Cancer Epidemiol Biomarkers Prev. Author manuscript; available in PMC 2015 April 01.

Published in final edited form as:
Cancer Epidemiol Biomarkers Prev. 2014 October ; 23(10): 2066–2077. doi: 10.1158/1055-9965.EPI-14-0322.

Adherence to dietary and lifestyle recommendations and prostate cancer risk in the Prostate Testing for Cancer and Treatment (ProtecT) trial

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Abstract

Background—The World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) published eight recommendations for cancer prevention but they are not targeted at prostate cancer prevention. We investigated whether adherence to the WCRF/AICR recommendations and a prostate cancer dietary index are associated with prostate cancer risk.

Methods—We conducted a nested case-control study of 1,806 PSA-detected prostate cancer cases and 12,005 controls in the ProtecT trial. We developed a prostate cancer dietary index by incorporating three dietary factors most strongly associated with prostate cancer. Scores were computed to quantify adherence to the WCRF/AICR recommendations and the prostate cancer dietary index separately.

Results—The prostate cancer dietary index score was associated with decreased risk of prostate cancer (OR per 1 score increment: 0.91, 95% CI: 0.84, 0.99; p-trend=0.04) but the WCRF/AICR index score was not (OR: 0.99, 95% CI: 0.94, 1.05; p-trend=0.71). There was no heterogeneity in association by prostate cancer stage (p=0.81) or grade (p=0.61). Greater adherence to

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Authors' contribution:
RMM, MJ, JAL, JLD, DEN, and FCH designed research; VE, PE, RG, KNLA, and EW prepared data; VE analysed data; VE, RMM, MJ, and JAL wrote paper; JAL, MJ, and RMM provided supervision; VE, RMM, MJ, and JAL had primarily responsibility for final content. All authors read and approved final paper.

Disclaimers:
The views expressed herein are those of the authors and do not necessarily reflect those of Cancer Research UK, the NHS, the NIHR, or the Department of Health.

Conflict of interest:
The authors declare that there are no conflicts of interest.

Trial registry:
ProtecT was registered at International Standard Randomised Controlled Trial Registry, http://isrctn.org as ISRCTN20141297.

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recommendations to increase plant foods (OR per 0.25 index score increment: 0.94; 95% CI: 0.89, 0.99; p-trend=0.02) and tomato products (OR adherence vs. non-adherence: 0.82; 95% CI: 0.70, 0.97; p=0.02) were inversely associated with overall prostate cancer risk.

Conclusions—Adherence to the prostate cancer-specific dietary recommendations was associated with decreased risk of prostate cancer. High intake of plant foods and tomato products in particular may help protect against prostate cancer.

Impact—Meeting the WCRF/AICR recommendations alone is insufficient for prostate cancer prevention. Additional dietary recommendations should be developed.

Keywords

Prostatic neoplasms; Diet; Lifestyle; Cancer Prevention; Dietary Index

Introduction

Prostate cancer is the second most common cancer in men worldwide, with higher incidence and mortality observed in developed countries (1). Evidence from ecological and migrant studies suggests that the wide variation in international rates of prostate cancer may be attributed to a ‘Westernised’ diet and lifestyle (2). Studies that examined diet and prostate cancer risk association traditionally focused on specific nutrients or food groups. However, there is growing interest in assessing overall dietary pattern, as it accounts for the mixed composition of diet and interactions between nutrients. Dietary and lifestyle index is frequently used to assess dietary pattern as it is usually developed based on dietary and lifestyle recommendations, which means the results can be interpreted with ease and have practical implications for public health policy (3).

In 2007, the World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) published eight recommendations on physical activity, diet and body weight for cancer prevention (4). Whether adherence to these recommendations reduces prostate cancer risk is uncertain (5, 6). As prostate cancer is a clinically heterogeneous disease, the effects of dietary and lifestyle factors may differ in localised compared to more advanced cancers, or well versus less differentiated cancers (7). The large European Prospective Investigation into Cancer and Nutrition (EPIC) study reported that men who followed the WCRF/AICR recommendations did not have a lower prostate cancer risk, compared to those who did, although the authors did not examine the association by markers of advanced prostate cancer such as high grade or stage. Conversely, another study found that men who met these recommendations had a reduced risk of aggressive cancer (6).

Because the WCRF/AICR recommendations are not targeted at prostate cancer prevention, it may be useful to have prostate cancer-specific recommendations as an adjunct to the general WCRF/AICR recommendations that could be targeted at men or those at higher risk. The WCRF/AICR comprehensive systematic review found observational evidence that calcium is probably positively associated with prostate cancer risk, while selenium and foods containing lycopene are probably inversely associated (4). Therefore, additional

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dietary recommendations for prostate cancer prevention could include low consumption of calcium and high intake of selenium and foods containing lycopene.

In a nested case-control study, we investigated the association of prostate specific antigen-detected prostate cancer with adherence to the WCRF/AICR recommendations for cancer prevention, and prostate cancer dietary index which we developed by incorporating three dietary factors most strongly associated with prostate cancer risk in the WCRF/AICR systematic review: calcium, selenium and foods containing lycopene. We also investigated if the associations differed by stage and grade of cancer.

Materials and Methods

Study population

The men included in this study were participants in the PSA-tested cohort of the ProtecT trial (8). ProtecT is a population-based randomised controlled trial investigating the effectiveness of treatments for localised prostate cancer. Approximately 227,300 men aged 50-69 years registered at general practices in nine U.K. cities were invited to attend a prostate check clinic between 2001 and 2009. Over 111,000 men had a prostate specific antigen (PSA) test after giving written consent. Of these, 11% of men with raised PSA (≥3ng/ml) were invited for repeated PSA test, digital rectal examination and 10 core-transrectal ultrasound guided biopsy. Uropathology specialists reviewed histological materials obtained at biopsy and assigned Gleason score. For the purpose of this analysis, tumours with Gleason score of ≤6 were defined as low and ≥7 as high grade. Clinical staging was recorded using the tumour node metastasis system. Cases were classified as having localised (T1-T2, NX, M0) and advanced (T3-T4, N1, M1) prostate cancer. Study participants gave informed consent for the use of their data for research purposes. The Trent Multicentre Research Ethics Committee approved the ProtecT (MREC/01/4/025) and the associated ProMPT study (MREC01/4/061).

Selection of cases and controls

Cases were men aged 50-69 years with histologically confirmed prostate cancer, who had attended for PSA testing and had their PSA results recorded between 2001 and 2009**.** During this period**,** 2,939 cases were identified; 2,588 localised cases (88.7%) and 331 advanced cases (11.3%). The majority of advanced cases were T3 (73%), also defined here as locally advanced cases. All men within the ProtecT cohort who had no evidence of prostate cancer (PSA<3ng/ml or raised PSA but with ≥1 negative biopsy), were eligible for random selection as controls: 20,781 controls were randomly selected for targeted data entry. Cases were frequency matched with controls by 5-year age band and recruiting general practice. Overall, 1,806 cases (61.4%) and 12,005 controls (57.8%) were included in our analyses (Supplementary Figure 1). We excluded men who did not return the questionnaires (n=7,420), men within the top or bottom 1% of the cohort distribution of the ratio of reported energy intake to energy requirements (n=302), and men with missing data on: physical activity (n=761), body size (n=1,055), waist circumference (n=151), alcohol intake (n=79), and dietary exposure variables (n=141).

