Original Article

Gender Differences in Major Dietary Patterns and Their Relationship with Cardio-Metabolic Risk Factors in a Year before Coronary Artery Bypass Grafting (CABG) Surgery Period

Mahdieh Abbasalizad Farhangi PhD[1], Asal Ataie-Jafari PhD[2], Mahdi Najafi MD•[3], Gholamreza Sarami Foroushani PhD[4], Mohammadreza Mohajeri Tehrani MD[5], Leila Jahangiry PhD[6]

Abstract

Background: Previous studies reported the association between dietary patterns and prevalence of diabetes, cardiovascular disease and other chronic disease. However, there are no studies reporting major dietary patterns in patients awaiting coronary artery bypass graft surgery (CABG). The aim of this study was to obtain the major dietary patterns and their association with demographic, dietary factors and biochemical parameters in these patients.

Materials and Methods: This was a cross-sectional study on 454 patients aged 35 – 80 years as candidates of CABG and hospitalized in the Tehran Heart Center. Anthropometric and demographic characteristics were obtained from all participants and a 138-item semi-quantitative food frequency questionnaire (FFQ) was used to evaluate dietary patterns by factor analysis. Biochemical parameters including HbA_1c, serum lipids, hematocrit (HCT), albumin, creatinine and CRP were assessed by commercial laboratory methods.

Results: Five major dietary patterns, including: healthy, intermediate, neo-traditional, western and semi-Mediterranean patterns were extracted. Top quartile of healthy pattern was associated with higher educational attainment and lower serum low-density lipoprotein cholesterol (LDL), and total cholesterol (TC) in men, as well as higher high-density lipoprotein cholesterol (HDL) concentrations in women ($P < 0.001$). Individuals in top quartiles of intermediate and neo-traditional pattern were more likely to be male, had higher smoking and drinking habits, as well as the lower prevalence of diabetes, hyperlipidemia and hypertension ($P < 0.05$). They also had higher serum triglyceride (TG) concentrations. Patients in the western pattern also had a higher prevalence of a family history of cardiovascular disease and higher serum TG concentrations. Top quartiles of semi-Mediterranean pattern were associated with lower C-reactive protein (CRP) concentrations in women.

Conclusions: There were five major dietary patterns using FFQ among patients awaiting CABG surgery. Significant associations were observed between major dietary patterns and risk of diabetes and hypertension. Top quartiles of healthy eating patterns were associated with lower cardio-metabolic risk factors.

Keywords: CABG, cardiovascular disease, dietary patterns, factor analysis

Cite this article as: Abbasalizad Farhangi M, Ataie-Jafari A, Najafi M, Sarami Foroushani G, Mohajeri Tehrani MR, Jahangiry L. Gender differences in major dietary patterns and their relationship with cardio-metabolic risk factors in a year before coronary artery bypass grafting (CABG) surgery period. *Arch Iran Med*. 2016; **19(7):** 470 – 479.

Introduction

Cardiovascular diseases (CVDs) account for the major cause of death and morbidity worldwide, accounting for 25 to 45 percent of total deaths,[1] and the leading cause of death in Iran.[2,3] Dietary intake is thought to exert a great influence on the risk of CVDs.[4]

Coronary artery bypass grafting (CABG) is a very common surgical intervention for the treatment of patients with higher stages of coronary artery disease (CAD), where atherosclerosis of one or more coronary arteries is severe enough to show at least 50% stenosis of arterial lumen in angiographic image.[5] The number of CABG operations carried out to treat CAD has increased more than fivefold since 1980, and the general trend has been an almost steady rise in the number of operations performed each year. The National Health Service (NHS) is increasingly drained of valuable resources each year on treating CAD.[6] Since diet is a complex exposure variable, it is now recognized that we must develop and refine methods of assessing dietary intake that focus on the total diet and not just on individual dietary components (e.g., nutrients). As a result, the study of patterns of intakes of nutrients, foods, and food groups has begun to emerge in nutrition research.[7] Assessment of the total diet takes into account all nutrient interactions and allows us to capture diet-disease or diet-biomarker relations without knowing the specific nutrient or food component involved. Since many nutrients are highly correlated within foods, it is difficult to examine their effects separately.[8]

Most evidence in this field comes from observational studies assessing the risk of cardiovascular problems in relation to dietary patterns.[9–14] Limited existing randomized, lifestyle interventions

Authors' affiliations: [1]Nutrition Research Center, Department of Community Nutrition, School of Nutrition, Tabriz University of Medical Sciences, Tabriz, Iran, [2]Department of Nutrition, Faculty of Medicine, Science and Research Branch, Islamic Azad University, Tehran, Iran, [3]Research Department, Tehran Heart Center, Tehran University of Medical Sciences, Tehran, Iran, [4]Statistics Department, Kharazmi University, Tehran, Iran, [5]Endocrinology and Metabolism Research Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran, [6]Department of Health Education and Health Promotion, School of Public Health, Tabriz University of Medical Sciences, Tabriz, Iran.

•**Corresponding author and reprints:** Mahdi Najafi MD, Department of Research, Tehran Heart Center, Tehran University of Medical Sciences, North Karegar Street, Tehran, P. O. Box: 1411713138, Iran. E-mail: najafik@sina.tums.ac.ir.

Accepted for publication: 4 May 2016

support a beneficial role for dietary patterns in relation to the progression of atherosclerosis.[15,16] In the Lyon Diet Heart study, de Lorgeril[15] found that a Mediterranean-type diet rich in α-linolenic acid reduced the rate of recurrence after the first myocardial infarction over a period of 46 months.

There are some studies assessing dietary quality in patients with myocardial infarction[17] or established CAD,[18] in which a priori healthy diet pattern score was used. However, very limited information is available on the dietary habits of patients undergoing CABG surgery in Iran. Until such information is available, we cannot begin to control for diet as a risk factor post operatively, nor make recommendations for the follow-up and care of these patients.

In this study, we investigated major dietary patterns in CABG patients during 1-year pre-operation period, and looked for associations with some demographic factors, dietary intakes, and biochemical risk factors.

Materials and Methods

Subjects

Patients in the current cross-sectional study were candidates for isolated CABG with cardiopulmonary bypass and were recruited for Tehran Heart Center-Coronary Outcome Measurement (THC-COM) study. Reasons for drop-out or exclusion were incomplete dietary questionnaires (n = 1), and incomplete demographic questionnaires (n = 5). The final analytic sample in this study consisted of 454 patients aged 35 – 80 years who completed both the questionnaire and the medical examination. More details of study procedure and biochemical assays have been provided elsewhere.[19] The study sample size was calculated according to our previous report[19] using the formula for comparing two proportions: $n = [(Z_{\alpha/2} + Z_\beta)^2 \times \{(p_1 (1-p_1) + (p_2 (1-p_2))\}]/ (p_1-p_2)^2$ considering the α error = 0.05, and power = 80% (1-β). Accordingly, a 125-subject sample size was determined for the study (125 in each group). We also assumed 20% loss (125 + 25) and as men with CAD are twice as women (150 + 300), the final sample size of 450 was considered for the study. Written informed consent was obtained from each participating subject. The study was approved by the research committee of Tehran Heart Center, Tehran University of Medical Sciences, Tehran, Iran.

Dietary assessment methods

A 138-item semi-quantitative food frequency questionnaire (FFQ) was used to assess the habitual dietary intakes of patients. Use of a questionnaire was adopted, as it is a relatively easy, quick and inexpensive method for measuring the usual diet of a population. All questionnaires were administered by a trained dietitian. The FFQ consisted of a list of foods with standard serving sizes commonly consumed by Iranians.

