RESEARCH ARTICLE

# Dietary Patterns in Relation to Prostate Cancer in Iranian Men: A Case-Control Study

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## Abstract

**Background: Prostate cancer is the most frequently occurring cancer among males in economically developed countries. Among the several risk factors that have been suggested, only age, ethnicity, diabetes, and family history of prostate cancer are well-established and primary prevention of this disease is limited. Prior studies had shown that dietary intake could be modified to reduce cancer risk. We conducted a hospital-based, case-control study to examine the association between dietary patterns and prostate cancer risk in Iran. Materials and Methods: A total of fifty patients with prostate cancer and a hundred controls underwent face-to-face interviews. Factor analysis was used to determine the dietary patterns. Multivariate logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs). Results: 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) and 'healthy diet' (high in legumes, fish, dairy products, fruits and fruit juice, vegetables, boiled potatoes ,whole cereal and egg). Both Healthy and western pattern scores were divided into two categories (based on medians). Higher scores on Healthy pattern was marginally significantly related to decreased risk of prostate cancer (above median *vs* below median, OR =0.4, 95%CI=0.2-1.0). An increased risk of prostate cancer was observed with the higher scores on the Western pattern (above median *vs* below median, OR=4.0, 95%CI=1.5-11.0). Conclusions: The results of this study suggested that diet might be associated with prostate cancer among Iranian males.**

**Keywords:** Prostate cancer - dietary pattern - case-control study

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## Introduction

Prostate cancer is the most frequently occurring cancer among males in economically developed countries (Jemal et al., 2011). Sadjadi et al. (2007) had shown in their study that age-standardized rate (ASR) of prostate cancer in five provinces of Iran, between 1996 to 2000, had been 5.1 per 100,000 person-years. Furthermore they emphasized that underestimation had been inevitable due to inefficient registration system for prostate cancer in Iran (Sadjadi et al., 2007). Among the several risk factors that have been suggested for prostate cancer, only age, ethnicity, diabetes, and family history of prostate cancer are well-established (Ghafoor et al., 2002) and primary prevention of this disease is limited. Prior studies had shown that dietary intake could be modified to reduce cancer risk (Chan et al., 1998; Clinton and Giovannucci, 1998). According to researches, as we consume foods in combination, investigating the whole dietary pattern intake rather than focusing on individual dietary components would gain more (Hu et al., 1999; Jacques and Tucker, 2001; Wirfalt et al., 2001; Jacobs and Steffen, 2003; De Stefani et al., 2010; Masko et al., 2012). Factor analysis is used to reduce a large number of foods or nutrients items to smaller number of factors that could be more appropriate for modeling purposes. There isn't enough published data about dietary pattern and cancers in developing countries and most of the data in this area have been drawn from Western world studies (Hu et al., 1999; Jacobs and Steffen, 2003). Whereas epidemiological studies in developing countries can both substantiate or change existing evidence.

The purpose of the present research was therefore to assess the relationship between dietary patterns and prostate cancer risk among Iranian men.

## Materials 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-NejadHospital' with incident, histologically confirmed cancers of the prostate within

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the past 6 mo and did not have a history of cancers of other sites. Controls were patients (43-71years) who were selected randomly from patients admitted to the same hospital as cases during the same time period for acute, non-neoplastic conditions and not afflicted with diet related chronic diseases. They were admitted to the hospitals for various medical issues (eye or nose disorders, skin diseases, fractures and sprains, for trauma and injuries, and for other illnesses e.g.; removal of plates, pins, screws and wires).

Cases and controls were frequency matched according to the age (5-year groups) and body mass index (<19, 19-25, 25-30, 30<).Participation rate was 85%. In total, 52 patients with prostate cancer and 104 controls underwent face-to-face inter-views by specifically trained professional interviewers. We excluded one patients from the analysis because their log scales of total energy intake were either>3or<3SDfromthe mean, indicating errors in their responses to the dietary questions. We further excluded 5 subjects due to poor responses with regard to dietary questions. Finally, the data for 50 cases with prostate cancer and 100 controls remained for analysis.

