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Diet and myocardial infarction: A case-control study in the population of Belgrade

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Abstract

Background

Diet, as a major modifiable risk factor, vary markedly in different regions of the world, and the aim of this study was to investigate the association between different food groups and risk of nonfatal myocardial infarction (MI) among Belgrade population.

Methods

A case-control study involving 155 newly diagnosed cases of MI and 310 hospital-based controls was conducted. The cases and controls were matched by age (± 2 years), gender, and place of residence. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using multivariate conditional logistic regression analysis.

Results

Daily consumption of full-fat dairy products (OR, 7.19; 95% CI, 3.8–13.7), eggs (OR, 3.47; 95% CI, 1.6–7.4) more than 3 times a week and processed meat (OR, 2.1; 95% CI, 1.2–3.7) more than 2 times increased the risk of MI after adjustment for traditional cardiovascular risk factors. Consumption of fish (OR, 0.29; 95% CI, 0.1–0.6) and white meats (OR, 0.28; 95% CI, 0.1–0.6) more than 2 times a week and daily consumption of fresh vegetables (OR, 0.34; 95% CI, 0.2–0.6) and low-fat dairy products (OR, 0.48; 95% CI, 0.3–0.9) significantly decreased the risk of MI.

Conclusions

The findings of this study suggest that dietary patterns may be associated with risk of MI in Belgrade population.

Keywords

Diet; Myocardial Infarction; Case-Control Study; Nutrition; Risk Factors

Introduction

Several studies have aimed to determine the components of diet that have the highest influence on the risk of cardiovascular diseases (CVDs). Increased consumption of fruits and vegetables reduces the risk of coronary heart diseases (CHDs) because fruits and vegetables contain protective constituents such as potassium, foliate, vitamins, fibre, and other phenolic compounds [1,2]. Consumption of fish also reduces the risk of myocardial infarction (MI) because of the protective effects of omega-3 fatty acids present in the fish [3,4]. Wholegrain foods also exert cardio protective effects; however, the exact mechanism of action is unclear. Nutrients and phyto chemicals such as complex carbohydrates, dietary fibre, minerals, vitamins, antioxidants and phytoestrogens may be important [5]. Meat, especially red and processed meat, is associated with an increased risk of CHDs [6,7]. Dairy fats contribute to the risk of CHDs primarily by increasing saturated fat intake, which increases plasma cholesterol [8].

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For a long time, nutritional research has focussed on the effects of constituents present within the foods rather than on the effects of whole foods. Focussing on the effects of constituents may underestimate or overlook the role of specific foods in the development of CHDs [9]. According to INTERHEART study, higher risk of acute MI is associated with unhealthy diet that is rich in fried foods, salty snacks, eggs and meats [10]. One prototype of a healthy diet is the Mediterranean style diet that includes high consumption of olive oil, fruits, vegetables, whole grains, legumes, and nuts; low consumption of meat and dairy products and moderate consumption of alcohol with meals [11]. The Mediterranean diet can improve the overall outcome and prognosis of the general population by reducing myocardial infarction event rates which can be explained through several mechanisms such as endothelial function amelioration, atherosclerosis burden reduction, antithrombotic activities, decreases in diabetes and metabolic syndrome incidence and evolution and improving dyslipidaemia via lipid metabolism mechanisms (such as improving para oxonase activities) [12]. Carotenoids present in fruits, vegetables, seaweeds and some sea foods, as a fundamental component of Mediterranean foods, decrease the incidence and prevalence of cardiovascular events, probably by their antioxidant action on free radicals or by acting as anti-inflammatory molecules [12,13,14].

In different regions of the world diet, as a major modifiable risk factor, vary markedly,[10] and it is not clear whether the results from studies conducted in other countries are applicable for Serbian population. CVDs are a leading cause of death in Serbia. In 2007, 35 people died every day due to CHDs. However, it is assumed that the number of deaths due to CHDs is even higher because of the poor understanding of the underlying causes [15]. In Belgrade, the capital of Serbia, mortality rates due to MI have decreased significantly in both genders after the mid-1990s in contrast to the increase observed in the early-1990s that was significant in women but non-significant in men [16] .

