

# FRUIT AND VEGETABLE INTAKE AND THE RISK FOR DEVELOPING CORONARY HEART DISEASE

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## SUMMARY

The aim of the paper was to study the relationship between dietary intake of fruit and vegetable intake and the risk of coronary heart disease. We used data from a case-control study, conducted from 2001 to 2003, among 290 randomly selected cases (mean age  $59.98 \pm 10.03$  years) with first event of an acute coronary syndrome and 290 selected paired controls by sex, age and region (mean age  $59.43 \pm 10.10$  years), admitted to the same hospitals as cases without any suspicion of coronary disease. Using questionnaires, we assessed fruit and vegetable intake and estimated odds ratio of developing coronary heart disease by the intake. The benefit of fruit or vegetable consumption increased proportionally by the number of servings consumed ( $p$  for trend  $< 0.0001$ ). Those in the upper tertile of fruit consumption ( $\geq 5$  items/day) had 60% lower risk for coronary heart disease (odds ratio = 0.56, 95% CI = 0.35–0.89,  $p < 0.05$ ), when compared to those in the lowest tertile ( $< 1$  item/day). Consumption of vegetable  $\geq 3$  items/day was associated with 70% lower risk of coronary heart disease (OR = 0.25, 95% CI = 0.09 – 0.66,  $p < 0.05$ ), compared to subjects who did not consume vegetables. In agreement with previous studies, we found an inverse relation between vegetable and fruit intake and coronary heart risk. Consumption of fruits and vegetables seemed to provide significant protection against coronary heart disease.

*Key words:* fruit intake, vegetable intake, diet, risk, coronary heart disease

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## INTRODUCTION

Worldwide, cardiovascular disease (CVD) has been estimated as the leading cause of death and disability, with major global public health implications (1, 2). Many risk factors for CVD, including high blood cholesterol, hypertension, obesity and diabetes are substantially influenced by dietary factors (3–5). Diet and physical activity together with smoking are the most important modifiable determinants of cardiovascular risk (6).

Dietary advice regarding CVD prevention is complex. The American Heart Association recommends a diet that includes more than 5 servings of fruit and vegetables daily (8, 9). Many constituents of fruits and vegetables may reduce the risk of coronary heart disease (10–15). It is possible, however, that the combined effects of these and other constituents in fruit and vegetables are best assessed by examining the relation between fruit and vegetable intake and CVD risk directly in the epidemiological studies (16–19). A clear understanding of the relation between fruit and vegetable intake and CVD risk provides health professionals with important information, significant in terms of public health and clinical practice (20).

More than 80% of the global burden of CVD occurs in underdeveloped and developing countries. During the last 30 years, CVD has become one of the leading causes of death in Serbia (21).

Consequently, the aim of the paper was to study the relationship between fruit and vegetable intake and risk of coronary heart disease among people in the southeast Serbia.

## MATERIAL AND METHODS

The data were derived from a case-control study of coronary heart disease conducted in Niš, Serbia between June 2001 and June 2003. This method was considered appropriate because longitudinal studies was not feasible to identify contributing risk factors to a disease. It is economical and requires less time than a cohort study. The cases were 290 patients (194 men, 96 women; median age  $59.98 \pm 10.03$  years, range 23–79 years) admitted to the Cardiology Clinic diagnosed for the first time of an acute coronary syndrome. Majority of cases (88.96%) had a first episode of non-fatal acute myocardial infarction, defined according to the World Health Organization criteria, while the others (11.04%) had an unstable angina pectoris. Each patient was matched with his/her control pair according to sex, age and region of residence and controls (194 men, 96 women; median age  $59.43 \pm 10.10$  years, range 24–79 years) admitted to the same hospitals for a wide spectrum of acute conditions unrelated to familiar risk factors for acute myocardial infarction. Among controls, 63.8% had trauma, 22.06% dermatologic and eye disorders and 14.14% other miscellaneous illnesses. There were neither cases nor controls with diagnosis of diabetes.

Patients and controls were interviewed by a trained physician in a hospital. A questionnaire was developed based on a review of the literature. Structured questionnaires were applied and physical examinations were undertaken in the same manner both in cases and controls. Information about socio-demographic factors, life-

style (smoking, physical activity and dietary patterns), personal and family history of cardiovascular disease was obtained from the first part of the questionnaire. Second part of the questionnaires inquired about the dietary habits of the participants, including frequency of fruits and vegetables dietary intake. The servings were specified with one cup (250 ml). Part III of the questionnaire was to be completed after measuring participants' body weight, body height and waist circumferences were determined by a standard protocol. The serum concentrations of cholesterol and triacylglycerols were obtained from medical records.

