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Associations of Coffee and Tea Consumption with Survival to Age 90 among Older Women

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Abstract

BACKGROUND: Coffee and tea are two of the most widely consumed beverages worldwide and have been associated with reduced risk of mortality in some studies. However, it is unknown whether consumption of these beverages is associated with survival to an advanced age.

OBJECTIVE: To examine associations of coffee and tea consumption with survival to age 90 years.

DESIGN: Prospective cohort study among participants from the Women's Health Initiative, recruited during 1993-1998 and followed until March 31, 2018.

SETTING: 40 U.S. clinical centers.

PARTICIPANTS: A racially and ethnically diverse cohort of 27,480 older women aged 65-81 years at baseline.

MEASUREMENTS: Women were classified as having either survived to age 90 or died before this age. Consumption of caffeinated and decaffeinated coffee and caffeinated tea was assessed at baseline and categorized as none; 1 cup/day; 2-3 cups/day; or ≥4 cups/day. Associations of coffee and tea consumption with survival to age 90 were examined using logistic regression models adjusted for sociodemographic characteristics, lifestyle behaviors, dietary quality, and chronic disease history.

RESULTS: 14,659 (53.3%) women survived to age 90 during follow-up. Caffeinated coffee, decaffeinated coffee, or caffeinated tea consumption was not significantly associated with survival to age 90 after adjusting for confounders. Findings did not significantly vary by smoking, BMI, or race/ethnicity.

CONCLUSION: No amount of coffee or tea consumption was associated with late-age survival among older women. These findings may be reassuring to older women who consume coffee and tea as part of their daily diets but do not support drinking these beverages to achieve longevity.

Keywords

coffee; tea; diet; aging; longevity

INTRODUCTION

Coffee is one of the most widely consumed beverages in the United States. There are an estimated 154 million U.S. adults ages 20 years and older who drink coffee.[1] Some epidemiologic studies have linked coffee consumption to lower risk of type 2 diabetes,[2,3]

cardiovascular diseases,[4-6] and cancer;[7] inconsistent associations have been shown with mortality.[8-25] Consumption of tea, another commonly consumed beverage, has also been associated with lower risk of these adverse health outcomes in some, but not all, studies.[26-36]

Several mechanisms may explain the inverse associations of coffee and tea with morbidity and mortality. Coffee contains >1,000 different compounds, including several that are biologically active.[37] Any potential benefits of coffee on longevity and chronic disease risk may be due to antioxidant and anti-inflammatory properties derived mainly from phenolic compounds (e.g., chlorogenic acids), caffeine, diterpenes, trigonelline, and melanoidins.[37-39] Many compounds in coffee have been shown to have beneficial effects on insulin and glucose metabolism. Chlorogenic acids, in particular, have been shown to reduce plasma glucose concentrations and increase insulin sensitivity.[38] The potential benefits of tea on morbidity and mortality may be attributed to polyphenolic compounds and antioxidant properties.[40]

Associations of coffee and tea consumption with longevity, or survival to a specific advanced age, have received little attention. The population has been aging throughout the past century.[41] Individuals aged ≥90 years comprise the fastest growing segment of the older adult (≥65 years) U.S. population.[42] There are approximately 1.3 million women currently aged ≥90 years in the United States, and by 2050, more than 4 million women are expected to be in this age group.[42] However, factors predisposing to longevity among women are not fully understood. As common staples of diets worldwide, even modest effects of coffee and tea on health could have important consequences for population longevity.

Given the inconsistent associations of coffee and tea with survival and the lack of data on their relationships with longevity, we examined associations of caffeinated and decaffeinated coffee and caffeinated tea consumption with survival to age 90 years in a large, well-characterized cohort of older women. Consistent with previous studies, we examined whether associations varied by race/ethnicity, body mass index (BMI), or smoking history. We hypothesized that higher consumption of coffee or tea would be associated with longevity.

METHODS

Study population and design

The Women's Health Initiative (WHI) Observational Study is a large, prospective study investigating major determinants of chronic diseases among women. A racially and ethnically diverse cohort of 93,676 postmenopausal women ages 50-79 years and with a range of educational attainments was recruited during 1993-1998 from 40 U.S. clinical centers. Details of the study are described elsewhere.[43]

The current study was restricted to women born on or before March 31, 1928 who were eligible, because of birth year, to survive to ≥90 years during the follow-up period ending March 31, 2018. Only women with complete information on coffee or tea consumption whose survival status could be ascertained were included, leading to an analytic cohort of 27,480 women with up to 25 years of follow-up (Supplementary Figure S1). All participants

provided written informed consent, and institutional review board approval was received by all participating institutions.

Exposure assessment

At the baseline visit, women completed a questionnaire evaluating coffee and tea drinking habits. Women were asked: “Do you usually drink coffee each day?” Caffeinated coffee consumption was subsequently assessed using responses to the following question: “How many cups of regular coffee (not decaf) do you usually drink each day?” Consumption of decaffeinated coffee was asked separately in the following question: “How many cups of decaf coffee do you usually drink each day?” Women selected from the following categories: none; 1 cup/day; 2-3 cups/day; 4-5 cups/day; or ≥6 cups/day. Tall cups (i.e., ≥12 oz.) and espresso drinks made with double shots of espresso were counted as 2 cups. Women were also asked about their tea drinking habits as follows: “Do you usually drink tea each day (do not count decaf or herbal tea)?” Those who responded affirmatively were subsequently posed the following question: “How many cups of tea do you usually drink each day?” Response categories included 1 cup/day; 2-3 cups/day; 4-5 cups/day; or ≥6 cups/day. For coffee and tea analyses, 4-5 cups/day and ≥6 cups/day were combined into a single category, because the number of women in the latter category was low.

