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Authors

Langlais, Crystal S
Chan, June M
Kenfield, Stacey A
et al.

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Post-Diagnostic Coffee and Tea Consumption and Risk of Prostate Cancer Progression by Smoking History

Crystal S. Langlais[1], **June M. Chan**[1,2,3], **Stacey A. Kenfield**[2,3], **Janet E. Cowan**[2], **Rebecca E. Graff**[1,3], **Jeanette M. Broering**[2], **Peter Carroll**[2,3], **Erin L. Van Blarigan**[1,2,3]

[1]Department of Epidemiology and Biostatistics, University of California, San Francisco, San Francisco, CA, USA.

[2]Department of Urology, University of California, San Francisco, San Francisco, CA, USA.

[3]Helen Diller Family Comprehensive Cancer Center, University of California, San Francisco, San Francisco, CA, USA.

Abstract

Purpose: Post-diagnostic coffee and tea consumption and prostate cancer progression is understudied.

Methods: We examined 1,557 men from the Cancer of the Strategic Urologic Research Endeavor who completed a food frequency questionnaire a median of 28 months post-diagnosis. We estimated associations between post-diagnostic coffee (total, caffeinated, decaffeinated) and tea (total, non-herbal, herbal) and risk of prostate cancer progression (recurrence, secondary treatment, bone metastases, or prostate cancer death) using Cox proportional hazards regression. We also examined smoking (current, former, never) modified these associations.

Results: We observed 167 progression events (median follow-up 9 years). Higher coffee intake was associated with higher risk of progression among current smokers (n=95). The hazard ratio (HR) [95% confidence interval (CI)] for 5 vs 0 cups/day of coffee was 0.5 (CI: 0.2, 1.7) among never smokers, but 4.5 (CI: 1.1, 19.4) among current smokers (*p*-interaction: 0.001). There was no association between total coffee with prostate cancer progression among never and former smokers. However, we observed an inverse association between decaffeinated coffee (cups/days) and risk of prostate cancer progression in these men (HR>0-<$_{1\text{ vs }0}$: 1.1 (CI: 0.7, 1.8); HR$_{1-<2\text{ vs }0}$:

Corresponding Author: Crystal S. Langlais, MPH, crystal.langlais@ucsf.edu, Address: University of California, San Francisco, Dept of Epidemiology & Biostatistics, 550 16th Street, 2nd Floor, San Francisco, CA, 94143-3110.

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Conflict of Interest:. The authors declare that they have no conflict of interest.

Declarations

Ethics Approval: The study obtained institutional review board (IRB) approval and the study was conducted in accordance with the Belmont Report and U.S. Common Rule under local IRB supervision.

Consent to Participate: Informed consent was obtained from all individual participants included in the study.

Availability of Data and Material: Data may be available for replication or meta-analyses upon request.

Code Availability: Code may be available for replication or meta-analyses upon request.

0.7 (CI:0.3, 1.4); $HR_{\geq 2 \text{ vs } 0}$: 0.6 (CI:0.3, 1.1); p trend=0.03). There was no association between tea and prostate cancer progression, overall or by smoking status.

Conclusion: Among non-smoking men diagnosed with localized prostate cancer, moderate coffee and tea consumption was not associated with risk of cancer progression. However, post-diagnostic coffee intake was associated with increased risk of progression among current smokers.

Keywords

coffee; tea; survivorship; cancer recurrence; post-diagnostic lifestyle

Introduction

In the United States, the 5-year survival rate following prostate cancer diagnosis is 98% [1]. Yet, prostate cancer is projected to remain the 2nd leading cause of cancer-related death among men in 2020 [1]. Prostate cancer has a heterogeneous disease course, and research continues to be warranted to identify which tumors are likely to progress. Among men diagnosed with localized disease, there is growing interest in identifying modifiable behaviors associated with prostate cancer progression, in an attempt to minimize cancer death and improve overall patient outcomes.

Coffee consumption has been studied in the pre-diagnostic setting with some evidence that it may lower the risk of developing prostate cancer, including lethal disease and progression [2–5]. Coffee is comprised of many biologically active compounds that have antioxidant properties and has been shown to affect circulating levels of biomarkers thought to affect risk of prostate cancer progression, including insulin and sex hormones [6–8]. Similarly, tea consumption is hypothesized to improve patient outcomes due to its antioxidant properties [9,10]. While several studies have examined tea in relation to risk of prostate cancer in Asian populations, generally null results, few studies have examined tea and prostate cancer in the United States [11].

A single study looked at the association between post-diagnostic tea and coffee intake and prostate cancer progression, but was unable to assess caffeinated versus decaffeinated coffee consumption [12]. Further, the authors were only able to adjust for a crude measure of smoking status (ever versus never smoked) and did not test for effect modification by smoking status.

Thus,in this study we investigated associations between post-diagnostic consumption of total, caffeinated, and decaffeinated coffee and tea intake with risk of prostate cancer progression among men initially diagnosed with localized prostate cancer. Because smoking been associated with increased coffee and caffeine intake [13,14], and is associated with worse prostate cancer outcomes [15], we examined models stratified by smoking status (to control for residual confounding) and explored interactions between smoking and coffee and tea intake in relation to prostate cancer progression.

