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Relationship between intakes of meat, fish and poultry and risk of prostate cancer among Iranian men: A case-control study

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A B S T R A C T

Background: Red/processed meats are suggested to increase risk of prostate cancer (PCa). We examined the link between unprocessed red meat, processed meat, fish and poultry consumption with risk of PCa.

Methods: In this hospital based, case–control study, a total of 50 patients with prostate cancer and 100 controls underwent face-to-face interviews. Logistic regression analysis, were used to examine the relation between unprocessed red meat, processed meat, fish and poultry consumption and risk of PCa.

Results: It was observed that a significant positive association between consumption of total meat and risk of PCa (above median vs. below median: OR = 4.6, 95%CI 1.7-12.5). A significant positive association between organ meat (above median vs. below median: OR=3.1, 95%CI =1.3-7.6) and processed meat (above median vs. below median: OR=2.5, 95%CI =1.0-6.1) and risk of PCa was observed ($p<0.05$). Positive association between beef and mutton consumption and risk of PCa was not significant ($p =0.762$). Fish consumption were also negatively associated with risk of PCa (above median vs. below median: OR = 0.07, 95% CI =0.02-0.2) ($p<0.05$). The association between poultry consumption and risk of PCa, was not significant ($p =0.083$).

Conclusion: The results of the present study suggest that high consumption of processed meat and organ meat might be positively associated with an increased risk of PCa in Iranian men. Furthermore, fish consumption might be a protective factor for PCa in Iranian men.

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Introduction

Prostate cancer (PCa) is the third most commonly diagnosed cancer in many countries and the second cause of cancer death among men (1). PCa is reportedly the 3rd most commonly diagnosed visceral cancer, accounting for almost

7.75% of new cancer cases in Iran, and is the 7th most common cause of cancer death in this country (2). According to the Ministry of Health Cancer Registry report in 2004 and 2005 to 2006, the age-standardized incidence rate of PCa in Iran were 7.24 and 9.22 men per 100,000 respectively (3, 4) . This rate is significantly lower than the rates reported for Western countries and the United States (49.4 per 100,000 and 158.2 per 100,000, respectively) (5) . As a result, it is interesting to explore the underlying reasons for the lower incidence and mortality rate of PCa among Asian men compared to their Western counterparts. PCa, especially considering the fact that latent or clinically insignificant of the PCa is found at autopsy at about the same rate in men from Asian countries as those from the United States (about 30% of men aged over 50 years) (6). Is it possible that diet and nutrition play an important role in accelerating or inhibiting the process by which clinically significant PCa develops.

Studies in China (6) and Japan (7) have shown that consumption of soybeans and fish would decrease the risk of PCa. However, intakes of these foods are not common in Iran. Recently published findings suggest that high intakes of certain types of meat (e.g., red and processed meat) may increase the risk of PCa (8, 9); however, this finding is based on a mostly-Caucasian population and may therefore not apply to individuals with different lifestyles and ethnic backgrounds. Iranians have certain different dietary preferences based on their cultural influences; for instance consumption of red meat (beef, lamb) and red meat products (sausage, and hamburgers) in population living in western Iran is quite higher than the average (594.6 ± 956.2 g/week for red meat and 132.5 ± 251.1 g/week for red meat products)(10). Therefore, due to the large racial differences in PCa risk, further investigation of diet is warranted. To our knowledge, there are only few diet studies on PCa in Iran.

The aim of the present study was to assess the role of unprocessed red meat, processed meats, fish and poultry intake in the etiology of PCa in a hospital-based case-control study in Tehran (capital city of Iran) with high prevalence of this cancer.

Subjects and methods

Study population

The present study was conducted in Tehran Province in Iran. Cases were patients aged 40–78 years who were admitted to 'Labbafi-Nejad Hospital' with incident, histologically confirmed cancers of the prostate. Cases were diagnosed not before 6 months of the interview, with no history of cancers of other sites.

Controls were patients (43-71years) who were admitted to the same hospital without neoplastic conditions and long-term modification of diet. Cases and controls were frequency matched according to the age (5-year groups) and body mass index (<19, 19-25, 25-30, 30<). In total, fifty patients with prostate cancer and 100 controls underwent face-to-face interviews by specifically-trained professional interviewers.

