An assessment of Dietary Intake Associated with the Coronary Heart Disease among Adults in Yerevan, Armenia

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Abstract: Epidemiologic studies have demonstrated the relationship between the dietary intake and coronary heart disease (CHD) in various countries. Extreme changes have occurred in lifestyles as well as dietary patterns in industrialized countries. Also, no study has been done to address the association between CHD and food consumption in these populations. This case-control study was conducted to assess the dietary intake in individuals with and without CHD during 2010 and 2011; we randomly selected 320 patients with CHD and 320 subjects without CHD (≥ 30 years old) from the hospitals, polyclinics and center of preventive cardiology in Yerevan. Dietary intakes with 135 food items over the previous 12 months were evaluated using a semi-quantitative food frequency questionnaire. We observed an inversely significant association between fruits, vegetables (not potatoes), whole grain, and plant food consumption and CHD. In a logistic regression, after adjusting for confounder risk factors, each 100 g increase in fruit or vegetables decreased 63% odds of CHD. The odds ratio for those with intake of sweet and dessert in the highest quartile was 2.64 (95% CI 1.65-4.21). 85% of cases and 81.3% of controls, consumed fish and seafood less than 200 g/wk ($P>0.05$), also, low intake of whole grain (below 100 g/d) was most common both in cases (95.9%) and controls (93.4%).This pioneering study indicates which fruit, vegetable intakes, whole grain and plant food independently associated with the CHD risk in the population under investigation.
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Introduction

Coronary heart disease (CHD) is one of the most common causes of morbidity and mortality in different communities (Hadaegh et al. 2009). Many risk factors for cardiovascular disease (CVD), including high blood cholesterol, hypertension, obesity, and diabetes are substantially influenced by dietary factors (*Liu et al., 2000).* Dietary intake and food habits are recognized to play key roles in the prevention and treatment of CHD (Lancaster et al., 2006). During the past decade, numerous key epidemiologic studies related to dietary intake and CVD have been published that suggested a strong association between CHD and dietary factors (Jakobsen et al., 2009; Holmberg et al., 2009; *Xu et al., 2006*). The recent and drastic changes that have occurred in industrialized countries have led to unhealthy dietary patterns (*Lairon et al., 2005*). Findings showed differences in dietary intake and risk of CHD and related health conditions among ethnic subgroups of Blacks living in the United States (Lancaster et al., 2006). Furthermore factors such as genetic predisposition as well as changing lifestyle including physical inactivity may also increase the coronary risk profile (Ghosh et al., 2003). As far as Armenia is concerned, there have been no studies investigating food pattern variables in explaining risk factors for CHD. This pioneering study was carried out to evaluate dietary intake in individuals with and without CHD in this country.

Materials and methods

Participants: This Observational Case-Control study was conducted during the period of March 2010 to February 2011 in the Yerevan State Medical University (YSMU) hospitals, polyclinics and in the Center of preventive cardiology. Patients aged ≥ 30 years as the case group (n=320) with established CHD were identified by cardiologist. The controls (n=320) consisted of individuals aged ≥ 30 years without CHD who attended for check-up in hospitals and polyclinics in Yerevan.

All participants were given a written informed consent prior to their participation in the study. The inclusion criteria were as follows: subjects, who attended YSMU hospitals and polyclinics and in the Center of preventive cardiology for check-up and age > 30 years. Patients were excluded if they had any previous history of MI, admission for angiography, and previous history of any kind of heart surgery or angioplasty for CHD. Pregnant women and patient with history of systemic diseases according to the medical records were also excluded. The study protocol was approved by the Ethics Committee of the Yerevan State Medical University.