Methods

Study Design.

Data for this study were obtained from the Cancer of the Prostate Strategic Urologic Research Endeavor (CaPSURE™), a longitudinal observational study of 15,310 men with biopsy-proven prostate cancer. Participants were enrolled from any of 43 practices across the United States between 1999 and 2018. Data on clinical and pathological factors, treatments, and recurrence were reported by participating urologists. All participants provided written informed consent following institutional review board (IRB) approval and the study was conducted in accordance with the Belmont Report and U.S. Common Rule under local IRB supervision. Additional details of CaPSURE are reported elsewhere [16]. A subset of patients volunteered to participate in the CaPSURE Diet and Lifestyle (CDL) sub-study, consisting of a comprehensive diet and lifestyle questionnaire. A total of 2,216 men completed the first questionnaire, administered in 2004–2006. The questionnaire asked about various behaviors and included a validated food frequency questionnaire (FFQ) [17,18].

For this analysis, data from the CDL sub-study were used to assess the relationship between coffee and tea consumption after diagnosis and risk of prostate cancer progression. Men who completed the CDL questionnaire and had been diagnosed with localized disease (<T3a) were considered for this analysis (n=2,067). We then excluded men who experienced prostate cancer recurrence prior to the date that they completed the questionnaire (n=353), those without documented primary treatment (n=46), and those lacking clinical follow-up after questionnaire (n=2). Smoking status and median coffee and tea intake were similar among men included compared to men excluded due to documented recurrence prior to completing the questionnaire. To reduce measurement error in dietary assessment, we further excluded men with extreme caloric intake (n=30 with caloric intake <800; n=29 with caloric intake ≥4,200) and men who failed to respond to at least half of the FFQ questions (n=30). Finally, we excluded men with unknown smoking history (n=20). This left us with a sample size of 1,557 men.

Assessment of Coffee and Tea Intake.

Post-diagnostic coffee and tea consumption were self-reported on the FFQ, a median of 28 months after diagnosis [interquartile range (IQR): 15, 48 months]. Specifically, the FFQ asked men how frequently they consumed 1 cup of decaffeinated coffee, regular coffee, non-herbal tea (contains caffeine), and herbal tea with the following frequency options: never or <1/month, 1–3/month, 1/week, 2–4/week, 5–6/week, 1/day, 2–3/day, 4–5/day, or ≥6/day. Total coffee consumption included combined intake of caffeinated and decaffeinated coffee and total tea consumption included combined intake of non-herbal and herbal tea. Midpoint values of categories were used to convert the categorical response options to continuous values (e.g., 2–3 cups/day was treated as 2.5 cups/day). Coffee (total, caffeinated, decaffeinated) and tea (total, non-herbal, herbal) were treated as both continuous and categorical (none, >0 to <1, 1 to <2, 2 to <3, and ≥3 cups/day for coffee and none, >0 to <1, ≥1 cups/day for tea) variables in final models. Category cut-points were based on the distribution of in takes the study population. In subgroup analyses (e.g., decaffeinated coffee

intake), highest categories were collapsed due to small number of men, as needed. The deattenuated correlations between the FFQ and the average of four 7-day diet records reported previously were 0.93 for coffee and 0.77 for non-herbal tea [19].

Assessment of Smoking Status.

The CDL survey asked participants if they had smoked 20 packs of cigarettes in their lifetime. Those who responded “no” were classified as never smokers. Men who responded “yes” were asked whether they currently smoke or quit, how many cigarettes they usually consumed or used to consume, and how long ago they quit (if applicable).

Outcome Ascertainment.

Prostate cancer progression outcome, defined as biochemical recurrence, secondary treatment, bone metastases, or death attributed to prostate cancer [20]. *Biochemical recurrence* was defined as two consecutive prostate-specific antigen (PSA) ≥0.2ng/mL following radical prostatectomy or a rise of 0.2ng/mL above post-radiation nadir. *Secondary treatment* was defined as any treatment started at least 6 months following primary treatment. *Bone metastases* were attributed to prostate cancer if the treating urologist reported prostate cancer progression to bone or advancement to TNM stage M1b, patient had a positive bone scan, or patient underwent radiation to treat bone metastases. *Cause of death* was determined by study centers and through confirmation with the National Death Index. Deaths were attributed to prostate cancer if the death certificate included ICD code: 185 [(metastatic) malignant ofprostate] astheprimary orsecondary cause of death. Time-to-progression was measured from date of completion of CDL questionnaire to the date of progression (i.e., first date associated with recurrence, secondary treatment, bone metastases, or death). A patient was censored at his last date of follow-up or death (from other cause) if he did not have documented progression.

Statistical Analysis.

Cox proportional hazards models were used to estimate the hazard ratio (HR) and 95% confidence interval (CI) for overall associations between both coffee and tea consumption and risk of prostate cancer progression. We used robust standard errors to account for clustering by CaPSURE clinical site. We assessed potential effect modification by time between diagnosis and completion of CDL questionnaire and, separately, by smoking status (never, former, or current) by adding a product term between total coffee (continuous) or total tea (continuous) and the possible effect modifier to the model and using a Wald test. If a significant interaction (p-interaction <0.05) was observed between smoking and the exposures of interest, we planned to present stratified models and report HR (95% CI) at various levels of intake within strata of smoking.

