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ORIGINAL ARTICLE

Dietary intake of patients with angiographically defined coronary artery disease and that of healthy controls in Iran

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OBJECTIVE: The aim of this study was to investigate the relationship between dietary intake and biomarkers of cardiovascular risk in individuals with and without angiographically defined coronary artery disease.
SUBJECTS/METHODS: Coronary angiography was undertaken in 445 individuals who were divided into those with significant disease (>50% occlusion) (Angio+ ($n=273$)) and those with <50% coronary artery occlusion (Angio− ($n=172$)). Apparently healthy, non-symptomatic individuals ($n=443$) were considered as the control group. Dietary intake was assessed using a 24-h dietary recall method and dietary analysis was performed using Diet Plan 6 software.
RESULTS: Concentrations of starch, saturated fatty acids, polyunsaturated fatty acids, magnesium, iron and copper in the control group were less than those in the other groups ($P<0.05$), but after adjusting for total energy intake these differences were no longer apparent. The mean intake of protein, cholesterol, phosphorus, zinc, zinc/copper ratio, selenium, iodine, carotene, vitamin E, niacin, pantothene and pyridoxine was less in the control group compared with the other two groups ($P<0.05$), and the mean of sugar, fiber, transfatty acids, manganese, folate and vitamin C was higher in the control group than in other groups ($P<0.05$). Lipid profile values between the three groups did not differ significantly.
CONCLUSIONS: These results indicate that the amount of intake of various nutrients can be considered as an independent risk factor for CAD. Further research on the relationship between CAD and nutrient intake, especially intake of essential micronutrients, is needed.

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INTRODUCTION

Coronary artery disease (CAD) is the major cause of death, disability and financial burden in developed countries.[1] There is a very high prevalence of CAD in Iran compared with other parts of the world,[2–5] and it has been found that a national program for reducing the risk factors for CAD is essential, based on lifestyle changes including diet.[5]

Determination of the relationship between dietary habits and CAD requires a dietary assessment. Dietary assessment may include a Food Frequency Questionnaire and 24-h dietary recall, with the aim of investigating the role of diet in causing various diseases and improving them in order to prevent these diseases.[6,7] Previous studies have investigated the relationship between diet and the risk for CAD, and the impact of changes in diet on the risk factors of this disease has shown that modification of diet restricts the progress and facilitates the regression of CAD and also modifies the risk factors.[8–10]

However, previous studies have generally compared the effects of overall dietary patterns or change in one or more specific biomarker or nutritional parameters through diet. A more comprehensive approach that attempts to examine all nutritional parameters (macronutrients and their subgroups, minerals and vitamins) and determine the cardiovascular effects of various dietary patterns can provide more useful information about nutritional effects on CAD and its risk factors.[11–13]

The aim of this study was to investigate the association between dietary micronutrients, macronutrients and biomarker risk factors for CAD, including lipid profile, and angiographically defined CAD.

MATERIALS AND METHODS

Subjects

Individuals aged 20–80 years who had undergone coronary angiography were divided into two groups depending on the results of their angiogram: (1) those who were angiogram positive with >50% coronary artery stenosis (Angio+ ($n=273$, 172 men and 101 women) and (2) those who were angiogram negative (Angio− ($n=172$, 63 men and 109 women)). Patients were selected from those referred to the Catheterization section of Cardiology Department of Ghaem Hospital (Mashhad, Iran). Apparently healthy individuals ($n=443$) between 20 and 80 years of age, from the population of Mashhad, formed the control group.

All patients provided informed consent, and participation in the study was approved by the Ethics Committee of the Research Council of Mashhad University of Medical Sciences.

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Demographic and health status assessment

Information on demographic variables (age and gender) and health status (history of cardiovascular disease, hypertension, diabetes, dyslipidemia (total cholesterol >200, triglycerides >150, low-density lipoprotein cholesterol (LDL-C) >130, high-density lipoprotein cholesterol (HDL-C) <40 (for men) and HDL-C <50 (for women)),[14] cerebral vascular accident, smoking, pregnant or lactating status and history of consumption of dietary supplements) was collected using a questionnaire.