Data collection: In this study we assessed family history of diabetes, heart diseases, hypertension, socioeconomic status, lifestyle factors (including smoking habits, physical activity, alcohol drinking), and dietary intake for each subject. Next, anthropometric measures (height, weight, and hip and waist circumferences) were obtained. Waist and hip measures were assessed by using a soft tape measure, with waist measures taken at the midpoint between the costal margin and ileac crest and hip measures taken at the widest circumference. Finally systolic and diastolic blood pressure was measured twice with a standard mercury sphygmomanometer after the participants sat for 15 min; the mean of the two measurements was considered to be the participant's blood pressure at the time of health check-up.

Assessment of dietary intake: Information on the usual intakes of foods and dishes over the previous year was estimated using a semi-quantitative food frequency questionnaire (FFQ). Nutritionists and Public health specialists assisted to determine constructing a list of foods which ultimately consisted of approximately 135 foods and beverage items with a standard serving size that commonly consumed by Armenians. Before the FFQ was implemented in the study, it was adapted to Armenian conditions and was field-tested on 50 individuals.

Food items were classified into eleven categories: fruits (17 items), dried fruit (6 items), vegetables (23 items), meat, fish, poultry, egg and legumes (17 items), Dairy Products and Fats (18 items), miscellaneous (9 items), beverages (13 items), bread, cereal and potato (12 items), nuts (9 items), dishes and soups (8 items), and fast food (3 items). Subjects were asked to select their frequency of consumption and portion sizes of each food item in the past year on a daily (egg, bread), weekly (egg, rice or meat, vegetable, fruit), or monthly (egg, fish) basis by using household measures. If the subject did not consume that item, the "never" box was marked. For each subject, mean intake according to grams per day of each indicated categories were calculated.

Statistical analysis: A special database was developed to store and analyze the obtained data. The data collected through the questionnaire were entered into the database. Dietary variables are presented as means and standard deviations for normally distributed parameters. Comparison of numeric data was made using unpaired t-tests for normally distributed variables and the chi-square test for category parameters. To assess associations of CHD with food intake we calculated the lowest and highest quartiles of food groups. In logistic regression analysis, the odd ratio was computed according to the quartile value. All statistical analyses were done using the SPSS (Statistical Package for Social Sciences, Version 15). All p-values reported were based on two-sided tests, and the statistical significance was defined as $p < 0.05$ for all tests.

Results

Table 1 shows CHD risk factors of cases and controls. 50.6% of the patients with CHD were males and 49.4% were females. Also 44.1% of the controls were males and 55.9% were females. Cases had significantly higher prevalence of hypertension, MetS, current smoking, current alcohol consuming, and family history of CHD, while no statistically significant differences were found for obesity.

Table 2 shows the average consumption and standard error of each food group (g/d) for cases and Controls. In our study, the cases had significantly higher intakes of refined grain, sweets and dessert but lower intakes of fruits, vegetables (not potatoes), green leafy vegetables, fish, and seafood, nuts and plant food compared to the control group. No significant difference was observed in legumes, egg, whole grain and animal food intakes between individuals with and without CHD.

Distribution of case and control groups based on consumed food items is presented in Table 3. Among the food groups, the strongest associations were observed for fruits and vegetables. Percent of individuals who consumed fruits and vegetables less than 200 g/d was significantly higher in patient with CHD (case, 85% vs. control, 43.8%; P<0.000; case, 88.1% vs. control, 59.7%; P<0.0001 respectively). Reversely the percentage of cases who consumed processed meat ≥60 g/wk and egg ≥120 g/wk was significantly higher than that of the control group (cases, 33.1% vs. controls, 23.8%; P<0.05; cases, 27.8% vs. controls, 19.7%; P<0.05 respectively), while no statistically significant differences were found in distribution of cases and controls regarding the whole grain < 100 g/d, and fish < 200g/wk. P>0.05).

Participations defined by the CHD risk factors were calculated according to the mean of fruit and sweet & dessert intake (Table 4). In each category, the CHD group had a lower intake of fruit than controls. Also, other subgroups of cases had higher sweet and dessert consumptions except in current smokers.

