattern with high sodium and saturated fatty acids and low fiber was related to the prevalence of HTN significantly,[35] and in addition, Khalesi *et al*. confirmed a significant association between western pattern and HTN among Australian adults.[36]

In previous studies, several mechanisms have been suggested and perused for the relationship between healthy and unhealthy diet and BP; however, synergistic effects of dietary patterns on BP are still unclear exactly. Fruits, vegetables, and legumes are rich in flavonoids and flavonoids have antioxidant and anti-inflammatory effects that may be effective on BP[37] because oxidative stress has

Table 3: The relationship between dietary patterns and blood pressure

variables	Western pattern		Healthy pattern	
	β[a] (95% CI for β)	*P*	β (95% CI for β)	*P*
SBP				
Unadjusted model	0.98 (0.01, 1.96)	0.048	−0.90 (−1.88, 0.07)	0.068
Model 1	1.29 (0.34, 2.23)	0.008	−1.3 (−2.25, −0.33)	0.007
Model 2	0.56 (−0.30, 1.41)	0.201	−0.48 (−1.35, 0.39)	0.283
Model 3	0.31 (−0.61, 1.19)	0.611	−0.47 (−1.35, 0.38)	0.257
DBP				
Unadjusted model	0.72 (0.09, 1.34)	0.024	−0.35 (−0.97, 0.28)	0.278
Model 1	0.90 (0.29, 1.50)	0.004	−0.58 (−1.19, 0.04)	0.067
Model 2	0.48 (−0.09, 1.05)	0.099	−0.13 (−0.71, 0.45)	0.657
Model 3	0.39 (−0.25, 0.94)	0.212	−0.19 (−0.71, 0.39)	0.541

[a]Correlation coefficient. Model 1: Was adjusted for age, Model 2: Was adjusted for age, sex, marital, smoking, and income status, Model 3: Was adjusted for age, sex, marital, smoking, income, BMI, WHR, family history of HTN, energy intake, and physical activity level. CI: Confidence interval, WHR: Waist to hip ratio, BMI: Body mass index, HTN: Hypertension

been proposed as the cause of HTN.[38] Epidemiological and clinical studies proposed that magnesium reduces vascular tone and cellular uptake of calcium and so may decrease BP.[39] The western pattern is associated with increased waist circumference, BMI, and serum insulin,[18,36,40] and thus, it can be effective on BP. Provided these hypotheses are correct; therefore, a healthy pattern rich in fruits, vegetables, and legumes should be related to BP.

The causes of the contradiction between the results of studies, including lack of significant relationship in our study could be the type of study design, difference in the method of evaluation dietary pattern, diversity in statistical analysis and confounders are considered, and difference in individuals and type of questioner that was used.

This is the first study that has evaluated the association between dietary patterns and BP in the Iranian military staffs. From other strength in our study can be noted to control a lot of covariates, high quality in data collection and method of sampling.

Our study had several limitations. The main limitation of the current study was the cross-sectional design although there were other restrictions such as relatively low-sample size. Although many confounding factors were controlled in the study, factors such as family history diseases were not controlled.

Conclusion

The purpose of this study was to check the relationship between dietary pattern and BP among military staffs. We identified two dominant dietary patterns include the healthy and western pattern in military staffs. Our findings indicated that dietary patterns did not have any significant relationship with SBP and DBP after adjustment for confounders in the healthy people. Due to the high prevalence of hypertension in the military, identification of risk factors associated with HTN is necessary. To identify the dietary patterns associated with BP in the healthy military, more strong design studies and more participants should be conducted in the future.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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