The 2006 National Health Survey in Serbia indicated that more than half of the Serbian population (57.2%) used white bread while only 14.8% Serbian adults used whole grain, rye and similar types of bread. Approximately 48.7% of the population ate fish less than once a week [17]. Fresh vegetables were consumed daily by 54.8% adults, and fresh fruits were consumed by 44% adults. The richest people consumed fish, fresh fruits and vegetables more often than the poorest people who consumed animal fats more often.

The objective of this study was to investigate the importance of dietary factors for the occurrence of nonfatal MI in the population of Belgrade.

Materials and Methods

In all, 155 cases and 310 controls were recruited in this case-control study from January 2006 to October 2009. The included cases were of patients who experienced their first episode of MI and who were admitted to the coronary care unit of an emergency room, Belgrade. MI was diagnosed by cardiologists based on the World Health Organization (WHO) criteria that included presence of typical chest pain symptoms and elevation of cardiac enzyme concentrations or diagnostic changes on an electrocardiogram [18]. Controls were selected from patients who were treated for rheumatic and gastrointestinal diseases and minor injuries during the same period at the Institute of Rheumatology, Institute for Gastroenterology and Clinic for Orthopedics, Belgrade, Serbia. Subjects were excluded from the study if they had a history of MI or chronic medical illness that would affect the risk factors for CVDs or if they were physically or mentally unable to answer the questions. The patients and controls were individually matched by sex, age (±2 years), and place of residence (urban or rural communities of Belgrade).

Two physicians interviewed the patients face to face by using a questionnaire during the first five days of their hospital stay after the diagnosis of MI. Neither any of MI patients nor any of controls refused to participate in the study. Data were collected on demographic characteristics (sex, age, place of residence, nationality, education, occupation and marital status), habits (smoking, alcohol consumption and coffee and tea consumption), anthropometric characteristics (body height, body weight, and waist and hip circumference), diet, stressful life events (work related stressful life events, family related stressful life events, financial problems, death and diseases) and personal and family history. This study focused on the dietary habits of the subjects. The patients and controls were interviewed about their dietary habits in the previous 12 months. Dietary information was collected using food frequency questionnaire (FFQ) proposed by Willett [19,20]. We modified the questionnaire to suit the Serbian population and the common dietary habits in Serbia. The 134 food items captured by the FFQ were grouped together in 15 non-overlapping food groups comprising related food items (Table 1).

The degree of obesity was estimated based on the body mass index (BMI) and waist-to-hip ratio (WHR). According to the WHO classification of obesity, subjects with a BMI of ≥30.00 kg/m2 are considered obese [21]. According to the WHO classification of obesity based on the WHR, men are classified as obese if their WHR is >0.90 and women are classified as obese if their WHR is >0.85 [21]. Data on the personal history of participants were obtained from medical documentation.

Laboratory data were also obtained from medical records. Subjects were considered as having hypertension and diabetes mellitus if they received medication for these conditions. The Eethics committee of hospitals approved the study, and all the participants provided informed consent before participating in the study.

Multiple conditional logistic regression analysis was used to calculate matched odds ratios (ORs) and 95% confidence

