Cancer preventative effects of tea

Tea is a widely consumed beverage around the world and has received much attention regarding its potential health benefits. One such claim is that regular consumption of tea reduces the risk of certain cancers, specifically breast cancer. This is of interest since breast cancer was the second most common cancer in the United States in 2018 (Worldwide Cancer Data, 2018), and thus determining foods that can act as chemopreventive agents is of utmost importance.

However currently, results from investigations have been inconclusive. Many epidemiological studies conclude that consuming more tea results in a reduced risk of developing breast cancer, while others demonstrate no statistically significant relationship. The evidence supporting the claim usually arises from case-control studies that find the odds ratios of those who consume tea in large quantities to be statistically significantly lower than those who drink less tea. This side of the controversy argues that the cancer-inhibiting effects of polyphenols found in teas are effective, while the other side argues there is no significant effect – this side draws conclusions from evidence usually found in prospective cohort studies that demonstrate no difference in hazard ratios between high-volume tea drinkers and non-tea drinkers.

I have identified four separate studies that investigate the association between tea consumption and breast cancer risk, and after critical analysis, I argue that the side disproving any beneficial effects of tea presents comparatively more compelling evidence.

One epidemiological study that supports the side arguing against tea having preventive effects against cancer was published in 2010 (Iwasaki, Inoue, Sasazuki, Sawada, Yamaji, Shimazu, Willett, & Tsugane, 2010). The study aimed to investigate the hypothesis that there is a link between green tea consumption and risk of breast cancer in Japan, in response to research that showed breast cancer risk to be lower in Asian countries, which generally consume more green tea, than in Western countries.

This hypothesis is tested by analysing data from a prospective cohort study conducted by the Japan Public Health Center. A baseline questionnaire was sent out to Japanese women aged 49 to 69 years, and after excluding responses that reported a history of cancer, resulted in 54, 376 responses forming a baseline. A five-year follow up survey was conducted, returning 44, 812 responses.

The questionnaire was disseminated in written form and ascertained the consumption of various beverages by asking responders to quantify the frequency and amount by selecting the appropriate category, ranging from less than one cup per week to five or more cups per day. In accordance with good practice, the reported values were cross-referenced with the cohort's sampled dietary records to validate the accuracy of the questionnaire responses.

Notifications of new cancer incidences were provided by local hospitals, data linkage with population-based cancer registries, and death certificates. In summary, the results showed that out of the 53, 793 women monitored from 1990 to 2006, 581 new cases of breast cancer were diagnosed, and 350

cases were identified for the 43, 639 women followed from 1995 to 2006 (Iwasaki et al, 2010).

Using the Cox proportional hazards model and adjusting for potential confounders including age, alcohol intake, and body mass index, no inverse association was evident to suggest that drinking more green tea reduced a woman's breast cancer risk. The adjusted hazard ratio (HR) for women who drank more than five cups a day compared to those who drank less than one cup a day was 1. 12 with a P-trend of 0. 60. This, and other data published, showed no evidence for a significant relation between green tea consumption and breast cancer risk (Iwasaki et al, 2010).

The authors clearly conclude that the study showed no evidence of a decreased risk of breast cancer due to drinking more green tea. These results are convincing since this study was very thoroughly conducted for a significantly large population. In addition, the variation of green tea intake was notably high – ranging from zero cups per day to over ten cups per day. This ensures sufficient variation of the concentration of the exposure under study – in this case, green tea. The nature of a prospective study also merits an advantage over case-control studies, which suffer recall bias and being unable to collect data from a more general and larger population.

However, one limitation of this study is that it was limited to a cohort aged 49 to 69 years. Other studies suggest an inverse association for younger women (Kumar et al, 2009), which this study would have failed to detect. Furthermore, a self-administered questionnaire always risks mismeasurement or misunderstanding by the respondent, which could

distort the results – as opposed to a phone interview, in which the respondent can ask for clarification.

Another weakness is the potential for misclassification due to inaccurate measurements of tea consumption between the baseline and follow-up surveys. This could skew the results since respondents are not providing accurate quantities of tea consumed. However, the authors acknowledge this and further proceed to compare women who reported very high consumption of tea with those who rarely drank tea to eliminate the aforementioned uncertainties. Still, no association was discovered, providing further confidence in the main conclusion.

In summary, the authors of this study argue that tea consumption does not have an effect on breast cancer risk. The evidence is convincing and thorough, given the large sample size and multitude of potential confounders adjusted for. The limitations are acknowledged and, mostly, well responded to.

A study in the United States also observed the cancer-inhibiting effects of polyphenols found in tea, and thus hypothesized that tea consumption has a role in reducing breast cancer risk (Kumar, Titus-Ernstoff, Newcomb, Trentham-Dietz, Anic, & Egan, 2009). This study discovered a statistically significant relationship that pertained mostly to younger women.