Ethical approval for the study was given by the university where the study was based and approval for access was obtained from the Clinical Center, Nis.

We considered fruit and vegetable intake as both a continuous variable (servings/d) and a categorical variable (in tertiles). Odds ratios (OR) of coronary heart disease, and the corresponding 95% confidence intervals (CI), were derived from data stratified by age with Mantel-Haenszel procedure. Data were analyzed with SAS (version 6.12; SAS Institute Inc, Cary, NC).

## RESULTS AND DISCUSSION

Table 1 shows the characteristics of the subject. More patients were overweight and obese than controls. Compared to controls, there were more smokers among the cases. There was also a significant difference in the proportions of subjects with hypercholesterolemia and hypertriacylglycerolemia among the cases and the controls. The patients had a significantly more positive family history of cardiovascular diseases than the controls.

**Table 1.** Baseline characteristics of the participants

Variable	Case	Controls	p*
Duration of education (years)			< 0.001
≤8 (%)	21.0	14.1	
9-12 (%)	55.9	46.9	
> 12 (%)	23.1	39.0	
Smokers (%)	61	59	< 0.00001
Positive familiar anamnesis (%)	51.4	32.8	< 0.00001
Body mass index (kg/m <sup>2</sup> )			< 0.01
≤ 25 (%)	33.1	44.5	
> 25 (%)	66.9	55.5	
Waist circumference (cm)			< 0.001
≤94 ♂ or ≤ 80 ♀ (%)	39	56.2	
>94 ♂ or > 80 ♀ (%)	61	43.8	
Blood cholesterol (mmol/l)			< 0.00001
≤5.2 (%)	19.6	42.1	
>5.2 (%)	80.4	57.9	
Blood triacylglycerols (mmol/l)			< 0.00001
≤ 2.3 (%)	62.8	86.2	
>2.3 (%)	37.2	13.8	

\* t test

Table 2 shows the odds ratio of coronary heart disease according to the frequency of vegetable consumption. The patients, when compared to the controls, consumed fewer vegetable portions. The risk of coronary heart disease was enlarged with the reduction of vegetable intake ( $\chi^2$ -test for trend = 4.040;  $p < 0.05$ ). A rare vegetable consumption (mostly once a week) increased the risk of coronary heart disease 3.14 times (OR = 3.14; 95%CI = 1.32–8.01; Mantel-Haenszel  $\chi^2$ -test = 7.17;  $p < 0.01$ ) when compared to subjects who consumed vegetables more frequently (more than up to once once a day), and was even 4.04 times higher than in individuals who consumed vegetables many times a day (OR = 4.04; 95%CI = 1.51–11.41; Mantel-Haenszel  $\chi^2$ -test = 8.15;  $p < 0.01$ ).

**Table 2.** Risk of coronary heart disease and consumption of vegetable

	Frequency of consumption		
	Lower	Middle	Upper
Number of cases	25	211	54
OR (95% CI)	4.04 (1.51-11.41)	1.06 (0.69-1.65)	1

\* $\chi^2$  - test for trend = 4.04,  $p = 0.04$

The controls, when compared to the cases, consumed more fruit portions a day, as shown in Table 3 (Mantel-Haenszel  $\chi^2$  - test = 6.12;  $p < 0.05$ ). Coronary heart disease risk was higher if the consumption of fruits was lower (mostly once a week) – OR = 1.78 (95%CI = 1.12–2.87).

**Table 3.** Risk of coronary heart disease and consumption of fruit

Frequency of consumption	Cases (n = 290)	Controls (n = 290)	OR (95% CI)
One serving a week till once a day	62	39	1.78 (1.12–2.87)
More times a day	228	251	1

$\chi^2$  - test = 6.12,  $p < 0.05$

The result showed that frequent use/intake of fruit juices was associated with the lower risk of CVD incidence (Table 4). Cases drank fruit juices statistically very rarely compared to the controls (Mantel-Haenszel  $\chi^2$  - test = 11.09;  $p < 0.001$ ). The results confirmed that low frequency of juice intake (mostly once a week) increased the risk of coronary heart disease (OR = 1.78; 95%CI = 1.27–2.54).