Anthropometric assessment

Height (in cm), weight (in kg), body mass index (in kg/m^2), waist circumference (in cm), hip circumference (in cm), demispan (in cm), mid-arm circumference (in cm) and blood pressure (mm Hg) were measured in all subjects. Height, waist circumference, hip circumference, demispan and mid-arm circumference were measured to the nearest millimeter with a tape measure, and weight was measured to the nearest 0.1 kg with electronic scales. Blood pressure was measured by a qualified physician to the nearest millimeter of mercury, using a mercury standard sphygmomanometer, after the patient was asked to remain in the sitting position for at least 15 min.

Laboratory evaluation

Fasting blood sugar was measured using an autoanalyzer. Triglycerides were measured using the routine three-step enzymatic interaction procedure with Trinder end point and total cholesterol using the enzymatic Trinder method. Determination of the levels of HDL-C and LDL-C and study of complete blood count were carried out using the enzymatic method.[15]

Dietary assessment

Dietary intake was assessed by means of a questionnaire that was designed on the basis of a 24-h dietary recall; dietary analysis was performed using Diet Plan 6 software (Forestfield Software Ltd., Horsham, West Sussex, UK), which can analyze macro- and micronutrient intake. A trained interviewer performed face-to-face interviews, and individuals were asked about all foods and beverages that were consumed.

Statistical analysis

Data collected from subjects, including personal, demographic, anthropometric and laboratory specifications and angiographic results, were imported first into a software, which was designed on the basis of the questionnaire, and then into SPSS 11.5 software (SPSS Inc., Champaign, IL, USA), which is a statistical software. Information about nutritional intake was obtained from the 24-h dietary recall and imported into Diet plan 6 software; the final results were added to other data in the SPSS 11.5 software. The independent sample *t*-test, the Mann–Whitney test, one-way analysis of variance and the Tukey, Kruskal–Wallis and χ^2 tests were used to analyze the data. Residual regression was used for adjusting of total energy and the multinominal regression was used for adjusting of other confounding variables. A *P*-value less than 0.05 was considered significant.

RESULTS

The descriptive statistics including the means and standard deviations of confounding variables and their *P*-values are presented in Table 1. In the control group the incidence of hypertension, diabetes and smoking, the mean of waist circumference, demispan, fasting blood sugar, white blood cell and the mean corpuscular volume were significantly lower than those of the other two groups ($P<0.001$). Values of body mass index and mid-arm circumference in the control group were slightly lower than those of the Angio − group ($P<0.037$). Incidence of diabetes and levels of fasting blood sugar and white blood cell count in the Angio − group were less than those of the Angio + group ($P<0.001$).

The lipid profile data values, the mean and standard deviations of macro- and micronutrients and their *P*-values are presented in Tables 2–4. In this study, the mean total energy intake in the control group was less than that of the Angio − and Angio + groups ($P<0.001$). The mean intakes of starch, saturated fatty acids, polyunsaturated fatty acids, magnesium, iron and copper in the control group were less than those of the Angio − and Angio + groups ($P<0.05$); however, after adjusting for total energy intake, significant differences disappeared in all cases ($P>0.05$). In the case of potassium, calcium, thiamine and riboflavin, unadjusted values were significantly lower in the control group compared with the other two groups; there was a decrease in differences after adjusting for energy intake, but no change in significant difference among groups ($P<0.05$).

