

SHORT COMMUNICATION

Pizza and risk of acute myocardial infarction

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Objectives: Pizza eating has been favourably related to the risk of cardiovascular disease, but the data are limited. To evaluate the potential role of pizza consumption on the risk of acute myocardial infarction (AMI), we considered data from an Italian study.

Design: We conducted a hospital-based case-control study on 507 cases of nonfatal AMI and 478 controls in Milan, Italy, between 1995 and 1999.

Results: The multivariate odds ratios were 0.78 for occasional, 0.62 for regular and 0.44 for frequent eaters. The estimates were similar across strata of age, sex, smoking and other major covariates.

Conclusions: Some of the ingredients of pizza have been shown to have a favourable influence on the risk of cardiovascular disease. However, there is no single explanation for the present findings. Pizza may in fact represent a general indicator of Italian diet, that has been shown to have potential cardiovascular benefits.

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Introduction

Pizza has been favourably related to the risk of cardiovascular disease (CVD) and cancer, but the data are limited. In the Women's Health Study, a prospective study of almost 40 000 middle-age and older women and based on 719 CVD cases, an inverse association was found between pizza and CVD, the multivariate relative risk being 0.66 for ≥ 2 portions per week (Sesso *et al*, 2003). In a network of case-control studies from several Italian regions, pizza eating was inversely related to the risk of several digestive tract cancers (Gallus *et al*, 2003). Since pizza is one of the most widespread and best-known Italian foods, Italy represents the ideal environment to investigate potential relations between pizza eating and disease risk.

Methods

We considered the potential role of pizza consumption on the risk of acute myocardial infarction (AMI) in a case-control

study conducted in Milan, Italy, between 1995 and 1999 (Tavani *et al*, 2001). Cases were 507 patients (378 men, 129 women, aged 25–79 y, median age 61 y) in hospital with a first episode of nonfatal AMI and controls were 478 patients (297 men, 181 women, aged 25–79 y, median age 59 y) admitted to the same hospitals for acute conditions unrelated to AMI risk factors (34% traumas, 30% nontraumatic orthopaedic disorders, 14% surgical conditions, 22% miscellaneous other diseases). Interviews were conducted in the hospital using a structured questionnaire, including information on socio-demographic factors, anthropometric variables, tobacco, alcohol, other lifestyle habits, medical history, physical activity and family history of AMI. The subject's usual diet before diagnosis (or hospital admission) was investigated using a validated 78-item food frequency questionnaire (Franceschi *et al*, 1995a; Decarli *et al*, 1996) that included a specific question on pizza, in portions per week, one portion corresponding to 200 g. For the present analyses, pizza eating was classified into three categories: noneaters, occasional eaters (one–three portions per month) and regular eaters (≥ 1 portion of pizza per week; mean amount around 250 g of pizza per week). Frequent eaters were subjects eating ≥ 2 portions of pizza per week (mean amount around 500 g of pizza per week).

The odds ratios (OR) were derived using unconditional multiple logistic regression, including terms for age, sex, place of birth, education, body mass index (BMI), serum cholesterol, smoking, coffee, alcohol, vegetable, fruit and

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meat consumption, caloric intake, physical activity, history of hyperlipidaemia, diabetes and hypertension and a family history of AMI in first-degree relatives.

Results

Compared to controls, cases were slightly more educated (multivariate OR was 1.20 for ≥ 12 vs < 7 y), reported less physical activity (OR was 1.39 for low vs high), were more frequently smokers (OR was 2.51 for ≥ 15 cigarettes per day vs never smokers) and coffee drinkers (OR was 1.46 for ≥ 21 vs < 10 cups per week), and less frequently alcohol drinkers (OR was 0.55 for ≥ 3 vs < 1 drinks per day), had higher BMI (OR was 1.34 for ≥ 27 vs < 24 kg/m²), and reported more frequently a history of hypertension (OR was 1.47), diabetes (OR was 2.72) and a family history of AMI (OR was 4.34 for

≥ 2 vs 0 first degree relatives). Among other characteristics linked to Mediterranean diet, cases were less frequently consumers of vegetables (OR was 0.79 for ≥ 11 vs < 7 portions per week) and fruit (OR was 0.66 for ≥ 15 vs < 10 portions per week) and had higher caloric intake (OR was 1.46 for higher vs lower quartile).