Covariates

At baseline, participants completed questionnaires assessing sociodemographic characteristics, lifestyle behaviors, and medical history. Sociodemographic characteristics were race/ethnicity, age, education, income, marital status, and employment status. Lifestyle behaviors included smoking status, pack-years of smoking, alcohol consumption, and total energy expenditure from self-reported duration and frequency of recreational physical activity (summarized into metabolic equivalent-hours/week). Participants reported past oral contraceptive use, hormone therapy use, history of depressive symptoms, and history of major chronic diseases including coronary heart disease, stroke, diabetes, and cancer. Self-rated health and physical function score were determined from the SF-36 questionnaire, with the latter determined from 10 items measuring whether one’s health limits the ability to perform various activities; higher scores indicate better function.[44] Trained clinic staff measured height and weight at baseline. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared and categorized according to standard cutpoints.[45]

Information on dietary intake was derived from a validated, semi-quantitative food frequency questionnaire (FFQ) administered at baseline, which assessed average daily nutrient intakes during the previous 3-month period. The FFQ included 122 items for individual foods and food groups and has shown high correlation with 24-hour dietary recall interviews and food records in the WHI.[46] Overall diet quality was assessed using the Healthy Eating Index 2015 (HEI-2015), which measures conformance to recommendations from the 2015-2020 Dietary Guidelines for Americans.[47] The HEI-2015 contains 13 components (e.g., total fruits; total vegetables; whole grains; dairy; total protein foods; added sugars; saturated fats) summing to a total score ranging from 0-100, with higher scores indicating better diet quality.

As with previous published studies on coffee and survival, we did not consider medications containing caffeine in the analysis, as the focus of this study was on beverages.

Outcome

Women were classified as having survived to age 90 years or died before this age. The age of 90 was selected because it is past average life expectancy and is considered long-lived for contemporary birth cohorts.[41]

Trained physician adjudicators verified deaths with hospital records, autopsy or coroner's reports, or death certificates. Periodic linkage to the National Death Index was performed for all participants, including those lost to follow-up, for verification if medical records or death certificates were not available. Survival status was ascertained for 93% of participants born on or before March 31, 1928.

Statistical analysis

Normally and non-normally distributed continuous variables were compared across coffee and tea consumption categories (none; 1 cup/day; 2-3 cups/day; or ≥4 cups/day) using analysis of variance and Kruskal Wallis tests, respectively. Categorical variables were compared across consumption categories using chi-square tests.

Associations of caffeinated and decaffeinated coffee and caffeinated tea consumption with survival to age 90 were examined using multivariable logistic regression models, with results presented as odds ratios (OR) and 95% confidence intervals (CI). This approach to evaluating longevity is different than examining time-to-mortality. By examining mortality, or the rate of death irrespective of survival to any given age, it cannot be determined whether exposure predicts survival to very old ages, and more weight is given to earlier age deaths than later ones, since those who do not die are censored in the analysis. Our approach enables the examination of predictors of survival to the milestone of age 90 years, as has been done in previous studies examining survival to advanced ages.[48,49]

All models were adjusted for confounders selected from the literature including age; race/ethnicity; education; income; employment status; marital status; alcohol consumption; smoking status; pack-years of smoking; total physical activity; BMI; oral contraceptive use; hormone therapy use; self-rated health; physical function score; history of depressive symptoms; history of coronary heart disease, stroke, diabetes, or cancer; and HEI-2015 score.[8,10,15,34] Models for caffeinated coffee consumption were adjusted for decaffeinated coffee consumption and vice versa; however, they were not adjusted for tea consumption, because this variable has not been largely controlled for in coffee-mortality models in previous literature. Models for tea consumption were adjusted for caffeinated and decaffeinated coffee consumption. Linear trend associations of coffee and tea consumption were examined by including these variables as continuous predictors in the models. Findings were stratified by race/ethnicity, BMI, and smoking status as in previous studies,[8,11,13] and interactions between coffee and tea variables and these factors were evaluated by examining cross-product terms in the multivariable models.

To evaluate potential reverse causation, multivariable models excluding those with fair or poor health at baseline (according to the self-rated health variable) and separately those with preexisting chronic diseases (coronary heart disease, stroke, diabetes, or cancer) at baseline were examined in sensitivity analyses. Analyses excluding women who died within the first four years of follow-up were also conducted. Finally, analyses excluding those who drank decaffeinated coffee from models of caffeinated coffee consumption and vice versa were performed.

P-values were two-sided and considered statistically significant at $P<0.05$. Statistical analyses were performed using SAS Version 9.4 (SAS Institute, Cary NC).