Participants were asked to report how often they consumed each of the food items listed as the number of times per day, per week, per month or per year during the previous year. The reported frequency of each food item was then converted to a daily intake. Portion sizes of consumed foods were converted to grams by using household measures.[20] Total energy intake was calculated by summing up energy intakes from all foods. Due to a large number of the food items, we assigned each food item into 1 of 43 defined food groups (Table 1). The food grouping was based on the similarity of nutrients or culinary usage of the foods. Some individual food items were considered as a food group, because it was inappropriate to incorporate them into a certain food group (eg, eggs, margarine, coffee, and tea) or their consumption was considered to reflect a distinct dietary pattern [eg, garlic, lemon juice, or yogurt drink]. The FFQ was a version of a 168-item questionnaire and was previously validated on a sample of the healthy population and revealed good correlations between dietary intakes assessed by a similar FFQ and those from multiple days of 24 hours dietary recalls.[21] Biochemical assays were explained with details before.[19]

Statistical analysis

To identify major dietary patterns based on the 43 food groups, we used principal component analysis, and the factors were rotated by varimax transformation. The natural interpretation of the factors in conjunction with eigenvalues > 1.5 and the Scree test [22] determined whether a factor should be retained. Choosing 1.5 cut-points for eigenvalues, is for fitting those straight, principal-component lines to the variance of the data. Because in this limit eigenvectors trace, the principal lines of force, and the axes of greatest variance and covariance illustrate where the data is most susceptible to change.[22]

The derived factors (dietary patterns) were labeled on the basis of our interpretation of the data and of the earlier literature. The factor score for each pattern was calculated by summing intakes of food groups weighted by their factor loadings,[22] and each participant received a factor score for each identified pattern.

We categorized participants by quartiles of dietary pattern scores. One-way analysis of co-variance was performed to evaluate significant differences in general characteristics (age and anthropometric measures) across quartile categories of dietary pattern scores adjusting for possible confounding variables. The distribution of qualitative variables across quartiles was evaluated using Chi-square tests. All statistical analyses were performed by SPSS software (version 15.0; SPSS Inc, Chicago IL).

Results

Using factor analysis, five major dietary patterns were extracted. We labeled these factors as following: the healthy pattern (high in fruits, cruciferous and green leafy vegetables and other kinds of vegetables, low or regular fat dairy products, and low in tea, sugars and soft drinks), the intermediate pattern (high in fish and other sea products, fresh fruit juice, condiments, vegetable oils, margarine, dried fruits, sweets and desserts), the neo-traditional pattern (high in butter, refined grains, hydrogenated fats, sugars, pickles, doogh and kashk), the western dietary pattern (high in processed, red and organ meats, egg, high-fat dairy products, coffee, pizza, salty snacks, nuts, and low in poultry, yellow vegetable, and whole grains), and Semi-Mediterranean pattern (high in fruit, dried fruit, yellow vegetable and nuts, olive, sugars and low in margarine and hydrogenated fats). Factor-loading matrixes for these dietary patterns are available in Table 2. Totally, these factors explained 29.6% of the whole variance. General characteristics of study participants according to the quartiles of dietary pattern score are presented in Table 3.

Individuals in the top quartile of healthy pattern were more likely to have a higher educational level (*P* = 0.018). Patients in the top quartile of this pattern were also more likely to have a higher BMI compared with patients in lower quartiles, although this difference

Table 1. Food grouping used in dietary pattern analysis

Food items	Food groups
Processed meats	Sausages
Red meats	Beef, lamb
Organ meats	Liver and other organ meats, such as heart, kidney, tongue, and tripe (menu do)
Fish and other sea foods	Canned tuna fish, other fish, shrimp
Poultry	Chicken, all types, including baked, fried, chicken nuggets
Eggs	Eggs, including scrambled, fried, omelets, hard-boiled eggs
Butter	Butter
Margarine	Margarine
Low or regular-fat dairy products	Skim to 2.5% fat milk and yogurt
High fat dairy products	High-fat milk, cream, high-fat yogurt, cream yogurt, cheese and cream cheese, pizza cheese, ice cream
Tea	Tea
Coffee	Coffee
Fruit	Pears, apricots, cherries, apples, grapes, bananas, strawberries, peaches, nectarine, fresh mulberry, plums, persimmons, pomegranates, pineapples, fresh figs, cantaloupe, watermelon, melon, Oranges, grapefruit, kiwi, tangerine, lemons
Fresh fruit juice	Apple juice, orange juice, grapefruit juice, other fruit juices
Dried fruit	Dried figs, dates, dried mulberry, raisins
Cruciferous vegetables	Cabbage, cauliflower, kale
Yellow vegetable	Carrot, pumpkin
Tomatoes	Tomato, tomato sauce
Green leafy vegetables	Spinach, parsley, leek and mixed vegetables, lettuce, celery
Other vegetables	Cucumber, eggplant, squash, green pepper, mushrooms
Legumes	Beans, peas, lima beans, broad beans, lentils, soy
Garlic	Garlic
Potatoes	Potatoes
French fries	French fries
Whole grain	Iranian breads (dark breads), barley bread, biscuit made from whole grain
Refined grain	White breads (lavash, baguettes), noodles, pasta, rice, toasted bread, sweet bread, biscuits
Pizza	Pizza
Salty snacks	Potato chips, corn puffs
Nuts	Peanuts, almonds, pistachios, hazelnuts, roasted seeds, walnuts
Olive	Olive and olive oil
Hydrogenated fats	Hydrogenated fats
Vegetable oils	Vegetable oils (except for olive oil)
Animal oil	Animal fat, animal oil
Mayonnaise	Mayonnaise
Sugars	Sugars, candies, gaz (an Iranian confectionery made of sugar, nuts, and tamarisk)
Sweets and desserts	Chocolates, cookies, cakes, confections
Condiments	Jam, jelly, honey
Soft drinks	Soft drinks
Pickles	Pickles
Compote	Compote (a dessert made of whole or pieces of fruit in sugar syrup)
Lemon juice	Lime juice
Doogh	Doogh (An Iranian dairy beverage)
Kashk	Kashk (A kind of dairy product used in Iranian foods)

was not significant.

Subjects in the upper quartile of "intermediate" dietary pattern score had lower prevalence of diabetes, hypertension and hyperlipidemia, and were highly educated ($P < 0.05$). Patients in top quartiles of intermediate pattern were also younger, more likely to be male and had a higher frequency of smoking and drinking habits ($P < 0.05$).

Compared with those in the lowest quartile, individuals in the upper quartile of neo-traditional dietary pattern were more likely to be male or smoker, had a lower BMI, and had lower prevalence of diabetes, hypertension and hyperlipidemia ($P < 0.05$). Patients in the upper quartile of the western pattern score were younger, with a higher prevalence of smoking and alcohol drinking compared to those in the lowest quartile. The percentage of higher education was higher in this group as well.

Lower prevalence of diabetes and higher prevalence of smoking, drinking and being male participant was observed in patients of the top quartile of semi-Mediterranean dietary pattern.

Mean energy, macronutrient and micronutrient intakes of study participants according to the dietary pattern's score quartiles are presented in Table 4. Male participants in the top quartiles of almost all dietary patterns had higher energy, macronutrients and micronutrient intake compared with lower quartiles. However, in females, difference in top and lower quartiles were only significant for the difference in energy, carbohydrate and fiber intake in intermediate pattern, as well as the difference in total fat, saturated fats, mono unsaturated fats and cholesterol intake in neo-traditional pattern ($P < 0.05$).

According to quartiles of dietary pattern score, comparison of biochemical parameters of participants is presented in Table 5. In top quartile of healthy pattern, men had lower serum concentrations of LDL, TC and higher creatinine concentrations while women had higher HDL concentrations. Men in top quartiles of intermediate pattern had also higher TG and lower HCT concentrations compared with low quartile. While in top quartile of neo-traditional and western pattern, men had higher TG concentrations. Biochemical parameters in top and low quartiles of these patterns among women were not significant. In top quartiles of semi-Mediterranean pattern, men had higher TG concentrations while women had lower HDL and CRP levels ($P < 0.05$).