Compared to nonpizza eaters, the age- and sex-adjusted OR was 0.81 for occasional and 0.59 for regular eaters. Corresponding estimates from multivariate analyses were 0.78 and 0.62, respectively (Table 1). The multivariate OR was 0.44 (95% confidence interval (CI): 0.20–0.97) for ≥ 2 portions per week.

The estimates were similar across strata of age, sex, BMI, cigarette smoking and alcohol drinking, even if the protective effect of pizza seemed to be stronger in current smokers (Table 2). Data were inadequate to investigate diabetics only,

Table 1 Distribution of 507 cases of acute myocardial infarction (AMI) and 478 controls, and corresponding odds ratios (OR) with 95% confidence intervals (CI), according to pizza consumption (Italy, 1995–1999)

	AMI cases:controls	OR ^a (95% CI)	OR ^b (95% CI)
<i>Pizza</i>			
Noneaters	167:119	1 ^c	1 ^c
Eaters		0.73 (0.55–0.98)	0.73 (0.53–1.01)
Occasional ^d	230:214	0.81 (0.59–1.10)	0.78 (0.55–1.10)
Regular ^d	110:145	0.59 (0.41–0.85)	0.62 (0.41–0.94)
χ^2_{trend} ^e (p)		7.78 (0.005)	5.10 (0.024)

^aEstimates from multiple logistic regression equations including terms for age and sex.

^bEstimates from multiple logistic regression equations including terms for age, sex, place of birth, education, BMI, serum cholesterol, smoking, coffee, alcohol, vegetables, fruit, meat, caloric intake, physical activity, hyperlipidaemia, diabetes, hypertension and family history of AMI in first-degree relatives.

^cReference category.

^dOccasional means one–three portions per month; regular ≥ 1 portions per week.

^eBased on three levels (non/occasional/regular pizza eaters).

Table 2 Odds ratios (OR), with corresponding 95% confidence intervals (CI), 507 cases of acute myocardial infarction (AMI) and 478 controls, according to pizza consumption (Italy, 1995–1999)

Strata	OR ^{a,b} (95% CI)		χ^2_{trend} ^d (p)	OR ^{a,b} (95% CI)
	Occasional ^f	Regular ^f		All eaters
<i>Age (y)</i>				
<55	0.45 (0.19–1.06)	0.50 (0.21–1.19)	1.31 (0.252)	0.47 (0.21–1.06)
≥ 55	0.88 (0.60–1.30)	0.56 (0.33–0.93)	4.40 (0.036)	0.78 (0.54–1.13)
<i>Sex</i>				
Males	0.70 (0.46–1.07)	0.67 (0.41–1.11)	2.50 (0.114)	0.69 (0.46–1.04)
Females	1.16 (0.55–2.44)	0.49 (0.20–1.17)	2.30 (0.129)	0.86 (0.43–1.70)
<i>BMI (kg/m²)</i>				
<25	0.98 (0.60–1.61)	0.56 (0.31–1.03)	3.18 (0.075)	0.84 (0.53–1.35)
≥ 25	0.63 (0.38–1.06)	0.65 (0.35–1.19)	2.13 (0.144)	0.64 (0.39–1.04)
<i>Smoking</i>				
Never and ex-	0.89 (0.58–1.38)	0.71 (0.42–1.21)	1.55 (0.213)	0.83 (0.55–1.26)
Current	0.43 (0.22–0.83)	0.35 (0.16–0.74)	7.22 (0.007)	0.40 (0.22–0.76)
<i>Alcohol (drinks/week)</i>				
<14	0.73 (0.44–1.23)	0.58 (0.31–1.06)	3.22 (0.073)	0.68 (0.42–1.10)
≥ 14	0.82 (0.50–1.35)	0.80 (0.44–1.49)	0.52 (0.469)	0.81 (0.50–1.31)

^aEstimates from multiple logistic regression equations including terms for age, sex, place of birth, education, BMI, serum cholesterol, smoking, coffee, alcohol, vegetables, fruit, meat, caloric intake, physical activity, hyperlipidaemia, diabetes, hypertension and family history of AMI in first-degree relatives.