Table1. Description of selected food groups common to Serbian diet

Food group	Description
Red meat	Pork, lamb, beef, bacon, and viscera
Meat processed	Ham, salami, 'mortadella' sausage, raw fermented sausages, hotdogs, prosciutto and pate
White meat	Chicken and turkey
Fish	River fish, marine fish and canned fish
Fresh fruits	Lemons, oranges, mandarin oranges, grapefruits, apples, pears, peaches, apricots, strawberries, raspberries, blackberries, cherries, bananas, watermelon, cantaloupe, grapes and plums
Fresh vegetables	Lettuce, kale, cabbage, spinach, collard, broccoli, cauliflower, carrots, cucumbers, onion, garlic, paprika and beetroots
Cooked vegetables	Potatoes, tomatoes, mushrooms, carrots, beans, peas, cabbage, aubergine, paprika, onion and garlic
Pickled vegetables	Pickled cabbage, paprika, cauliflower, beetroot and cucumber
Low-fat dairy products	Low-fat milk, skimmed milk, light yoghurt and cottage cheese
Full-fat dairy products	Whole milk, full-fat yoghurt, sour cream, ice cream, fresh white cheese, cream cheese, white and yellow processes cheese and kaymak
Whole grain	Whole and dark bread
Refined grain	White bread, white rice, macaroni, spaghetti and pancakes
Added fats	Butter and margarine
Sweets	Chocolate, cookies, cakes, pastry, biscuits and donuts
Eggs	Hen eggs

intervals (95% CI) adjusted for potential confounders such as hypertension, diabetes, hyperlipidaemia, BMI, smoking status, sedentary job, stressful life events and family history of MI. Univariate conditional logistic regression analysis was used to examine the predictive effect of each variable. All the statistical analyses were performed using SPSS version 15.

Results

Table 2 describes the basic characteristics of the patients and controls. Age, gender and place of living were variables that matched between the groups. In all, 75.3% patients and controls were men. Stressful life events and sedentary job were significantly more common in patients than in controls; however, education and leisure time activity were not significantly different between the two groups. The presence of conventional cardiovascular risk factors like diabetes mellitus, hypertension, family history of MI, smoking, BMI, total cholesterol and triglycerides was significantly higher among patients than among controls.

Table 3 shows the ORs for primary nonfatal MI in relation with the selected foods after adjustment for traditional coronary risk factors. Consumption of eggs more than three times a week, and processed meat and full-fat dairy products more than two times a week was significantly associated with an increased risk of MI. The risk of MI was significantly decreased in participants who consumed fresh vegetables and low-fat dairy products daily and fish and white meat weekly. Daily consumption of cooked and pickled vegetables, fresh fruits and whole and refined grains and weekly consumption of butter and margarine, red meat and sweets were not significantly associated with the risk of MI. Consumption of selected foods was not significantly different between men and women.

Discussion

The results of present study suggested that consumption of eggs, processed meat and full-fat dairy products was significantly associated with a higher risk of MI even after adjusting for potential confounding factors. In contrast, consumption of white meat, low-fat dairy products, fresh vegetables and fish had cardio protective effects.

Many epidemiological studies have shown a positive correlation between meat consumption and high risk of MI [6, 10, 22]. Gramenzi et al. found that women who consumed ham and salami more than 2 times a week had significantly higher risk of MI [23]. Moreover, women who had high intake of red and processed meat showed an increased risk of cardiovascular mortality [24]. Bernstein, found that high intake of red meat (but not processed meat) and high-fat dairy was significantly associated with an elevated risk of CHDs while high intake of poultry, fish, and nuts was significantly associated with a low risk of CHDs [25]. A systematic literature review and meta-analysis showed that consumption of red meat was not associated with CHDs but consumption of processed meat was associated with

Table2. Characteristics and risk factors of cardiovascular diseases in myocardial infarction cases and their controls in Belgrade