Table 5 depicts the odds ratio and 95% confidence interval for CHD according to food items intake. Among the food groups included in logistic regression analysis that adjusted to calorie and gender, intake of sweet and dessert was observed to be risk factor for CHD. The odds ratio for those with intake of sweet and dessert in the highest quartile were 2.64 (95% CI 1.65-4.21), but fruit, vegetable, whole grain, and plant food (highest vs. lowest quartile) intake proved to be inversely significantly associated with CHD. More individuals in the CHD group were in the lowest quartile of them while, there were no statistically significant interactions for nuts and animal food consumption (highest vs. lowest quartile) with CHD.

Table 1: Characteristics of Patients with CHD and Controls

Variable	CHD group		Controls		P-value
	Males N (%)	Females N (%)	Males N (%)	Females N (%)	
Number	162(50.6)	158(49.4)	141(44.1)	179(55.9)	0.11
Current Smoking	108(66.7)	20(12.7)	66(46.8)	1(0.6)	0.000
Current Alcohol Consumption	124(70.9%)	51(32.3)	77(54.6)	29(16.2)	0.000
Hypertension	120(74.1)	130(82.3)	82(58.2)	124(69.3)	0.000
MetS	126(77.8)	129(81.6)	87(61.7)	135(75.4)	0.004
Family History of CHD	21(13)	24(15.2)	3(2.1)	7(3.9)	0.000
Obesity (BMI≥30)	65(40.1)	72(45.6)	57(40.4)	76(42.5)	0.40

Comparisons were based on the chi-squared test. P-value is for group differences after controlling for gender.

Table 2: Average Daily Food Consumption (g/d) in Case and Control groups

Food consumption	**Group**		**P value**
	Cases (n=320) Mean (SE)	Controls (n=320) Mean (SE)	
Fruits	129.1 (3.96)	223.4 (6.77)	P<0.0001
Vegetables (not potatoes)	140.1 (3.21)	215.8 (6.78)	P<0.0001
Green Leafy Vegetable	4.9 (0.23)	11.4 (1.05)	P<0.0001
Fish and Seafood	16.0(0.92)	19.7 (1.57)	P<0.05
Legumes	12.4 (0.80)	14.7 (0.99)	P>0.05
Egg	17.3 (1.08)	16.7 (1.12)	P>0.05
Whole Grain	25.3 (1.99)	30.0 (2.28)	P>0.05
Refined Grain*	181.3 (6.23)	157.1(4.36)	P<0.05
Nuts	14.2 (1.28)	22.8 (1.91)	P<0.0001
Sweets and Dessert **	34.8 (2.19)	24.7 (1.48)	P<0.0001
Animal Food	427.2(10.62)	441.2(10.74)	P>0.05
Plant Food	625.1(13.18)	791.3(16.64)	P<0.0001

* Refined grain included white wheat (lavash and matnakash), loaf, toast, rolls, macaroni, and rice.
**Sweets and dessert included candy, chocolate, sugar, jam, jelly, cake, cookies, and ice cream.

Table 3- Food Consumption in Case and Control groups

Food consumption	**Group**		**P value**
	Cases n=320 (%)	Controls n=320 (%)	
Fruit < 200 g/d	272 (85)	140 (43.8)	P<0.0001
Vegetable <200 g/d	282 (88.1)	191 (59.7)	P<0.0001
Total Fruit & Vegetable < 400 g/d	287 (89.7)	156 (48.8)	P<0.0001
Whole Grain < 100 g/d	307 (95.9)	299 (93.4)	P>0.05
Fish < 200g/wk	272 (85)	260 (81.3)	P>0.05
Processed Meat ≥60 g/wk	106 (33.1)	76 (23.8)	P<0.05
Egg ≥120 g/wk	89 (27.8)	63 (19.7)	P>0.05

Table 4- Mean and Standard Deviation (SD) of Fruit and Sweet and Dessert Intakes in Subgroups

