

Pizza consumption and the risk of breast, ovarian and prostate cancer

Silvano Gallus^a, Renato Talamini^b, Cristina Bosetti^a, Eva Negri^a,
Maurizio Montella^c, Silvia Franceschi^d, Attilio Giacosa^e and Carlo La Vecchia^{a,f}

Pizza has been favourably related to the risk of prostate cancer in North America. Scanty information, however, is available on sex hormone-related cancer sites. We therefore studied the role of pizza consumption on the risk of breast, ovarian and prostate cancers using data from three hospital-based case-control studies conducted in Italy between 1991 and 2002. These included 2569 women with breast cancer, 1031 with ovarian cancer, 1294 men with prostate cancer, and a total of 4864 controls. Compared with non-pizza eaters, the multivariate odds ratios for eaters were 0.97 (95% confidence interval (CI) 0.86–1.10) for breast, 1.06 (95% CI 0.89–1.26) for ovarian and 1.04 (95% CI 0.88–1.23) for prostate cancer. Corresponding estimates for regular eaters (i.e. ≥ 1 portion per week) were 0.92 (95% CI 0.78–1.08), 1.00 (95% CI 0.80–1.25) and 1.12 (95% CI 0.88–1.43), respectively. Our results do not show a relevant role of pizza on the risk of sex hormone-related cancers. The difference with selected studies from North America suggests that dietary and lifestyle correlates of pizza eating vary between

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^aIstituto di Ricerche Farmacologiche "Mario Negri", 20157 Milan, Italy, ^bServizio di Epidemiologia e Biostatistica, Centro di Riferimento Oncologico, 33081 Aviano (PN), Italy, ^cIstituto Tumori "Fondazione Pascale," Cappella dei Cangiani, 80100 Naples, Italy, ^dInfection and Cancer Epidemiology Group, International Agency for Research on Cancer, F-69372 Lyon, cedex 08, France, ^eGastroenterology and Nutrient Unit, National Institute for Cancer Research, 16100 Genoa, Italy and ^fIstituto di Statistica Medica e Biometria, Università degli Studi di Milano, 20133 Milan, Italy

Correspondence to: Silvano Gallus, Istituto di Ricerche Farmacologiche "Mario Negri", Via Eritrea 62, 20157 Milan, Italy
Tel: +39 02 39014 526; fax: +39 02 33200231;
e-mail: gallus@marionegri.it

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Introduction

In the Italian population, pizza has been favourably related to the risk of cardiovascular disease (Gallus *et al.*, 2004a) and of several digestive tract cancers, including those of the oral cavity and pharynx, oesophagus and colon (Gallus *et al.*, 2003). Scanty information is available on other cancer sites, including breast, ovary and prostate. A case-control study from the USA showed a direct association between savoury meals, including pizza, and breast cancer (Ingram *et al.*, 1991). An inverse trend in risk with pizza eating was observed for prostate cancer in the US Health Professionals Follow-Up Study (Giovannucci *et al.*, 1995). This has been interpreted in terms of a favourable effect of lycopene, a carotenoid with strong antioxidant activity, found mainly in (cooked) tomatoes and tomato sauce, on the risk of prostate cancer (Giovannucci *et al.*, 1995; Giovannucci, 1999) and possibly other neoplasms (La Vecchia, 2002).

We therefore analysed data from an integrated series of case-control studies on breast, ovarian and prostate cancer, conducted in Italy, a country where pizza consumption is frequent.

Materials and methods

We analysed data on pizza consumption in three hospital-based case-control studies (Franceschi *et al.*, 1995a; Bosetti *et al.*, 2001, 2004) conducted in various regions of northern, central and southern Italy, between 1991 and 2002. These included 2569 women with histologically confirmed breast cancer (Franceschi *et al.*, 1995a), 1031 women with ovarian cancer (Bosetti *et al.*, 2001), 1294 men with prostate cancer (Bosetti *et al.*, 2004), and a total of 4864 controls (3413 women and 1451 men), admitted to the same hospitals as cases for acute, non-neoplastic conditions (24% for traumas, 32% for non-traumatic orthopaedic disorders, 15% for surgical conditions, and 29% for miscellaneous other diseases). In all the studies, interviews were conducted in hospital using the same structured questionnaire, including information on socio-demographic factors, anthropometric variables, tobacco and alcohol consumption, other lifestyle habits and physical activity. Each subject's usual diet before diagnosis (or hospital admission) was investigated using a validated 78-item food-frequency questionnaire (Decarli *et al.*, 1996) that included a specific question on pizza consumption, in portions per week. Pizza eating was classified in three categories: non-eaters (< 1 portion