RESULTS

Women were aged on average 72.4 (standard deviation [SD] 3.1; median 72.0; range 65-81) years old at baseline. Among the 27,480 women who met the inclusion criteria for this study, 14,659 (53.3%) survived to age 90 during follow-up. Average age at death was 83.2 (SD 4.5) years, and the most common causes of death were cardiovascular disease, cerebrovascular disease, and cancer. Among 26,948 women who responded to the question assessing caffeinated coffee consumption, 43.7% reported no consumption and 19.1%, 28.9%, and 8.3% reported drinking 1 cup/day, 2-3 cups/day, or ≥4 cups/day, respectively. Among 26,721 women who responded to the question assessing decaffeinated coffee consumption, 66.4% reported no consumption, and 16.3%, 14.1%, and 3.2% reported drinking 1 cup/day, 2-3 cups/day, or ≥4 cups/day, respectively. Caffeinated tea consumption was distributed as follows among 27,205 women who reported tea consumption: 73.1% (none); 13.3% (1 cup/day); 11.2% (2-3 cups/day); and 2.4% (≥4 cups/day).

At baseline, women who drank the most cups of caffeinated coffee per day were more likely to be younger, white, current smokers, currently employed, and obese, and have lower income, higher pack-years of smoking, lower HEI-2015 score, lower levels of physical activity, higher physical function score, a history of oral contraceptive use, and excellent self-rated health. They were less likely to be married, currently use hormone therapy, or have a history of coronary heart disease (Table 1 and Table S1). Women who drank the most cups of decaffeinated coffee per day were more likely to be white and current smokers and have higher pack-years of smoking, higher physical function score, and excellent self-rated health; they were less likely to be current users of hormone therapy (Table S2). Women who drank the most cups of caffeinated tea per day were more likely to be white, be current smokers, have higher pack-years of smoking, and have lower HEI-2015 score (Table 2 and Table S3). Given the large sample size of our study and slight differences in characteristics according to coffee and tea consumption, it is possible that, while some differences are statistically significant, they may not necessarily be clinically significant.

Drinking 1 cup, 2-3 cups, or ≥4 cups compared with no cups of caffeinated coffee per day was not significantly associated with survival to age 90 in the multivariable model ($P_{trend} = 0.19$) (Table 3). Drinking 1 cup, 2-3 cups, or ≥4 cups compared with no cups of decaffeinated coffee per day was not significantly associated with survival to age 90, and the linear trend was not significant ($P_{trend} = 0.76$) (Table 3). Drinking 1 cup, 2-3 cups, or ≥4

cups compared with no cups of caffeinated tea per day was not significantly associated with survival to age 90 (P_{trend} = 0.27) (Table 3).

In sensitivity analyses excluding women with fair or poor health at baseline, findings for caffeinated coffee, decaffeinated coffee, and caffeinated tea consumption were similar (Table S4). After excluding women with preexisting chronic diseases at baseline from the model, higher caffeinated coffee consumption was associated with significantly higher odds of survival to age 90 (OR 0.98 [95% CI 0.89-1.08]; OR 1.07 [95% CI 0.98-1.16]; and OR 1.16 [95% CI 1.02-1.33] for 1 cup/day, 2-3 cups/day, and ≥4 cups/day versus none, respectively; P_{trend} = 0.02) (Supplementary Table S5). Decaffeinated coffee or caffeinated tea consumption was not significantly associated with survival to age 90 after excluding women with preexisting chronic diseases at baseline. Overall findings did not significantly vary by race/ethnicity, BMI, or smoking history (Tables S6-S8). Exclusion of those who drank decaffeinated coffee did not materially change findings for caffeinated coffee consumption in the multivariable models or vice versa, and findings were similar after removal of women who died within the first four years of follow-up (data not shown).

DISCUSSION

In a large, prospective study of women aged on average 72 years at baseline, no amount of caffeinated coffee, decaffeinated coffee, or caffeinated tea consumption was associated with survival to age 90, independent of smoking history and other measured confounders. Findings did not vary by race/ethnicity, BMI, or smoking history. Our findings suggest that daily consumption of coffee or tea by older women may not have longevity benefits. These findings have important implications for the aging population of women, given the wide consumption of coffee and tea throughout the world. While prior studies were focused on mortality, to our knowledge, our study was the first to evaluate associations of coffee and tea consumption with late-age survival.

Our findings suggest that consumption of coffee or tea may not extend survival into late life among older women. There are several explanations for our null findings. First, in contrast to prior studies,[8-25] ours was exclusively focused on survival to a specific advanced age and did not examine time-to-mortality. However, mortality analyses do not inform survival into late ages by censoring individuals who live longer past follow-up. Unlike prior studies, ours was exclusive to older women ages 65-81 years at baseline; hence, these women had already reached an older age and their likelihood of death may have been lower compared with a younger population. This may partially explain the null findings in our study and the inverse associations of coffee with mortality in prior studies that examined populations with wider age ranges. It is also possible that coffee consumption is associated with lower risk of mortality earlier in life yet, conditional upon survival to an older age such as 65 years, is not associated with longevity.