Variables	**Fruit intake (g/day)**		**P**	**Sweet & dessert intake (g/day)**		**P**
	cases mean (SD)	controls mean (SD)		cases mean (SD)	controls mean (SD)	
Obese	141.5(78.7)	219.2(123.7)	P<0.0001	37(34.2)	21.2(21.7)	P<0.0001
Hypertension	120(64.7)	212.6(118.3)	P<0.0001	32(31.2)	20.5(20.4)	P<0.0001
MetS	129.7(71)	223.1(122)	P<0.0001	33.27(30.5)	21.51(21.61)	P<0.0001
Family History of CHD	131.9(95)	291(182.9)	P<0.0001	41.8(26.1)	24.2(17)	P<0.05
Current Smokers	120.1(66.2)	201.2(105.4)	P<0.0001	39.2(52.1)	37.1(39.7)	P>0.05
Current Alcohol Consumers	119.3(65.4)	216.6(132.5)	P<0.0001	31.8(29.7)	25.1(21)	P<0.05

Table 5 -Distribution of Cases and Controls in the Highest and Lowest Quartiles, the Odds Ratio (95% Confidence Intervals) According to Food Groups Intakes

Food groups intake	Cases N (%)		Controls N (%)		Odds ratio	95% CI
	1st quartile	4th quartile	1st quartile	4th quartile		
Fruit (g/day	116(84.7)	21(15.3)	44(24)	139(76)	0.06	0.03 – 0.10
Vegetable (g/d)	170(78.7)	46(21.3)	60(26.1)	170(73.9)	0.10	0.06 – 0.15
Sweet-Dessert(g/d)	63(39.6)	96(60.4)	97(60.2)	64(39.8)	2.64	1.65- 4.21
Whole grain (g/d)	91(56.2)	71(43.8)	69(43.7)	89(27.8)	0.58	0.36– 0.91
Nuts (g/d)	84(26.3)	64(43.2)	76(44.2)	96(55.8)	0.65	0.41 -1.03
Animal Food	80(55.2)	65(44.8)	80(45.7)	95(54.3)	0.83	0.49-1.41
Plant Food	90(67.7)	43(32.3)	34(22.5)	117(77.5)	0.11	0.06 – 0.21

Discussion

To our knowledge, this is the first epidemiologic study that evaluated the association between dietary intakes with CHD in Armenia. In this case-control study, as expected, in the t-test analysis, it was revealed that mean of fruit, vegetable, fish and sea food, and nuts intake was lower in the CHD group, whereas there was no significant difference for egg, legume, whole grain and animal food consumption in both groups.

We found that the mean daily intake of fruit and vegetable differed significantly between the two groups (case, 129.1 g/d vs. control, 223.4 g/d; case, 140.1 g/d vs. control, 215.8 g/d, respectively). The inverse association of fruit and vegetable intake with the CHD risk in some prospective cohort studies has been shown (*Fung* et al., 2008; www.plosone.org, 2012). One of the most important dietary recommendations in relation to potential health gains and the elimination of CHD to a large extent in the individuals aged below 70 years is "eat ≥400 g of vegetables and fruits per day" (Kromhout et al., 2002) while in the sample under study 89.7% of cases and 48.8% of controls consumed total fruit and vegetable less than 400 g/d (Table 3). Recently, the American Heart Association has recommended a diet that includes at least 4.5 servings of fruits and vegetables daily (www.heart.org, 2012). In the present study, in logistic regression analysis, the odds ratio of individual with total fruit and vegetable intake in the highest quartile compared to the lowest were 0.06 (95% CI 0.03– 0.1) and 0.1 (95% CI 0.06-0.15), respectively, after adjusting for sex and calorie (Table 5). Also, these were independently associated with CHD after they were adjusted for other risk factors including calorie, gender, smoking and exercising. For each 100 g increase in fruit or vegetable consumption, there was a 63% reduction in the odds ratio of CHD (data not shown). A meta-analysis of 9 cohort studies reported a weaker association, i.e. a 4% lower risk of the CHD incidence for each additional portion of fruit and vegetables (Dauchet et al., 2006). B.C.Zyriax et al, in Germany reported a 30% decline risk for every 100 g consumption of fruit and vegetable (Zyriax et al., 2005). In a case-control study among Indian population, persons consuming a median of 3.5 serving/wk green leafy vegetable had a 67% lower relative risk than did those consuming 0.5 servings/wk. (Rastogi et al., 2004).

