Association between certain foods and risk of acute myocardial infarction in women

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Abstract

***Study objective*—To examine the relation between selected foods and acute myocardial infarction in women.**

***Design*—Case-control study conducted over five years.**

***Setting*—30 Hospitals with coronary care units in northern Italy.**

***Subjects*—287 Women who had had an acute myocardial infarction (median age 49, range 22-69 years) and 649 controls with acute disorders unrelated to ischaemic heart disease (median age 50, range 21-69 years) admitted to hospital during 1983-9.**

***Main outcome measures*—Frequency of consumption of various foods and odds ratios of risks associated with these foods.**

***Results*—The risk of acute myocardial infarction was directly associated with frequency of consumption of meat (odds ratio 1·5 for upper *v* lower thirds of consumption), ham and salami (1·4), butter (2·3), total fat added to food (1·6), and coffee (2·8). Significant inverse relations were observed for fish (0·6), carrots (0·4), green vegetables (0·6), and fresh fruit (0·4). The risk was below one for moderate alcohol consumption (0·7) and above one for heavier intake (1·2). Allowance for major non-dietary covariates, including years of education, smoking, hyperlipidaemia, diabetes, hypertension, and body mass index, did not appreciably alter the estimates of risk for most of the foods; for coffee, however, the odds ratio fell to 1·8 on account of its high correlation with smoking.**

***Conclusions*—The frequency of consumption of a few simple foods may provide useful indicators of the risk of myocardial infarction. Furthermore, specific foods such as fish, alcohol, or vegetables and fruits may have an independent protective role in the risk of cardiovascular diseases.**

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Introduction

Serum cholesterol concentration is strongly suspected to be the main correlate of coronary heart disease in populations as well as in individual people,[1] but it has been suggested that specific nutrients or foods may also have some independent influence on the risk of cardiovascular disease. A prospective study of a community of retired people in California found that a high intake of fibre gave a strong protection against the disease (relative risk 0·3-0·4), which persisted after allowance was made for total intake of energy, fat, cholesterol, and other nutrients.[2] Likewise, the Ireland-Boston diet-heart study showed that intake of vegetables and fibre had an independent effect on mortality from coronary heart disease, with relative risks around 0·6 for the upper third of intake.[3] A longitudinal investigation of 852 middle aged men from The Netherlands found that mortality from coronary heart disease at 20 years' follow up was more than 50% lower in those who consumed more fish.[4] This is consistent with the low death rate from coronary heart disease among Greenland Eskimos.[5] Dietary fish intake may have an effect by lowering plasma concentrations of lipids and total cholesterol and increasing concentrations of high density lipoproteins[6]; an antihypertensive effect of fish oils[7]; or an antithrombotic[8] or anti-inflammatory[9] effect of eicosapentaenoic and other n-3 fatty acids.

It is possible, therefore, that specific foods have independent effects on the risk of coronary heart disease, although these effects may be mediated largely through the foods' influence on serum cholesterol or lipoprotein concentrations. Information on the effects of specific foods would be interesting in terms of public health. We studied the relation between a few selected foods and acute myocardial infarction among women in northern Italy.

Subjects and methods

The present report is derived from a continuing case-control study of myocardial infarction in women based on a network of coronary care units in 30 hospitals in northern Italy. As previously described, women aged under 54 began to be recruited to the study in January 1985, and the upper age limit was raised to 69 in June 1987.[10,11]

Our analysis is based on data collected before March 1989 on 287 women who had had a myocardial infarction (aged 22-69, median age 49) and 649 controls (aged 21-69, median age 50). Table I shows the age distribution of the cases and controls. Of the control group, 162 had been admitted for conditions arising from trauma; 247 for orthopaedic disorders not caused by trauma (mostly lower back pain and disc disorders); 104 for surgical conditions (including plastic surgery); and 136 for miscellaneous illnesses such as acute infections, dental disorders, and disorders of the skin, ear, nose, and throat. Women were excluded from the control group if they had any chronic or digestive conditions; cardiovascular, malignant, hormonal, or gynaecological diseases; or any disorder that was potentially related to consumption of alcohol or smoking.

Women were interviewed with a structured questionnaire to obtain information on sociodemographic factors and general characteristics and habits (for example, smoking, related personal and family medical history, and history of specific drug use). The women were asked whether they drank coffee (or other drinks containing methylxanthine) and various types of alcoholic beverages; their average daily consumption of coffee and alcohol (number of cups or drinks) before the onset of the symptoms of the disease that had led to their admission to hospital; and the total duration of

the habit in years. Data were also collected on the usual frequency of consumption each week of 10 specific foods. We used simple subjective scores based on the womens' rating (low, intermediate, or high) to measure consumption of wholemeal bread or pasta and fats added to food (butter, margarine, and oil). The reproducibility and reliability of the questionnaire were checked by repeating the interview by telephone a few weeks later in about 10% of the patients with infarction and controls.