Table 2. Factor-loading matrix for major dietary patterns

Food groups	Major dietary patterns				
	Healthy pattern	Intermediate pattern	Neo - traditional pattern	Western pattern	Semi-Mediterranean pattern
Processed meats	- - -	- - -	- - -	**0.301**	- - -
Red meats	- - -	- - -	- - -	**0.364**	0.321
Organ meats	- - -	- - -	- - -	**0.362**	- - -
Fish and other sea foods	- - -	**0.656**	- - -	- - -	- - -
Poultry	- - -	- - -	- - -	-0.302	- - -
Eggs	- - -	- - -	0.200	**0.299**	- - -
Butter	- - -	0.307	**0.476**	- - -	- - -
Margarine	- - -	**0.436**	- - -	- - -	-0.427
Low or regular-fat dairy products	**0.465**	- - -	- - -	- - -	- - -
High fat dairy products	- - -	- - -	- - -	**0.310**	- - -
Tea	-0.213	- - -	0.287	- - -	**0.410**
Coffee	- - -	- - -	- - -	**0.304**	- - -
Fruit	**0.360**	0.260	- - -	0.298	**0.317**
Fresh fruit juice	- - -	**0.585**	- - -	- - -	- - -
Dried fruit	- - -	0.309	- - -	- - -	**0.334**
Cruciferous vegetables	**0.489**	- - -	- - -	- - -	- - -
Yellow vegetable	**0.288**	- - -	- - -	-0.267	**0.458**
Tomatoes	**0.666**	- - -	- - -	- - -	- - -
Green leafy vegetables	**0.561**	- - -	0.211	- - -	- - -
Other vegetables	**0.710**	- - -	- - -	- - -	- - -
Legumes	0.242	- - -	0.241	- - -	**0.468**
Garlic	**0.420**	- - -	- - -	- - -	- - -
Potatoes	- - -	- - -	- - -	- - -	- - -
French fries	- - -	- - -	0.462	0.209	- - -
Whole grain	- - -	**0.286**	**0.218**	-0.294	- - -
Refined grain	- - -	- - -	**0.606**	- - -	- - -
Pizza	- - -	- - -	- - -	**0.441**	- - -
Salty snacks	- - -	- - -	- - -	**0.547**	- - -
Nuts	- - -	- - -	0.209	**0.327**	**0.551**
Olive	0.254	- - -	-0.220	- - -	**0.490**
Hydrogenated fats	- - -	0.201	**0.580**	- - -	-0.281
Vegetable oils	- - -	**0.335**	-0.385	- - -	- - -
Animal oil	0.244	- - -	0.222	- - -	- - -
Mayonnaise	- - -	- - -	0.201	0.354	- - -
Sugars	-0.293	- - -	**0.478**	- - -	0.347
Sweets and desserts	- - -	**0.411**	- - -	0.235	- - -
Condiments	- - -	**0.573**	0.232	- - -	- - -
Soft drinks	-0.202	**0.368**	- - -	0.358	- - -
Pickles	- - -	0.314	**0.282**	0.262	0.209
Compote	- - -	- - -	0.265	- - -	- - -
Lemon juice	- - -	0.307	- - -	- - -	- - -
Doogh	- - -	0.238	**0.249**	- - -	- - -
Kashk	- - -	- - -	**0.257**	- - -	- - -
Percentage of variance explained	11.6	6.3	4.2	4.0	3.5

[1]Values < 0.20 were excluded for simplicity.

Discussion

In the present study, we identified five major dietary patterns, namely healthy, intermediate, western, neo-traditional and semi-Mediterranean dietary patterns in patients who were candidate for CABG in the preoperative period. Higher healthy pattern scores were associated with higher educational attainments, as well as lower LDL, TC and higher HDL concentrations in men and women, respectively. While individuals in top quartiles of intermediate and neo-traditional pattern were more likely to be male, had higher smoking and drinking habits, as well as the lower prevalence of diabetes, hyperlipidemia and hypertension. They also had higher serum TG concentrations. Patients in the western pattern also had a higher prevalence of family history of cardiovascular disease and higher serum TG concentrations. Numerous data evaluated the major dietary patterns in cardiovascular disease; however, no data are available regarding the major dietary patterns and their association with demographic characteristics, dietary intakes and biochemical risk factors in candidates of CABG.

Healthy dietary pattern and western pattern were also derived in several previous studies in patients with cardiovascular events. In the INTERHEART study[23] evaluating the association between dietary patterns and myocardial infarction (MI), three major dietary patterns in patients after (MI) were obtained including prudent, western and oriental dietary patterns. The prudent dietary pattern, which was high in fruits and all kinds of vegetables, was

Table 3. General characteristics of total participants according to quartiles of dietary patterns score

Characteristics	Quartiles of dietary patterns score				*P*-value
	1st Quartile (n = 112)	2nd Quartile (n = 114)	3rd Quartile (n = 114)	4th Quartile (n = 114)	
Healthy pattern					
Age (y)	58.60 ± 9.58	59.58 ± 9.11	59.38 ± 9.01	58.34 ± 8.18	0.68
Male [n (%)]	83(74.1)	81(71.1)	85 (74.6)	84 (73.6)	0.91
Body mass index (kg/m^2)	26.99 ± 3.99	27.19 ± 3.82	27.52 ± 4.06	28.04 ± 4.09	0.22
Current smoker [n (%)]	42 (37.5)	34 (29.8)	44 (38.5)	40 (35.4)	0.91
Current drinker [n (%)]	18 (16.1)	16 (14.1)	18 (15.8)	12 (10.5)	0.34
High education level[3] [n (%)]	11 (10.1)	16 (14.2)	23 (20.2)	17 (15.2)	**0.018**
Diabetes [n (%)]	48 (42.9)	50 (43.9)	41 (36)	53 (46)	0.94
Hyperlipidemia [n (%)]	78 (69.6)	78 (68.4)	84 (73.7)	84 (73.5)	0.38
Hypertension [n (%)]	50 (44.1)	53 (46.5)	52 (45.61)	63 (55.9)	0.16
Family history of CVD [n (%)]	58 (51.8)	45 (39.5)	62 (54.1)	64 (56.14)	0.21
Intermediate pattern					
Age (y)	60.14±8.82	59.82 ± 9.22	59.70 ± 8.14	59.20 ± 9.26	**0.002**
Male [n (%)]	72 (64.3)	75 (65.8)	87 (76.1)	100 (87.7)	**< 0.001**
Body mass index (kg/m^2)	27.65 ± 4.37	28.03 ± 4.05	27.05 ± 3.58	27.02 ± 3.91	0.17
Current smoker [n (%)]	28 (25)	38 (33.3)	43 (37.7)	52 (45.6)	**0.001**
Current drinker [n (%)]	9 (8.1)	13 (11.4)	21 (18.4)	20 (17.5)	**0.016**
High education level[3] [n (%)]	17 (15.2)	12 (10.5)	16 (14.1)	23 (20.2)	**0.003**
Diabetic [n (%)]	57 (44.6)	52 (45.6)	49 (42.9)	33 (29.1)	**0.001**
Hyperlipidemic [n (%)]	90 (79.1)	79 (69.2)	75 (65.8)	79 (69.1)	**0.037**
Hypertensive [n (%)]	59 (53.1)	58 (50.9)	55 (48.3)	45 (39.4)	**0.039**
Family history of CVD [n (%)]	52 (46.4)	57 (50)	54 (47.0)	66 (57.8)	0.13
Neo-traditional pattern					
Age (y)	59.82 ± 7.83	59.66 ± 9.49	59.18 ± 9.23	57.34 ± 9.15	0.13
Male [n (%)]	68 (60.71)	72 (63.2)	94 (82.5)	100 (87.6)	**< 0.001**
Body mass index (kg/m^2)	28.24 ± 3.95	27.83 ± 3.97	27.19 ± 4.22	27.44 ± 3.99	**0.005**
Current smoker [n (%)]	24 (21.4)	34 (30.1)	42 (36.8)	60 (52.6)	**< 0.001**
Current drinker [n (%)]	11 (9.82)	13 (11.4)	19 (16.6)	20 (17.5)	0.07
High education level[3] [n (%)]	20 (17.9)	14 (12.3)	14 (12.3)	19 (16.6)	0.19
Diabetic [n (%)]	79 (70.5)	62 (54.4)	30 (26.3)	20 (17.7)	**< 0.001**
Hyperlipidemic [n (%)]	91 (81.4)	85 (74.6)	75 (65.8)	71 (62.3)	**< 0.001**
Hypertensive [n (%)]	65 (58.1)	50 (44.2)	56 (49.1)	45 (39.5)	**0.016**
Family history of CVD [n (%)]	52 (46.4)	57 (50)	60 (52.6)	57 (50)	0.54
Western pattern					
Age (y)	59.98 ± 9.04	61.57 7.87	58.28 ± 8.70	56.16 ± 9.43	**< 0.001**
Male [n (%)]	70 (62.5)	78 (68.4)	85 (74.6)	101 (88.5)	**< 0.001**
Body mass index (kg/m^2)	28.16 ± 4.38	27.51 ± 4.27	27.09 ± 3.88	26.97 ± 3.28	0.11
Current smoker [n (%)]	23 (20.5)	34 (29.8)	43 (37.7)	60 (52.7)	**< 0.001**
Current drinker [n (%)]	10 (8.6)	15 (13.3)	16 (14.1)	22 (19.3)	**0.025**
High education level[3] [n (%)]	17 (15.3)	15 (13.3)	17 (15)	18 (15.8)	**0.04**
Diabetic [n (%)]	60 (53.6)	54 (47.4)	39 (34.2)	38 (33.6)	**< 0.001**
Hyperlipidemic [n (%)]	89 (79.5)	81 (71.1)	75 (65.8)	78 (68.4)	**0.037**
Hypertensive [n (%)]	58 (51.8)	56 (49.1)	57 (50.0)	46 (40.1)	0.096
Family history of CVD [n (%)]	50 (44.6)	50 (43.9)	64 (56.1)	63 (55.4)	**0.04**
Semi-Mediterranean pattern					
Age (y)	60.03 ± 9.37	60.61 ± 8.40	58.29 ± 8.91	57.06 ± 8.86	**0.011**
Male [n (%)]	79 (70.8)	75 (65.8)	83 (73)	96 (83.9)	**0.023**
Body mass index (kg/m^2)	27.43 ± 4.33	27.29 ± 3.93	27.76 ± 3.93	27.27 ± 3.8	0.78
Current smoker [n (%)]	25 (22.3)	34 (29.8)	45 (39.5)	56 (49.1)	**< 0.001**
Current drinker [n (%)]	13 (11.6)	11 (9.4)	18 (15.8)	22 (19.3)	**0.048**
High education level[3] [n (%)]	17 (15.2)	9 (8)	18 (15.8)	24 (21.1)	0.15
Diabetic [n (%)]	53 (47.9)	51 (44.7)	42 (36.5)	47 (41.1)	0.21
Hyperlipidemic [n (%)]	82 (73.2)	81 (71.1)	79 (69.3)	80 (70.5)	0.59
Hypertensive [n (%)]	56 (49.1)	61 (53.5)	47 (41.2)	54 (47.3)	0.22
Family history of CVD (%)	54 (48.2)	66 (57.9)	56 (49.1)	51 (44.6)	0.36