Data collection and dietary questionnaire

Prior to diagnosis, men filled out questionnaires on socio-demographic, medical and family history, anthropometry, lifestyle and diet. Among the men included in the final analysis, the questionnaire was completed by 75.7% of controls (n=9,082) and 71.6% of cases (n=1,293), before receipt of the initial PSA test results. *Anthropometry*. Trained nurses measured men's weight at the prostate check clinic according to standard protocol. If unavailable, self-reported weight was used (4.4% of men). Height was self-reported. Body mass index (BMI) was derived as weight over height squared (kg/m^2). We provided men with a tape measure and instructions for measuring their waist. Body size at age 20 years, 40 years and at study baseline served as an indicator of body weight throughout adulthood. We asked men to select the figure that best reflected their body size using the Stunkard's figure rating scale (9), which consists of nine body sizes in ascending order. We adapted a method recommended by Bulik and colleague (10) to categorise men. Those who had selected figure 1-3, were categorised as normal weight; figure 4-9 as overweight/obese. *Physical activity.* We used Godin's Leisure Time Physical Activity questionnaire to assess physical activity (11). Men were asked on average, how often they do strenuous, moderate and mild physical activity for more than 15 minutes in a week. Physical activity was computed as number of times/week of moderate and strenuous exercise. Mild exercise was not included as it is not a strong contributor to health benefits (12) and was not cited in WCRF recommendations. *Alcohol and Smoking.* Alcohol intake was based on the number of spirits/wine/beer consumed and the amount of alcohol (g) per drink. We categorised men as never, former, and current smokers. *Dietary intake.* Dietary intake in the past 12 months was assessed using a validated 114 item-food frequency questionnaire (FFQ) adapted from the UK arm of the EPIC study (13). Men reported frequency of intake for each food item across nine mutually exclusive categories, ranging from "never/less than once per month" to "six or more times per day". The assignment of portion size in grams for each food item was based on UK food portion sizes (14), food weights derived from a 7-day diet diary from a sub-sample of ProtecT participants, and data from the Carnegie survey of diet and health (15). Food intake was computed as the product of frequency of intake and portion size. Nutrient intake was derived by multiplying frequency of intake by the nutrient content per portion of food, using nutrient values from the composition tables of McCance and Widdowson, and its supplements (16).

WCRF/AICR index

To develop the WCRF/AICR index, we operationalised six of the eight recommendations (Table 1), as we did not have sufficient dietary information to translate the recommendations on 'Preservation, Processing, Preparation' and 'Dietary Supplements'. We gave participants a score based on quantitative cut-offs provided in the WCRF/AICR recommendations. A score of 1, 0.5, and 0 was assigned for complete, partial, and non-adherence, respectively (Table 2). Where unspecified, *a priori* cut-offs were used for: (i) waist circumference (17), (ii) red and processed meat intake (5) and (iii) dietary energy density (5). There are sub-recommendations on 'Body Fatness', 'Food and Drinks that Promote Weight Gain', and 'Plant Foods'. The score for the main recommendation was derived as the average of the sub-recommendation scores. We gave equal weight to each of the six main

recommendations. The final score ranged from 0 to 6, and we further categorised men into quartiles of index score: 0-2, >2-<3, 3-<4, 4-6. *Foods and drinks that promote weight gain.* Dietary energy density was computed as total energy intake from food divided by total food weight. We used energy density of the overall diet instead of energy-dense food intake to operationalise this recommendation, as it is based on evidence that a high energy density diet promotes weight gain, rather than consumption of specific energy-dense food items (18). We defined sugary drinks as non-diet soft drinks, fruit squash and fruit juice. For participants who consumed fruit juice only (no soft drink and fruit squash intake), 1 serving (150g) per day was considered as meeting the recommendation (19). *Plant foods*. In categorising plant foods, we only included whole fruit and vegetable intake, and computed daily intake in grams. Potatoes, fruit and vegetable juices were excluded. *Meat foods.* Beef, lamb and pork were included as red meat items, and processed meat items included beef burgers, ham, bacon, sausages, luncheon meat, corned beef, 'Spam' and savoury pies. The recommended intake for processed meat is less than 20g/d as a higher intake is associated with an increased risk of mortality (20). However, the WCRF/AICR advised abstinence, so a lower cut off point of 3g/d was used as meeting the recommendation (5).

Prostate cancer dietary index

To develop the prostate cancer dietary index, we included calcium, selenium, and foods rich in lycopene in the index (Table 2), as these dietary components were strongly associated with prostate cancer incidence in the WCRF/AICR systematic review in their second expert report (4). Fresh tomato and tomato product intake were used as an indicator of lycopene intake as they are rich sources of lycopene. Tomato products include tomato juice, tomato sauce, pizza and baked beans. Participants received a score of 1 for complete adherence, and 0 for non-adherence. The cut-off criteria were derived from the WCRF/AICR second expert report (4) for calcium; studies by Hurst and colleagues (21, 22) for selenium; and the Health Professionals Study (23) for tomato and tomato products. Each recommendation contributed equally to the total score, with a maximum score of three. We categorised men into tertiles of index score: 0 & 1, 2, 3.

Statistical analysis

We estimated odds ratios (ORs) and 95% confidence intervals (CIs) for associations of the index score with risk of prostate cancer using conditional logistic regression, matched by 5-year age band and centre of recruitment, and further adjusted for age (continuous variable). We used multinomial unconditional logistic regression to assess the associations of index score with prostate cancer risk by stage and grade sub-types. We ran two separate analyses, each with the outcome variable grouped into 3 categories: (i) controls, localised cases (T1-T2, NX, M0), and locally advanced cases (T3-T4, N1, M1); (ii) controls, low-grade cases (Gleason score ≤6), and high-grade cases (Gleason score ≥7). The models were adjusted for age (continuous variable) and the study centre where the recruiting general practice was based. In case-only analyses, we used unconditional logistic regression to estimate associations of the index scores with cancer stage (locally advanced vs. localised) and grade (high vs. low); both models adjusted for age (continuous variable) and the study centre where the recruiting general practice was based. The effect-estimates of the associations are

expressed as relative risk ratios (RRRs). To test for linear trend for associations of index scores with prostate cancer risk, we modelled the index scores as continuous variables.