In this study, we found an inverse association between fruit and vegetable intake and the CVD risk. Our study confirmed the results from many other epidemiological studies. In a 5-year study of 1,273 Massachusetts residents aged 65 years, it was found that those residents whose intake of carotene-containing fruits or veg-

**Table 4.** Risk of coronary heart disease and consumption of fruit juices

Frequency of consumption	Case (n = 290)	Controls (n = 290)	OR (95% CI)
Once a week till once a day	168	127	1.78 (1.27-2.54)
More times a day	122	163	1

\*  $\chi^2$  - test = 11.09,  $p < 0.001$

ables was in the highest quartile and they had a 46% lower death risk than those whose intake was in the lowest quartile (22).

In a 14-year study of 5,133 Finnish adults (12), assessed vegetable intake with a diet history method showed a relative risk of 0.66 ( $p = 0.02$ ) of coronary mortality when compared to the highest and the lowest tertiles of vegetable intake. However, few prospective studies have attempted to relate fruit and vegetable intake to CVD morbidity in general and to the incidence of myocardial infarct in particular (23).

As far as coronary heart disease is concerned nine out of ten ecological studies, two out of three case-control studies and six out of 16 cohort studies have found a significant protective association with fruit and vegetable consumption. No attempt was made to arrive at a summary measure of the interrelation because of the differences in study type, study quality and the different exposure measures used (24).

Some researchers (25) evaluated the association between fruit and vegetable consumption and the risk of coronary heart disease using the nurses prospective health study and the health professionals follow-up cohort study. They reviewed diet and disease incidence in over 84,200 women aged between 34 and 59 and 42,100 men, aged between 40 and 75. After determining standard cardiovascular risk factors, they found that those who ate the highest number of fruits and vegetables servings had a lower relative risk for coronary heart disease than those who consumed the least amount of fruits and vegetables. People consuming 4 or more servings of fruits and vegetables a day had a decreased risk for coronary heart disease. Those with the intake of at least 8 servings a day produced a further decrease. They found that people who ate more fruits and vegetables had a tendency to live longer, had healthier life habits and smoked less than people who did not eat them. Green leaf vegetables and vitamin C-rich fruits and vegetables appeared to contribute the most to the apparent protective effect of total fruit and vegetable intake. Each increase of 1-serving/day of fruits or vegetables was associated with a 4% lower risk of coronary heart disease (relative risk, 0.96 [95% CI = 0.94 to 0.99];  $p = 0.01$ , test for trend).

More than 250 descriptive studies confirmed that frequent fruit and vegetable consumption was associated with a 6–22% lower risk for coronary heart disease mortality (26). Also prevention of other non-communicable diseases should be based on higher dietary intake of fruit and vegetables (27).

Cereal fiber consumption late in life is associated with lower risk of CVD incidence, therefore supporting recommendations for the elderly to increase consumption of dietary cereal fiber (28). In one study, vegetable intake was not associated with myocardial infarction (29). Fruit dietary fiber has better cardioprotective effects than vegetable fiber, probably because of a more frequent vegetable intake after thermal processing.

## CONCLUSIONS

These data support a protective effect of higher fruits and vegetables consumption against risk of coronary heart disease. Diet modification has the potential to prevent most premature cases of coronary heart disease worldwide. Our results provide further support for the recommendation to consume at least 5 servings of fruits and vegetables a day. The findings of our study suggest that a more aggressive education about the relationship of obesity and exercise with the CVD risk is a must.

Our study calls for efforts such as targeted public health education in order to expand knowledge of fruit and vegetable intake as protective factors of heart disease. Education can be provided to the public through the media (including both electronic and printed) and workshops as well. These programmes must take into consideration attitudes, views and intellectual capabilities of target individuals or groups. Physicians must also play an important part in education of their patients and patients usually rely on them for the first hand information.

## Acknowledgement

We thank the participants of the study for their cooperation. We also thank Mrs. Svetlana Stević, MD, MSc, for her assistance in the statistical analysis. Proofreading was done by a university lecturer for the English language at School of Medicine University of Niš, Nataša Bakić-Mirić, B.A., M.A.

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*Received August 6, 2007  
Accepted in revised form October 29, 2007*