[1]Data are means ± SD unless indicated; [2]From ANOVA for quantitative variables and Chi-square for qualitative variables; [3]High educational levels was defined based on education more than 12 years educational attainment.

Table 4. Energy and nutrient intakes of participants according to dietary pattern score quartiles

Variables	Dietary pattern score quartiles					
	Men			Women		
	1st Quartile	4th Quartile	*P*-value	1st Quartile	4th Quartile	*P*-value*
	(n = 112)	(n = 114)		(n = 112)	(n = 114)	
Healthy pattern						
Energy (kcal)	2599.77 ± 95.64	3502.71 ± 166.87	**< 0.001**	2863.77 ± 399.57	2657.08 ± 180.66	0.64
Carbohydrates (g)	398.81 ± 16.37	540.98 ± 26.32	**< 0.001**	440.93 ± 72.90	404.40 ± 34.01	0.64
Protein (g)	94.31 ± 4.13	126.98 ± 6.24	**< 0.001**	103.27 ± 12.51	97.79 ± 5.78	0.68
Fat (g)	75.58 ± 3.49	101.38 ± 6.23	**< 0.001**	83.36 ± 10.62	79.82 ± 5.00	0.76
Saturated fat (g)	27.55 ± 1.15	38.88 ± 2.41	**< 0.001**	35.02 ± 4.92	32.14 ± 2.08	0.58
Monounsaturated fat (g)	29.76 ± 1.45	38.64 ± 2.38	**0.002**	29.88 ± 3.62	29.59 ± 2.15	0.94
Polyunsaturated fat (g)	18.48 ± 1.05	24.5 ± 1.42	**0.001**	18.29 ± 2.25	17.65 ± 1.39	0.81
Cholesterol (g)	243.28 ± 14.66	320.12 ± 26.25	**0.01**	283.72 ± 44.63	249.09 ± 18.72	0.46
Fiber (g)	32.88 ± 1.66	49.08 ± 2.44	**< 0.001**	37.65 ± 5.91	38.38 ± 3.13	0.91
Intermediate pattern						
Energy (kcal)	2700.58 ± 126.63	3228.74 ± 152.38	**0.008**	2175.58 ± 137.08	3071.91 ± 293.12	**0.013**
Carbohydrates (g)	410.67 ± 21.82	499.41 ± 23.67	**0.008**	316.01 ± 20.37	493.40 ± 50.91	**< 0.001**
Protein (g)	97.70 ± 4.91	113.39 ± 5.56	**0.036**	80.50 ± 4.45	106.03 ± 8.94	**0.02**
Fat (g)	80.73 ± 4.16	94.59 ± 5.90	0.057	72.27 ± 6.23	82.08 ± 9.39	0.39
Saturated fat (g)	31.60 ± 1.65	35.74 ± 2.21	0.15	27.73 ± 2.06	32.55 ± 4.13	0.31
Monounsaturated fat (g)	30.40 ± 1.65	37.67 ± 2.40	**0.014**	26.02 ± 2.29	31.62 ± 3.93	0.23
Polyunsaturated fat (g)	16.85 ± 0.99	23.54 ± 1.33	**< 0.001**	14.97 ± 1.63	20.76 ± 2.72	0.08
Cholesterol (g)	258.01 ± 15.96	308.08 ± 24.09	0.085	223.87 ± 18.88	251.74 ± 31.50	0.45
Fiber (g)	33.65 ± 1.62	45.72 ± 2.34	**< 0.001**	28.24 ± 1.77	41.14 ± 5.06	**0.03**
Neo-traditional pattern						
Energy (kcal)	2480.98 ± 101.84	3312.88 ± 156.20	**< 0.001**	2723.69 ± 309.96	3016.06 ± 252.06	0.46
Carbohydrates (g)	381.22 ± 18.72	505.83 ± 24.16	**< 0.001**	428.94 ± 58.60	432.16 ± 46.54	0.96
Protein (g)	95.20 ± 4.08	113.62 ± 5.51	**0.008**	104.19 ± 10.10	107.31 ± 7.77	0.81
Fat (g)	70.59 ± 3.32	100.92 ± 6.07	**< 0.001**	72.98 ± 5.90	103.29 ± 6.82	**0.002**
Saturated fat (g)	26.08 ± 1.13	38.95 ± 2.43	**< 0.001**	28.66 ± 2.53	41.53 ± 3.32	**0.004**
Monounsaturated fat (g)	26.96 ± 1.34	38.84 ± 2.43	**< 0.001**	26.85 ± 2.38	38.18 ± 3.14	**0.007**
Polyunsaturated fat (g)	18.20 ± 1.16	22.53 ± 1.33	**0.015**	19.19 ± 2.35	21.55 ± 2.15	0.46
Cholesterol (g)	217.18 ± 14.01	335.33 ± 23.97	**< 0.001**	231.08 ± 27.19	375.10 ± 44.62	**0.01**
Fiber (g)	36.56 ± 2.19	41.70 ± 2.13	0.095	40.46 ± 4.98	36.50 ± 4.14	0.54
Western pattern						
Energy (kcal)	2650.61 ± 116.52	3262.07 ± 145.89	**0.001**	2453.23 ± 246.75	2746.38 ± 254.50	0.41
Carbohydrates (g)	415.83 ± 20.76	488.54 ± 22.65	**0.019**	376.63 ± 43.92	416.21 ± 44.58	0.53
Protein (g)	98.28 ± 4.76	115.34 ± 5.32	**0.018**	92.00 ± 7.68	92.33 ± 9.44	0.97
Fat (g)	73.10 ± 3.43	101.95 ± 5.71	**< 0.001**	71.16 ± 6.28	85.04 ± 10.58	0.27
Saturated fat (g)	28.27 ± 1.35	38.50 ± 2.18	**< 0.001**	27.72 ± 2.55	33.86 ± 4.37	0.24
Monounsaturated fat (g)	28.42 ± 1.39	39.32 ± 2.32	**< 0.001**	25.99 ± 2.30	32.29 ± 3.91	0.18
Polyunsaturated fat (g)	16.93 ± 0.94	22.64 ± 1.29	**< 0.001**	16.52 ± 1.51	18.62 ± 2.47	0.47
Cholesterol (g)	232.83 ± 16.59	345.71 ± 23.35	**< 0.001**	242.44 ± 30.71	257.02 ± 37.98	0.76
Fiber (g)	37.86 ±2.13	41.51 ± 2.06	0.22	33.30 ± 3.10	31.71 ± 4.07	0.75
Semi-Mediterranean pattern						
Energy (kcal)	2468.28 ± 92.21	3136.39 ± 137.27	**< 0.001**	2461.03 ± 167.47	2880.30 ± 282.65	0.18
Carbohydrates (g)	370.98 ± 15.30	479.62 ± 21.79	**< 0.001**	374.84 ± 26.90	449.26 ± 45.36	0.16
Protein (g)	92.49 ± 3.37	110.74 ± 47.50	**0.003**	89.80 ± 4.72	98.77 ± 8.72	0.37
Fat (g)	74.86 ± 3.50	94.08 ± 5.24	**0.003**	74.46 ± 7.57	85.66 ± 11.74	0.42
Saturated fat (g)	29.14 ± 1.47	35.23 ± 2.02	**0.016**	27.82 ± 2.45	34.68 ± 6.14	0.31
Monounsaturated fat (g)	28.33 ± 1.36	36.31 ± 2.00	**0.001**	27.35 ± 2.70	32.04 ±16.91	0.338
Polyunsaturated fat (g)	16.80 ± 0.92	22.48 ± 1.24	**< 0.001**	17.89 ± 2.14	18.16 ±8.12	0.52
Cholesterol (g)	243.11 ± 14.27	307.50 ± 22.76	**0.018**	217.99 ± 17.86	241.15 ± 35.71	0.56
Fiber (g)	34.60 ± 1.64	41.06 ± 2.20	**0.02**	34.31 ±2.29	41.60 ±4.68	0.17