We compared the basic logistic regression models, with the models additionally adjusted for the following confounding factors identified *a priori*: family history of prostate cancer (yes/no), self-reported diabetes (yes/no), ethnicity (White/others), occupational class (managerial/intermediate/routine), smoking status (never/former/current) and total energy intake (kcal/d). For each of the confounding factors that we adjusted for, we grouped men with missing data into a separate category, except for total energy intake which has complete data. Diabetes, ethnicity and occupational class were subsequently excluded from the fully-adjusted models as they did not confound the observed associations between index score and prostate cancer risk. Cases with missing stage (n=10) or grade (n=6) were included in the analyses of overall prostate cancer risk, but omitted from stage or grade-specific analyses. For analyses based on the prostate cancer dietary index, two controls with missing score were excluded.

We also examined the associations of the individual components in each index with prostate cancer risk separately. For the WCRF/AICR index, we adjusted for all other components in the index except for dietary energy density since total energy intake was included as a covariate in the models. We modelled index scores as a continuous variable to test for linear trend across index score for each component. For the prostate cancer dietary index, we ran the models with and without BMI and physical activity, but the estimates did not differ appreciably.

To assess the possibility of recall bias, we repeated the analyses restricted to men who completed the questionnaire before receiving their initial PSA test results. To investigate if the association for body weight recommendation differs when BMI is used as an indicator of body weight, we repeated the analyses using BMI at baseline instead of body size and waist measurement. Finally, we repeated analyses for the plant food recommendation, but restricted it to fruit and vegetable intake only to avoid double counting due to the close relationship of dietary fibre and fruit and vegetable intake. All statistical analyses were performed using Stata v12.1 (StataCorp, College Station, TX USA).

Results

The baseline characteristics of cases and controls were largely similar (Table 3) but more cases than controls reported having family history of prostate cancer, and never-smoking. Conversely, the prevalence of diabetes was lower in cases, as previously published (24). Overall, 50.2% controls and 51.9% cases reported taking dietary supplements. Of these, only a small proportion (17.3% controls, 16.0% cases) provided details on the types of supplement, dosage and frequency of intake. Four controls and no cases specifically stated that they took lycopene, and 38 controls and four cases took selenium. When the characteristics of controls were compared by WCRF/AICR index scores, men in the highest index score quartiles had lower BMI and total energy intake and were more likely to be non-smokers and of higher occupational class, than those in the lowest quartiles (Supplementary Table 1).

Table 1 and 2 show the scoring criteria and the proportion of cases and controls who met each of the WCRF/AICR and prostate cancer dietary recommendations respectively. Adherence to the WCRF/AICR recommendations was similar between cases and controls, although the proportion of controls who met WCRF/AICR recommendations for fruit and vegetable (56.3% vs. 53.3%), and red and processed meat (5.0% vs. 3.6%) intake was slightly higher than cases. Adherence to the specific prostate cancer dietary recommendations was similar in cases and controls (Table 2), but fewer cases (11%) had more than 10 servings of tomato and tomato products per week compared with controls (13%).

Table 4 shows the associations of WCRF/AICR index score with prostate cancer risk. In the adjusted models, the WCRF/AICR index score was not associated with overall prostate cancer risk (OR per 1 score increment: 0.99, 95% CI: 0.94, 1.05; *p-trend*=0.71). There was no heterogeneity in the association of index score and cancer stage (p-trend =0.81) or grade (p-trend=0.61). Conversely, adherence to the WCRF/AICR recommendation on plant foods was inversely associated with overall prostate cancer risk and risk of localised prostate cancer (Table 5). A 1-quintile increment in the score was associated with 6% reduction in overall prostate cancer risk (OR: 0.96, 95% CI: 1%, 11%; *p*=0.02), and localised prostate cancer (95% CI: 1%, 11%, *p*=0.02). There was no evidence of heterogeneity comparing associations with localised versus locally advanced cancer (*p*=0.81), or high versus low grade cancer (Supplementary Table 2). When we restricted our analyses for plant recommendation to fruit and vegetable intake only, the inverse association of plant food intake with prostate cancer risk remained (results not shown).

Table 6 shows the associations of prostate cancer dietary index score with prostate cancer risk. A 1-point increment in the score was associated with a risk reduction of 9% for overall prostate cancer (95% CI: 0.84, 0.99; *p*=0.04). In analyses of the association between individual components of the index and prostate cancer (Supplementary Table 3), there was an 18% lower risk of prostate cancer associated with adherence to the tomato intake recommendation (eating more than 10 servings per week). When analysed by cancer stage, the inverse association was observed in localised prostate cancer only (OR: 0.82; 95% CI: 0.70, 0.97, *p*=0.02). There was no evidence of heterogeneity comparing localised and locally advanced prostate cancer (*p*=0.82).

Discussion

Prostate cancer dietary index score, but not the WCRF/AICR index score was associated with a decreased risk of overall prostate cancer. There was also some evidence that following the WCRF/AICR plant recommendation and eating more than 10 servings of tomato and tomato products per week was associated with a reduced risk of overall and localised prostate cancer.

Our findings of a null association between overall prostate cancer risk and adherence to WCRF/AICR recommendations is consistent with the large EPIC cohort study (5). There is only one study that examined the association by cancer stage and grade (6). In that case-only study, an inverse relationship between WCRF/AICR index score and risk of aggressive

prostate cancer was reported (OR per 1 increment in score: 0.87; 95% CI: 0.79, 0.96). However, differences in definition of cancer subtypes and scoring system for operationalization preclude us from directly comparing our results.

We were able to assess changes in body size throughout adulthood instead of a single measurement of BMI around the time of diagnosis. We also had waist measurements of participants, albeit around the time of diagnosis only, to operationalise the WCRF/AICR body fatness recommendation. Using recalled body size might result in non-differential misclassification and bias the result to null. However, recalled body size has been shown to have a moderate correlation with measured body mass index at childhood and adolescence (25). Adherence to the body fatness recommendation, based on men's BMI around the time of diagnosis, was also not associated with prostate cancer risk in our study (results not shown).

Meeting the recommendation on plant foods have a dose-dependent inverse relationship with overall (*p-trend*= 0.02) and localised prostate cancer (*p-trend*= 0.02). There was also a risk reduction of similar magnitude for locally advanced cases, although the confidence interval was wide. Plant foods contain a variety of nutrients and phytochemicals; cruciferous vegetables in particular have been linked to decreased risk of prostate cancer incidence and progression (26, 27). Despite this, evidence on the plant food-prostate cancer association is inconsistent. This may be due to differences in methodology (quantification and definition), small range of intake and residual confounding of healthy lifestyle behaviours (28, 29). It is plausible that the beneficial effect of plant food intake observed in our study is due to a wider range of fruit and vegetable and dietary fibre intake in our participants as compared to other large cohort studies (30, 31). We also defined dietary fibre as non-starch polysaccharides rather than using the Association of Analytical Communities' (AOAC) definition.