Assessment of dietary intakes

Subjects' dietary intakes during the past year, was evaluated using a valid and reliable semi-quantitative food frequency questionnaire (FFQ) (through face-to-face interviews)(11). This FFQ comprises of 168 food items with standard serving sizes and participants were asked to specify their consumption frequency for each food item on a daily, weekly, monthly or yearly basis. These reported intakes were then converted to daily frequencies and the manual for household measures was used to convert intake frequencies to daily grams of food intake (12). Calories from foods were then measured using the United States Department of Agriculture (USDA) food composition table included in the Nutritionist 4 software (First Databank, Hearst Corp, San Bruno, CA, USA). We did not use the Iranian food composition table since it is incomplete and contains information on limited number of raw food items. However for some traditional Iranian food items that are not included in Nutritionist 4 software (e.g., traditional breads, some dairy products such as Kashk, and sour cherry) Iranian food composition table was used alternatively (13). To prevent the data complexity, we grouped individual items into twenty-five distinct food groups. Grouping was based on the similarity of nutrient profiles or their association with cancer and was similar to what was used in earlier studies (14, 15). Unprocessed red meat, processed meats, organ meat, fish and poultry were among these food groups that we aimed to consider their association with risk of prostate cancer. Since alcohol consumption was not answered by our participants due to their cultural beliefs, it was not included in the analysis.

Assessment of non-dietary exposures

We used general questionnaires to collect participants' socio demographic and lifestyle information, including age (years), ethnicity (Persian, not Persian), smoking (yes/no), family

Table 1 Characteristics of the subjects in a case–control study of prostate cancer in Iran

	Controls	Prostate cancer	p-value
Number	100	50	
Age (median, yr)	56.9 (6.0)*	57.4 (5.9)*	0.816[a]
BMI (median, kg/m ^{2})	27.1 (4.6)*	27.8 (4.5)*	0.103[a]
Waist circumference (mean, cm)	102.9 (9.1)*	105.7 (8.3)*	0.247[a]
Ethnicity			0.071[b]
Fars (n, %)	89 (89)	41 (82)	
Not Fars	11 (11)	9 (18)	
Smoking (n, %)			0.010[b]
Yes	5 (5)	23 (46)	
No	95 (95)	27 (54)	
Family history of cancer (n, %)			0.621[b]
Yes	13 (13)	14 (28)	
No	87 (87)	36 (72)	
Diabetes (n, %)			0.031[b]
Yes	7 (7)	13 (26)	
No	93 (93)	37 (74)	

*indicates mean (SD); otherwise data are presented as n (%).

[a]Student t-test

[b]Chi-square

history of cancer (yes/no) and having diabetes (yes/no).

Weight and height were measured while participants were wearing only light clothing without shoes. Weight was measured using digital scales (Seca 881, Germany) and it was recorded to the nearest 0.1 kilograms.

Height was measured using a stadiometer (Seca 214 portable stadiometer) and was recorded to the nearest 0.1 cm. Body mass index (BMI) was then calculated dividing the weight in kg by square of height in meters.

Statistical analysis

Unprocessed red meat, processed meat, fish and poultry intake scores and scores for each of the components of these groups were divided into two categories (based on the medians, because of the small sample size). We used Chi-square test to evaluate the differences in distribution of categorical variables (e.g. and smoking), and analysis of variance tests to check the differences in distribution of continuous variables (e.g. BMI) across meat score categories. Unconditional logistic regression was used to estimate Odds Ratios (OR). Having diabetes (yes/no), and total energy intake were considered as potential confounders and were also included in the logistic regression models.