* Dietary intake of energy and nutrients are adjusted for sex and age. The statistical test was ANCOVA.

Table 5. Comparison of biochemical parameters of participants according to quartiles of dietary pattern score.

Variables	Dietary pattern score quartiles					
	Men			Women		
	1st Quartile	4th Quartile	*P*-value	1st Quartile	4th Quartile	*P*-value*
Healthy pattern	**(n = 112)**	**(n = 114)**		**(n = 112)**	**(n = 114)**	
Hb A_1C (%)	6.16 ± 0.22	6.10 ± 0.24	0.85	6.38 ± 0.24	6.32 ± 0.24	0.85
LDL (mg/dL)	90.43 ± 3.82	77.30 ± 3.18	**0.009**	94.03 ± 6.92	92.09 ± 8.56	0.86
HDL (mg/dL)	39.76 ± 0.79	39.46 ± 1.14	0.83	40.48 ± 1.47	46.35 ± 1.54	**0.008**
TC (mg/dL)	160.17 ± 4.44	149.74 ± 3.90	**0.05**	179.46 ± 13.00	173.89 ±8.62	0.71
TG (mg/dL)	166.23 ± 8.07	178.93 ± 11.29	0.36	191.09± 14.22	179.22 ± 13.89	0.55
HCT (%)	43.33 ± 0.42	42.71 ± 0.58	0.39	40.35 ± 0.71	39.65 ± 0.56	0.44
Albumin (g/dl)	4.69 ± 0.35	4.67 ± 0.32	0.73	4.60 ± 0.068	4.58 ± 0.04	0.81
Creatinine (mg/dL)	1.37 ± 0.03	1.47 ± 0.036	**0.01**	1.13 ± 0.036	1.15 ±0.036	0.78
CRP (mg/dL)	7.43 ± 0.62	6.57 ± 0.41	0.25	6.87 ± 1.21	7.44 ± 1.27	0.75
Intermediate pattern						
Hb A_1C (%)	5.91 ± 0.20	6.08 ± 0.20	0.59	6.70 ± 0.24	5.92 ± 0.50	0.18
LDL (mg/dL)	85.16 ± 5.92	84.65 ± 5.00	0.93	99.19 ± 6.70	111.13 ± 11.25	0.37
HDL (mg/dL)	39.72 ± 0.91	39.40 ±1.00	0.83	44.88 ± 1.50	44.27 ± 2.00	0.83
TC (mg/dL)	154.66 ± 4.43	155.51 ± 4.68	0.89	186.34 ± 0.09	183.06 ± 11.60	0.83
TG (mg/dL)	149.85 ± 7.07	179.83 ± 11.33	**0.04**	189.85 ± 10.87	139.97 ± 10.67	**0.002**
HCT (%)	43.85 ± 0.41	42.55 ± 0.37	**0.02**	39.88 ± 0.45	40.50 ± 0.53	0.38
Albumin (g/dl)	4.62 ± 0.04	4.68 ± 0.03	0.26	4.62 ± 0.05	4.68 ± 0.08	0.56
Creatinine (mg/dL)	1.39 ± 0.04	1.34 ± 0.019	0.30	1.11 ± 0.03	1.06 ± 0.05	0.44
CRP (mg/dL)	7.16 ± 0.65	6.89 ± 0.42	0.72	6.29 ± 0.34	8.36 ± 2.66	0.20
Neo-traditional pattern						
Hb A_1C (%)	6.31 ± 0.25	6.13 ± 0.20	0.57	6.60± 0.23	6.20 ± 0.45	0.44
LDL (mg/dL)	86.59 ± 6.76	82.49 ± 3.21	0.58	90.46 ± 6.04	77.43 ± 11.82	0.34
HDL (mg/dL)	38.92 ± 0.96	38.81 ± 0.98	0.94	44.08 ± 1.39	46.43 ± 1.87	0.38
TC (mg/dL)	153.79 ± 5.86	154.51 ± 3.99	0.91	174.63 ± 7.72	153.57 ± 12.21	0.15
TG (mg/dL)	167.04 ± 9.68	190.82 ± 12.33	0.13	188.92 ± 11.57	150.36 ± 18.51	0.09
HCT (%)	42.94 ± 0.55	44.21 ± 1.04	0.28	39.67 ± 0.50	38.30 ± 0.93	0.21
Albumin (g/dl)	4.65 ± 0.04	4.69 ± 0.03	0.46	4.62 ± 0.055	4.62 ± 0.08	0.96
Creatinine (mg/dL)	1.37 ± 0.03	1.34 ± 0.02	0.557	1.12 ± 0.03	1.14 ± 0.07	0.79
CRP (mg/dL)	6.33 ± 5.94	6.99 ± 0.43	0.37	6.84 ± 0.80	7.22 ± 2.54	0.88
Western pattern						
Hb A_1C (%)	5.85 ± 0.23	6.29 ± 0.21	0.15	6.17± 0.20	6.20 ± 0.56	0.97
LDL (mg/dL)	85.77 ± 3.71	86.99 ± 3.94	0.82	90.38 ± 5.20	102.89 ± 18.10	0.51
HDL (mg/dL)	38.45 ±1.00	39.11 ± 0.97	0.64	44.12 ±1.26	41.21 ± 2.15	0.25
TC (mg/dL)	156.08 ±4.56	161.64 ± 4.79	0.40	176.49± 7.23	175.07 ± 17.94	0.94
TG (mg/dL)	156.77 ± 8.66	200.44 ± 12.55	**0.005**	195.12 ± 12.77	156.96 ± 22.53	0.15
HCT (%)	42.67 ± 0.61	43.75 ± 1.03	0.37	40.46± 0.45	39.94 ± 0.94	0.62
Albumin (g/dl)	4.64 ± 0.04	4.72 ± 0.03	0.16	4.58 ± 0.05	4.63 ± 0.08	0.66
Creatinine (mg/dL)	1.36 ± 0.03	1.37 ± 0.02	0.84	1.12± 0.02	1.10 ± 0.05	0.71
CRP (mg/dL)	6.81 ± 0.49	6.83 ±0.41	0.98	8.18 ± 1.86	8.30 ± 2.91	0.97
Semi-Mediterranean pattern						
Hb A_1C (%)	6.20 ± 0.22	6.04 ± 0.18	0.59	5.61 ± 0.19	6.52 ± 0.41	0.06
LDL (mg/dL)	83.94 ± 4.38	80.58± 4.56	0.60	102.61 ± 8.73	99.80 ± 10.02	0.84
HDL (mg/dL)	39.66 ±0.85	37.87 ±1.01	0.17	46.07 ± 1.62	45.03 ± 1.78	0.98
TC (mg/dL)	156.12 ± 5.10	148.11 ± 3.73	0.21	182.74 ± 9.49	195.27 ± 19.61	0.57
TG (mg/dL)	161.20 ± 8.02	187.87 ± 10.45	**0.045**	172.32 ± 9.85	190.42 ± 20.13	0.42
HCT (%)	43.61 ± 0.36	43.12 ± 0.45	0.41	40.13 ± 0.54	39.93 ± 0.63	0.81
Albumin (g/dl)	4.65± 0.04	4.67 ± 0.02	0.63	4.63 ± 0.06	4.58 ± 0.06	0.57
Creatinine (mg/dL)	1.33 ± 0.02	1.36 ±0.02	0.56	1.14 ± 0.03	1.11 ± 0.03	0.52
CRP (mg/dL)	6.13 ± 0.19	6.32 ± 0.55	0.44	6.87 ± 0.38	5.80 ± 0.38	**0.05**