To our knowledge, we are the first study to develop a prostate cancer dietary index based on dietary risk factors for prostate cancer. This index score was inversely associated with prostate cancer risk in a dose-dependent nature. Although the evidence for heterogeneity comparing localised versus locally advanced prostate cancer was weak (p=0.08), risk reduction was higher in locally advanced prostate cancer. Epidemiological evidence suggests that selenium and tomato exert a higher risk reduction effect on advanced or aggressive prostate cancer than localised cancer (32). Conversely, risk of advanced and fatal prostate cancer is higher in men with high calcium intake (33, 34). To maintain bone health, men in the UK are still advised to meet the recommended calcium intake of 750mg/d, as the increase in prostate cancer risk was only apparent at intake above 1500mg/d (4).

The association between prostate cancer risk and the prostate cancer dietary index score was largely driven by high consumption of tomato and tomato products. The effect estimate for the association of tomato intake and overall prostate cancer risk is consistent with a risk reduction of about 20-30% reported in a meta-analysis (32). It has been postulated that the protective effect is conferred by lycopene, the major carotenoid in tomato, although epidemiological evidence remained controversial (32, 35). While lycopene is more bioavailable in tomato products as a result of food processing and preparation, men should

consume pizza, tomato sauce and baked beans in moderation due to their high salt, sugar and fat content. The lack of association observed for calcium and selenium with prostate cancer risk in our study might be due to misclassification of men by their intakes. This is because we did not have sufficient information on the types, dosage and frequency of supplement intakes, so the true intakes of these nutrients might be underestimated. Nonetheless men should obtain these nutrients from dietary sources as much as possible and avoid taking high-dose supplements as there is no evidence that supplements have beneficial effects on prostate cancer.

In our study, the risk reduction was higher for locally advanced than localised prostate cancer in men with optimal dietary selenium intake (29% vs. 3%), but the confidence interval was wide. A recent observational study conducted in a low selenium status population reported 63% risk reduction of advanced prostate cancer for men in the highest quintile of toenail selenium concentration compared to the lowest quintile (36). We included selenium to the index, despite the fact that the US Selenium and Vitamin E Cancer Prevention Trial (SELECT) reported a null effect of selenium supplementation on prostate cancer risk. Some argued that participants of SELECT were selenium-replete at baseline, so supplementation would not provide additional benefit (37, 38).

Strengths of our study include its relatively large sample size and population-based, prospective design. Detection bias was minimised, as case finding was part of the trial design and there were accurate records of cancer stage and grade, allowing stratification of associations by cancer stage and grade. It is possible that men with vague symptoms might be more likely to participate in our study. However, we believe this potential problem is small and unlikely to bias our results as a characteristic of PSA-detected prostate cancers is that they are largely small, organ-confined and asymptomatic. We also assessed potential recall bias among men who filled in their questionnaire after receiving their initial PSA test results. As an elevated PSA may be indicative of prostate cancer, men who completed their questionnaire after knowing their PSA test result may report their diet, health and lifestyle differently from those who did not. The effect estimates for the associations did not differ appreciably (results not shown).

Although we used validated and detailed questionnaires, there might still be measurement errors and misclassification of exposures. Compared to food diaries, FFQ is prone to a greater degree of misclassification, but the effect is likely to be non-differential as most of the questionnaires (80.3%) were filled out prior to receipt of initial PSA test results. Thus, the true effect of adherence to WCRF/AICR recommendations and prostate cancer dietary guidelines on prostate cancer risk might be underestimated. While FFQ is not the gold standard for assessing selenium intake, a recent review showed that compared to diet records they gave acceptable values for selenium over the long term (39). In addition, a study in New Zealand found that selenium intakes assessed by diet records were very similar to those measured by chemical analysis in duplicate diets. Thus, the available literature suggests some validity for dietary methods (40).

We were unable to operationalise WCRF/AICR recommendations on ‘dietary supplements’ and ‘preservation, processing, preparation’. Evidence remains inconclusive on the

association between dietary supplements and prostate cancer incidence (4, 41). There is currently no evidence to suggest that the latter recommendation, which advocates lower salt intake, is a risk factor for prostate cancer (4). Inclusion of these recommendations in the index score could have biased the results towards null. We cannot rule out chance findings due to multiple testing. To minimise this error, we had decided *a priori* on the variables to be tested and used a strength of evidence approach to interpret our results (42).

In conclusion, the prostate cancer dietary index but not the WCRF/AICR index was associated with decreased risk of prostate cancer. Adherence to WCRF/AICR recommendations alone is insufficient for prostate cancer prevention. In addition to meeting the optimal intake for the three dietary factors associated with prostate cancer, men should maintain a healthy weight and an active lifestyle to reduce risk of developing prostate cancer, cardiovascular diseases and diabetes (43). The prostate cancer dietary index requires validation, and additional dietary recommendations to prevent prostate cancer should be developed. High intake of plant foods and tomato products in particular may help protect against prostate cancer, which warrants further investigations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors would like to thank all men who took part in the study and the contribution of all members of the ProtecT study research group.

Financial support:

VE is a recipient of a 3-year PhD studentship at the National Institute for Health Research (NIHR) Bristol Nutrition Biomedical Research Unit. RG is funded by a Cancer Research UK Population Research Postdoctoral Fellowship (C31211/A15194). The Bristol Nutrition Biomedical Research Unit is funded by the NIHR and is a partnership between University Hospitals Bristol NHS Foundation Trust and the University of Bristol. ProtecT is funded by the NIHR Health Technology Assessment programme (HTA 96/20/99).

References

1. Ferlay J, Shin H-R, Bray F, Forman D, Mathers C, Parkin DM. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. International Journal of Cancer. 2010; 127:2893–917.
2. Armstrong B, Doll R. Environmental factors and cancer incidence and mortality in different countries, with special reference to dietary practices. International Journal of Cancer. 1975; 15:617–31.
3. Lazarou C, Newby PK. Use of dietary indexes among children in developed countries. Advances in Nutrition. 2011; 2:295–303. [PubMed: 22332071]
4. World Cancer Research Fund/American Institute for Cancer Research. Food, nutrition, physical activity, and the prevention of cancer: a global perspective. AICR; Washington DC: 2007.
5. Romaguera D, Vergnaud A-C, Peeters PH, van Gils CH, Chan DSM, Ferrari P, et al. Is concordance with World Cancer Research Fund/American Institute for Cancer Research guidelines for cancer prevention related to subsequent risk of cancer? Results from the EPIC study. American Journal of Clinical Nutrition. 2012; 96:150–63. [PubMed: 22592101]
6. Arab L, Su J, Steck SE, Ang A, Fontham ETH, Bensen JT, et al. Adherence to World Cancer Research Fund/American Institute for Cancer Research lifestyle recommendations reduces prostate

cancer aggressiveness among African and Caucasian Americans. Nutrition and Cancer. 2013; 65:633–43. [PubMed: 23859030]