^bReference category is 'non pizza eaters'.

^cOccasional means one–three portions per month; regular ≥ 1 portion per week.

^dBased on three levels (non/occasional/regular pizza eaters).

but when excluding 74 cases and 30 controls with history of diabetes, the OR for regular pizza eaters was 0.55 (95% CI: 0.36–0.85).

Discussion

The strengths of the study include the validity and reproducibility of the food frequency questionnaire (Franceschi *et al*, 1995a; Decarli *et al*, 1996). Moreover, cases and controls were interviewed in the same hospitals and came from the same geographical area, participation was over 95%, and a different recall of pizza intake on the basis of the disease status is unlikely. We were also able to allow in the analyses for a large number of identified potential confounding factors, which however did not explain the inverse association with pizza. The main value of this study, moreover, is given by the originality of the population studied and of the results obtained.

In Italy, most pizza is usually consumed in relatively cheap traditional restaurants called Pizzerias, whereas fast food pizza consumption remains unusual, and the average energy yield of a standard pizza is relatively limited, ie 500–800 kcal. A 100 g of the traditional Italian pizza include approximately 50 g of carbohydrates, 20 g of tomato sauce, 20 g of mozzarella cheese, 4 g of olive oil, 2 g of yeast plus various other toppings (Salvini *et al*, 1998). Some of the ingredients of pizza have been shown to have a favourable influence on the risk of CVD (Hu & Willett, 2002). We separately considered the association of major ingredients of pizza with AMI risk: although the OR for tomatoes and mozzarella cheese tended to be below unity (Tavani *et al*, 2002), no consistent association was observed for lycopene or olive oil (Bertuzzi *et al*, 2002).

In a clinical study based on 25 subjects, pizza consumption, unlike high-fat meals, did not increase the stickiness of the endothelium (Giugliano *et al*, 2001). Nonetheless, there is no single explanation for the present findings, and pizza may simply represent a general indicator of Italian diet (Gallus *et al*, 2003; Sesso *et al*, 2003), that, as other Mediterranean dietary patterns, has been shown to have potential cardiovascular benefits (Verschuren *et al*, 1995; Trichopoulos *et al*, 2003). However, allowance for an *a priori* defined Mediterranean score (Bosetti *et al*, 2003) did not materially modify the OR for pizza.

In Italy, pizza may also be a general indicator of dietary diversity, that has been shown to be beneficial on the risk of CVD (Kant *et al*, 1995), as well as several common cancers (Franceschi *et al*, 1995b; La Vecchia *et al*, 1997; Fernandez *et al*, 2000) and all cause mortality (Kant *et al*, 1993). In our data, pizza consumption was strongly related to a diet diversity score (the average amounts of the diet diversity score were 27.8, 30.8 and 33.5 in non, occasional and regular pizza eaters, respectively; $F = 49$, $P < 0.0001$). However, after further adjustment for variety, the OR for regular pizza eaters did not materially change (OR was 0.63). Likewise, pizza consumption was positively correlated with a number of

micronutrients inversely related to the risk of CVD (Tavani *et al*, 2001; Hu & Willett, 2002; Tavani *et al*, 2002; Hu, 2003), including n-3 polyunsaturated fatty acids, folate, potassium, antioxidant vitamins and calcium.

These cautions notwithstanding, the present results suggest that pizza consumption is a favourable indicator of risk of AMI in Italy.

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