In a prospective study among >86,000 women from the Nurses' Health Study, those who drank 5-7 cups/week, 2-3 cups/day, or ≥4 cups/day compared with <1 cup/month of caffeinated coffee had lower risk of all-cause mortality, independent of smoking status, BMI, physical activity, hormone therapy use, and other confounders.[11] There was also a

significant linear trend toward lower mortality for higher caffeinated coffee consumption, and findings did not vary by smoking status or BMI.[11] Other studies have observed linear associations of higher caffeinated coffee consumption with lower mortality among men and women.[8-15,18-20] Higher decaffeinated coffee consumption has been associated with lower mortality in some[8,10,11,13-15] but not all[9,23,24] studies. While we did not observe any significant association of caffeinated or decaffeinated coffee consumption with survival to age 90 in the overall cohort after adjusting for a large number of confounders including sociodemographic characteristics, lifestyle behaviors, and medical history, exclusion of women with a history of chronic diseases at baseline resulted in a significant linear trend toward higher longevity for higher caffeinated coffee consumption, suggesting the potential of residual confounding due to chronic diseases in our analysis. It is also possible that, because these women were healthy and did not have a history of major chronic diseases, they were more likely to achieve longevity, which may be one explanation for the significantly positive association of caffeinated coffee with longevity in the sensitivity analysis. However, replication in both younger and older cohorts is needed to determine whether coffee consumption is associated with longevity and whether consumption extends survival into late life among those with chronic diseases and a lifestyle involving poor health habits.

Some studies have suggested that drinking beyond 5 cups of coffee per day may not be associated with lower mortality.[13,22] It has also been reported that drinking >28 cups per week (or approximately >4 cups per day) of caffeinated coffee may increase risk of mortality.[25] However, our data in the overall cohort did not indicate lower likelihood of longevity for drinking >4 cups of caffeinated coffee per day in older women. Current U.S. Dietary Guidelines allow moderate amounts of coffee consumption as part of a healthy diet, and our findings do not contradict these recommendations.[50]

Tea consumption has been associated with lower all-cause and cause-specific mortality in some studies, predominantly among populations of Asian descent.[28,31-35] In a prospective study among >90,000 Japanese individuals, green tea consumption was associated with lower risk of mortality among men and women, with 10%, 13%, and 17% lower risk for 1-2, 3-4, and >5 cups/day compared with <1 cup per day among women; there were also a significant linear trend toward lower mortality for higher tea consumption.[35] Similar findings were observed in another large study among a Japanese population, which showed a stronger inverse association of green tea consumption with all-cause and CVD mortality among women than men.[32] We did not observe any association of tea consumption with longevity in our population of largely white, older American women, and findings did not vary by race/ethnicity; however, there were fewer women of Asian/Pacific Islander ancestry in our study compared with other races. Our data were also limited by lack of information on specific types of tea (e.g., green tea). In a prospective study among a largely white, well-educated, American population aged on average 43 years, no association of tea consumption with all-cause, CVD, or cancer mortality or linear associations with mortality were observed.[36] These inconsistent findings suggest that associations of tea consumption with survival may be population-specific.

Our study has several limitations. Caffeinated and decaffeinated coffee and caffeinated tea consumption were examined using data from a single time point at baseline. However, patterns of coffee consumption have been shown to be relatively stable over time in large cohort studies, supporting the use of a single measure as indicative of long-term consumption habits.[13] Coffee and tea drinking habits were self-reported and thus prone to measurement error. Residual confounding due to poor health at baseline is also possible; for example, women with poor health could have stopped drinking coffee due to their health status. This is supported by a positive linear association between caffeinated coffee and survival to age 90 after exclusion of women with chronic diseases at baseline in our study. Women included in this study were aged 72 years on average at enrollment and thus may have been more likely to achieve longevity, as they had already survived to their 70s. Therefore, findings may not be applicable to the general population of older women. Participants may have had different experiences with respect to historical events that may have influenced their life expectancies; however, any confounding due to birth cohort effects was minimal due to the relatively narrow age range of the cohort. Strengths of this study include its prospective design, long follow-up period, high retention of study participants over time, detailed information on a large number of confounders, multiethnic cohort, and sample size with a large number of women who survived to age 90.

In conclusion, no amount of caffeinated coffee, decaffeinated coffee, or caffeinated tea consumption was associated with survival to age 90 years among older women aged on average 72 years at baseline. Our findings have implications for the clinical care of older women. First, these findings may be reassuring to older women who consume coffee and tea as part of their daily diets but do not support drinking these beverages to achieve longevity. Further, these results suggest that data showing inverse associations of coffee and tea consumption with mortality do not imply that drinking these beverages increases longevity. In addition, findings from prior studies of coffee, tea, and mortality among populations with wide age ranges may not necessarily translate to older adults. Our population was unique, because women had already survived to an old age at baseline, and 53% had achieved longevity during follow-up, which may not reflect the chances of longevity of the general population of women under geriatric care. Nevertheless, in the coming decades, the population of women 65 years and older is expected to increase substantially,[41,42] highlighting the need for additional dietary studies of health outcomes exclusively in the older population of women. In order to help refine dietary guidelines for older adults, prospective studies are needed to determine whether coffee or tea consumption is associated with survival into advanced ages and, more importantly, if consumption is associated with healthy aging, or survival into late life with excellent physical and cognitive functioning and quality of life.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