7. Giovannucci E. Does prostate-specific antigen screening influence the results of studies of tomatoes, lycopene, and prostate cancer risk? J Natl Cancer Inst. United States. 2007:1060–2.
8. Lane JA, Hamdy FC, Martin RM, Turner EL, Neal DE, Donovan JL. Latest results from the UK trials evaluating prostate cancer screening and treatment: The CAP and ProtecT studies. European Journal of Cancer. 2010; 46:3095–101. [PubMed: 21047592]
9. Stunkard AJ, Sorensen T, Schulsinger F. Use of the Danish Adoption Register for the study of obesity and thinness. Research publications - Association for Research in Nervous and Mental Disease. 1983; 60:115–20. [PubMed: 6823524]
10. Bulik CM, Wade TD, Heath AC, Martin NG, Stunkard AJ, Eaves LJ. Relating body mass index to figural stimuli: population-based normative data for Caucasians. International Journal of Obesity. 2001; 25:1517–24. [PubMed: 11673775]
11. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. Can J Appl Sport Sci. 1985; 10:141–6. [PubMed: 4053261]
12. Godin G. The Godin-Shephard leisure-time physical activity questionnaire. The Health & Fitness Journal of Canada. 2011; 4:18–22.
13. Bingham SA, Welch AA, McTaggart A, Mulligan AA, Runswick SA, Luben R, et al. Nutritional methods in the European prospective investigation of cancer in Norfolk. Public Health Nutrition. 2001; 4:847–58. [PubMed: 11415493]
14. Ministry of Agriculture, Fisheries and Food (GB). Food portion sizes. HMSO; London UK: 1993.
15. Maynard MJ, Blane D. Dietary assessment in early old age: experience from the Boyd Orr cohort. European Journal of Clinical Nutrition. 2009; 63:S58–S63. [PubMed: 19190646]
16. Royal Society of Chemistry (GB). Ministry of Agriculture, Fisheries and Food (GB). McCance and Widdowson's The Composition of Foods. 5th ed.. HMSO; London: 1991.
17. World Health Organization. Waist circumference and waist-hip ratio: Report of a WHO expert consultation, Geneva, 8-11 December 2008. Geneva, Switzerland: 2011.
18. Drewnowski A, Almiron-Roig E, Marmonier C, Lluch A. Dietary energy density and body weight: Is there a relationship? Nutrition Reviews. 2004; 62:403–13. [PubMed: 15622713]
19. Department of Health (GB). 2010. 5 A Day
20. Rohrmann S, Overvad K, Bueno-de-Mesquita HB, Jakobsen MU, Egeberg R, Tjonneland A, et al. Meat consumption and mortality - results from the European Prospective Investigation into Cancer and Nutrition. BMC Medicine. 2013:11. [PubMed: 23324495]
21. Hurst R, Armah CN, Dainty JR, Hart DJ, Teucher B, Goldson AJ, et al. Establishing optimal selenium status: results of a randomized, double-blind, placebo-controlled trial. American Journal of Clinical Nutrition. 2010; 91:923–31. [PubMed: 20181815]
22. Hurst R, Hooper L, Norat T, Lau R, Aune D, Greenwood DC, et al. Selenium and prostate cancer: systematic review and meta-analysis. American Journal of Clinical Nutrition. 2012; 96:111–22. [PubMed: 22648711]
23. Giovannucci E, Ascherio A, Rimm EB, Stampfer MJ, Colditz GA, Willett WC. Intake of carotenoids and retinol in relation to risk of prostate cancer. Journal of the National Cancer Institute. 1995; 87:1767–76. [PubMed: 7473833]
24. Turner EL, Lane JA, Donovan JL, Davis MJ, Metcalfe C, Neal DE, et al. Association of diabetes mellitus with prostate cancer: nested case-control study (Prostate testing for cancer and Treatment study). International Journal of Cancer. 2011; 128:440–6.
25. Must A, Willett WC, Dietz WH. Remote recall of childhood height, weight, and body build by elderly subjects. American Journal of Epidemiology. 1993; 138:56–64. [PubMed: 8333427]
26. Kirsh VA, Peters U, Mayne ST, Subar AF, Chatterjee N, Johnson CC, et al. Prospective study of fruit and vegetable intake and risk of prostate cancer. Journal of the National Cancer Institute. 2007; 99:1200–9. [PubMed: 17652276]
27. Richman EL, Carroll PR, Chan JM. Vegetable and fruit intake after diagnosis and risk of prostate cancer progression. International Journal of Cancer. 2012; 131:201–10.

28. Key TJ. Fruit and vegetables and cancer risk. British Journal of Cancer. 2011; 104:6–11. [PubMed: 21119663]
29. Bingham SA, Day NE, Luben R, Ferrari P, Slimani N, Norat T, et al. Dietary fibre in food and protection against colorectal cancer in the European Prospective Investigation into Cancer and Nutrition (EPIC): an observational study. Lancet. 2003; 361:1496–501. [PubMed: 12737858]
30. Stram DO, Hankin JH, Wilkens LR, Park S, Henderson BE, Nomura AMY, et al. Prostate cancer incidence and intake of fruits, vegetables and related micronutrients: the multiethnic cohort study (United States). Cancer Causes & Control. 2006; 17:1193–207. [PubMed: 17006725]
31. Drake I, Sonestedt E, Gullberg B, Ahlgren G, Bjartell A, Wallstrom P, et al. Dietary intakes of carbohydrates in relation to prostate cancer risk: a prospective study in the Malmo Diet and Cancer cohort. American Journal of Clinical Nutrition. 2012; 96:1409–18. [PubMed: 23134882]
32. Etminan M, Takkouche B, Caamano-Isorna F. The role of tomato products and lycopene in the prevention of prostate cancer: A meta-analysis of observational studies. Cancer Epidemiology Biomarkers & Prevention. 2004; 13:340–5.
33. Giovannucci E, Liu Y, Stampfer MJ, Willett WC. Prospective study of calcium intake and incident and fatal prostate cancer. Cancer Epidemiology Biomarkers & Prevention. 2006; 15:203–10.
34. Schwartz GG, Skinner HG. A Prospective Study of Total and Ionized Serum Calcium and Time to Fatal Prostate Cancer. Cancer Epidemiology Biomarkers & Prevention. 2012; 21:1768–73.
35. Ilic D, Forbes KM, Hassed C. Lycopene for the prevention of prostate cancer. Cochrane Database of Systematic Reviews. 2011
36. Geybels MS, Verhage BAJ, van Schooten FJ, Goldbohm RA, van den Brandt PA. Advanced prostate cancer risk in relation to toenail selenium levels. Journal of the National Cancer Institute. 2013; 105:1394–401. [PubMed: 23878355]
37. Richman EL, Chan JM. Selenium and prostate cancer: the puzzle isn't finished yet. American Journal of Clinical Nutrition. 2012; 96:1–2. [PubMed: 22623750]
38. Rayman MP, Combs GF Jr. Waters DJ. Selenium and Vitamin E Supplementation for Cancer Prevention. Jama-Journal of the American Medical Association. 2009; 301:1876–7.
39. Serra-Majem L, Pfrimer K, Doreste-Alonso J, Ribas-Barba L, Sanchez-Villegas A, Ortiz-Andrellucchi A, et al. Dietary assessment methods for intakes of iron, calcium, selenium, zinc and iodine. British Journal of Nutrition. 2009; 102:S38–S55. [PubMed: 20100367]
40. Duffield AJ, Thomson CD. A comparison of methods of assessment of dietary selenium intakes in Otago, New Zealand. British Journal of Nutrition. 1999; 82:131–8. [PubMed: 10743485]
41. Jiang L, Yang K-h, Tian J-h, Guan Q-l, Yao N, Cao N, et al. Efficacy of antioxidant vitamins and selenium supplement in prostate cancer prevention: a meta-analysis of randomized controlled trials. Nutrition and Cancer. 2010; 62:719–27. [PubMed: 20661819]
42. Sterne JAC, Smith GD. Sifting the evidence - what's wrong with significance tests? British Medical Journal. 2001; 322:226–31. [PubMed: 11159626]
43. Eyre H, Kahn R, Robertson RM, ACS/ADA/AHA Collaborative Writing Committee. Preventing cancer, cardiovascular disease, and diabetes: A common agenda for the American Cancer Society, the American Diabetes Association, and the American Heart Association. CA:A Cancer Journal for Clinicians. 2004; 54:190–207. [PubMed: 15253917]