Final models were adjusted for time between diagnosis and CDL survey completion (continuous), year of diagnosis (continuous), age at diagnosis (continuous), race (white, other), smoking status (restricted models: never, former; interaction models: never, former, current), Gleason grade at diagnosis (continuous), PSA at diagnosis (continuous), primary treatment (radical prostatectomy, radiation therapy, hormone therapy, active surveillance/watchful waiting, other), total caloric intake (continuous), and CaPSURE clinical site.

Models for coffee were additionally adjusted for total tea intake while models for tea were adjusted for total coffee intake. Additionally, models looking at subtypes of coffee (caffeinated, decaffeinated) or tea (non-herbal, herbal) were further adjusted for the other type (e.g., models for decaffeinated coffee intake were adjusted for caffeinated coffee intake). We considered additional covariates, including height, body mass index, walking pace, history of diabetes, family history of prostate cancer, household income, and education level; use of alcohol, multivitamins, calcium supplements, and vitamin E supplements; and intake of processed meat, tomatoes, fish, cruciferous vegetables, whole milk, eggs, and poultry with skin. Inclusion of these variables did not meaningfully change results so they were not included in the final models. Log-minus-log plots and Schoenfeld tests were used to assess the proportional hazards assumption, and Martingale residuals and smoothing were used to assess the linearity of the predictors assumption. Linear trends were assessed using contrast analyses. All analyses were performed in Stata (version 16; College Station, TX) using a two-sided alpha level of 0.05 to assess statistical significance.

Given the relatively low number of events (n=167) and the large number of potential confounders, we conducted a secondary analysis using a propensity score to control for additional covariates. The results were consistent with the main analyses presented here. Thus, a description of how the propensity score was built and the results from this approach can be found in the online resources material.

To address possible residual confounding from smoking, we performed four sensitivity analyses. The first assessed the relationship between both coffee and tea consumption and prostate cancer among never smokers only. The rest also included former smokers and adjusted for number of years smoked, number of cigarettes smokes, and both number of years and number of cigarettes smoked, in place of smoking status, assigning never smokers to 0 years smoked and 0 cigarettes smoked. These latter excluded former smokers who did not respond to questions regarding number of years smoked (n=20 out of 840 former smokers) or number of cigarettes consumed (n=38 out of 840 former smokers).

Results

The 1,557 men who met inclusion criteria for this analysis were followed for a median of 9.1 years (IQR: 4.0, 12.6) after completing the CDL survey, for a total of 12,765 person-years. During the follow-up period, 167 men had documented progression of prostate cancer (151 with biochemical recurrence, 0 required secondary treatment, 5 with bone metastases, and 11 deaths related to prostate cancer). Four of the men with biochemical recurrence and one of the men with bone metastases eventually died as a result of their prostate cancer.Overall, 1,302 (84%) and 861 (55%) men reported at least some coffee and tea consumption, respectively, with average coffee intake higher than average tea intake (1.7 vs 0.5 cups/day). Only 95 (6%) men reported being current smokers following diagnosis, whereas 622 (40%) and 840 (54%) reported being never and former smokers, respectively. Most former smokers (n=721; 86%) reported having quit 10 or more years prior to completing the survey. The frequency of never smokers increased with increasing tea intake but declined with increasing coffee intake; 14% of men who consumed ≥3 cups of coffee per day were current smokers

versus 3% of those that consumed between 1 and 2 cups per day. Baseline patient and clinical characteristics are shown in Table 1 by total coffee and tea intake.

We found no evidence of interaction between coffee (p-interaction=0.07) or tea intake (p-interaction=0.23) and time between diagnosis and survey completion for the association with prostate cancer progression. However, the association with coffee varied by smoking status, such that higher daily coffee consumption was associated with a higher risk of progression among current smokers (p-interaction=0.001) (Table 2). Among current smokers, the HR (95% CI) was 1.35 (1.01, 1.81) for 1 cup/day, 2.47 (1.03, 5.93) for 3 cups/day, and 4.52 (1.05, 19.41) for 5 cups/day (compared to no coffee intake). Among never smokers, the corresponding HR's (95% CI) were 0.88 (0.70, 1.11) for 1 cup/day, 0.69 (0.34, 1.38) for 3 cups/day, and 0.54 (0.17, 1.72) for 5 cups/day. No evidence of interaction was observed between tea and smoking status (former smoker: p-interaction=0.50; current smoker: p-interaction=0.90).