Table 1. Comparison of the baseline characteristics between the study groups

	Control (N = *443*)	*Angio −* (N = *172*)	*Angio +* (N = *273*)	P	P1	P2	P3
Age (years)	55.98 ± 9.09	53.26 ± 11.52	58.29 ± 10.16	*<0.001*	*0.002*	*0.049*	*<0.001*
Hypertension	19%	35.1%	42.9%	*<0.001*	*<0.001*	*<0.001*	0.169
Diabetes	2. %5	20.9%	34.1%	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Dyslipidemia	65.01%	53.5%	52.4%	*<0.001*	*0.017*	*<0.001*	0.260
Statin user	0%	40%	45%	*<0.001*	*<0.001*	*<0.001*	0.306
Smoking	18.6%	28.5%	35.5%	*<0.001*	*0.008*	*<0.001*	0.133
Height (cm)	161.85 ± 9.56	160.20 ± 9.07	162.35 ± 9.28	0.077	0.050	0.502	*0.032*
Weight (kg)	68.07 ± 11.90	68.85 ± 13.31	69.38 ± 12.77	0.398	0.776	0.381	0.908
BMI (kg/m^2)	25.95 ± 3.75	26.90 ± 5.23	26.28 ± 4.17	*0.046*	*0.037*	0.568	0.320
Waist circumference (cm)	92.40 ± 11.29	97.87 ± 13.46	99.26 ± 11.91	*<0.001*	*<0.001*	*<0.001*	0.524
Hip circumference (cm)	100.05 ± 7.53	101.98 ± 10.58	101.40 ± 8.88	*0.028*	0.050	0.136	0.802
Demispan (cm)	77.23 ± 5.54	84.07 ± 5.96	85.75 ± 10.16	*<0.001*	*<0.001*	*<0.001*	0.149
Mid-arm circumference (cm)	29.38 ± 3.01	30.68 ± 4.27	30.21 ± 3.40	*0.002*	*0.004*	0.076	0.622
Systolic BP (mm Hg)	121.90 ± 13.72	119.76 ± 19.63	122.20 ± 17.29	*0.262*	*0.310*	0.968	*0.281*
Diastolic BP (mm Hg)	74.95 ± 7.83	72.25 ± 9.28	74.38 ± 10.16	*0.004*	*0.002*	0.696	0.43
FBS (mg/dl)	86.19 ± 24.01	120.79 ± 45.63	138.42 ± 65.18	*<0.001*	*<0.001*	*<0.001*	*<0.001*
WBC	5.95 ± 1.44	6.98 ± 1.66	7.79 ± 2.24	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Hemoglobin (g/dl)	13.95 ± 1.52	12.79 ± 1.51	13.15 ± 1.53	*<0.001*	*<0.001*	*<0.001*	0.085
Hematocrit (%)	41.67 ± 3.88	39.69 ± 3.93	40.54 ± 4.24	*<0.001*	*<0.001*	*0.002*	0.130
MCV (fl)	85.67 ± 5.25	87.60 ± 6.29	88.56 ± 6.08	*<0.001*	*<0.001*	*<0.001*	0.155

Abbreviations: ANOVA, analysis of variance; BMI, body mass index; BP, blood pressure; FBS, fasting blood sugar; MCV, mean corpuscular volume; WBC, white blood cells. Values are expressed as mean ± s.d. Significant values are italicized. *P*: from comparison of all the three groups with appropriate statistical test (such as ANOVA, χ^2, and so on). *P*1: from comparison of control group with Angio − group. *P*2: from comparison of control group with Angio + group. *P*3: from comparison of Angio − group with Angio + group.

Table 2. Comparison of the lipid profile among the study subjects

	Control (N = *443*)	*Angio* − (N = *172*)	*Angio* + (N = *273*)	P	P1	P2	P3
Cholesterol (mg/dl)	194.60 ± 40.78	166.48 ± 41.20	169.59 ± 37.60	*< 0.001*	*< 0.001*	*< 0.001*	0.702
Triglycerides (mg/dl) median (interquartile range)	121 (90)	135 (39)	147 (26)	*0.011*	0.717	0.035	0.020
LDL-C (mg/dl)	122.54 ± 36.78	96.79 ± 34.58	100.95 ± 36.67	*< 0.001*	*< 0.001*	*< 0.001*	0.469
HDL-C (mg/dl)	42.48 ± 9.54	45.92 ± 21.29	38.59 ± 7.67	*< 0.001*	0.005	*< 0.001*	*< 0.001*

Abbreviations: HDL-C, high-density lipoprotein-cholesterol; LDL-C, low-density lipoprotein-cholesterol. Values are expressed as mean ± s.d. Significant values are italicized. *P*: from comparison of all the three groups. *P1*: from comparison of control group with Angio − group. *P2*: from comparison of control group with Angio + group. *P3*: from comparison of Angio − group with Angio + group.

Table 3. Comparison of the dietary intake of macronutrients between understudy subjects