*Assessment of dietary intake*

We assessed participants' dietary intakes during the past year by using a valid and reliable semi-quantitative food frequency questionnaire (FFQ) (Esfahani et al., 2010). This FFQ consists of 125 food items with standard serving sizes, and we asked participants to specify their consumption frequency for each food item on a daily, weekly, monthly or yearly basis. We converted These data to daily frequencies and then to the daily grams of food intake, using the manual for household measures(Ghaffarpour et al., 1999). Food energy value was based on the Nutrients Composition of Iranian Foods and the USDA Food Composition Data (Safari et al., 2013). The latter was used for foods or food ingredients that were not available in Nutrients Composition of Iranian Foods. To reduce the complexity of the data, we grouped the individual items according to similarity of their nutrients or culinary usage of the foods. The consumption of alcohol was not answered by our participants due to their cultural beliefs and 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 (fars, not fars), smoking (yes/no), family 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. Waist circumference was measured at the slimmest part, using a tape 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*

Dietary patterns were derived using Principal Component Analysis (PCA) based on the 125 food items. Orthogonal (varimax) rotation was used for easier interpretation and to ensure that factors are uncorrelated. Although factors with eigenvalues (a measure of the amount of variance that is accounted for) >1.0 indicate that the factor describes more variability in the data than the average variability for any individual item within the factor, the selection of factors was based on interpretability and scree plot(Kim JO and Mueller CW, 1998).

In fact, the scree plot showed a clear break, and we selected two factors with eigenvalues >1.9. Factor loadings are correlation coefficients between food groups and dietary patterns. A positive loading in a factor indicates a direct association

With the factor, whereas a negative loading indicates that the food group is inversely associated with the factor. Factor scores were then calculated for each study participant for two dietary patterns (Healthy and western patterns). Both Healthy and western pattern scores were divided into two categories (based on medians for controls)and used as the outcome variable. We used chi-square tests to check the differences of distribution of categorical variables (e.g. smoking), and Independent t-test to check the differences of distribution of continuous variables (e.g. BMI) across dietary pattern score categories. Unconditional logistic regression was used to estimate OR with 95%CI. Having diabetes (yes/no) and total energy intake were considered as potential confounders and were also included in the models. Data were analyzed with Statistical Package Software for Social Science, version 16 (SPSS Inc., Chicago, IL, USA).

## Results

Table 1 shows the characteristics 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.

Factor analysis revealed two dietary patterns and the factor loadings for each dietary pattern are presented in Table 2. The first dietary pattern, accounting for 17.1%of the variance in the food groups, was characterized by high intake of foods generally thought to be unhealthy(including sweets and desserts, organ meat, snacks, tea and coffee, French fries, salt, carbonated drinks, red or processed meat) and was labeled as 'western diet'. The second dietary pattern(accounting for 14.6%of the variance in the food groups), labeled as 'Healthy', was characterized by high consumption of legumes, fish, dairy products, fruits and fruit juice, vegetables, boiled potatoes ,whole cereal and egg.

Table 3 shows the distribution of some risk factors for prostate cancer according to the two dietary pattern scores (2 categories based on medians). Compared to participants in the lowest category of Healthy diet scores, those in the highest category, had lower smoking usage (p=0.01), total energy intake (p=0.05), and BMI (p=0.06). Compared to participants in the lowest category of western diet scores, participants in the highest category, had higher smoking

usage (p=0.03), and waist circumference (p=0.06). The other results were not significant.

The OR and their 95%CI for prostate cancer by the median of dietary pattern scores are shown in Table 4. After controlling for the potential confounding effects of having diabetes (yes/no) and total energy intake, the Healthy dietary pattern tended to decrease the risk of prostate cancer (high 2nd median *vs* low 1st median, OR=0.4, 95%CI=0.2- 1.0) and increased risk of Prostate cancer, was observed with the western dietary pattern (high 2nd median *vs* low 1st median, OR=4.0, 95%CI= 1.5-11.0).

## Discussion

By using the factor analysis technique, two dietary patterns were identified. Western pattern that characterized by high sweets and desserts, organ meat, snacks, tea and coffee, French fries, salt, carbonated drinks and red or processed meat and Healthy pattern that characterized by high legumes, fish, dairy products, fruits and fruit juice, vegetables, boiled potatoes ,whole cereal and egg intake. Participants who scored high for the first pattern tended to have significant elevated risks for prostate cancer and the second pattern was significantly associated with a lower risk of prostate cancer.