Given evidence of interaction between smoking and coffee consumption and a limited number of current smokers in our dataset, we conducted analyses restricted to the 1,462 never and former smokers (adjusting for never vs. past smoker in our models). In this subset of participants, there was no evidence of an association between total coffee or tea (total, non-herbal, and herbal) intake and prostate cancer progression (Table 3). There was a non-significant downward trend in risk with higher coffee intake up to the consumption of <3 cups per day, but this trend did not hold for men with the highest level of consumption (≥3 cups/day; HR 1.02, 95% CI: 0.43, 2.42). A similar pattern was observed when looking at caffeinated coffee intake. However, we did observe an inverse relationship between decaffeinated coffee consumption and prostate cancer progression among never and former smokers. Specifically, men who consumed 1-<2 or =2 cups of decaffeinated coffee per day had 32% and 41% lower risk of prostate cancer progression, respectively, compared to men who consumed no decaffeinated coffee ($HR0_{-<1\text{ vs none}}$: 1.14 (95% CI: 0.73, 1.76), $HR_{1-<2\text{ vs none}}$: 0.68 (95% CI: 0.33, 1.40), $HR_{\geq 2\text{ vs none}}$: 0.59 (95% CI: 0.31, 1.13); p-trend = 0.03). (Note, only 30 men consumed ≥3 cups of decaffeinated coffee per day.) As stated in the methods, estimates from propensity score models were similar (Online Resource 1).

Because the relative frequency of former smokers increased with increasing coffee intake, we performed a sensitivity analysis to assess the relationship between coffee intake and prostate cancer progression restricted to never smokers (Table 4). The results were similar, although the non-statistically significant downward trend in risk with higher coffee intake continued across all levels of coffee consumption. Results of the caffeinated coffee analysis among never smokers was similar to analyses including former smokers, though the point estimate among the highest consumers (≥3 cups/day) was attenuated towards the null (HR: 1.40 (95% CI: 0.53, 3.72), p-trend=0.76 vs. HR 1.03 (95%CI: 0.36, 2.95), p-trend=0.61). Categorized analyses for decaffeinated werelimited to any versus none due to the low number of events among never smokers. Decaffeinated coffee was not associated with prostate cancer progression in these analyses (p= 0.18). However, when we treated decaffeinated coffee intake as a continuous variable, we observed a 33% reduction in prostate cancer progression for each 1 cup/day increase in decaffeinated coffee consumption (HR: 0.67, 95% CI: 0.46, 0.97) among never-smoking men. The associations between tea

and prostate cancer progression in analyses restricted to never smokers were unchanged. Results were also similar when we adjusted for number of years smoked, number of cigarettes smoked, and both number of years and number of ciagrettes smoked in place of smoking status (data not shown).

Discussion

In this study, we observed no association between total coffee or tea intake with prostate cancer progression among never or former smokers. However, there was evidence of an interaction between coffee intake and smoking status. Among current smokers, higher coffee intake was associated with a higher risk of prostate cancer progression; whereas the risk of progression was lower with higher coffee intake among men who reported never smoking. We also observed evidence of an association between decaffeinated coffee intake and lower risk of prostate cancer progression among never and former smokers.

Multiple observational studies have examined pre-diagnostic coffee consumption and risk of developing incident prostate cancer with mixed results that suggest an inverse association [2,21,22]. Data are limited on coffee and outcomes, such as recurrence and mortality, among men with prostate cancer. Geybels and colleagues reported that *pre-diagnostic* coffee consumption was associated with a decreased risk of prostate cancer recurrence/progression [5]. Most recently, Gregg and colleagues examined the relationship between *post-diagnostic* coffee consumption and risk of prostate cancer progression among 411 men on active surveillance, and found no evidence of an association. However, similar to our findings, they observed a non-significant downward trend across all levels of coffee consumption except among the highest consumers. The lack of a continuation of the seemingly downward trend in risk among the highest consumers of total coffee and caffeinated coffee may reflect residual confounding due to smoking history. Former smokers are more likely to consume larger quantities of caffeinated coffee [13,14] and have an elevated risk of prostate cancer progression (which may depend on time since quitting) [15,23]. Indeed, the point estimates suggesting harmful effects for the highest coffee consumers were attenuated in analyses restricted to never smokers.

Our observation of an inverse association between decaffeinated coffee and lower risk of prostate cancer progression should be interpreted with caution given the low decaffeinated coffee intake in our study sample: median (IQR) intake was 0.00 (0.0, 0.8) cups per day; only 30 men reported >3 cups per day. However, others have studied this relationship in the pre-diagnostic setting and found an inverse association between decaffeinated coffee and risk of developing lethal and advanced prostate cancer [2]. Coffee has many components beyond caffeine that make it biologically plausible that it could act to lower the risk of disease development and progression. For example, chlorogenic acid lignans and phytoestrogens have antioxidant properties and have been shown to inhibit glucose absorption, which may improve insulin sensitivity [6,8,7]. Insulin is thought to promote tumor growth and, among men with prostate cancer, elevated insulin levels have been associated with carcinogenesis, including prostate cancer progression and mortality [24–27]. However, as has been seen for other antioxidants [28], coffee may have a different association with cancer outcomes among smokers. Further, effects of these biologically

active components is posited to be relatively small and therefore it is possible any effect cannot offset the harm introduced by smoking, which is associated with poorer prostate cancer outcomes. Further research is needed to replicate this finding and elucidate the biologic pathways.