*Biochemical variables are adjusted for age. The statistical test was ANCOVA; LDL: low density lipoprotein cholesterol; HDL: high density lipoprotein cholesterol; TC: total cholesterol; TG: triglyceride; HCT: hematocrit; BUN: blood urea nitrogen; CRP: C- reactive protein.

identical to our healthy dietary pattern. Patients in the top quartile of prudent pattern were less likely to be male and had a higher educational attainment similar to our findings. Similar results were also reported in the Fung study,[24] evaluating the association between dietary patterns and risk of coronary artery disease (CAD) in women and found a lower risk of CAD among patients of higher quartiles of the prudent pattern high in fruits, vegetables, legumes and whole grains after 12 years follow-up. Interestingly, our patients in the top quartile of healthy pattern had a lower serum LDL and TC and higher HDL concentrations. These findings were in agreement with our previous report in patients with metabolic syndrome,[25] as well as previous findings by Esmailzadeh[26] and Gadgil[27] reporting the lower prevalence of metabolic syndrome components and lower LDL concentrations in top quartiles of healthy patterns in the general population. Additionally, men in top quartiles of healthy pattern had also higher serum creatinine concentrations. This might be attributed to a higher muscular mass in men rather than women.[28]

Unlike the healthy dietary pattern, semi-Mediterranean dietary pattern, which was high in fruit, dried fruit, yellow vegetable and other vegetables, nuts and olive was associated with more probability of being male, higher prevalence of smoking and drinking and low CRP concentrations in women against higher TG concentrations in men. Mediterranean diet, which is characterized by the use of olive oil, as the major source of fat, abundance of fruit and vegetables, and a moderate consumption of fish is associated with lower incidence of cardiovascular disease and myocardial infarction as well as reduction of all cause and cause-specific mortality.[29,30] Numerous previous evidences suggest the protective role of Mediterranean diet against developing diabetes.[31,32] The major protective characteristics of this diet is higher content of fiber and monounsaturated fatty acids, a lower content of saturated fatty acid, which improves lipid profile, glycemic load and promotes insulin sensitivity.[33] The unexpected finding of high TG concentrations in males of top quartiles of semi- Mediterranean pattern might be attributed to higher smoking habits in top quartiles of this pattern as confirmed in previous researches.[34] Higher number of men compared with women in top quartiles is in parallel of higher smoking habits. Previous findings by Haglin[35] also highlighted the higher serum TG concentrations in smoker men with type 2 diabetes. This relationship between smoking and serum TG also existed after adjusting for confounding effects of age and other CVD risk factors.

Consistent with our report, Nettleton, et al.[36] reported an inverse relationship between fruits, nuts and pattern of green leafy vegetables with CRP concentrations. They also reported an inverse relationship between vegetable and fish pattern with serum IL-6 concentrations.

CAD and atherosclerosis are all inflammatory process and CRP has been proposed as a potential tool in the prediction of coronary artery disease.[37,38] This implies that measures designed to reduce the inflammatory process could reduce the risk of CAD. Numerous studies have evaluated the role of the traditional Mediterranean diet in protecting against inflammation and coagulation process. In a study by Chrysohoou, et al. participants in the highest quartile of the Mediterranean diet had 20% lower CRP levels ($P = 0.015$) as compared to participants in the lowest quartile.[39] In another study by Richard,[40] Mediterranean diet reduced CRP concentrations by 26.1% in patients with metabolic syndrome even without weight loss. In our analysis,the intermediate pattern that was high in fish and other sea products, fresh fruit juice and vegetable oils was associated with lower prevalence of diabetes, hyperlipidemia, hypertension and higher smoking and drinking habits. The major component of this pattern with high matrix loading factor was fish and sea products high in ω-3 poly-unsaturated fatty acids and numerous evidences has confirmed their protective role in the risk of type two diabetes and other chronic disease.[41] Accordingly, women had lower serum TG concentrations as expected, while men had higher TG concentrations. Again,this could be attributed to higher smoking habits in men of the intermediate pattern. Another possible contributing factor in high TG concentrations in this pattern is a high consumption of sweets and desserts in this pattern as the major differentiating factor from semi-Mediterranean pattern.