1. Loftfield E, Freedman ND, Dodd KW, et al. Coffee drinking is widespread in the United States, but usual intake varies by key demographic and lifestyle factors. J Nutr 2016;146:1762–8. [PubMed: 27489008]
2. Van Dam RM, Feskens EJM. Coffee consumption and risk of type 2 diabetes mellitus. Lancet 2002;1477–8. [PubMed: 12433517]
3. Van Dam RM, Hu FB. Coffee consumption and risk of type 2 diabetes: a systematic review. JAMA 2005;294:97–104. [PubMed: 15998896]
4. Ding M, Bhupathiaju SN, Satija A, et al. Long-term coffee consumption and risk of cardiovascular disease. Circulation 2013;129:643–59. [PubMed: 24201300]
5. Wu J, Ho SC, Zhou C, Ling W, Chen W, Wang C, Chen Y. Coffee consumption and risk of coronary heart diseases: a meta-analysis of 21 prospective cohort studies. Int J Cardiol 2009;137:216–25. [PubMed: 18707777]
6. Larsson SC, Virtamo J, Wolk A. Coffee consumption and risk of stroke in women. Stroke 2011;42:908–12. [PubMed: 21393590]
7. Yu X, Bao Z, Zou J, et al. Coffee consumption and risk of cancers: a meta-analysis of cohort studies. BMC Cancer 2011;11:96. [PubMed: 21406107]
8. Gunter MJ, Murphy N, Cross AJ, et al. Coffee drinking and mortality in 10 European countries: a multinational cohort study. Ann Intern Med 2017;167:236–47. [PubMed: 28693038]
9. Navarro AM, Gonzalez M, Gea A, et al. Coffee consumption and total mortality in a Mediterranean prospective cohort. Am J Clin Nutr 2018;108:1113–20. [PubMed: 30475964]
10. Freedman ND, Park Y, Abnet CC, et al. Association of coffee drinking with total and cause-specific mortality. N Engl J Med 2012;366:1891–904. [PubMed: 22591295]
11. Lopez-Garcia E, van Dam RM, Li TY, et al. The relationship of coffee consumption with mortality. Ann Intern Med 2008;148:904–14. [PubMed: 18559841]
12. Crippa A, Discacciati A, Larsson SC, et al. Coffee consumption and mortality from all causes, cardiovascular disease, and cancer: a dose-response meta-analysis. Am J Epidemiol 2014;180:763–75. [PubMed: 25156996]
13. Ding M, Satija A, Bhupathiraju SN, et al. Association of coffee consumption with total and cause-specific mortality in 3 large prospective cohorts. Circulation 2015;132:2305–15. [PubMed: 26572796]
14. Loftfield E, Freedman ND, Graubard BI, et al. Association of coffee consumption with overall and cause-specific mortality in a large US prospective cohort study. Am J Epidemiol 2015;182:1010–22. [PubMed: 26614599]
15. Park S, Freedman ND, Haiman CC, et al. Association of coffee consumption with total and cause-specific mortality among nonwhite populations. Ann Intern Med 2017;167:228–35. [PubMed: 28693036]
16. van Dongen LH, Molenberg F, Soedamah-Muthu SS, et al. Coffee consumption after myocardial infarction and risk of cardiovascular mortality: a prospective analysis in the Alpha Omega Cohort. Am J Clin Nutr 2017;106:1113–20. [PubMed: 28835365]
17. Gapstur SM, Anderson RL, Campbell PT, et al. Associations of coffee drinking and cancer mortality in the Cancer Prevention Study-II. Cancer Epidemiol Biomarkers Prev 2017;26:1477–86. [PubMed: 28751477]
18. Tsujimoto T, Kajio H, Sugiyama T. Association between caffeine intake and all-cause and cause-specific mortality: a population-based prospective cohort study. Mayo Clin Proc 2017;92:1190–202. [PubMed: 28697850]