	Control (N = *443*)	*Angio* − (N = *172*)	*Angio* + (N = *273*)	P	P1	P2	P3
Energy intake (kcal)	1601.47 ± 517.92	1853.16 ± 594.23	1904.73 ± 616.11	*< 0.001*	*< 0.001*	*< 0.001*	0.616
Protein (g)	58.99 ± 22.81	98.11 ± 38.32	100.43 ± 37.68	*< 0.001*	*< 0.001*	*< 0.001*	0.726
Adjusted protein (g)	65.16 ± 18.05	92.38 ± 22.49	92.26 ± 24.73	*< 0.001*	*< 0.001*	*< 0.001*	0.998
Carbohydrate (g)	223.25 ± 88.47	228.46 ± 84.71	242.77 ± 97.86	*0.023*	*0.262*	*0.007*	0.115
Adjusted carbohydrate (g)	241.99 ± 41.64	212.61 ± 39.80	219.84 ± 43.15	*< 0.001*	*< 0.001*	*< 0.001*	0.240
Starch (g)	137.39 ± 66.50	157.50 ± 63.67	168.05 ± 68.11	*< 0.001*	*0.002*	*< 0.001*	0.233
Adjusted starch (g)	151.44 ± 42.29	147.73 ± 36.85	153.40 ± 36.53	0.337	0.549	0.795	0.304
Sugar (g)	83.25 ± 51.47	67.47 ± 49.38	70.08 ± 52.57	*< 0.001*	*< 0.001*	*< 0.001*	0.807
Adjusted sugar (g)	89.15 ± 44.62	63.35 ± 44.77	63.89 ± 44.62	*< 0.001*	*< 0.001*	*< 0.001*	0.999
Fiber (g)	14.90 ± 8.70	12.71 ± 8.49	12.86 ± 8.50	*< 0.001*	*0.001*	*< 0.001*	0.922
Adjusted fiber (g)	15.46 ± 7.30	11.44 ± 7.15	11.22 ± 7.27	*< 0.001*	*< 0.001*	*< 0.001*	0.797
Total fat (g)	58.81 ± 23.36	67.52 ± 26.48	66.06 ± 24.87	*< 0.001*	*< 0.001*	*< 0.001*	0.814
Adjusted total fat (g)	63.82 ± 15.15	64.00 ± 14.94	60.80 ± 14.47	*0.018*	0.990	*0.023*	0.071
Cholesterol (mg)	194.66 ± 158.73	229.10 ± 139.25	234.97 ± 131.40	*< 0.001*	*< 0.001*	*< 0.001*	0.523
Adjusted cholesterol (mg)	207.22 ± 153.72	219.18 ± 126.36	220.41 ± 118.75	*0.001*	*0.003*	*0.001*	0.842
Saturated fatty acid (g)	16.21 ± 7.78	19.46 ± 8.52	19.13 ± 7.84	*< 0.001*	*< 0.001*	*< 0.001*	0.675
Adjusted saturated fatty acid (g)	17.25 ± 6.28	18.20 ± 5.99	17.39 ± 5.81	0.216	0.194	0.950	0.364
Trans fatty acid (g)	0.83 ± 0.69	0.63 ± 0.61	0.62 ± 0.60	*< 0.001*	*< 0.001*	*< 0.001*	0.828
Adjusted trans fatty acid (g)	0.88 ± 0.64	0.59 ± 0.57	0.56 ± 0.58	*< 0.001*	*< 0.001*	*< 0.001*	0.488
Mono unsaturated fatty acid (g)	15.94 ± 6.76	17.09 ± 8.00	16.31 ± 6.55	0.185	0.159	0.765	0.489
Adjusted monounsaturated fatty acid (g)	17.14 ± 4.96	16.28 ± 5.94	15.10 ± 4.83	*< 0.001*	*0.003*	*< 0.001*	*0.036*
Polyunsaturated fatty acid (g)	19.96 ± 10.43	24.62 ± 11.52	23.73 ± 11.75	*< 0.001*	*< 0.001*	*< 0.001*	0.437
Adjusted polyunsaturated fatty acid (g)	21.12 ± 8.75	22.67 ± 8.06	21.15 ± 8.82	0.111	0.113	0.999	0.168

Values are expressed as mean ± s.d. Significant values are italicized. *P*: from comparison of all the three groups. *P1*: from comparison of control group with Angio − group. *P2*: from comparison of control group with Angio + group. *P3*: from comparison of Angio − group with Angio + group.

The mean levels of protein, cholesterol, phosphorus, zinc, zinc/copper ratio, selenium, iodine, carotene, vitamin E, niacin, pantothene and pyridoxine before and after adjustment in the control group were less than those of the Angio − and Angio + groups ($P < 0.05$), and the mean levels of sugar, fiber, transfatty acids,AQ manganese, folate and vitamin C both before and after adjustment in the control group were higher than those of the Angio − and Angio + groups ($P < 0.05$). The only differences between the Angio − and Angio + group lay in the higher levels of monounsaturated fatty acids seen in men and in the total population in the Angio − group in comparison with the Angio + group ($P < 0.05$) and in the lower levels of iodine in women in the Angio − group in comparison with women of the Angio + group ($P = 0.014$). With respect to lipid profile values, the levels of total cholesterol, LDL, HDL and triglycerides were significantly different among the three groups ($P < 0.001$).