Table 1 presents the frequency distribution of fifty cases of prostate cancer and one hundred controls according to the selected variables. Cases had higher family history of cancer, smoking usage, and diabetes (Table 1). Table 2 shows the association between total red meat, organ meat, beef, mutton, processed meat, poultry and fish intake, with risk of PCa. We observed a significant positive association between consumption of total meat and risk of PCa (above median vs. below median: OR = 4.6, 95%CI 1.7-12.5). A significant positive association between organ meat (above median vs. below median: OR=3.1, 95%CI =1.3-7.6) and processed meat (above median vs. below median: OR=2.5, 95%CI =1.0-6.1) and risk of PCa was observed ($p<0.05$). Positive association between beef and mutton consumption and risk of PCa was not significant ($p =0.762$). Fish consumption were also negatively associated with the risk of PCa (above median vs. below median: OR = 0.07, 95% CI =0.02-0.2) ($p<0.05$). The association between poultry consumption and risk of PCa, was not significant ($p =0.083$).

Discussion

In the present research, high consumption of red meat, organ meat and processed meat was associated with a significantly increased risk of PCa. The beef and mutton consumption was associated with risk of PCa. But the relation was not significant. Furthermore, findings of our study support an inverse association between fish consumption and PCa development. There was an inverse association between poultry intake and risk of PCa too. But this relation was not

Table 2 - Adjusted odds ratios and 95% confidence interval (based on the median control group) received for prostate cancer associated with red meat, processed meat, organ meat, fish and poultry

	Median of intakes (g/day)		Crude OR (95%CI)	Adjusted OR (95% CI)	p-value
Total red meat	<20.1	>20.1			
Cases, n (%)	8 (16)	42 (84)	5.2 (2.2-12.3)	4.6 (1.7-12.5)	0.002
Control, n (%)	50 (50)	50 (50)	1.0 (ref)	1.0 (ref)	
Organ meat	<1.9	>1.9			
Cases, n (%)	10 (20)	40 (80)	4.0 (1.8-8.9)	3.1 (1.3-7.6)	0.013
Control, n (%)	50 (50)	50 (50)	1.0 (ref)	1.0 (ref)	
Processed meat	<0.2	>0.2			
Cases, n (%)	12 (24)	38 (76)	2.8 (1.3-5.9)	2.5 (1.0-1.6)	0.041
Control, n (%)	50 (50)	50 (50)	1.0 (ref)	1.0 (ref)	
Beef an Mutton	<16.9	>16.9			
Cases, n (%)	22 (44)	28 (56)	2.1 (0.6-2.0)	1.8 (0.4-1.9)	0.762
Control, n (%)	50 (50)	50 (50)	1.0 (ref)	1.0 (ref)	
Fish	<3.2	>3.2			
Cases, n (%)	40 (80)	10 (20)	0.06 (0.03-0.15)	0.07 (0.02-0.2)	0.001
Control, n (%)	50 (50)	50 (50)	1.0 (ref)	1.0 (ref)	
Poultry	<47.0	>47.0			
Cases, n (%)	27 (54)	23 (46)	0.6 (0.06-2.9)	0.6 (0.05-2.6)	0.083
Control, n (%)	50 (50)	50 (50)	1.0 (ref)	1.0 (ref)	

a: Abbreviations are as follows: CI, confidence interval.

b: having diabetes (yes/no) and total energy intake were also included in the regression models as covariates.

[a] Analysis of variance

[b] Analysis of covariance, adjusted for energy intake

[c] PUFAs, polyunsaturated fats

significant. The strength of the present study is the high participation rate (more than 90%). We collect our data from Labafi Nejad Hospital that is a referral hospital for prostate cancer. To decrease the probability of recall bias, we registered incident cases. We also carefully selected controls from patients only with conditions that were not associated with diet or other major risk factors of PCa. Studies in developing countries can provide unique opportunities to test the association between diet and cancer. Furthermore, there is a wide range of differences in demographic related factors; mainly access to the health care systems, between western and developing countries that play a vital role in influencing the outcome (16).

Before the implications of our findings, it is necessary to consider some limitations of our study; First, although we used a validated food-frequency questionnaire (FFQ) for assessing the dietary intake, measurement errors that might led to underestimation or even over estimation of associations were inevitable. Second, there is also a possibility that individuals with prostate cancer would recall their diets differently than controls as a result of their disease status (recall bias). Third, Small sample size is also another limitation which might result unstable results and extreme relative risk estimates. Fourth, we forced to pre specify the number of factors and although we used eigenvalues, scree plots, and interpretability, that we should accept such a decision is subjective (17). PCa is a slowly growing cancer. Even though diet in mid-life may be more important than the diet later in life, the long time passed from the patients' mid-life restricts our ability to evaluate that time period. In this study we measured diet during the past year to avoid the measurement errors and assumed that probability of changing diet was lower using this approach. Furthermore, the studies have suggested that if remote diet is of interest, focusing questions on the period of interest provides the most accurate information. However the use of current diet as a surrogate for past diet provides almost the similar information in some instances (16). The possibility of selection bias and small sample size are also a limitation which might result unstable results and extreme relative risk estimates.