The neo-traditional pattern with the major contributors including butter, refined grains, hydrogenated fats, doogh and kashk was associated with a higher BMI and a lower incidence of diabetes and hypertension. Doogh and kashkare low fat dairy product used in the Iranian dietary style. The high calcium content of dairy products could be partly accounted for the observed lower risk of hypertension in this dietary pattern; numerous evidences are in accordance with these findings.[42,43] Same as our findings, these studies also found the protective role of low-fat dairy products but not high fat dairies. Alonso[42] suggested that probably higher saturated fat content of high fat dairy products may neutralize the beneficial effect of dairy consumption.Therefore, foods that are high in fat, such as whole-fat dairy foods, might hinder calcium absorption via increasing saponification rate of calcium and therefore reducing the bioavailability of calcium. Several possible mechanisms are higher angiotensin converting enzyme inhibitory peptides in milk proteins such as caseins and whey proteins, which have been shown to significantly reduce blood pressure in animal models.[44] Accordingly, high BMI in top quartiles of this pattern can also be attributed to anti-adipogenic effects of high calcium intakes by increasing adipose tissue, intracellular calcium concentrations, and inhibiting lipogenesis.[45–47]

High serum concentrations of TG were also a feature of the top quartile of the western pattern. Western pattern high in processed, red and organ meats, egg and high-fat dairy products are known dietary risk factors for increase TG and inducing dyslipidemia in diverse populations.[48]

Our findings regarding the association of biochemical parameters with dietary patterns were different in two genders. Baseline values of biochemical risk factors, including: obesity, hypertension, hypercholestrolemia and diabetes were more prevalent among women.[19] These gender differences influenced their association with dietary patterns. The frequency and characteristics of the risk factors among women with coronary disease seem different from those of men. In fact, women are more likely to have modifiable risk factors that are related to life habits, such as obesity and physical inactivity.[49–51] Moreover, we have shown previously that their self-concept of health as reflected by the quality of life is poor compared to men with CAD.[52]

The current study also has several limitations. We did not evaluate the physical activity and its relationship with dietary patterns and study parameters. Thus, further studies are warranted to evaluate effects of gender difference in the relationship between physical activity and dietary patterns. Moreover, we did not know the dietary patterns of our patients before being candidates of CABG. Therefore, we cannot precisely claim that their current dietary pattern is different from the pattern they followed before becoming patient or not.

In conclusion, the results of this study provide evidence of the potential protective role of healthy pattern and semi-Mediterranean dietary pattern in men and women awaiting coronary artery bypass graft surgery. These dietary profiles are characterized by higher intake of fruits, vegetables, nuts and olive. On the other hand, higher content of doogh and kash as low-fat dairy products might contribute to lower prevalence of hypertension and diabetes in neo-traditional dietary pattern. These findings need to be supported by further prospective studies and to more clarify gender differences in the association between dietary habits and lifestyle schedule with CAD risk factors.

Author's Contribution

Dr. Mahdieh Abbasalizad Farhangi has written the first draft of the manuscript and was involved in data analysis, Dr. Asal Ataie-Jafari was involved in project designing and data collection, Dr. Mahdi Najafi was the main investigator who designed the research, supervised the work and helped in recruitment, data collection and clinical assessment and revised the first draft of the paper, Dr. Gholamreza Sarami Foroushani helped in statistics, Dr. Mohammadreza Mohajeri Tehrani and Dr. Leila Jahangiry were involved in data analysis and interpretation.

Conflict of interest

The authors declare that there is no conflict of interest.

Funding

This work was supported by Tehran University of Medical Sciences.

References

1. World Health Organization multinational monitoring of trends and determinants in cardiovascular disease (MONICA) project: Myocardial infarction and coronary deaths in the World Health Organization. *Circulation*. 1994; 90: 583 – 612.
2. Ministry of Health and Medical Education. Report of the 3rd evaluation of health–for–all strategies up to 2000. Tehran, Ministry of Health and Medical Education, 2000.
3. Sokhanvar S, Khoshi A, Hajiaghaei S, Mousavinasab SN, Olmohammadi Z: Association between Apo lipoprotein B levels at admission of patientsand short–term morbidity and mortality after myocardial infarction. *J Cardiovas Thorac Res*. 2012; 4(3): 61 – 64.
4. Kerver JM, Yang EJ, Bianchi L, Song WO: Dietary patterns associated with risk factors for cardiovascular disease in healthy US adults. *Am J Clin Nutr*. 2003; 78: 1103 – 1110.
5. Hirotani T, Kameda T, Kumamoto T, Shirota S, Yamano M. Coronary artery bypass grafting in patients with cerebrovascular disease. *Ann Thorac Surg*. 2000; 70: 1571 – 1576.
6. Head SJ, Kieser TM, Falk V, Huysmans HA, Kappetein AP. Coronary artery bypass grafting: Part 1–the evolution over the first 50 years. *Eur Heart J*. 2013; 34 (37): 2862 – 2872.
7. Jacobs DR Jr , Murtaugh MA: It's more than an apple a day: an appropriately processed, plant – centered dietary pattern may be good for your health. *Am J Clin Nutr*. 2000; 72: 899 – 900.
8. Hu FB: Dietary pattern analysis: a new direction in nutritional epidemiology. *Curr Opin Lipidol*. 2002; 13: 3 – 9.
9. Diehr P , Beresford SA: The relation of dietary patterns to future survival, health, and cardiovascular events in older adults. *J Clin Epidemiol*. 2003; 56: 1224 – 1235.
10. Millen BE, Quatromoni PA, Nam BH, O'Horo CE, Polak JF, Wolf PA, et al. Dietary patterns, smoking, and subclinical heart disease in women: opportunities for primary prevention from the Framingham Nutrition Studies. *J Am Diet Assoc*. 2004; 104: 208 – 214.
11. Panagiotakos D, Pitsavos C, Chrysohoou C, Palliou K, Lentzas I, Skoumas I, et al. Dietary patterns and 5–year incidence of cardiovascular disease: a multivariate analysis of the ATTICA study. *Nutr Metab Cardiovasc Dis*. 2009; 19(4): 253 – 263.
12. Osler M, Helms Andreasen A, Heitmann B, Hoidrup S, Gerdes U, Morch Jorgensen L, et al. Food intake patterns and risk of coronary heart disease: a prospective cohort study examining the use of traditional scoring techniques. *Eur J Clin Nutr*. 2002; 56: 568 – 574.
13. Bahadoran z, Mirmiran P, Azizi F. Fast food pattern and cardiometabolic disorders: A review of current studies. *HPP*. 2015; 5(4): 231 – 240.
14. Millen BE, Quatromoni PA, Pencina M, Kimokoti R, Nam BH, Cobain S, et al. Unique dietary patterns and chronic disease risk profiles of adult men: the Framingham nutrition studies. *J Am Diet Assoc*. 2005; 105(11): 1723 – 1734.
15. Lorgeril M, Salen P, Martin JL, Monjaud I, Delaye J, Mamelle N. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. *Circulation*. 1999; 99(6): 779 – 785.
16. Niebauer J, Hambrecht R, Schlierf G, Marburger C, Kalberer B, Kubler W, et al. Five years of physical exercise and low fat diet: effects on progression of coronary artery disease. *J Cardiopulm Rehabil*. 1995; 15: 47 – 64.
17. Lockheart MS, Steffen LM, Rebnord HM, Fimreite RL, Ringstad J, Thelle DS, et al: Dietary patterns, food groups and myocardial infarction: A case–control study. *Br J Nutr*. 2007; 98(2): 380 – 387.
18. Ma Y, Li W, Olendzki BC, Pagoto SL, Merriam PA, Chiriboga DE, et al. Dietary quality 1 year after diagnosis of coronary heart disease. *J Am Diet Assoc*. 2008; 108(2): 240 – 246.
19. Najafi M , Sheikhvatan M: Gender differences in coronary artery disease: Correlational study on dietary pattern and known cardiovascular risk factors. *Int Cardiovasc Res J*. 2013; 7(4): 124 – 129.
20. Ghaffarpour M, Houshiar–Rad A, Kianfar H, The manual for household measures, cooking yields factors and edible portion of foods (In Persian). 1999, Tehran, Iran: Keshaverzi Press.
21. Asghari G, Rezazadeh A, Hosseini–Esfahani F, Mehrabi Y, Mirmiran P, Azizi F. Reliability, comparative validity and stability of dietary patterns derived from an FFQ in the Tehran Lipid and Glucose Study. *Br J Nutr*. 2012; 108(6): 1109 – 1117.
22. Kim JO, Mueller CW. Factor Analysis: Statistical Methods and Practical Issues (Quantitative Applications in the Social Sciences). 1978: Sage Publications.
23. Iqbal R, Anand S, Ounpuu S, Islam S, Zhang X, Rangarajan S, et al. Dietary patterns and the risk of acute myocardial infarction in 52 countries results of the INTERHEART study. *Circulation*. 2008; 118(19): 1929 – 1937.
24. Fung T, Willett W, Stampfer M, Manson J, Hu F. Dietary patterns and the risk of coronary heart disease in women. *Arch Intern Med*. 2001; 161(15): 1857 – 1862.
25. Farhangi MA, Jahangiry L, Asghari–Jafarabadi M, Najafi M. Association between dietary patterns and metabolic syndrome in a sample of Tehranian adults. *Obes Res Clin Prac*. 2015; In Press. doi:10.1016/j.orcp.2015.05.011
26. Esmaillzadeh A, Kimiagar M, Mehrabi Y, Azadbakht L, Hu F, Willett W. Dietary patterns, insulin resistance, and prevalence of the metabolic syndrome in women. *Am J Clin Nutr*. 2007; 85: 910 – 918.
27. Gadgil MD, Anderson CM, Kandula NR, Kanaya AM. Dietary patterns in Asian Indians in the United States: An analysis of the metabolic syndrome and atherosclerosis in south Asians living in America study. *J Acad Nutr Diet*. 2014; 114(2): 238 – 243.
28. Baxmann AC, Ahmed MS, Marques NC, Menon VB, Pereira AB, Kirsztajn GM, et al. Influence of muscle mass and physical activity on serum and urinary creatinine and serum cystatin C. *Clin J Am Soc Nephrol*. 2008; 3(2): 348 – 354.
29. Barzi F, Woodward M, Marfisi RM, Tavazzi L, Valagussa F, Marchioli R: Mediterranean diet and all–causes mortality after myocardial infarction: results from the GISSI Prevenzione trial. *Eur J Clin Nutr*. 2003; 57: 604 – 611.
30. Mitrou PN, Kipnis V, Thiebaut AC, Reedy J, Subar AF, Wirfalt E, et al. Mediterranean dietary pattern and prediction of all–cause mortality in a us population: Results from the nih–aarp diet and health study. *Arch Intern Med*. 2007; 167(22): 2461 – 2468.