Table 1 Distribution of 2569 breast cancer cases and corresponding 2588 controls, 1031 ovarian cancer cases and 2411 controls, and 1294 prostate cancer cases and 1451 controls, according to pizza consumption, and corresponding odds ratios (OR) and 95% confidence intervals (CI). Italy, 1991–2002

Pizza	Breast cancer		Ovarian cancer		Prostate cancer	
	Cases:controls ^a	OR ^b (95% CI)	Cases:controls ^{a,c}	OR ^b (95% CI)	Cases:controls	OR ^b (95% CI)
Non-eaters	904:968	1 ^d	331:906	1 ^d	552:626	1 ^d
Eaters		0.97 (0.86–1.10)		1.06 (0.89–1.26)		1.04 (0.88–1.23)
Occasional ^e	1059:1029	0.99 (0.87–1.14)	436:939	1.09 (0.91–1.31)	529:602	1.02 (0.85–1.21)
Regular ^e	606:591	0.92 (0.78–1.08)	263:566	1.00 (0.80–1.25)	213:223	1.12 (0.88–1.43)
χ^2_{trend} ^f (P)		0.92 (0.34)		0.01 (0.93)		0.68 (0.41)

^a1586 female controls were common for the studies of ovarian and breast cancer.

^bEstimated from multiple logistic regression equations including terms for age, study center, education, body mass index, cigarette smoking, alcohol drinking, total energy intake and physical activity.

^cThe sum does not add up to the total because of one missing value among cases.

^dReference category.

^eOccasional means 1–3 portions per month; regular ≥ 1 portion per week.

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

of pizza per month), occasional (1–3 portions per month) and regular eaters (≥ 1 portion of pizza per week). All the three studies had a statistical power greater than 90% to estimate an odds ratio (OR) lower than 0.77 and greater than 1.30. Moreover, the number of subjects was large enough to allow in the model for several covariates.

Results

Compared with non-pizza eaters, the multivariate ORs for eaters were 0.97 (95% confidence interval (CI) 0.86–1.10) for breast, 1.06 (95% CI 0.89–1.26) for ovarian and 1.04 (95% CI 0.88–1.23) for prostate cancer. Corresponding estimates for regular pizza eaters were 0.92 (95% CI 0.78–1.08), 1.00 (95% CI 0.80–1.25) and 1.12 (95% CI 0.88–1.43), respectively (Table 1). None of the trends in risk was significant.

Discussion

Our results are of specific interest, given the widespread attention given in the USA to the inverse association between pizza consumption and prostate cancer found in the Health Professionals cohort study (Giovannucci *et al.*, 1995).

Potential limitations of these studies are selection and information bias related to the hospital-based case-control design. However, 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. Moreover, Italy represents an interesting environment to investigate the issue, since pizza is one of the best known and most widespread Italian foods, and prevalence of pizza consumption is relatively high, thus increasing the study power. Other strengths of the study include the large number of subjects, the satisfactory validity and reproducibility of the food-frequency questionnaire (Franceschi *et al.*, 1995b; Decarli

et al., 1996), and the possibility of allowance for a large number of potential confounding factors, including education, body mass index, physical activity and total energy intake.

Our results do not support the hypothesis of a relevant role of pizza consumption on the risk of sex hormone-related cancers. Nonetheless, pizza could represent a general indicator of a Mediterranean diet, which has been shown to have appreciable benefits on several digestive cancers, but smaller effects on the risk of sex hormone-related cancers (Bosetti *et al.*, 2003; Gallus *et al.*, 2004a,b).

The difference with selected studies from North America, including the US Health Professionals Follow-Up Study (Giovannucci *et al.*, 1995) (i.e. a study conducted in a health-conscious population), suggests that dietary (since pizza is not consumed independent of other foods) and lifestyle correlates of pizza eating vary between and within different populations and social groups.

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