The strength of our study is that fortunately we didn't have any missing data. We collect our data from LabafiNejad Hospital that is a referral hospital for prostate cancer. Studies in developing countries can provide unique opportunities to test the association between diet and cancer(Willet, 1998). As economic resources are severely restricted in developing countries, there is a strong link between food intake and income and a small economic difference will directly effect on diet. This linkage would tend to increase between person variations. 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.

There are several potential biases in our study too. First, although we used a validated food-frequency questionnaire (FFQ) for assessing the dietary intake, measurement errors that might led to underestimation of associations were inevitable. Second the possibility of selection bias cannot be avoided incase–control studies. The present study minimized this problem by matching the cases and controls by age and sex. Furthermore, both groups were distributed similarly by hospital status. Third 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). As cases were selected not more than 6 months of cancer diagnosis and during the interview, cases were reminded to report foods consumed prior to diagnosis, these could minimize the possibility of cases reporting post-diagnosis. 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 (Newby et al., 2004). Fifth, we could not adjust our risk estimates for potentially confounding effects of physical activity, educational level and access to health care because information about these exposures was not collected at baseline (residual confounding). Small sample size is also another limitation which might result unstable results and extreme relative risk estimates.

Tseng et al investigated the relation between dietary patterns and prostate cancer risk in a cohort study. They found three dietary patterns: "vegetable-fruit," "red meat-starch," and a "Southern" pattern, which was characterized by higher intakes of foods such as okra, cornbread, or sweet potatoes. The "Southern pattern" had a suggestive inverse association with prostate cancer risk (high 2nd median *vs* low 1st median, OR=0.6; 95%CI= 0.4-1.1; Ptrend=0.08). But the authors speculated that the observed association was due to living in the South, which may be related to lower risk of prostate cancer due to higher sunlight (vitamin D) exposure (Tseng et al., 2004). However, the relationship between solar exposure and serum 25 (OH) D with prostate cancer risk is controversial due to the methodological differences and uncertainties regarding the critical period for vitamin D exposure (Schwartz, 2013). Specifically, the relationship between serum 25 (OH) D levels and prostate cancer may be dependent on calcium intake. A recent review has suggested that the probable harmful effect of dairy intakes on cancer is dose-dependent and it may occur only in excessive and indiscriminate intakes rather than regular daily intakes (Davoodi et al., 2013). Furthermore, there is evidence that excessive sun exposure is a risk factor for prostate cancer in Asians (Chia et al., 2012).

In the Grant study (2004), sweeteners were among the risk factors for prostate cancer mortality (p<0.001). In our study sweets were among the western food pattern groups too.

In Salem S et al study, was shown that red meat intake increase the risk of prostate cancer. Although, this relation wasn't significant. In our study, red meat was among the western food pattern (Salem et al., 2011). Vlajinac H et al had shown that consumption of meat play a role in the development of prostate cancer and chicken and potato consumption may have protective effect (Vlajinac et al., 2010). In our study meat was among the western food pattern groups and boiled potato was among the Healthy food pattern groups. Masko et al. did a literature review using the PubMed database for all studies published on diet and prostate cancer in June 2012 or earlier with regard to dietary macro- and micro nutrients and prostate cancer incidence and progression. The literature was reviewed on seven dietary components: carbohydrates, protein, fat and cholesterol, vegetables, vitamins and minerals, and phytochemicals. Results shown that consumption of carbohydrates, saturated and ω-6 fats, and certain vitamin supplements may promote prostate cancer risk and progression. Conversely, consumption of many plant phytochemicals may slow the risk and progression of the disease. In our study fruits and vegetables were among the Healthy diet group. All other nutrients seemed to have no effect or data were inconclusive. They conclude in this way that due to the number and heterogeneity of published studies investigating diet and prostate cancer, it had been difficult to determine what nutrients make up the perfect

diet for the primary and secondary prevention of prostate cancer. They suggested that because diets are made of multiple macro and micro nutrients, further prospective studies are needed, particularly those investigating the relationship between whole foods instead of a single nutritional component (Masko et al., 2012). It was what we have done in our study.