As with any study, we are mindful of potential limitations. First, we cannot control for confounders that were unknown or unmeasured. However, propensity scores allow us to control for all plausible (measured and known) confounders, with little concern for dimensionality issues. Here, in addition to using standard multivariable adjustment, we explored using a propensity score to adjust for additional potential confounders. Our results were robust to such methods, decreasing the likelihood that other measured confounders influenced our findings. Second, we recognize that the relative concentration of compounds consumed may vary based on the type of coffee and preparation methods, which this study was unable to assess. Third, risk patterns may change for the most extreme (e.g., 6+ cups per day) consumers, as reported in the pre-diagnostic setting [2]. We were unable to assess this as no man in this study reported consuming 6 or more cups per day. Fourth, men in our study were predominantly white and may be healthier than the general population of men with prostate cancer, given the relatively low prevalence of current smokers [29] and lower than average BMI [30] compared to national data, potentially limiting generalizability. Fifth, we were unable to control for pre-diagnostic coffee or tea Intake, and thus cannot conclude our results are independent of pre-diagnostic exposure. Finally, while it remains possible that the observed interaction effect may be due to chance, this concern may be diminishied in light of the observation of trends in the results (dose-escalation) and the biological plausibility aligned with prior reports, as detailed above. Futher, the finding of interaction between coffee consumption and current smokwers was still borderline statistically significant, even at an alpha level calculated from the conservative Bonferroni for multiple comparisons (0.05/38 tests = new alpha of 0.0013).

In sum, coffee and tea consumption appear to be safe in moderation among men with prostate cancer without a smoking history, and decaffeinated coffee may even be beneficial among non-smokers (never and former) following diagnosis. Further studies with larger sample sizes that can examine risk of prostate cancer mortality are needed to confirm these findings. Consistent with all public health advice, men diagnosed with prostate cancer who are current smokers should be counseled and provided with resources to help them quit. It may also be prudent for current smokers to limit coffee consumption following a prostate cancer diagnosis, as evidence from this study suggests coffee intake may substantially increase risk of progression in this subgroup of men.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Baseline patient and clinical characteristics of 1,557 men with localized prostate cancer, overall and by total post-diagnostic coffee and tea intake

Characteristic, Median (IQR) or N (%)[a]	Total Coffee Intake (cups/day)					Total Tea Intake (cups/day)			Total
	None (n = 255)	>0–<1 (n = 335)	1–<2 (n = 276)	2–<3 (n = 509)	≥3 (n = 182)	None (n = 696)	>0–<1 (n = 607)	≥1 (n = 254)	(n = 1,557)
Coffee Intake, Total (cups/day)	0.0 (0.0, 0.0)	0.4 (0.1, 0.8)	1.0 (1.0, 1.1)	2.5 (2.5, 2.5)	4.5 (4.5, 4.9)	2.0 (0.8, 2.5)	1.0 (0.4, 2.5)	1.0 (0.0, 2.5)	1.0 (0.4, 2.5)
Caffeinated	0.0 (0.0, 0.0)	0.1 (0.0, 0.4)	1.0 (0.1, 1.0)	2.5 (0.4, 2.5)	4.5 (2.5, 4.5)	0.8 (0.0, 2.5)	0.8 (0.0, 2.5)	0.1 (0.0, 1.0)	0.8 (0.0, 2.5)
Decaffeinated	0.0 (0.0, 0.0)	0.1 (0.0, 0.4)	0.1 (0.0, 1.0)	0.0 (0.0, 2.5)	0.0 (0.0, 2.5)	0.0 (0.0, 0.8)	0.0 (0.0, 0.4)	0.0 (0.0, 0.4)	0.0 (0.0, 0.8)
Tea Intake, Total (cups/day)	0.1 (0.0, 1.0)	0.1 (0.0, 0.8)	0.1 (0.0, 0.6)	0.0 (0.0, 0.3)	0.1 (0.0, 0.2)	0.0 (0.0, 0.0)	0.1 (0.1, 0.4)	2.0 (1.0, 2.5)	0.1 (0.0, 0.4)
Non-Herbal	0.0 (0.0, 0.8)	0.1 (0.0, 0.4)	0.1 (0.0, 0.4)	0.0 (0.0, 0.1)	0.1 (0.0, 0.1)	0.0 (0.0, 0.0)	0.1 (0.1, 0.4)	1.0 (1.0, 2.5)	0.0 (0.0, 0.4)
Herbal	0.0 (0.0, 0.0)	0.0 (0.0, 0.1)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.1)	0.0 (0.0, 0.4)	0.0 (0.0, 0.0)
Age at diagnosis (yrs)	64 (57, 69)	65 (59, 71)	67 (61, 72)	65 (59, 70)	65 (58, 69)	65 (59, 70)	65 (58, 70)	65 (60, 70)	65 (59, 70)
BMI (kg/m^2)	26.5 (24.4, 29.3)	26.6 (24.5, 29.5)	26.4 (24.4, 29.3)	27.1 (25.1, 29.3)	27.7 (25.4, 30.4)	27.2 (25.1, 29.6)	26.5 (24.5, 29.4)	26.6 (24.4, 29.2)	26.8 (24.7, 29.4)
Alcohol (serv/day)[b]	0.1 (0.0, 0.6)	0.4 (0.0, 1.1)	0.4 (0.0, 1.2)	0.7 (0.1, 1.7)	0.2 (0.0, 1.3)	0.4 (0.0, 1.4)	0.4 (0.0, 1.1)	0.3 (0.0, 1.1)	0.4 (0.0, 1.3)
Race/Ethnicity									
White	236 (93)	315 (94)	267 (97)	492 (97)	179 (98)	673 (97)	579 (95)	237 (93)	1489 (96)
Black	15 (6)	14 (4)	2 (1)	8 (2)	0 (0)	15 (2)	17 (3)	7 (3)	39 (3)
Other	4 (2)	6 (2)	7 (3)	9 (2)	3 (2)	8 (1)	11 (2)	10 (4)	29 (2)
Smoking Status[c]									
Never	154 (60)	157 (47)	111 (40)	155 (30)	45 (25)	237 (34)	269 (44)	116 (46)	622 (40)
Former	94 (37)	161 (48)	156 (57)	317 (62)	112 (62)	407 (58)	305 (50)	128 (50)	840 (54)
Quit ≥10 yrs	85 (90)	137 (85)	137 (88)	270 (85)	92 (82)	352 (86)	261 (86)	108 (84)	721 (86)
Quit <10 yrs	9 (10)	23 (14)	19 (12)	46 (15)	20 (18)	54 (13)	43 (14)	20 (16)	117 (14)
Current	7 (3)	17 (5)	9 (3)	37 (7)	25 (14)	52 (7)	33 (5)	10 (4)	95 (6)
Walking Pace (MPH)[d]									
Easy (<2)	37 (15)	47 (14)	48 (17)	72 (14)	24 (13)	104 (15)	84 (14)	40 (16)	228 (15)
Normal (2 to <3)	104 (41)	168 (50)	137 (50)	247 (49)	92 (51)	355 (51)	283 (47)	110 (43)	748 (48)
Brisk (3 to <4)	90 (35)	96 (29)	71 (26)	159 (31)	58 (32)	196 (28)	193 (32)	85 (33)	474 (30)
Fast (≥4)	13 (5)	14 (4)	11 (4)	19 (4)	5 (3)	28 (4)	23 (4)	11 (4)	62 (4)
Unable	6 (2)	4 (1)	4 (1)	2 (<1)	1 (<1)	5 (1)	8 (1)	4 (2)	17 (1)
Family History of Prostate Cancer[e]	49 (19)	48 (14)	35 (13)	92 (18)	32 (18)	122 (18)	100 (16)	34 (13)	256 (16)
Diabetes[f]	20 (8)	40 (12)	31 (11)	43 (8)	21 (12)	74 (11)	58 (10)	23 (9)	155 (10)