According to Tables 5 and 6, there was no significant difference among the three groups with respect to high fat intake in the 24-h recall assessment and with respect to the incidence of dyslipidemia on blood sampling on the day of study between statin users and nonusers ($P > 0.05$).

DISCUSSION

Total cholesterol, LDL, HDL and triglycerides were significantly different among the three groups. In previous studies, lipid profile values, especially low levels of HDL-C and high levels of cholesterol and LDL-C, were the strongest risk factors for CAD.[16,17] In addition, we found that a high fat diet was not necessarily correlative with dyslipidemia. Ku *et al* in 1998 found no link between dietary fat and serum lipids.[18]

The mean total energy intake in the control group was less than that in the other two groups. In previous research, especially as per the recommendation of the American Heart Association, avoiding excess energy needed to control weight is determined as one of the most important factors in the prevention of CAD.[19] Although here we do not have a pure case–control study, we found an association between excess energy intake and CAD.

The mean dietary protein intake in the control group was less than that in the other two groups. High levels of consumption of animal protein have been shown to increase the risk for heart disease. It is also reported that the total protein and animal protein intake is associated with increased weight gain, whereas a similar significant association between vegetable protein intake and weight gain has not been observed.[20,21] In this study, nutrient intake (total protein) was calculated on the basis of total protein intake.

We found that the adjusted mean of carbohydrate intake in the control group was higher than that in the Angio − and Angio + groups. In addition, the mean concentration of starch was also less than that of the Angio − and Angio + groups, but after adjusting for total energy intake significant differences disappeared.

Table 4. Comparison of the dietary intake of micronutrients between the study subjects