DATA ANALYSIS AND CONTROL OF CONFOUNDING

The frequency of consumption of each food and drink was divided into approximate thirds; for many of the foods the numbers of patients in each third of consumption were unevenly distributed—for instance, the lower third for consumption of liver (less than one portion per week) contained most of the patients with infarction and controls.

Odds ratios for myocardial infarction together with approximate 95% confidence intervals[12] were derived from data stratified for age in decades by the Mantel-Haenszel procedure.[13] The significance of the linear trend in risk was assessed with the test described by Mantel.[14]

TABLE I—*Characteristics of 287 Italian women who had had acute myocardial infarction during 1983-9 and 649 controls as found by questionnaire. Values are numbers (percentages)*

	Women with myocardial infarction	Controls
Age (years):		
<40	36 (12·5)	140 (21·6)
40-49	103 (35·9)	182 (28·0)
50-59	109 (38·0)	209 (32·2)
≥60	39 (13·6)	118 (18·2)
Duration of education (years):		
<7	175 (61·0)	396 (61·0)
7-11	82 (28·6)	155 (23·9)
≥12	30 (10·5)	98 (15·1)
Hyperlipidaemia present:		
No	233 (81·2)	615 (94·8)
Yes	54 (18·8)	34 (5·2)
Diabetes present:		
No	248 (86·4)	622 (95·8)
Yes	39 (13·6)	27 (4·2)
Hypertension present:		
No	165 (57·5)	551 (84·9)
Yes	122 (42·5)	98 (15·1)
Body mass index (kg/m²):		
<25	219 (76·3)	578 (89·1)
≥25	68 (23·7)	71 (10·9)
Cigarette smoking:		
Never smoked	103 (35·9)	447 (68·9)
No longer smoked	13 (4·5)	24 (3·7)
Currently smoked	171 (59·6)	178 (27·4)

To account for the potential confounding effect of other, non-dietary variables we performed unconditional multiple logistic regression with maximum likelihood fitting.[12 15] All the regression equations included terms for age, years of education, smoking, hyperlipidaemia, diabetes, hypertension, and body mass index (table I). The significance of the linear trends in risk was assessed by computing the differences between the deviances of the models with and without the variable of interest. Finally, to analyse the relation between multiple dietary exposure factors, which may act to confound each other, models were produced that included non-dietary and dietary variables simultaneously.

Results

Table II shows the odds ratios for acute myocardial infarction according to the frequency of consumption of selected foods. Univariate analyses found several significant associations: the risk of myocardial infarction was directly associated with how the women ate meat (odds ratio 1·5 for upper *v* lower third), ham and salami (1·4), butter (2·3), total fat added to foods (1·6), and coffee (2·8). Significant inverse relations were observed for fish (0·6), carrots (0·4), green vegetables (0·6), and fresh fruit (0·4). The odds ratio was below one for moderate alcohol consumption (0·7) and above one for heavier consumption (1·2).

Allowance for the major non-dietary covariates (table III), including years of education, smoking, hyperlipidaemia, diabetes, hypertension, and body mass index, did not appreciably alter the odds ratios for most of the foods, although several associations, particularly that with fresh fruit, were weaker after multivariate analysis. In addition, the odds ratio for coffee fell from 2·8 to 1·8, probably because of the high correlation between coffee and smoking. All the trends in risk remained significant, except that for meat. For alcohol there was no linear trend in risk, but the protection of moderate intake was significant (odds ratio 0·6, 95% confidence interval 0·4 to 0·9).

When non-dietary covariates and foods that were significantly related to the risk of myocardial infarction were included in the same models, the pattern of risk was not substantially changed, although the standard errors of the estimates increased because of the co-linearity between several factors. Consequently, these models are hard to interpret in terms of statistical significance.

TABLE II—*Relation of risk of myocardial infarction and consumption of selected foods and beverages among Italian women who had had myocardial infarction (cases) and controls (1983-9). Results are expressed according to approximate third of frequency of consumption*