Characteristic, Median (IQR) or N (%)[a]	Total Coffee Intake (cups/day)					Total Tea Intake (cups/day)			Total
	None (n = 255)	>0–<1 (n = 335)	1–<2 (n = 276)	2–<3 (n = 509)	≥3 (n = 182)	None (n = 696)	>0–<1 (n = 607)	≥1 (n = 254)	(n = 1,557)
PSA at diagnosis	5.7 (4.4, 8.0)	5.6 (4.5, 7.9)	6.0 (4.6, 8.6)	5.3 (4.2, 7.5)	5.8 (4.3, 8.1)	5.5 (4.4, 7.8)	5.7 (4.3, 8.0)	5.7 (4.5, 7.9)	5.6 (4.4, 8.0)
Gleason grade at diagnosis[g]									
<7	186 (73)	222 (66)	187 (68)	371 (73)	130 (71)	490 (70)	437 (72)	169 (67)	1096 (70)
7	56 (22)	88 (26)	67 (24)	109 (21)	41 (23)	161 (23)	142 (23)	58 (23)	361 (23)
>7	9 (4)	21 (6)	20 (7)	21 (4)	9 (5)	37 (5)	19 (3)	24 (9)	80 (5)
Primary Treatment									
AS/WW	12 (5)	7 (2)	9 (3)	15 (3)	8 (4)	17 (2)	22 (4)	12 (5)	51 (3)
Radical Prostatectomy	172 (67)	199 (59)	159 (58)	326 (64)	122 (67)	421 (60)	405 (67)	152 (60)	978 (63)
Radiation Therapy	46 (18)	93 (28)	78 (28)	133 (26)	34 (19)	190 (27)	129 (21)	65 (26)	384 (25)
Hormone Therapy	11 (4)	24 (7)	18 (7)	18 (4)	9 (5)	33 (5)	30 (5)	17 (7)	80 (5)
Other	14 (5)	12 (4)	12 (4)	17 (3)	9 (5)	35 (5)	21 (3)	8 (3)	64 (4)

Abbreviations: AS/WW = Active Surveillance/Watchful Waiting; BMI = body mass index, IQR = interquartile range; MPH = miles per hour; PSA = prostate specific antigen; yrs = years.

[a] Percentages may not sum to 100% due to rounding or missing data (noted below).

[b] Alcohol = total servings per day of beer, light beer, red wine, white wine, and liquor.