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Table 1

WCRF/AICR recommendations for cancer prevention and scoring criteria[a]

WCRF/AICR recommendations	Personal recommendations	Operationalisation	Score	Cases n=1,806 %	Controls n=12,005 %
1) Body fatness. Be as lean as possible without becoming underweight.	1a) Ensure that body weight throughout childhood and adolescent growth projects toward the lower end of the normal BMI range at age 21 y.	Insufficient information	NA		
	1b) Maintain body weight within the normal range from age 21 y.	Lean at aged 20, 40 & trial entry	1	21.7	21.4
		Lean at 2 time-points	0.5	31.1	30.4
		Overweight at aged 20,40 & trial entry	0	47.2	48.2
	1c) Avoid weight gain and increases in waist circumference throughout adulthood.	WC <94cm	1	41.5	41.3
		WC ≥94 to <102cm	0.5	37.1	36.1
		WC ≥102cm	0	21.4	22.6
2) Physical activity. Be physically active as part of your everyday life.	2a) Be moderately physically active, equivalent to brisk walking, for 30 min every day.	PA ≥7 times/wk	1	28.1	27.1
		PA 3 to <7 times/wk	0.5	33.8	32.9
		PA <3 times/wk	0	38.1	40.0
	2b) As fitness improves, aim for 60 min of moderate or for 30 min of vigorous physical activity every day.	Insufficient information available	NA		
	2c) Limit sedentary habits such as watching television.	No information available	NA		
3) Foods and drinks that promote weight gain. Limit consumption of energy-dense foods; avoid sugary drinks.	3a) Consume energy-dense foods sparingly.	DED ≤125kcal.100g^{-1}.d^{-1}	1	16.2	18.0
		DED >125 to ≤175kcal.100g^{-1}.d^{-1}	0.5	63.1	62.0
		DED >175kcal/100.100g^{-1}.d^{-1}	0	20.7	20.0
	3b) Avoid sugary drinks.[b]	No sugary drinks or ≤1 fruit juice	1	45.1	44.5
		≤250g/d sugary drinks or	0.5	36.7	35.8
		>1 to ≤2 fruit juice	0	18.2	19.7
		>250g/d sugary drinks or >2 fruit juice			
	3c) Consume fast foods sparingly, if at all.	Insufficient information available			
4) Plant foods. Eat mostly foods of plant origin.	4a) Eat 5 portions/servings (400 g) of a variety of non starchy vegetables and of fruit every day.	F&V ≥400g/d	1	53.3	56.3
		F&V ≥200 to <400g/d	0.5	37.2	34.6
		F&V <200g/d	0	9.5	9.1
	4b) Eat relatively unprocessed cereals (grains) and/or pulses (legumes) with every meal.	NSP ≥18g/d	1	63.3	65.0
		NSP≥10 to <18g/d	0.5	33.2	31.8
		NSP <10g/d	0	3.5	3.2
	4c) Limit refined starchy foods.	Insufficient information available			
	4d) People who consume starchy roots or tubers as staples should also ensure sufficient intake of non starchy vegetables, fruit, and pulses (legumes).	Not applicable to our study population			

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WCRF/AICR recommendations	Personal recommendations	Operationalisation	Score	Cases n=1,806 %	Controls n=12,005 %
5) Animal foods. Limit intake of red meat and avoid processed meat.	5a) People who eat red meat should consume <500 g/wk and very few, if any, processed meats.	Red and processed meat<500g/wk & processed meat <3g/d Red and processed meat<500g/wk & processed meat ≥3g/d to ≤20g/d Red and processed meat≥500g/wk or processed meat >20g/d	1 0.5 0	3.6 28.3 68.1	5.0 26.1 68.9
6) Alcoholic drinks. Limit alcoholic drinks.	6a) If alcoholic drinks are consumed, limit consumption to 2 drinks/d for men and 1 drink/d for women.	Alcohol ≤20g/d Alcohol >20g/d to ≤30g/d Alcohol >30g/d	1 0.5 0	54.7 14.3 31.0	53.9 14.9 31.2

[a] WC, waist circumference; PA, physical activity; DED, dietary energy density; F&V, fruits and vegetables; NSP, non-starch polysaccharides

[b] Sugary drinks include non-diet soft drink, fruit squash and fruit juice. Fruit juice cut-offs apply to men who consumed fruit juice only.

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Table 2
Prostate cancer specific dietary recommendations and scoring criteria

Dietary component	Operationalisation	Score	Cases n=1,806 %	Controls n=12,005 %
Calcium	Calcium intake <1500mg/d	1	89.2	89.1
	Calcium intake ≥1500mg/d	0	10.8	10.9
Tomato and tomato products[a]	Tomato and products >10 servings/week	1	11.0	13.0
	Tomato and products ≤10 servings/week	0	89.0	87.0
Selenium	Selenium intake ≥105 to ≤200μg/d	1	26.3	27.4
	Selenium intake <105μg/d or >200μg/d	0	73.7	72.6

[a]Tomato products include tomato juice, tomato sauce, pizza and baked beans.