The method was a case-control study conducted from 1998 to 2001, whereby cases were women diagnosed with a first primary breast cancer between the ages of 20 and 74 living in Massachusetts, New Hampshire, and Wisconsin, while controls were randomly selected women with no personal

history of breast cancer. The 5, 082 cases and 4, 501 controls were interviewed via telephone to obtain information on average tea consumption five years before first diagnosis for the case women and a similar time frame for the control women. The interview also ascertained pertinent information relating to proposed and known factors that increase the risk of breast cancer (Kumar et al, 2009).

After adjusting for potential confounders such as physical activity, family history of breast cancer and exogenous hormone use, results showed a weak association between green tea consumption and breast cancer risk. Odds ratios (risk of cases divided by risk of controls) were estimated using unconditional logistic regression, using Wald 95% confidence intervals. The OR for women who consumed less than one cup per day was 1. 03 while the OR was 0. 86 for women who drank more than three cups per day. There is a weak inverse association, with a P trend of only 0. 18, thus showing poor evidence to suggest an *overall* link between green tea consumption and breast cancer risk (Kumar et al, 2009).

However, this study also stratifies the respondents by age, revealing a much stronger inverse relationship between green tea consumption and breast cancer risk. For women under age 50, the OR values for those drinking less than one cup per day and more than three cups per day were 0. 95 and 0. 63, respectively, with decreasing intermittent OR values showing a P trend of 0. 01. This relationship held even after further stratification of respondents by breast cancer type.

The author concludes that there is no *overall* inverse association between green tea consumption and breast cancer risk, although there is significantly convincing evidence that increased green tea consumption may result in reduced breast cancer risk in younger women.

The main strength of this study over the others is the method of collecting information from women via a structured telephone interview. As explained before, a self-administered questionnaire is prone to misinterpretations and mismeasurements, whereas a telephone interview allows for immediate clarification of questions to ascertain more accurate data.

Another strength is the large range of ages represented in the cases and controls – other studies have a narrower range, which would have failed to capture any potential evidence showing a strong inverse association between green tea consumption and breast cancer risk in younger, premenopausal women.

However, key limitations of this study point to the method of case-control studies. There is inherent selection bias in selecting cases and controls, and since cases are identified as women who have already been diagnosed with breast cancer, the sample size is reduced compared to a prospective study. Similarly, since cases already have breast cancer, the data may be affected by recall bias: women with the cancer may remember their dietary or behavioural history differently due to preexisting views of factors that they believe influenced their condition. For example, a woman with breast cancer may incorrectly report her tea consumption if she has a preconception that it reduces the likelihood of getting breast cancer.

In summary, this study supports the side of the controversy that argues that drinking more green tea can reduce a woman's breast cancer risk. The report concludes no strong evidence to show that this effect occurs for the general female population, but that the trend is stronger in younger women (under the age of 50). The low P trend value supporting this conclusion is statistically significant, and the paper offers insight into its shortcomings, although they are not defended as well as other papers.

Another study, published in 2018, supports the argument for no relationship between green tea consumption and breast cancer risk (Arthur, Kirsh, & Rohan, 2018). This study hypothesized a link between various beverage consumption, including tea, and certain cancers, including breast cancer, in Canadian women.

To investigate this hypothesis, this study examined a prospective study that compiled data from 39, 618 women between 1995 and 1998, from which a subcohort of 3, 120 women were selected for study relating to breast cancer risk. In the baseline survey, behavioural factors were determined using a self-administered questionnaire while dietary habits were surveyed using a food frequency questionnaire and validated using twenty-four hour diet recalls via phone interview. Respondents in the study were also taught to measure their hip and waist circumferences using tape measures.

The respondents were monitored throughout the study period until 2010, during which new incidences of cancer were detected through notification from the Canadian Cancer Registry and the Ontario Cancer Registry. The

median follow-up time was 13. 3 years, and out of the subcohort of 3, 120 women, 922 new cases were detected over the study period.

Cox proportional hazards models were used to calculate hazard ratios, adjusting for influencing factors such as age, education level, physical activity, BMI, caloric intake, among others collected from the lifestyle questionnaire. One key adjustment that sets this study apart is the adjustment for hormone replacement therapy (HRT).