	Frequency of consumption (No of portions per week)*			No of cases: No of controls†			Odds ratio‡			
	Lower third	Middle third	Upper third	Lower third	Middle third	Upper third	Lower third§	Middle third	Upper third	χ_1^2
Milk	<1	1-7	>7	115:219	101:280	71:150	1	0·7	0·9	2·7
Meat	<4	4-6	>6	99:241	70:230	118:178	1	0·8	1·5	7·0‖
Liver	<1	1	>1	235:504	39:127	13:18	1	0·6	1·4	0·9
Eggs	<1	1-2	>2	85:209	150:297	52:143	1	1·2	0·8	0·5
Ham and salami	<1	1-2	>2	66:183	107:263	114:203	1	1·1	1·4	4·2¶
Fish	<1	1	>1	148:270	81:220	58:159	1	0·7	0·6	6·4¶
Cheese	<4	4-6	>6	104:230	52:162	131:257	1	0·7	1·0	0·0
Carrots	<1	1	>1	178:274	41:139	67:236	1	0·5	0·4	30·9‖
Green vegetables	<7	7	>7	81:122	91:238	115:289	1	0·6	0·6	7·8‖
Fresh fruit	<7	7-13	>13	70:71	88:252	129:326	1	0·4	0·4	17·3‖
Wholemeal bread	1	2	3	208:463	36:94	42:87	1	0·9	1·1	0·0
Butter	1	2	3	159:399	86:208	42:42	1	1·0	2·3	7·5‖
Margarine	1	2	3	236:560	51:89		1	1·3		2·4
Oil	1	2	3	49:90	202:497	36:62	1	0·7	1·1	0·2
Total fat score	<5	5	>5	129:357	100:199	58:93	1	1·3	1·6	6·8‖
Alcohol	0	1-2	>2	117:257	62:196	108:196	1	0·7	1·2	0·7
Coffee	<2	2-3	>3	87:262	116:292	84:95	1	1·2	2·8	21·8‖
Tea	<1	1	>1	241:498	31:114	15:37	1	0·6	0·8	2·2

*Except for wholemeal bread and fats (subjective scores) and beverages (No of drinks or cups each day).
†For some items the sum of strata does not add up to the total because of missing values.
‡Mantel-Haenszel estimates adjusted for age in decades.
§Reference category.
¶$p<0·05$.
‖$p<0·01$.

TABLE III—*Multiple logistic regression estimates of risk of myocardial infarction in relation to thirds of frequency of consumption of selected foods among Italian women who had had a myocardial infarction and controls (1983-9)*

	Model*	Odds ratio for frequency of consumption: Lower third†	Middle third	Upper third	χ_1^2
Fish	A	1	0·8	0·7	3·9‡
	B	1	1·0	0·8	2·4
Carrots	A	1	0·4	0·4	20·8¶
	B	1	0·5	0·5	14·7¶
Green vegetables	A	1	0·7	0·6	4·3‡
	B	1	0·9	0·7	1·4
Fresh fruit	A	1	0·4	0·4	5·2‡
	B	1	0·5	0·6	1·4
Meat	A	1	0·8	1·4	2·3
	B	1	0·9	1·3	1·7
Ham and salami	A	1	1·2	1·8	7·6¶
	B	1	1·2	1·6	4·1‡
Butter	A	1	1·1	2·1	4·7‡
	B	1	1·0	1·7	1·8
Total fat score	A	1	1·5	1·8	7·8¶
	B	1	1·5	1·7	5·1‡
Coffee	A	1	1·0	1·8	4·9‡
	B	1	1·0	1·6	3·2
Alcohol	A	1	0·6	1·0	0·3
	B	1	0·6	1·0	0·0

*Model A included terms for age, area of residence, education, smoking, hyperlipidaemia, diabetes, hypertension, and body mass index. Model B included the factors in model A and all the food items listed in this table.
†Reference category. ‡$p<0·05$. ¶$p<0·01$.

Discussion

Our study confirms that several aspects of diet can influence the risk of myocardial infarction. Women who had had a myocardial infarction tended to consume meat, butter, fats, and coffee more frequently and fish, vegetables, and fruit less frequently than did controls. As the data were obtained only at interviews the odds ratios were probably underadjusted for the modifying effect of serum lipid concentrations. Even if the associations observed can partly or largely be accounted for by different lipid or lipoprotein patterns in the patients with infarction and controls, however, it is interesting, from a preventive and health education viewpoint, that the frequency of consumption of a few simple foods can serve as important indicators of the subsequent risk of myocardial infarction. Furthermore, specific foods or nutrients such as fish, alcohol, or vegetables and fruits may have some independent roles in cardiovascular disease.

Our study can be criticised for several reasons. For example, it was a typical hospital based case-control study, although we excluded all patients with chronic, cardiovascular, and digestive conditions from the control group and checked the comparability of the catchment areas of the patients with myocardial infarction and controls. We believe that other potential biases can be largely discounted because of the almost complete participation by subjects eligible for the study, the satisfactory reproducibility of the short dietary section of the questionnaire, and the absence of important confounding by the major non-dietary covariates.