31. Martinez-Gonzalez M, Fuente–Arrillaga C, Nunez–Cordoba JM, Basterra–Gortari FJ, Beunza JJ, Vazquez Z, et al. Adherence to Mediterranean diet and risk of developing diabetes: prospective cohort study. *BMJ*. 2008; 336(7657): 1348 – 1351.
32. Panagiotakos DB, Pitsavos C, Arvaniti F, Stefanadis C. Adherence to the Mediterranean food pattern predicts the prevalence of hypertension, hypercholesterolemia, diabetes and obesity, among healthy adults; the accuracy of the Med Diet Score. *Prev Med*. 2007; 44(4): 335 – 340.
33. Garg A: High monounsaturated–fat diets for patients with diabetes mellitus: a meta–analysis. *Am J Clin Nutr*. 1998; 67(suppl): 577 – 582.
34. Wakabayashi I: Associations of alcohol drinking and cigarette smoking with serum lipid levels in healthy middle–aged men. *Alcohol*. 2008; 43(3): 274 – 280.
35. Haglin LM, Törnkvist B, Bäckman LO. High serum phosphate and triglyceride levels in smoking women and men with CVD risk and type 2 diabetes. *Diabetol Metab Syndr*. 2014; 6: 39 – 46.
36. Nettleton JA, Steffen LM, Mayer–Davis EJ, Jenny NS, Jiang R, Herrington DM, et al. Dietary patterns are associated with biochemical markers of inflammation and endothelial activation in the multi–ethnic Study of atherosclerosis (MESA). *Am J Clin Nutr*. 2006; 83(6): 1369 – 1379.
37. Ridker PM, Hennekens CH, Buring JE, Rifai N. C–reactive protein and other markers of inflammation in the prediction of cardiovascular disease in women. *NEJM*. 2000; 342(12): 836 – 843.
38. Khatibi FK, Yaghoubi A, Zarghami N, Rahbani M, Babaie H. Evaluation of hs–CRP, antioxidant markers and MDA in patients of coronary artery disease (CAD) containing non–amokers and non–diabetics. *J Cardiovasc Thorac Res*. 2011; 2 (4): 13 – 18.
39. Chrysohoou C, Panagiotakos DB, Pitsavos C, Das UN, Stefanadis C. Adherence to the mediterranean diet attenuates inflammation and coagulation process in healthy adults: The ATTICA study. *Journal of the American College of Cardiology*. 2004; 44(1): 152 – 158.
40. Richard C, Couture P, Desroches S, Lamarche B. Effect of the mediterranean diet with and without weight loss on markers of inflammation in men with metabolic syndrome. *Obesity*. 2013; 21(1): 51 – 57.
41. Feskens EJ, Virtanen SM, Rasanen L, Tuomilehto J, Stengard J, Pekkanen J, et al. Dietary factors determining diabetes and impaired glucose tolerance: A 20–year follow–up of the Finnish and Dutch cohorts of the seven countries Study. *Diabetes Care*. 1995; 18(8): 1104 – 1112.
42. Alonso A, Beunza Delgado–Rodraguez M, Martinez JA, Martinez-Gonzalez MA. Low–fat dairy consumption and reduced risk of hypertension: the Seguimiento Universidad de Navarra (SUN) cohort. *Am J Clin Nutr*. 2005; 82(5): 972 – 979.
43. Toledo E, Delgado–Rodraguez M, Estruch R, Salas Salvada J, Corella D, Gomez–Gracia E, et al. Low–fat dairy products and blood pressure: follow–up of 2290 older persons at high cardiovascular risk participating in the PREDIMED study. *BJN*. 2009; 101(01): 59 – 67.
44. FitzGerald RJ, Murray BA, Walsh DJ. Hypotensive peptides from milk proteins. *J Nutr*. 2004; 134: 980S – 988S.
45. Rahimi AO, Mahboob SA, Farhanghi MA: The Effect of vitamin D supplementation on serum 25–Hydroxy vitamin D and parathyroid hormone levels in obese and non obese reproductive age women. *Pharm Sci*. 2009; 15(1): 9 – 16.
46. Astrup A: The role of calcium in energy balance and obesity: the search for mechanisms. *Am J Clin Nutr*. 2008; 88(4): 873 – 874.
47. Farhangi MA, Ostadrahimi A, Mahboob S. Serum calcium, magnesium, phosphorous and lipid profi le in healthy Iranian premenopausal women. *Biochemia Medica*. 2011; 21(3): 312 – 320.
48. Belinova L, Kahleova H, Malinska H. Differential acute postprandial effects of processed meat and isocaloricvegan meals on the gastrointestinal hormone response in subjects suffering from type 2 diabetes and healthy controls: A randomized crossover study. *PLoS One*. 2014; 9(9): e107561.
49. Mosca L, Benjamin EJ, Berra K, Bezanson JL, Dolor RJ, Lloyd–Jones DM, et al. Effectiveness–based guidelines for the prevention of cardiovascular disease in women-2011 update: A guideline from the American heart association. *J Am Coll Cardiol*. 2011; 57(12): 1404 – 1423.
50. Shafayi FS, Akef M, Sadegi H, Niknazhad A. A comparison of physical activity and nutritional practices in hypertensive and non–hypertensive pregnant women. *J Cardiovas Thorac Res*. 2012; 4(2): 53 – 56.
51. Kukreti VT, Bisht AT. Stress and nutritional status of individuals in uttarakhand, Northern India: differential effect of gender. *HPP*. 2013; 3(2): 255 – 260.
52. Najafi M, Sheikhvatan M, Montazeri A. Quality of life–associated factors among patients undergoing coronary artery bypass surgery as measured using the WHOQOL–BREF: Cardiovascular topic. *Cardiovasc J Afr*. 2009; 20(5): 284 – 289.