	Control (N = *443)*	*Angio* − (N = *172)*	*Angio* + (N = *273)*	P	P*1*	P2	P*3*
Sodium (mg)	1763.86 ± 1767.28	1460.87 ± 643.43	1519.70 ± 727.57	0.221	0.412	0.089	0.507
Adjusted Sodium (mg)	1845.99 ± 1706.37	1397.29 ± 562.88	1426.27 ± 687.34	0.049	0.095	0.025	0.628
Potassium (mg)	2432.98 ± 1006.40	2928.47 ± 1412.07	3122.37 ± 1506.17	< 0.001	< 0.001	< 0.001	0.192
Adjusted Potassium (mg)	2432.98 ± 1006.40	2928.47 ± 1412.07	3122.37 ± 1506.17	< 0.001	< 0.001	< 0.001	0.192
Phosphorus (mg)	1145.26 ± 439.34	1384.88 ± 506.45	1431.45 ± 502.37	< 0.001	< 0.001	< 0.001	0.569
Adjusted Phosphorus (mg)	1240.50 ± 288.26	1311.81 ± 290.90	1323.90 ± 315.89	< 0.001	0.021	0.001	0.908
Calcium (mg)	749.82 ± 349.40	860.25 ± 420.31	937.84 ± 456.10	< 0.001	0.005	< 0.001	0.072
Adjusted Calcium (mg)	809.11 ± 281.07	815.17 ± 348.14	871.37 ± 378.40	0.038	0.977	0.036	0.182
Magnesium (mg)	211.43 ± 100.28	242.88 ± 95.00	253.65 ± 94.10	< 0.001	< 0.001	< 0.001	0.242
Adjusted Magnesium (mg)	230.34 ± 76.58	229.69 ± 52.84	233.88 ± 53.37	0.093	0.270	0.034	0.419
Iron (mg)	9.47 ± 5.25	11.81 ± 8.57	12.75 ± 10.13	< 0.001	0.007	< 0.001	0.574
Adjusted Iron (mg)	10.46 ± 4.31	11.04 ± 7.31	11.61 ± 9.04	0.401	0.241	0.307	0.802
Manganese (mg)	3.04 ± 1.70	2.25 ± 1.07	2.37 ± 1.16	< 0.001	< 0.001	< 0.001	0.426
Adjusted Manganese (mg)	3.22 ± 1.45	2.13 ± 0.79	2.18 ± 0.93	< 0.001	< 0.001	< 0.001	0.974
Copper (mg)	1.15 ± 1.15	1.29 ± 1.49	1.30 ± 1.15	< 0.001	0.008	< 0.001	0.542
Adjusted Copper (mg)	1.22 ± 1.11	1.23 ± 1.47	1.22 ± 1.09	0.933	0.691	0.953	0.813
Zinc (mg)	7.48 ± 3.39	10.03 ± 4.52	10.32 ± 4.58	< 0.001	< 0.001	< 0.001	0.516
Adjusted Zinc (mg)	8.23 ± 2.54	9.44 ± 3.00	9.46 ± 3.11	< 0.001	< 0.001	< 0.001	0.999
Zinc/copper ratio	7.30 ± 2.69	8.88 ± 3.09	8.85 ± 3.10	< 0.001	< 0.001	< 0.001	0.932
Adjusted Zinc/copper ratio	7.41 ± 2.33	8.65 ± 2.82	8.62 ± 2.89	< 0.001	< 0.001	< 0.001	0.923
Selenium (mg)	31.67 ± 23.92	51.68 ± 29.14	53.90 ± 33.36	< 0.001	< 0.001	< 0.001	0.669
Adjusted Selenium (mg)	34.98 ± 22.93	48.70 ± 23.53	49.63 ± 29.75	< 0.001	< 0.001	< 0.001	0.826
Iodine (mg)	91.91 ± 69.14	102.65 ± 58.11	112.16 ± 64.00	< 0.001	0.007	< 0.001	0.115
Adjusted Iodine (mg)	97.17 ± 66.33	97.55 ± 53.81	104.92 ± 57.88	0.030	0.293	0.009	0.179
Carotene (μg)	1872.29 ± 2138.62	2216.31 ± 4268.24	2188.54 ± 4333.60	0.001	0.006	0.001	0.936
Adjusted Carotene (μg)	2057.68 ± 2096.05	2071.13 ± 4192.16	1975.62 ± 4201.60	< 0.001	< 0.001	< 0.001	0.581
Folate (μg)	214.82 ± 152.88	203.75 ± 183.93	198.30 ± 109./28	0.080	0.041	0.117	0.550
Adjusted Folate (μg)	224.81 ± 151.66	195.86 ± 174.29	186.74 ± 91.17	< 0.001	< 0.001	< 0.001	0.868
Retinol (μg)	402.33 ± 2184.53	490.91 ± 3005.70	346.34 ± 1885.94	0.129	0.487	0.050	0.244
Adjusted Retinol (μg)	382.68 ± 2187.35	506.98 ± 2997.00	369.84 ± 1883.14	< 0.001	0.007	< 0.001	0.269
Vitamin E (mg)	14.23 ± 7.76	17.48 ± 8.65	16.67 ± 8.99	< 0.001	< 0.001	< 0.001	0.349
Adjusted Vitamin E (mg)	15.03 ± 8.23	16.82 ± 6.83	15.72 ± 7.42	0.034	0.027	0.475	0.311
Vitamin D (μg)	1.27 ± 1.82	2.34 ± 3.96	2.67 ± 4.28	< 0.001	< 0.001	< 0.001	0.669
Adjusted Vitamin D (μg)	1.43 ± 1.84	2.22 ± 3.94	2.49 ± 4.17	0.371	0.510	0.282	0.218
Vitamin C (mg)	77.48 ± 69.96	76.92 ± 100.26	76.00 ± 99.24	< 0.001	0.002	< 0.001	0.831
Adjusted Vitamin C (mg)	83.95 ± 68.26	72.18 ± 94.48	68.94 ± 92.52	< 0.001	< 0.001	< 0.001	0.833
Thiamin(B_1) (mg)	1.21 ± 0.64	1.41 ± 0.54	1.46 ± 0.55	< 0.001	< 0.001	< 0.001	0.316
Adjusted Thiamin(B_1) (mg)	1.31 ± 0.49	1.33 ± 0.38	1.35 ± 0.40	0.066	0.132	0.029	0.656
Riboflavin(B_2) (mg)	1.18 ± 0.77	1.39 ± 0.87	1.43 ± 0.79	< 0.001	< 0.001	< 0.001	0.367

Values are expressed as mean ± s.d. Significant values are italicized. *P*: from comparison of all the three groups. *P*1: from comparison of control group with Angio − group. *P*2: from comparison of control group with Angio + group *P*3: from comparison of Angio − group with Angio + group.