In the present study, no significant relationship was observed between onions and allium family vegetables (p=0.07) and prostate cancer, which is in contrast to the Galeone et al. (2006) study in which the multivariate ORs for the highest category of onion and garlic intake were 0.29 and 0.81 respectively, and the Zhou et al. study (2013) where the OR was 0.77 for garlic.

Ambrosini et all. did an exploratory factor analysis of prostate cancer in a case–control study in Western Australia, including 546 cases and 447 controls. They identified three distinct dietary patterns that were labeled vegetable, Western, and health-conscious. An increased risk for prostate cancer was observed with the Western pattern, which consisted of high intakes of red and processed meats, fried fish, hamburgers, chips, high-fat milk, and white bread. The vegetable and health-conscious dietary patterns were not significantly associated with prostate cancer risk (Ambrosini et al., 2008). In our study high intakes of red and processed meats increased the risk of prostate cancer but fish has a protective effect. It may be because the fish in Ambrosini et all study was fried that could affects on fish quality. Walker et all did a factor analysis of prostate cancer, in a case–control study in Ontario, Canada, including 80 cases and 334controls. They could identify four dietary patterns: Healthy Living, Traditional Western, Processed and Beverages. Traditional Western pattern contributes to increased prostate cancer risk. Whereas other patterns were not significantly associated with prostate cancer risk (Walker et al., 2005). Stefani et al. explored the role of broader eating patterns in the etiology of prostate cancer. Factor analysis allowed them the extraction of five patterns, labeled as prudent, traditional, substitute, drinker, and Western. The traditional and Western patterns were directly associated with risk of prostate cancer. But the prudent, drinker, and substitute patterns were not associated with risk of the disease (De Stefani et al., 2010) .

Vegetables and fruits that are among healthy diet foods, are rich in several micronutrients and other food compounds such as carotenoids, vitamins C and E, fibers, flavonoids and other plant sterols, which display both complementary and overlapping mechanisms of action, including antioxidant effects, binding and dilution of carcinogens, and alteration of hormone metabolism It is reasonable to postulate that the changed dietary habits in populations in recent decades characterized by high intake of sweet and fat may partly explain the observed increasing incidence rates of prostate cancer, although the underlying mechanism is still unclear. (Lucenteforte et al., 2008). Conversely, reduction of intake of isoflavones may incrfease risk (Sugiyama et al., 2013).

In conclusion, the present findings suggested that a diet characterized by high intake of legumes, fish, dairy products, fruits and fruit juice, vegetables, whole cereal and egg (labeled as healthy diet) might be negatively associated with the risk of prostate cancer, whereas a diet with high consumption of sweets and desserts, organ meat, snacks, tea and coffee, French fries, salt, carbonated drinks and red or processed meat (named western diet) might be positively associated with prostate cancer.

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## References

Ambrosini G L, Fritschi L, de Klerk N H, Mackerras D, Leavy J (2008). Dietary patterns identified using factor analysis and prostate cancer risk: a case control study in Western Australia. *Ann Epidemiol*, **18**, 364-70.

Chan J M, Stampfer M J, Giovannucci E L (1998). What causes prostate cancer? a brief summary of the epidemiology. *Semin Cancer Biol*, **8**, 263-73.

Chia S-E, Wong K-Y, Cheng C, Lau W, Tan P-H (2012). (2013). Sun exposure and the risk of prostate cancer in the Singapore Prostate Cancer Study: a case-control Study. *Asian Pac J Cancer Prev*, **13**, 3179-85.

Clinton S K, Giovannucci E (1998). Diet, nutrition, and prostate cancer. *Annu Rev Nutr*, **18**, 413-40.

Davoodi H, Esmaeili S, Mortazavian A (2013). Effects of milk and milk products consumption on cancer: a review. *Compr Rev Food Sci F*, **12**, 249-64.

De Stefani E, Ronco A L, Deneo pellegrini H, et al (2010). Dietary patterns and risk of advanced prostate cancer: a principal component analysis in Uruguay. *Cancer Cause Control*, **21**, 1009-16.

Esfahani FH, Asghari G, Mirmiran P, Azizi F (2010). Reproducibility and relative validity of food group intake in a food frequency questionnaire developed for the Tehran Lipid and Glucose Study. *J Epidemiol*, **20**, 150-8.