19. Saito E, Inoue M, Sawada N, et al. Association of coffee intake with total and cause-specific mortality in a Japanese population: the Japan Public Health Center-Based Prospective Study. Am J Clin Nutr 2015;101:1029–37. [PubMed: 25762807]
20. Je Y, Giovannucci E. Coffee consumption and total mortality: a meta-analysis of twenty prospective cohort studies. Br J Nutrition 2014;111:1162–73. [PubMed: 24279995]
21. Grosso G, Stepaniak U, Micek A, et al. Coffee consumption and mortality in three Eastern European countries: results from the HAPIEE (Health, Alcohol and Psychosocial factors in Eastern Europe) study. Public Health Nutr 2017;20:82–91. [PubMed: 27411779]
22. Andersen LF, Jacobs DR, Carlsen MH, et al. Consumption of coffee is associated with reduced risk of death attributed to inflammatory and cardiovascular diseases in the Iowa Women's Health Study. Am J Clin Nutr 2006;83:1039–46. [PubMed: 16685044]
23. Torres-Collado L, Garcia-de-laHera M, Navarrete-Munoz EM, et al. Coffee consumption and mortality from all causes of death, cardiovascular disease and cancer in an elderly Spanish population. Eur J Nutr 2019;58:2439–48. [PubMed: 30066178]
24. Lopez-Garcia E, Rodriguez-Artalejo F, Li TY, et al. Coffee consumption and mortality in women with cardiovascular disease. Am J Clin Nutr 2011;94:218–24. [PubMed: 21562090]
25. Liu J, Sui X, Lavie CJ, et al. Association of coffee consumption with all-cause and cardiovascular disease mortality. Mayo Clin Proc 2013;88:1066–74. [PubMed: 23953850]
26. Yang J, Mao Q, Xu H, et al. Tea consumption and risk of type 2 diabetes mellitus: a systematic review and meta-analysis update. BMJ Open 2014;4:e005632.
27. Consortium InterAct, van Woudenbergh GJ, Kuijsten A, et al. Tea consumption and incidence of type 2 diabetes in Europe: the EPIC-InterACT case-cohort study. PLoS One 2012;7:e36910. [PubMed: 22666334]
28. Zhang C, Qin YY, Wei X. Tea consumption and risk of cardiovascular outcomes and total mortality: a systematic review and meta-analysis of prospective observational studies. Eur J Epidemiol 2015;30:103–13. [PubMed: 25354990]
29. Li Z, Yu C, Guo Y, et al. Tea consumption and risk of ischaemic heart disease. BMJ. 2017;103:783–9.
30. Arab L, Liu W, Elashoff D. Green and black tea consumption and risk of stroke: a meta-analysis. Stroke 2009;40:1786–92. [PubMed: 19228856]
31. Tang J, Zheng J, Fang L, et al. Tea consumption and mortality of all cancers, CVD and all causes: a meta-analysis of eighteen prospective cohort studies. Br J Nutr 2015;114:673–83. [PubMed: 26202661]
32. Kuriyama S, Shimazu T, Ohmori K, et al. Green tea consumption and mortality due to cardiovascular disease, cancer, and all causes in Japan. JAMA 2006;296:1255–65. [PubMed: 16968850]
33. Qiu L, Sautter J, Gu D. Associations between frequency of tea consumption and health and mortality: evidence from old Chinese. Br J Nutr 2012;108:1686–97. [PubMed: 22243697]
34. Ruan R, Feng L, Li J, et al. Tea consumption and mortality in the oldest-old Chinese. J Am Geriatr Soc 2013;61:1937–42. [PubMed: 24117374]
35. Saito E, Inoue M, Sawada N, et al. Association of green consumption with mortality due to all causes and major causes of death in a Japanese population: the Japanese Public Health Center-based Prospective Study (JPHC Study). Ann Epidemiol 2015;25:512–8. [PubMed: 25900254]
36. Yan Y, Sui X, Yao B, et al. Is there a dose-response relationship between tea consumption and all-cause, CVD, and cancer mortality? J Am Coll Nutr 2017;36:281–6. [PubMed: 28557683]
37. Godos J, Pluchionotta F, Marventano S, et al. Coffee components and cardiovascular risk: beneficial and detrimental effects. Int J Food Sci Nutr 2014;65:925–36. [PubMed: 25046596]
38. Grosso G, Godos J, Galvano F, et al. Coffee, caffeine, and health outcomes: an umbrella review. Ann Rev Nutr 2017;37:131–56. [PubMed: 28826374]
39. Martini D, Del Bo C, Tassoti M, et al. Coffee consumption and oxidative stress: a review of human intervention studies. Molecules 2016;21:8.
40. Yang CS, Lambert JD, Sang S. Antioxidative and anti-carcinogenic activities of tea polyphenols. Arch Toxicol 2009;83:11–21. [PubMed: 19002670]

41. Newman AB, Murabito JM. The epidemiology of longevity and exceptional survival. Epidemiol Rev 2013;35:181–97. [PubMed: 23372024]

42. US Census Bureau. 90+ in the United States: 2006–2008. Available from: https://www2.census.gov/library/publications/2011/acs/acs-17.pdf. Accessed December 19, 2019.

43. The Women's Health Initiative Study Group. Design of the Women's Health Initiative clinical trial and observational study. Control Clin Trials 1998;19:61–109. [PubMed: 9492970]

44. Hays RD, Sherbourne CD, Mazel RM. The RAND 36-item health survey, 1.0. Health Econ 1993;2:217–27.

45. National Institutes of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report. Obes Res 1998;6:51S–209S. [PubMed: 9813653]

46. Patterson RE, Kristal AR, Tinker LF, et al. Measurement characteristics of the Women's Health Initiative food frequency questionnaire. Ann Epidemiol 199;9:178–87. [PubMed: 10192650]

47. Krebs-Smith SM, Pannucci TE, Subar AF, et al. Update of the healthy eating index: HEI-2015. J Acad Nutr Diet 2018;118:1591–602. [PubMed: 30146071]

48. Willcox BJ, He Q, Chen R, et al. Midlife risk factors and healthy survival in men. JAMA 2006;296:2343–50. [PubMed: 17105797]

49. Shadyab AH, Gass ML, Stefanick ML, et al. Maternal age at childbirth and parity as predictors of longevity among women in the United States: The Women's Health Initiative. Am J Public Health 2017;107:113–9. [PubMed: 27854529]

50. Dietary Guidelines for Americans Advisory Committee. Dietary Guidelines for Americans: 2015–2020. 12 2015 – [cited 2019 December 30]. Available from: https://health.gov/dietaryguidelines/2015/guidelines/

Table 1.

Baseline characteristics by caffeinated coffee consumption among older women, Women's Health Initiative (N=26948)