[c] 2 former smokers did not report how long ago they quit.

[d] 28 with unknown walking pace.

[e] Family history = reported prostate cancer in father or brother.

[f] Diabetes = self-reported diagnosis of type 1 or type 2 diabetes.

[g] 20 with unknown Gleason grade.

Table 2.

Risk of prostate cancer progression at various levels of total coffee intake among 1,557 men initially diagnosed with localized prostate cancer, stratified by smoking status.

	Never Smoker n = 622		Former Smoker[a] n = 840		Current Smoker[b] n = 95	
Coffee Intake (cups/day)	**Events (n)[c]**	**Hazard Ratio (95% CI)[d]**	**Events (n)[c]**	**Hazard Ratio (95% CI)[d]**	**Events (n)[c]**	**Hazard Ratio (95% CI)[d]**
None	19	Ref	10	Ref	0	Ref
1	43	0.88 (0.70, 1.11)	85	1.06 (0.87, 1.28)	10	1.35 (1.01, 1.81)
2	19	0.78 (0.49, 1.24)	55	1.12 (0.76, 1.63)	8	1.83 (1.02, 3.28)
3	15	0.69 (0.34, 1.38)	45	1.18 (0.67, 2.09)	8	2.47 (1.03, 5.93)
4	4	0.61 (0.24, 1.54)	16	1.25 (0.59, 2.67)	5	3.34 (1.04, 10.73)
5	4	0.54 (0.17, 1.72)	14	1.32 (0.51, 3.41)	5	4.52 (1.05, 19.41)

[a] p-interaction = 0.09

[b] p-interaction = 0.001

[c] Total number of events occurring among men who consume more than the amount in the prior row (e.g., events in row associated with 2 cups/day reports the total events among men consuming >1 cup/day). Total number of events is 62 among never smokers, 95 among former smokers, and 10 among current smokers.

[d] Cox proportional hazards regression model included a product term between total coffee intake and smoking status (never, former, current) and was additionally adjusted for days from diagnosis to survey completion, year of diagnosis, CaPSURE clinical site, age, race (white, other), Gleason Grade at diagnosis, PSA at diagnosis, primary treatment (radical prostatectomy, radiation therapy, hormone therapy, active surveillance/watchful waiting, other), total caloric intake, and total tea intake. Post-estimation commands were used to estimate HR and 95% CI.

Table 3.

Association between Post-diagnostic Coffee and Tea Intake and Risk of Prostate Cancer Progression Among 1,462 Never or Former Smokers Initially Diagnosed with Localized Prostate Cancer

Total Coffee	Events/N	Continuous 1 cup/day	Coffee Intake (cups/day) - HR (95% CI)					p-trend
			None	>0 to <1	1 to <2	2 to <3	≥3	
Events/N		157/1,462	29/248	39/318	27/267	42/472	20/157	
Crude[a]	157/1,462	1.00 (0.82, 1.21)	Ref	1.09 (0.63, 1.89)	0.96 (0.53, 1.72)	0.78 (0.40, 1.50)	1.15 (0.44, 3.00)	0.95
Adjusted[b]	151/1,356	1.00 (0.82, 1.21)	Ref	0.98 (0.61, 1.58)	0.77 (0.47, 1.27)	0.70 (0.38, 1.27)	1.02 (0.43, 2.42)	0.74
Caffeinated			**None**	**>0 to <1**	**1 to <2**	**2 to <3**	**≥3**	
Events		157/1,462	57/533	37/301	16/190	32/347	15/91	
Crude[a]	157/1,462	1.03 (0.84, 1.26)	Ref	1.20 (0.75, 1.92)	0.86 (0.41, 1.78)	0.85 (0.54, 1.33)	1.55 (0.57, 4.25)	0.62
Adjusted[b]	151/1,356	1.02 (0.84, 1.25)	Ref	1.23 (0.76, 2.01)	0.79 (0.39, 1.59)	0.87 (0.54, 1.40)	1.40 (0.53, 3.72)	0.76
Decaffeinated			**None**	**>0 to <1**	**1 to <2**	**≥2**		
Events		157/1,462	87/799	47/362	10/121	13/180		
Crude[a]	157/1,462	0.93 (0.79, 1.09)	Ref	1.22 (0.83, 1.80)	0.80 (0.38, 1.65)	0.67 (0.42, 1.07)		0.02
Adjusted[b]	151/1,356	0.91 (0.71, 1.16)	Ref	1.14 (0.73, 1.76)	0.68 (0.33, 1.40)	0.59 (0.31, 1.13)		0.03
Total Tea	**Events/N**	**Continuous 1 cup/day**	**Tea Intake (cups/day) - HR (95% CI)**					**p-trend**
			None	**>0 to <1**	**≥1**			
Events		157/1,462	73/644	56/574	28/244			
Crude[a]	157/1,462	0.99 (0.85, 1.15)	Ref	0.89 (0.64, 1.22)	1.04 (0.69, 1.58)			0.85
Adjusted[b]	151/1,356	0.99 (0.86, 1.13)	Ref	0.96 (0.70, 1.34)	0.99 (0.68, 1.44)			0.96
Non-Herbal			**None**	**>0 to <1**	**≥1**			
Events		157/1,462	78/726	55/539	24/197			
Crude[a]	157/1,462	1.05 (0.88, 1.24)	Ref	0.99 (0.70, 1.40)	1.19 (0.76, 1.87)			0.44
Adjusted[b]	151/1,356	1.06 (0.89, 1.25)	Ref	1.08 (0.74, 1.56)	1.14 (0.75, 1.73)			0.54
Herbal			**None**	**>0**				
Events		157/1,462	130/1,144	27/318				
Crude[a]	157/1,462	0.73 (0.41, 1.31)	Ref	0.73 (0.47, 1.13)				0.16
Adjusted[b]	151/1,356	0.72 (0.43, 1.23)	Ref	0.79 (0.52, 1.20)				0.27