Characteristics	Cases (n = 155) No. (%)	Controls (n = 310) No. (%)	p value
Age			
≤50 years	43 (27.7)	79 (25.5)	Matched
51–60 years	55 (35.5)	116 (37.4)	
61–70 years	33 (21.3)	70 (22.6)	
>70 years	24 (15.5)	45 (14.5)	
Gender			
Male	116 (74.8)	232 (74.8)	Matched
Female	39 (25.2)	78 (25.2)	
Urban place of residence	138 (89.0)	276 (89.0)	Matched
Education			
Primary	13 (8.4)	16 (5.2)	0.775*
Secondary	88 (56.8)	201 (64.8)	
Higher	54 (34.8)	93 (30.0)	
Sedentary job	76 (49.0)	113 (36.5)	0.009*
Leisure time activity	71 (45.8)	144 (46.5)	0.897*
Stressful life events	121 (78.1)	162 (52.3)	<0.001*
Systolic blood pressure	136.13 ± 18.88	129.23 ± 13.16	<0.001**
Diastolic blood pressure	86.45 ± 11.03	82.27 ± 8.58	<0.001**
Diabetes mellitus	29 (18.7)	28 (9.0 %)	0.004*
Plasma total cholesterol (≥ 5.2 mmol/L)	61 (39.4)	60 (19.4%)	<0.001*
Plasma triglycerides (≥ 1.7 mmol/L)	61 (39.4)	51 (16.5%)	<0.001*
Family history of myocardial infarction	55 (35.5)	42 (13.5)	<0.001*
Body mass index			
Normal and underweight (<25 kg/m2)	43 (27.7)	103 (33.2)	0.026*
Overweight (25–29.9 kg/m2)	69 (44.6)	152 (49.0)	
Obese (≥30 kg/m2)	43 (27.7)	55 (17.7)	
High waist-to-hip ratio	46 (29.7)	83 (26.8)	0.505*
Current smoking habit	92 (59.4)	106 (34.2)	<0.001*

*According to univariate logistic regression analysis; **according to t-test;

Table3. Comparison of dietary patterns between myocardial infarction cases and their controls based on the food frequency questionnaire

Food groups	Consumption frequency	Cases (n = 154) No. (%)	Controls (n = 308) No. (%)	OR (95% CI) a	p value
Read meats	>2 times/w	72 (46.8)	124 (40.3)	1.39 (0.83–2.32)	0.206
White meats	>2 times/w	22 (14.3)	105 (34.4)	0.29 (0.15–0.57)	<0.001
Processed meats	>2 times/w	107 (69.5)	167 (54.2)	2.14 (1.23–3.69)	0.007
Fish	>2 times/w	19 (12.3)	87 (28.2)	0.29 (0.14–0.59)	0.001
Fresh vegetables	>1 time/d	37 (24.0)	144 (46.8)	0.34 (0.19–0.61)	<0.001
Pickled vegetables b	>1 time/d	25 (16.2)	61 (19.8)	0.78 (0.38–1.61)	0.494
Cooked vegetables	>1 time/d	31 (20.1)	74 (24.0)	0.88 (0.48–1.62)	0.683
Fresh fruits	>1 time/d	45 (29.2)	99 (32.1)	0.83 (0.48–1.42)	0.489
Full-fat dairy products	>1 time/d	96 (62.3)	69 (22.4)	7.19 (3.77–13.71)	<0.001
Low-fat dairy products	>1 time/d	30 (19.5)	92 (29.9)	0.47 (0.25–0.88)	0.019
Butter/Margarine	>2 times/w	72 (23.4)	28 (18.2)	1.46 (0.76–2.80)	0.259
Eggs	>3 times/w	34 (22.1)	22 (7.1)	3.47 (1.61–7.44)	0.001
Whole grains	>1 time/d	11 (7.1)	35 (11.4)	0.67 (0.26–1.72)	0.405
Refined grain	>1 time/d	113 (73.4)	212 (68.8)	1.53 (0.84–2.77)	0.165
Sweets	>3 times/w	26 (16.9)	39 (12.7)	1.54 (0.72–3.29)	0.261

aORs and 95% CIs were adjusted for hypertension, diabetes, hyperlipidaemia, body mass index, smoking status, sedentary job, stressful life events, and family history of myocardial infarction; bSeasonal consumption in winter

42% higher risk CHDs; [26] these results were in agreement with the results obtained in our study. In the present study, consumption of red meat was not associated with the risk MI but consumption of processed meats increased the risk of MI. In addition, the present study showed that consumption of poultry had protective effects against the risk of MI.

Consumption of eggs more than three times a week increased the risk of MI. A case-control study from Pakistan showed that consumption of eggs six or more times a week was associated with increased risk of ischaemic heart disease [27].