A diet rich in fruits and vegetables due to a higher content of antioxidants, folate, and flavonoids has beneficial effects on markers of inflammation and oxidative stress which may inhibit the development of atherosclerosis and may result resulting in lower cardiovascular risks (Holt et al., 2009).

In this study, we also found that the mean of nuts intake particularly sunflower nuts, was significantly higher in controls than that of the case group (controls, 22.8 g/d vs. cases, 14.2 g/d;

P<0.0001) (Table 2). But based on the comparison of the lowest and highest quartiles removed the impact of nuts on CHD risk (Table5). Association of nuts consumption was reported with decreased CHD in earlier prospective studies (Dontas et al., 2007). In previous studies, it was found that consumption of at least 5 servings/wk of nuts or peanut butter was associated with lower LDL cholesterol, non-HDL cholesterol, and total cholesterol (Li et al.,2009). Nuts and peanuts contain many bioactive components which exert beneficial effects on these CHD risk factors (Ros, 2009; Kris-Etherton et al., 2008).

In our study (Table 1) no significant difference was observed in average legume and whole grain intakes between individuals with and without CHD (case, 12.4 g/d vs. control, 14.7 g/d; cases, 25.3 g/d vs. controls, 30.0 g/d; respectively). In addition, the percentage of individuals in our study, who reported consuming less than 100 g/day of whole grain, was 95.9% and 93.4% of CHD patients and controls respectively. These findings are in contrast with other studies that indicated legume (*Bazzano et al., 2001*) and whole grain (www.plosone.org, 2012) might have beneficial health influences to reduce the risk of CHD. It is remarkable to mention here that both legume and whole grain consumption was not considerable among the study population under study.

Although the cases had significantly lower intakes of total fish and seafood (16.0 g/d) compared to the controls (19.7 g/d), the low intake of fish (below 200 g/week) was most common among cases (85%) and controls (81.3%).

In a Meta-analysis of cohort studies, compared with those who never consumed fish or ate fish less than once per month, individuals with a higher intake of fish had lower CHD mortality. Each 20-g/d increase in fish intake was related to a 7% lower risk of CHD mortality (*P* for trend=0.03) (*Bazzano et al.,* 2004).

Given the objectives of our study, we conducted the analysis of plant and animal food consumption. In this study, controls had a significantly higher intake of plant food than the cases (791.3 g/d vs. 625.0 g/d; P<0.0001). This was mainly due to the difference in the intakes of fruit and vegetable, while in stratified analyses for CHD, significant association was not observed when the bottom and top quintiles of animal foods consumption were compared. In contrast, in a case control study, which was conducted in Indonesia there was no difference in plant food intake between the two groups. Average intake of plant food was 1,061 g/d for the case group and 1,028 g/d in the control group. Also, the odds ratio for the subjects who consumed animal foods in the highest quartile (above 210 g) to those in the lowest quartile (below 108 grams) was 4.8 (95% CI 2.25-10.30, *P<0.0001*) (Lipoeto et al., 2004), these differences may be related to food culture in this country. However, because of many other potential risk factors among diverse countries, dietary intake alone may not be the mere factor underlying lower CHD incidence.

Conclusion: Our finding revealed that fruit, vegetable, whole grain and plant food intakes independently were associated with CHD events. Thus these food groups could be predicted risk of CHD in this population. However, more studies are required to examine association dietary intake and CHD in Armenia.

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