Over the past decade, several large-scale epidemiologic investigations of meat intake and PCa risk have been published. Our findings are in line with those reported in a recent meta-analysis of prospective studies (18) in which potential associations between red or processed meat intake and PCa were evaluated. Fifteen studies of red meat and 11 studies of processed meat were included in this analysis. The results of this meta-

analysis were not supportive of an independent positive association between red meat intake and PCa. However a weak association between processed meat and total PCa risk was found. In another meta-analysis, with the aim of evaluating the relation of fish consumption and risk of PCa and its related deaths, no significant relation between fish consumption and risk of PCa was observed. But fish consumption has an inverse relation with the deaths from PCa (19).

In Joshi AD et al. study, higher consumption of meat cooked in high temperatures (p=0.026) and roasted meat (p=035) was related with increasing risk of PCa. But, barbecued poultry consumption was related with decrease in risk of PCa (p=023) (20). In Ukoli et al study higher consumption of red meat is associated with increased risk of PCa. But they didn't found a significant relation between fish consumption and risk of PCa (21).

In Salem S et al study, observed that a non-significant relation between red meat consumption and risk of PCa (OR = 1.69, 95% CI =0.93-3.1) (p>0.05). (22). Furthermore, according to Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective second expert report, limiting intake of red meat and avoiding, processed meat consumption, are suggested for the prevention of cancer (23).

Multiple mechanisms have been proposed to explain the association between increased meat intake and subsequent cancer risk. One proposed mechanism is that the components of red meat are involved in the development of carcinogens that may increase the risk of cancer; for instance hem iron may cause oxidative biochemical and cellular damage (24), as well as increased endogenous formation of N-nitroso compounds (25). Furthermore cooking meat at high temperatures can generate carcinogens such as 2-amino-1-methyl-6-phenylimidazo pyridine (PhIP) (26), exposure to which has been shown to activate PCa in rats (27).

Our results support the hypothesis that fatty fish consumption decreases the risk of PCa, possibly through inhibition of arachidonic acid-derived eicosanoid biosynthesis. Results of a cross-sectional study within the European Prospective Investigation into Cancer and Nutrition (EPIC) cohort in 16 regions of Europe showed greatly elevated (three-fold to four-fold) plasma concentrations of eicosapentaenoic acid (EPA) in people from Sweden and Denmark who eat high amounts of fatty fish (28). EPA competes with arachidonic acid as a substrate for cyclo-oxygenases and, therefore, high concentrations of EPA can produce important changes in relative concentrations of tumor growth enhancing prostaglandins (29).

Fish is not the main source of protein in Iran, and is much less popular than red meat in this population. It is also possible that a high fish intake is a marker for some other aspects of diet that are associated with a decreased risk of PCa (30), such as fruit and vegetable intake (31). In our previous study (data not published) we defined two major dietary patterns in this population; "Western diet"(high in sweets and desserts, organ meat, snacks, tea and coffee, French fries, salt, carbonated drinks, red or processed meat) that was significantly related to increase risk of PCa and "Middle-Eastern diet "(high in legumes, fish, dairy products, fruits and fruit juice, vegetables, boiled potatoes ,whole cereal and egg) that was significantly related to decreased risk of PCa (32). In a review study adherences to healthy diet pattern was related to decreased risk of PCa (33). Thus it might be possible that the strong association that we found between fish intake and PCa is in fact due to the cumulative effect of other dietary factors that are correlated with fish intake.

Conclusion

Findings from this study suggest that high consumption of processed meat might be positively associated with an increased risk of PCa. Furthermore, fish consumption might be a protective factor for PCa.

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