Data on the relationship between consumption of dairy products and MI are not consistent; however, it is known that full-fat dairy products are rich in saturated fat. Several metabolic studies have shown that saturated fatty acids like lauric, myristic and palmitic acids increase the serum levels of total and LDL cholesterol [28]. A study in Iran showed that habitual consumption of hydrogenated fats and full-fat yoghurts increased the risk of coronary artery disease [29]. The Nurses' Health Study showed that consumption of dairy products containing a higher ratio of high fat to low fat was significantly associated with CHDs during 14 years of follow-up [30]. The results of the present study suggested that daily consumption of full-fat dairy products increased the risk of MI, while consumption of low-fat dairy products significantly decreases the risk of disease.

Fish is considered healthy because it contains long-chain n-3 polyunsaturated fatty acids; other nutrients in fish, such as selenium, may also be beneficial. Serum levels of omega-3 polyunsaturated fatty acids had been associated with the presence and degree of coronary artery lumen narrowing determined by atherosclerotic plaques and dietary supplementation with them have protective effect not only in patients with a history of coronary artery disease but also in subjects free of known cardiovascular disease.31 Omega-3 PUFAs supplementation has positive influence on lipid profile, insulin sensitivity, abdominal adiposity, platelet aggregation, endothelial function, blood pressure, and ventricular arrhythmias [31]. Once- or twice-weekly consumption of fish is associated with a reduced risk of CHDs in Western countries and in China [32]. In populations with high fish consumption, like Japan the highest intake of 8 times per week compared with lowest of once a week substantially reduced risk of CHD, myocardial infarction and sudden cardiac death [32]. A meta-analysis of cohort studies indicated that fish consumption was inversely associated with fatal CHDs and that 20 g/d increase in fish intake was associated with 7% lower risk of CHD mortality [33]. The present study showed that consumption of fish more than two times a week was associated with a lower risk of MI.

A diet rich in fruits and vegetables is associated with a reduced risk of CHDs; however, the extent of the association is unclear. He et al. highlighted that increased consumption of fruits and vegetables from less than 3 to more than 5 times a day is associated with 17% reduction in the risk of CHDs while increase in the intake to 3–5 servings/day is associated with a small but borderline significant reduction in the risk of CHDs. [2] Bendinelli et al. indicated that increasing the consumption of leafy vegetables decreased the risk of CHDs; however, no association was observed with respect to fruit consumption [34]. Chinese study examined the associations between plasma concentrations of specific carotenoids and incidence of acute myocardial infarction found that high plasma levels of β-cryptoxanthin and lutein were associated with decreased risk of acute myocardial infarction. The main dietary sources of lutein are leafy green vegetables, such as broccoli, kale and spinach while β-cryptoxanthin is mainly derived from papaya, tangerine, orange, mango, and their juices [35]. The present study also did not show the association between fruit consumption and risk of MI. However, daily consumption of fresh vegetables decreased the risk of MI.

Our study is a typical hospital-based case-control study and has several limitations. Patients with MI who died before they arrived at the hospital were not included in the study which may introduce selection bias.

In Serbia, women are traditionally involved in the preparation of meals. For this reason, many male participants were not aware of their own dietary habits. To reduce recall bias, we interviewed their wives and other household members.

The main limitation of our study was that we used the FFQ proposed by Willett because there is no validated FFQ for the Serbian population. The use of questionnaire is a limitation due to reproducibility issues regarding such an adoption. Nevertheless, we think that the findings of the present study are valid because they refer to large food groups. However, a more detailed study is necessary to validate the results of the present study.

The results of the present study suggest the beneficial effect of fish, fresh vegetables, low-fat dairy products and poultry on the risk of MI in men and women. Consumption of eggs, processed meat and full-fat dairy products increases the risk of MI. These results are in line with those of most other studies.

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Conflicts of Interest statement: The authors declare that there are no conflicts of interest.

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