It is also reassuring that the recognised major risk factors for myocardial infarction were confirmed in this study. For instance, we found a strong positive association with cigarette smoking (odds ratio above 10 for the heaviest smoking category), which confirms that smoking is the main avoidable cause of coronary heart disease in this population of Italian women.[11] There were also strong associations with history of hyperlipidaemia (odds ratio 3·8), diabetes (2·6) and hypertension (3·2).

When several dietary factors were simultaneously included in a logistic model no major interaction was observed between various foods and the pattern of risk was largely unchanged. Interpreting the significance of estimates from models that included various foods simultaneously was, however, difficult because of problems of colinearity and consequent overadjustment. Nevertheless, we believe that the main conclusions of this study are still valid: there are important and significant associations between the frequency of consumption of a few foods and subsequent risk of myocardial infarction, and the role of these foods may well be independent of that of known risk factors.

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1 Gordon T. The diet-heart idea. *Am J Epidemiol* 1988;**127**:220-5.
2 Khaw KT, Barrett-Connor E. Dietary fiber and reduced ischemic heart disease mortality rates in men and women: a 12-year prospective study. *Am J Epidemiol* 1987;**126**:1093-102.
3 Kushi LH, Lew RA, Stare FJ, *et al.* Diet and 20-year mortality from coronary heart disease: the Ireland-Boston diet-heart study. *N Engl J Med* 1985;**312**:811-8.
4 Kromhout D, Bosschieter EB, Coulander C de L. The inverse relation between fish consumption and 20-year mortality from coronary heart disease. *N Engl J Med* 1985;**312**:1205-9.
5 Bjerregaard P, Dyerberg J. Mortality from ischaemic heart disease and cerebrovascular disease in Greenland. *Int J Epidemiol* 1988;**17**:514-9.
6 Phillipson BE, Rothrock DW, Connor WE, Harris WS, Illingworth DR. Reduction of plasma lipids, lipoproteins, and apoproteins by dietary fish oils in patients with hypertriglyceridemia. *N Engl J Med* 1985;**312**:1210-6.
7 Hostmark AT, Bjerkedal T, Hierulf P, Flaten H, Veshagen K. Fish oil and plasma fibrinogen. *Br Med J* 1988;**297**:180-1.
8 Knapp HR, Fitzgerald GA. The antihypertensive effects of fish oil: a controlled study of polyunsaturated fatty acid supplements in essential hypertension. *N Engl J Med* 1989;**320**:1037-43.
9 Lee TH, Hoover RL, Williams JD, *et al.* Effect of dietary enrichment with eicosapentaenoic and decosahexaenoic acids on in vitro neutrophil and monocyte leukotriene generation and neutrophil function. *N Engl J Med* 1985;**312**:1217-24.
10 La Vecchia C, Franceschi S, Decarli A, Pampallona SA, Tognoni G. Risk factors for myocardial infarction in young women. *Am J Epidemiol* 1987;**125**:832-43.
11 Gramenzi A, Gentile A, Fasoli M, *et al.* Smoking and myocardial infarction in women: a case-control study from northern Italy. *J Epidemiol Community Health* 1989;**43**:214-7.
12 Breslow NE, Day NE. *Statistical methods in cancer research. Vol 1. The analysis of case-control studies.* Lyons: International Agency for Research on Cancer, 1980. (Publication No 32.)
13 Mantel N, Haenszel W. Statistical aspects of the analysis of data from restrospective studies of disease. *Journal of the National Cancer Institute* 1959;**22**:719-48.
14 Mantel N. Chi-square tests with one degree of freedom; extension of the Mantel-Haenszel procedure. *Journal of the American Statistics Association* 1963;**58**:690-700.
15 Baker RJ, Nelder JA. *The GLIM system. Release 3.* Oxford: Numerical Algorithms Group, 1978.

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ONE HUNDRED YEARS AGO

Dr. Regnard has raised the question as to whether a corpse which sinks to a very great depth is preserved indefinitely or otherwise from putrefaction. According to his researches, published in the archives of the Biological Society of Paris, putrefaction does not take place in decomposable substances submitted to a pressure of 600 to 700 atmospheres. These figures correspond to a depth of 6,000 to 7,000 metres at sea. From these experiments it must not be concluded, according to Dr. Regnard, that there is a total absence of putrefaction in the greater depths of the sea. The curious "abysmal" fishes discovered in the *Challenger* and other expeditions appear to rise after death, so that they are sometimes found on the surface, though, as a rule, they go to pieces as the surrounding pressure diminishes, long before they reach the air. Still, there is no proof that bathybial or abysmal micro-organisms do not exist, and, if so, they could cause decomposition in the corpses of men as well as in the dead bodies of abysmal fishes. The question is of considerable medico-legal, and yet greater biological, interest, and it is far from settled.

(*British Medical Journal* 1890;i:310.)