Table 3
Baseline characteristics of participants

Characteristics	Controls (maximum n=12,005)		Cases (maximum n=1,806)	
	n	Mean (SD) or %	n	Mean (SD) or %
Age (years)	12,005	61.6 (5.0)	1,806	62.0 (5.0)
Body mass index (kg/m^2)	11,901	27.4 (3.9)	1,787	27.1 (3.6)
Total energy intake (kcal/d)	12,005	2408 (681)	1,806	2398 (679)
Ethnicity				
White	11,843	98.7	1,775	98.3
Others	88	0.7	21	1.2
Missing	74	0.6	10	0.5
Family history of prostate cancer				
Yes	608	5.1	139	7.7
No	10,179	84.8	1,470	81.4
Missing	1,218	10.1	197	10.9
Diabetes				
Yes	884	7.4	111	6.1
No	10,448	87.0	1,580	87.5
Missing	673	5.6	115	6.4
Occupational class				
Managerial	5,843	48.7	851	47.1
Intermediate	1,814	15.1	272	15.1
Working	4,152	34.6	656	36.3
Missing	196	1.6	27	1.5
Smoking status				
Never	4,068	33.9	686	38.0
Past	6,296	52.4	880	48.7
Current	1,585	13.2	239	13.2
Missing	56	0.5	1	0.1
Dietary supplement intake				
Yes	6,027	50.2	938	51.9
No	5,740	47.8	829	45.9
Missing	238	2.0	39	2.2
Stage				
Localised	-	-	1,612	89.3
Locally advanced	-	-	184	10.2
Missing	-	-	10	0.5
Gleason grade				
Low (2-6)	-	-	1,204	66.7
High (7-10)	-	-	596	33.0
Missing	-	-	6	0.3

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Table 4

Associations of WCRF/AICR index score with prostate cancer risk

	WCRF/AICR Index Score				Dose-response (per 1 unit score)	P_{trend} [d]
	0-2	>2 to <3	3 to <4	4-6		
Controls, n	1,983	3,178	4,658	2,186		
Overall cases, n	294	479	688	345		
Model 1 [a]	1	1.02 (0.87, 1.19)	0.99 (0.85, 1.14)	1.05 (0.88, 1.24)		
Model 2	1	1.01 (0.86, 1.18)	0.96 (0.83, 1.11)	1.01 (0.85, 1.19)	0.99 (0.94, 1.05)	0.71
Localised cases [b], n	257	429	626	300		
Model 1	1	1.04 (0.88, 1.22)	1.02 (0.87, 1.19)	1.04 (0.87, 1.24)		
Model 2	1	1.02 (0.87, 1.21)	0.99 (0.84, 1.16)	0.99 (0.83, 1.19)	0.99 (0.93, 1.05)	0.72
Locally advanced cases [b], n	34	48	59	43		
Model 1	1	0.90 (0.57, 1.40)	0.73 (0.47, 1.12)	1.13 (0.71, 1.78)		
Model 2	1	0.90 (0.57, 1.40)	0.73 (0.48, 1.13)	1.16 (0.72, 1.84)	1.00 (0.85, 1.18)	0.97
Locally advanced vs. Localised [c], n	34/257	48/429	59/626	43/300		
Model 1	1	0.86 (0.54, 1.38)	0.70 (0.44, 1.09)	1.06 (0.65, 1.73)		
Model 2	1	0.87 (0.54, 1.41)	0.75 (0.47, 1.19)	1.17 (0.71, 1.94)	1.02 (0.86, 1.22)	0.81
Low grade cases [b], n	188	331	465	220		
Model 1	1	1.10 (0.91, 1.33)	1.06 (0.89, 1.27)	1.07 (0.87, 1.32)		
Model 2	1	1.08 (0.90, 1.31)	1.02 (0.85, 1.22)	1.00 (0.81, 1.24)	1.00 (0.93, 1.07)	0.93
High grade cases [b], n	106	146	220	124		
Model 1	1	0.84 (0.65, 1.09)	0.83 (0.66, 1.06)	0.99 (0.75, 1.29)		
Model 2	1	0.85 (0.66, 1.10)	0.84 (0.66, 1.07)	1.00 (0.76, 1.31)	0.97 (0.89, 1.07)	0.55
High vs. Low grade [c], n	106/188	146/331	220/465	124/220		
Model 1	1	0.76 (0.55, 1.03)	0.79 (0.59, 1.05)	0.93 (0.67, 1.30)		
Model 2	1	0.74 (0.54, 1.01)	0.79 (0.58, 1.06)	0.96 (0.68, 1.34)	0.97 (0.87, 1.09)	0.61

[a] Odds ratios and 95% confidence intervals from conditional logistic regression, matched by 5-year age band and recruitment centre, and adjusted by age (continuous variable).

[b] Relative risk ratios and 95% confidence intervals from multinomial logistic regression

[c] Relative risk ratios and 95% confidence intervals from logistic regression

[d] p-trend for the association of prostate cancer risk per 1 unit increment in index score. Model 1 for cancer sub-types: adjusted for age (continuous variable) and recruitment centre. Model 2: further adjusted for family history of prostate cancer, smoking status and total energy intake (continuous variable). For definitions of localised, locally advanced, low and high grade cancer, please refer to methods.

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Table 5

Associations of the components of WCRF/AICR index score and prostate cancer risk by cancer stage.[a]