	Caffeinated coffee consumption				*P*-value
	None (n=11765)	1 cup/day (n=5157)	2-3 cups/day (n=7788)	≥4 cups/day (n=2238)	
Age, mean (SD), years	72.4 (3.1)	72.6 (3.1)	72.3 (3.1)	71.9 (3.0)	<0.001
Race/ethnicity					
White	10003 (85.4)	4362 (84.8)	7090 (91.3)	2130 (95.6)	
Black	973 (8.3)	338 (6.6)	246 (3.2)	30 (1.4)	
Hispanic	189 (1.6)	141 (2.7)	153 (2.0)	25 (1.1)	<0.001
Asian/Pacific Islander	379 (3.2)	219 (4.3)	153 (2.0)	16 (0.7)	
Other	172 (1.5)	82 (1.6)	121 (1.6)	26 (1.2)	
Educational level					
Less than high school	790 (6.8)	336 (6.6)	511 (6.6)	139 (6.2)	
High school	2080 (17.8)	894 (17.5)	1377 (17.8)	412 (18.5)	0.15
Some college	4402 (37.7)	1956 (38.3)	3003 (38.8)	909 (40.8)	
College graduate	4407 (37.7)	1928 (37.7)	2850 (36.8)	766 (34.4)	
Income					
<$20,000	2616 (24.5)	1140 (24.3)	1723 (24.1)	514 (24.8)	
$20,000-<$50,000	5350 (50.2)	2327 (49.5)	3642 (50.9)	1097 (53.0)	0.03
≥$50,000	2701 (25.3)	1233 (26.2)	1790 (25.0)	460 (22.2)	
Marital status					
Married/living as married	6157 (52.6)	2659 (51.9)	3944 (50.9)	1080 (48.4)	
Widowed	3754 (32.1)	1653 (32.3)	2567 (33.1)	754 (33.8)	0.006
Divorced / separated	1289 (11.0)	556 (10.9)	906 (11.7)	288 (12.9)	
Never married	511 (4.4)	258 (5.0)	333 (4.3)	108 (4.8)	
Currently employed	1102 (9.7)	505 (10.1)	823 (11.0)	307 (14.2)	<0.001
Smoking history					
Never smoked	6790 (58.6)	2837 (56.2)	3761 (49.3)	923 (42.0)	
Past smoker	4473 (38.6)	2056 (40.8)	3442 (45.1)	986 (44.9)	<0.001
Current smoker	320 (2.8)	152 (3.0)	428 (5.6)	288 (13.1)	
Pack-years of smoking, mean (SD)	8.7 (18.5)	9.1 (18.6)	12.3 (21.4)	17.8 (26.4)	<0.001
Alcohol intake					
Nondrinker	2012 (17.2)	668 (13.1)	711 (9.2)	189 (8.5)	
Past drinker	2784 (23.9)	958 (18.8)	1284 (16.6)	416 (18.7)	<0.001
Current drinker	6873 (58.9)	3484 (68.2)	5736 (74.2)	1615 (72.8)	
Body mass index, kg/m^2					
Normal weight	4804 (41.9)	2107 (42.1)	3057 (40.3)	861 (39.8)	
Overweight	4063 (35.4)	1851 (37.0)	2862 (37.7)	798 (36.9)	0.005
Obese	2604 (22.7)	1046 (20.9)	1675 (22.1)	505 (23.3)	
Healthy Eating Index-2015 score, mean (SD)	69.4 (9.9)	68.5 (10.2)	67.6 (10.1)	65.6 (10.5)	<0.001

	Caffeinated coffee consumption				*P*-value
	None (n=11765)	1 cup/day (n=5157)	2-3 cups/day (n=7788)	≥4 cups/day (n=2238)	
History of major chronic diseases					
Coronary heart disease	538 (4.6)	209 (4.1)	268 (3.5)	71 (3.2)	<0.001
Stroke	321 (2.7)	125 (2.4)	168 (2.2)	47 (2.1)	0.05
Cancer	1892 (16.3)	846 (16.7)	1208 (15.7)	323 (14.7)	0.12
Diabetes	681 (5.8)	247 (4.8)	309 (4.0)	101 (4.5)	<0.001
Self-rated health					
Excellent	1407 (12.1)	669 (13.1)	1135 (14.7)	383 (17.2)	<0.001
Very good	4406 (37.8)	1999 (39.1)	3094 (40.1)	949 (42.7)	
Good	4408 (37.8)	1851 (36.2)	2755 (35.7)	717 (32.2)	
Fair/poor	1448 (12.4)	588 (11.5)	727 (9.4)	175 (7.9)	

Table 2.

Baseline characteristics by caffeinated tea consumption among older women, Women's Health Initiative (N=27205)