Table 5. Dyslipidemia and high-fat diet in the three groups (both statin users and nonusers)

	Dyslipidemia		*Total no. (%)*	P*-value*
	Yes (no. (%))	*No (no. (%))*		
Group				
Healthy				
High fat diet				
No, no. (%)	96 (64)	54 (36)	150 (33.9)	0.749
Yes, no. (%)	192 (65.5)	101 (34.5)	293 (66.1)	
Total, no. (%)	288 (65)	155 (35)	443 (100)	
Angiography −				
High fat diet				
No, no. (%)	36 (53.7)	31 (43.3)	67 (39)	0.959
Yes, no. (%)	56 (53.3)	49 (46.7)	105 (61)	
Total, no. (%)	92 (53.4)	80 (46.6)	172 (100)	
Angiography +				
High fat diet				
No, no. (%)	57 (47.9)	62 (52.1)	119 (43.6)	0.192
Yes, no. (%)	86 (55.8)	68 (44.2)	154 (56.4)	
Total, no. (%)	143 (52.3)	130 (47.7)	273 (100)	
Total	523 (58.8)	365 (41.1)	888 (100)	

Table 6. Dyslipidemia and high-fat diet in the three groups (no statin users)

	Dyslipidemia		*Total no. (%)*	P*-value*
	Yes (no. (%))	*No (no. (%))*		
Group				
Healthy				
High fat diet				
No, no. (%)	96 (64)	54 (36)	150 (33.9)	0.749
Yes, no. (%)	192 (65.5)	101 (34.5)	293 (66.1)	
Total, no. (%)	288 (65)	155 (35)	443 (100)	
Angiography −				
High fat diet				
No, no. (%)	26 (56.5)	20 (43.5)	46 (43.8)	0.146
Yes, no. (%)	24 (42)	33 (58)	57 (56.2)	
Total, no. (%)	50 (47.6)	55 (52.4)	105 (100)	
Angiography +				
High fat diet				
No, no. (%)	30 (46)	35 (54)	65 (43.3)	0.267
Yes, no. (%)	47 (55)	38 (45)	85 (56.7)	
Total, no. (%)	77 (51)	73 (49)	150 (100)	
Total	415 (59)	283 (41)	698 (100)	

Results of studies on high-carbohydrate diets vary, and many scientists believe the differences are due to the various types and sources of carbohydrates consumed.[6] Some studies have emphasized on the beneficial effects of high-carbohydrate and high-starch diets, whereas others have noted the detrimental effects of these on the lipid profile.[22,23] The mean concentration of sugar and fiber with and without adjustment in the control group was higher than that of the Angio − and Angio + groups. According to previous studies, the findings on the level of fiber intake were predictable.[24–26]

Unadjusted values of total fat, saturated fatty acids and polyunsaturated fatty acids and both adjusted and adjusted values of cholesterol in the control group were less than those of the Angio − and Angio + groups. These findings are consistent with previous studies that have shown the harmful effects of cholesterol, saturated fatty acids and total fat.[27–29] Previous studies have shown that high intake of transfatty acids increases the risk for CAD, and the contrasting results in this study can be the result of subjects being aware of the effect of diet modification on their disease.[30]

In this study, we used 24-h dietary assessment, but some authors believe that a 3-day dietary assessment may be better for assessment of human nutrition. In contrast, total calorie adjustment may not be appropriate for some micronutrients, which is one of the limitations of this study. Some other limitation is Cutoff point of 50% of stenosis in the patients with CAD in angiography procedure while those with 2–3% stenosis $<50\%$ are in Group Angio − while they will be Angio + in over the next few years.

CONCLUSION

These results indicate that the amount of intake of various nutrients can be considered an independent risk factor for CAD. Contrary results or lack of differences in intake of some nutrients can also exist, as subjects were aware of the results of diet modification on their disease. According to these findings, further research on the relationship between CAD and nutrient intake, especially intake of essential micronutrients, is needed.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTIONS

The study was conducted in accordance with the Principles of Declaration of Helsinki 1996 version and Good Clinical Practice standards. The study protocol, informed consent form and other study-related documents were reviewed and approved by the Human Research Ethics Committee of Mashhad University of Medical Sciences (MUMS). All patients were able to read and understand and were willing to sign the informed consent form.

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