	Score	Control n	Overall prostate cancer			Localised			Locally advanced			Locally advanced vs. Localised	
			n	OR (95% CI)	P_{tren}[d]	n	OR (95% CI)	P_{trend}	n	OR (95% CI)	P_{trend}	OR (95% CI)	P_{trend}
Body Fatness	0 to 0.25	5,007	747	1		679	1		65	1		1	
	0.5	2,928	448	1.02 (0.90, 1.16)		390	0.97 (0.84, 1.10)		52	1.37 (0.95, 1.99)		1.38 (0.93, 2.05)	
	0.75	1,998	293	0.96 (0.83, 1.11)		264	0.95 (0.81, 1.10)		29	1.16 (0.74, 1.81)		1.18 (0.73, 1.90)	
	1	2,072	318	1.00 (0.87, 1.16)		279	0.96 (0.82, 1.11)		38	1.48 (0.98, 2.24)		1.58 (1.01, 2.45)	
	Dose-response[b]			1.01 (0.97, 1.05)	0.73		1.00 (0.96, 1.04)	0.85		1.11 (0.99, 1.24)	0.08	1.11 (0.99, 1.26)	0.08
Physical activity	0	4,796	688	1		602	1		80	1		1	
	0.5	3,956	610	1.08 (0.96, 1.21)		559	1.13 (1.00, 1.28)		47	0.71 (0.49, 1.03)		0.62 (0.42, 0.93)	
	1	3,253	508	1.10 (0.97, 1.24)		451	1.11 (0.97, 1.27)		57	1.03 (0.72, 1.46)		0.96 (0.65, 1.41)	
	Dose-response[c]			1.05 (0.98, 1.12)	0.14		1.06 (0.99, 1.13)	0.09		1.00 (0.83, 1.20)	0.96	0.96 (0.79, 1.18)	0.71
Foods and drinks that promote weight gain	0 to 0.25	2,948	438	1		386	1		51	1		1	
	0.5	4,005	607	1.01 (0.88, 1.15)		545	1.03 (0.90, 1.19)		60	0.85 (0.58, 1.24)		0.79 (0.52, 1.20)	
	0.75	3,890	606	1.04 (0.91, 1.20)		545	1.07 (0.92, 1.23)		54	0.79 (0.53, 1.17)		0.75 (0.49, 1.15)	
	1	1,162	155	0.91 (0.74, 1.12)		136	0.91 (0.73, 1.12)		19	1.02 (0.58, 1.78)		1.06 (0.58, 1.95)	
	Dose-response[b]			1.00 (0.95, 1.06)	0.96		1.00 (0.95, 1.06)	0.97		0.99 (0.85, 1.15)	0.86	0.98 (0.83, 1.16)	0.81
Plant foods	0 to 0.25	1,063	165	1		145	1		18	1		1	
	0.5	2,456	398	1.04 (0.85, 1.27)		355	1.04 (0.84, 1.28)		41	1.06 (0.60, 1.87)		0.99 (0.54, 1.83)	
	0.75	2,547	403	1.00 (0.82, 1.22)		357	0.99 (0.80, 1.22)		44	1.10 (0.62, 1.95)		1.02 (0.55, 1.90)	
	1	5,939	840	0.87 (0.72, 1.06)		755	0.87 (0.71, 1.06)		81	0.88 (0.51, 1.54)		0.95 (0.52, 1.74)	
	Dose-response[b]			0.94 (0.89, 0.99)	0.02		0.94 (0.89, 0.99)	0.02		0.94 (0.81, 1.09)	0.45	0.98 (0.83, 1.15)	0.81
Animal foods	0	8,277	1,230	1		1,094	1		130	1		1	
	0.5	3,129	511	1.09 (0.97, 1.22)		458	1.10 (0.98, 1.24)		50	1.01 (0.72, 1.42)		0.94 (0.65, 1.35)	
	1	599	65	0.73 (0.56, 0.96)		60	0.76 (0.58, 1.01)		4	0.43 (0.16, 1.19)		0.61 (0.22, 1.74)	
	Dose-response[c]			0.98 (0.89, 1.07)	0.61		0.99 (0.90, 1.09)	0.84		0.86 (0.65, 1.14)	0.28	0.88 (0.65, 1.20)	0.43
Alcohol	0	3,745	559	1		500	1		55	1		1	

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Score	Control n	Overall prostate cancer			Localised			Locally advanced			Locally advanced vs. Localised	
		n	OR (95% CI)	P_{tren} [d]	n	OR (95% CI)	P_{trend}	n	OR (95% CI)	P_{trend}	OR (95% CI)	P_{trend}
0.5	1,788	259	0.97 (0.83, 1.14)		232	0.96 (0.82, 1.14)		26	1.02 (0.64, 1.65)		1.16 (0.70, 1.94)	
1	6,472	8	1.00 (0.90, 1.13)		880	1.00 (0.88, 1.12)		103	1.10 (0.78, 1.55)		1.12 (0.77, 1.62)	
Dose-response[c]			1.00 (0.95, 1.06)	0.89		1.00 (0.94, 1.06)	0.98		1.05 (0.89, 1.25)	0.58	1.05 (0.88, 1.26)	0.58

[a] Adjusted for age (continuous variable), recruitment centre, family history of prostate cancer, smoking status and total energy intake (kcal/d). All components were mutually adjusted for each other except for the 'foods and drinks that promote weight gain' component.

[b] Odds ratios and 95% CI per 0.25 score increment.

[c] Odds ratios and 95% CI per 0.5 score increment

[d] P-values for trend were calculated by modeling components of WCRF/AICR score as a continuous variable.

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Table 6

Associations of prostate cancer dietary index score with prostate cancer risk

	Prostate Cancer Dietary Index Score			Dose-response (per 1 unit score)	p_{trend} [d]
	0 to 1	2	3		
Controls, n	8,436	3,120	447		
Overall cases, n	1,311	437	58		
Model 1 [a]	1	0.90 (0.80, 1.01)	0.82 (0.62, 1.08)		
Model 2	1	0.90 (0.80, 1.02)	0.82 (0.61, 1.09)	0.91 (0.84, 0.99)	0.04
Localised cases [b], n	1,165	398	49		
Model 1	1	0.92 (0.82, 1.04)	0.78 (0.58, 1.06)		
Model 2	1	0.92 (0.81, 1.04)	0.78 (0.57, 1.06)	0.93 (0.85, 1.01)	0.10
Locally advanced cases [b], n	138	37	9		
Model 1	1	0.71 (0.49, 1.02)	1.18 (0.60, 2.34)		
Model 2	1	0.71 (0.49,1.04)	1.17 (0.58, 2.36)	0.79 (0.61, 1.03)	0.08
Locally advanced vs. Localised [c], n	138/1,165	37/398	9/49		
Model 1	1	0.81 (0.54, 1.19)	1.45 (0.68, 3.06)		
Model 2	1	0.84 (0.56, 1.25)	1.48 (0.68, 3.19)	0.90 (0.69, 1.19)	0.46
Low grade cases [b], n	873	292	39		
Model 1	1	0.90 (0.79, 1.04)	0.84 (0.60, 1.17)		
Model 2	1	0.89 (0.77, 1.03)	0.82 (0.59, 1.16)	0.93 (0.84, 1.03)	0.15
High grade cases [b], n	433	144	19		
Model 1	1	0.89 (0.73, 1.08)	0.80 (0.50, 1.28)		
Model 2	1	0.92 (0.75, 1.12)	0.83 (0.51, 1.34)	0.90 (0.78, 1.04)	0.16
High vs. Low grade [c], n	433/873	144/292	19/39		
Model 1	1	0.99 (0.78, 1.25)	1.06 (0.60, 1.88)		
Model 2	1	1.04 (0.81, 1.33)	1.13 (0.63, 2.03)	0.98 (0.82, 1.18)	0.86

[a] Odds ratios and 95% confidence intervals from conditional logistic regression, matched by 5-year age band and recruitment centre, and adjusted by age (continuous variable).

[b] Relative risk ratios and 95% confidence intervals from multinomial logistic regression

[c] Relative risk ratios and 95% confidence intervals from logistic regression

[d] p-trend for the association of prostate cancer risk per 1 unit increment in index score. Model 1 for cancer sub-types: adjusted for age (continuous variable) and recruitment centre. Model 2: further adjusted for family history of prostate cancer, smoking status and total energy intake (continuous variable).