	Caffeinated tea consumption				*P*-value
	None (n=19886)	1 cup/day (n=3620)	2-3 cups/day (n=3044)	≥4 cups/day (n=655)	
Age, mean (SD), years	72.3 (3.1)	72.5 (3.0)	72.5 (3.1)	72.2 (2.9)	0.003
Race/ethnicity					
White	17359 (87.6)	3200 (88.7)	2664 (87.9)	595 (91.0)	
Black	1323 (6.7)	161 (4.5)	106 (3.5)	13 (2.0)	
Hispanic	392 (2.0)	68 (1.9)	42 (1.4)	8 (1.2)	<0.001
Asian/Pacific Islander	445 (2.3)	133 (3.7)	162 (5.3)	26 (4.0)	
Other	291 (1.5)	45 (1.3)	57 (1.9)	12 (1.8)	
Educational level					
Less than high school	1300 (6.6)	248 (6.9)	211 (7.0)	36 (5.6)	
High school	3491 (17.7)	679 (18.9)	525 (17.4)	121 (18.7)	0.67
Some college	7588 (38.4)	1356 (37.7)	1173 (38.8)	244 (37.7)	
College graduate	7370 (37.3)	1314 (36.5)	1112 (36.8)	247 (38.1)	
Income					
<$20,000	4409 (24.3)	803 (24.1)	692 (25.0)	162 (27.1)	
$20,000-<$50,000	9176 (50.6)	1706 (51.3)	1381 (49.9)	273 (45.7)	0.31
≥$50,000	4553 (25.1)	820 (24.6)	697 (25.2)	163 (27.3)	
Marital status					
Married/living as married	10089 (51.0)	1885 (52.2)	1657 (54.7)	341 (52.4)	
Widowed	6449 (32.6)	1223 (33.9)	939 (31.0)	213 (32.7)	<0.001
Divorced/separated	2340 (11.8)	356 (9.9)	298 (9.8)	66 (10.1)	
Never married	907 (4.6)	145 (4.0)	134 (4.4)	31 (4.8)	
Currently employed	2023 (10.5)	362 (10.3)	292 (9.9)	74 (11.8)	0.53
Smoking history					
Never smoked	10370 (53.1)	2060 (58.2)	1682 (56.4)	346 (53.6)	
Past smoker	8240 (42.2)	1365 (38.6)	1195 (40.1)	255 (39.5)	<0.001
Current smoker	925 (4.7)	116 (3.3)	106 (3.6)	44 (6.8)	
Pack-years of smoking, mean (SD)	11.0 (20.7)	8.8 (18.6)	9.3 (19.2)	11.2 (21.5)	<0.001
Alcohol intake					
Nondrinker	2664 (13.5)	422 (11.7)	436 (14.5)	92 (14.2)	
Past drinker	4075 (20.7)	700 (19.5)	583 (19.4)	128 (19.8)	0.006
Current drinker	12992 (65.9)	2473 (68.8)	1994 (66.2)	426 (65.9)	
Body mass index, kg/m^2					
Normal weight	7906 (40.8)	1549 (44.0)	1219 (41.1)	266 (41.5)	
Overweight	6979 (36.1)	1291 (36.7)	1139 (38.4)	252 (39.3)	<0.001
Obese	4474 (23.1)	680 (19.3)	607 (20.5)	123 (19.2)	
Healthy Eating Index (HEI)-2015 score, mean (SD)	68.5 (10.1)	68.3 (9.9)	68.0 (10.1)	66.4 (10.5)	<0.001

	Caffeinated tea consumption				*P*-value
	None (n=19886)	1 cup/day (n=3620)	2-3 cups/day (n=3044)	≥4 cups/day (n=655)	
History of major chronic diseases					
Coronary heart disease	808 (4.1)	142 (3.9)	133 (4.4)	20 (3.1)	0.46
Stroke	482 (2.4)	94 (2.6)	71 (2.3)	22 (3.4)	0.42
Cancer	3060 (15.6)	630 (17.7)	519 (17.3)	99 (15.5)	0.005
Diabetes	978 (4.9)	178 (4.9)	160 (5.3)	31 (4.7)	0.87
Self-rated health					
Excellent	2666 (13.5)	452 (12.6)	384 (12.7)	101 (15.5)	0.33
Very good	7759 (39.4)	1368 (38.2)	1179 (39.1)	245 (37.6)	
Good	7128 (36.2)	1349 (37.7)	1123 (37.2)	241 (37.0)	
Fair/poor	2165 (11.0)	409 (11.4)	333 (11.0)	64 (9.8)	

Table 3.

Multivariable associations of coffee and tea consumption with survival to age 90 among older women, Women's Health Initiative, 1993-2018

	No./total survived to age 90‡	OR (95% CI)	P-value for trend
Caffeinated coffee, cups/day*			
None	6285/11765 (53.4)	1.00	
1	2787/5157 (54.0)	0.96 (0.88-1.04)	
2-3	4181/7788 (53.7)	1.03 (0.95-1.11)	0.19
≥4	1133/2238 (50.6)	1.09 (0.97-1.23)	
Decaffeinated coffee, cups/day*			
None	9447/17751 (53.2)	1.00	
1	2363/4355 (54.3)	1.06 (0.97-1.15)	
2-3	2026/3762 (53.9)	1.06 (0.97-1.16)	0.76
≥4	415/853 (48.7)	0.86 (0.72-1.03)	
Caffeinated tea, cups/day†			
None	10508/19886 (52.8)	1.00	
1	2004/3620 (55.4)	1.07 (0.98-1.17)	
2-3	1663/3044 (54.6)	1.07 (0.97-1.18)	0.27
≥4	344/655 (52.5)	0.95 (0.78-1.16)	

CI, confidence interval; OR, odds ratio.

*Multivariable model includes caffeinated coffee intake, decaffeinated coffee intake, age, race/ethnicity, marital status, education, employment status, income, smoking history, pack-years of smoking, alcohol consumption, body mass index, total physical activity, oral contraceptive use, hormone therapy use, Healthy Eating Index-2015 score, self-rated health, physical function, depressive symptoms, coronary heart disease, stroke, diabetes, and cancer (N=19323 for caffeinated and decaffeinated coffee models).

†Multivariable model includes caffeinated coffee intake, decaffeinated coffee intake, age, race/ethnicity, marital status, education, employment status, income, smoking history, pack-years of smoking, alcohol consumption, body mass index, total physical activity, oral contraceptive use, hormone therapy use, Healthy Eating Index-2015 score, self-rated health, physical function, depressive symptoms, coronary heart disease, stroke, diabetes, and cancer (N=19180 for caffeinated tea model).

‡Represents the no./total survived to age 90 among each individual category of beverage intake.