[a]Crude models adjusted for days from diagnosis to survey completion, year of diagnosis, and CaPSURE clinical site.

[b]Adjusted models additionally adjusted for age, race (white, other), smoking status (never, former), Gleason Grade at diagnosis, PSA at diagnosis, primary treatment (radical prostetectomy, radiation therapy, hormone therapy, active surveillance/watchful waiting, other), and total caloric intake.

Coffee models were further adjusted for total tea intake and tea models were further adjusted for total coffee intake. Caffeinated models were further adjusted for decaffeinated coffee intake and decaffeinated models were further adjusted for caffeinated coffee intake. Herbal tea models were further adjusted for non-herbal tea intake and non-herbal tea models were further adjusted for herbal tea intake.

Table 4.

Association between Coffee and Tea Intake and Risk of Prostate Cancer Progression Among 622 men initially diagnosed with Localized Prostate Cancer who Never Smoked

Total Coffee	Events/N	Continuous 1 cup/day	Coffee Intake (cups/day); HR (95% CI)					p-trend
			None	>0 to <1	1 to <2	2 to <3	≥3	
Crude[a]	62/622	0.87 (0.68, 1.11)	Ref	1.16 (0.58, 2.34)	0.55 (0.24, 1.25)	0.60 (0.23, 1.60)	0.74 (0.22, 2.48)	0.32
Adjusted[b]	60/586	0.87 (0.70, 1.09)	Ref	0.88 (0.44, 1.76)	0.39 (0.16, 0.93)	0.53 (0.22, 1.27)	0.59 (0.19, 1.85)	0.20
Caffeinated			**None**	**>0 to <1**	**1 to <2**	**2 to <3**	**≥3**	
Crude[a]	62/622	0.94 (0.74, 1.19)	Ref	1.39 (0.69, 2.79)	0.53 (0.17, 1.65)	0.71 (0.28, 1.79)	1.53 (0.57, 4.10)	0.89
Adjusted[b]	60/586	0.90 (0.72, 1.13)	Ref	1.42 (0.70, 2.85)	0.47 (0.13, 1.72)	0.71 (0.27, 1.87)	1.03 (0.36, 2.95)	0.61
Decaffeinated			**None**	**>0**				
Crude[a]	62/622	0.73 (0.39, 1.36)	Ref	0.82 (0.47, 1.45)				0.50
Adjusted[b]	60/586	0.67 (0.46, 0.97)	Ref	0.69 (0.40, 1.19)				0.18
Total Tea	**Events/N**	**Continuous 1 cup/day**	**Tea Intake (cups/day); HR (95% CI)**					**p-trend**
			None	**<1**	**≥1**			
Crude[a]	62/622	0.98 (0.81, 1.20)	Ref	0.83 (0.51, 1.35)	0.93 (0.50, 1.76)			0.83
Adjusted[b]	60/586	0.94 (0.79, 1.14)	Ref	0.78 (0.39, 1.56)	0.80 (0.45, 1.45)			0.47
Non-Herbal			**None**	**<1**	**≥1**			
Crude[a]	62/622	1.06 (0.83, 1.34)	Ref	0.93 (0.62, 1.39)	1.01 (0.53, 1.92)			0.98
Adjusted[b]	60/586	1.03 (0.79, 1.35)	Ref	0.84 (0.44, 1.59)	0.87 (0.49, 1.55)			0.64
Herbal			**None**	**>0**				
Crude[a]	62/622	0.78 (0.43, 1.44)	Ref	0.73 (0.36, 1.47)				0.37
Adjusted[b]	60/586	0.75 (0.43, 1.30)	Ref	0.84 (0.48, 1.45)				0.53

[a]Crude models adjusted for days from diagnosis to survey completion, year of diagnosis, and CaPSURE clinical site.

[b]Adjusted models additionally adjusted for age, race (white, other), Gleason grade at diagnosis, PSA at diagnosis, primary treatment (radical prostatectomy, radiation therapy, hormone therapy, active surveillance/watchful waiting, other), and total caloric intake. Coffee models were further adjusted for total tea intake and tea models were further adjusted for total coffee intake. Caffeinated models were further adjusted for decaffeinated coffee intake and decaffeinated models were further adjusted for caffeinated coffee intake. Herbal tea models were further adjusted for non-herbal tea intake and non-herbal tea models were further adjusted for herbal tea intake.