Galeone C, Pelucchi C, Levi F, et al (2006). Onion and garlic use and human cancer. *Am J Clin Nutr*, **84**, 1027-32.

Ghaffarpour M, Houshiar Rad A, Kianfar H (1999). The Manual for Household Measures,Cooking Yields Factors and Edible Portion of foods. Agriculture Sciences Press, 243-9.

Ghafoor A, Jemal A, Cokkinides V, et al (2002). Cancer statistics for African Americans. *CA Cancer J Clin*, **52**, 326-41.

Grant W B (2004). A multicountry ecologic study of risk and risk reduction factors for prostate cancer mortality. *Eur Urol*, **45**, 271-9.

Hu F B, Rimm E, Smith Warner S A, et al (1999). Reproducibility and validity of dietary patterns assessed with a food-frequency questionnaire. *Am J Clin Nutr*, **69**, 243-9.

Jacobs D R JR, Steffen L M (2003). Nutrients, foods, and dietary patterns as exposures in research: a framework for food synergy. *Am J Clin Nutr*, **78**, 508-13.

Jacques P F, Tucker K L (2001). Are dietary patterns useful for understanding the role of diet in chronic disease? *Am J Clin Nutr*, **73**, 1-2.

Jemal A, Bray F, Center M M, et al (2011). Global cancer statistics. *CA Cancer J Clin*, **61**, 69-90.

Kim Jo, Mueller CW (1998). Factor Analysis: Statistical Methods and Practical Issues, New York: Oxford University Press.

Lucenteforte E, Garavello W, Bosetti C, et al (2008). Diet diversity and the risk of squamous cell esophageal cancer. *Int J Cancer*, **123**, 2397-400.

Masko E M, Allott E H, Freedland S J (2012). The relationship between nutrition and prostate cancer: is more always better? *Eur Urol*, **63**, 810-20.

Newby P K, Muller D, Hallfrisch J, Andres R, Tucker K L (2004). Food patterns measured by factor analysis and anthropometric changes in adults. *Am J Clin Nutr*, **80**, 504-13.

Sadjadi A, Nooraie M, Ghorbani A (2007). The incidence of prostate cancer in Iran: results of a population-based cancer registry. *Arch Iran Med*, **10**, 481-5.

Safari A, Shariff Z M, Kandiah M, Rashidkhani B, Fereidooni F (2013). Dietary patterns and risk of colorectal cancer in Tehran Province: a case-control study. *BMC Public Health*, **13**, 222.

Salem S, Salahi M, Mohseni M (2011). Major dietary factors and prostate cancer risk: a prospective multicenter case-control study. *Nutr Cancer*, **63**, 21-7.

Schwartz G G (2013). Vitamin d, sunlight, and the epidemiology of prostate cancer. *Anticancer Agents Med Chem*, **13**, 45-57.

Sugiyama Y, Masumori N, Fukuta F, et al (2013). Influence of isoflavone intake and equol-producing intestinal flora on prostate cancer risk. *Asian Pac J Cancer Prev*, **14**, 1-4.

Tseng M, Breslow R A, Devellis R F, Ziegler R G (2004). Dietary patterns and prostate cancer risk in the National Health and Nutrition Examination Survey Epidemiological Follow-up Study cohort. *Cancer Epidemiol Biomarkers Prev*, **13**, 71-7.

Vlajinac H, Ilic M, Marinkovic J, Sipetic S (2010). Nutrition and prostate cancer. *J BUON*, **15**, 698-703.

Walker M, Aronson K J, King W (2005). Dietary patterns and risk of prostate cancer in Ontario, Canada. *Int J Cancer*, **116**, 592-8.

Willet W (1998). Nutritional epidemiology, New York, Oxford University Press.

Wirfalt E, Hedblad B, Gullberg B (2001). Food patterns and components of the metabolic syndrome in men and women: a cross-sectional study within the Malmo Diet and Cancer cohort. *Am J Epidemiol*, **154**, 1150-9.

Zhou X-F, Ding Z-S, Liu N-B (2013). Allium vegetables and risk of prostate cancer: evidence from 132,192 subjects. *Asian Pac J Cancer Prev*, **14**, 4131-4.