The results showed no correlation between daily tea consumption and hazard ratio. To summarize, the hazard ratio was 0. 96 for women drinking 1-2 cups per day, 0. 87 for 2-3 cups per day, 1. 16 for 3-4 cups per day and 0. 95 for greater than 4 cups per day. The resulting P trend was 0. 95, showing no link between tea consumption and breast cancer risk. After stratifying the cohort by menopausal status and HRT use, the P trends were 0. 37, 0. 24, 0. 72, and 0. 65 for the subgroups of premenopausal, postmenopausal, non-HRT users, and HRT-users, respectively. These values are still noticeably above the significance level used of 0. 05.

The authors concluded that there was no relationship between drinking green tea and breast cancer risk, although other parts of the study showed potential associations with coffee consumption (Arthur et al, 2018). The authors conclude that further study using a larger cohort size is required.

The strength that stands out is the validation of the dietary questionnaire by phoning participants. It is likely that respondents incorrectly measure their food intake, thus having a direct phone call to detect potential inaccuracies and calibrate the data accordingly ensures more accurate dietary behavior

data. Another key strength is the stratification of women by HRT use and menopausal status – since other studies showed that the effects of green tea in cancer prevention are statistically evident in younger populations (Kumar et al, 2009), it is important to consider how different subgroups within women may react to green tea.

However, limitations of this study include not accounting for how the tea consumed is prepared. Given that this study also investigated how caffeine in general affects breast cancer incidence, it would have been better to account for how the steeping method of tea may have influenced the concentration of polyphenols and caffeine, which the paper cites to potentially reduce carcinogenesis. Another limitation is the comparatively small cohort size of 3, 120 which, as explained before, may not be sufficiently large enough to show strong trends.

Overall, this paper shows that tea has no effect on breast cancer risk. I find this paper to be more convincing due to its prospective study nature compared to case-control studies. The potential confounders are well adjusted for, and questionnaires were validated to a larger extent compared to the other papers, thus I believe this to be a strong paper arguing on the side that tea and breast cancer risk are unrelated.

The final study I analyzed was published by Anna H. Wu et al in 2003, which used a case-control study to investigate the hypothesis that green tea reduced the risk of breast cancer. This study was conducted only on women classified as Asian Americans, and concluded that green tea had a strong preventive effect (Wu, Yu, Tseng, Hankin, & Pike, 2003).

In the study, 523 women who were registered breast cancer cases were identified, and 594 controls living in the same neighborhoods were selected. Interviews were carried out in-person using a structured questionnaire to determine dietary habits, specifically consumption of both black and green tea. In addition, interviewers showed participants measuring cups to more accurately estimate consumption quantities.

Odds ratios (ORs) were determined from the data and adjusted for other demographic and behavioural factors. In summary, the OR for women who drank: only green tea was 0. 57, green and black tea was 0. 69, and only black tea was 1. 00 – compared to a non-tea drinker. The P trend was 0. 03, suggesting evidence that green tea consumption, over black tea, was effective at reducing the risk of breast cancer. The authors conclude that green tea is potentially chemopreventive and reduces the risk of breast cancer (Wu et al, 2003).

However, I believe this study is weaker than the others described in this paper since it has a much smaller sample size, less than 1000, and therefore requires more investigation with larger sample sizes to back up the conclusions it claims. Another big limitation is the failure to consider how the tea was steeped, as explained above. The age range is also quite large, and given how small the sample size is, this cohort is not a representative approximation of the female population.

Some redeeming strengths of this study, however, are the in-person interviews conducted. This allows for more accurate data collection,

especially since measuring cups were shown – this ensures that data collected was consistently quantified.

In summary, this article argues on the side of green tea having chemopreventive effects against breast cancer although the small sample size and self-imposed limit to Asian Americans renders this conclusion to be less convincing. The paper itself calls for further investigation (Wu et al, 2003), which I agree is duly required.

To conclude, Iwasaki et al. and Arthur et al. both conducted prospective cohort studies that showed weak correlations between tea consumption and breast cancer hazard ratio. These studies were comprehensive in their sample sizes and corrections, and concluded that drinking more tea does not lower one's risk of developing breast cancer. On the other side of the spectrum, Kumar et al. and Wu et al. conducted case-control studies to show that the odds ratios of tea-drinkers were much lower than those who did not drink tea (Kumar et al, 2009) (Wu et al, 2003).

After analyzing the four research studies, I conclude that there is stronger evidence demonstrating that there is no significant beneficial effect of tea in reducing breast cancer risk. Firstly, the studies arguing against the claim are prospective cohort studies, which are inherently less biased than the case-control method of the other two studies. Additionally, the sample size was significantly larger for the prospective cohort studies: Iwasaki et. al. analyzed data from over 50, 000 women while Wu et. al. only considers responses from around 1, 000 women. Furthermore, even the evidence arguing for the claim is weak – Kumar et al's study only detects a statistically significant

trend in younger women under age 50, which can be explained by other reasons, such as recall bias. The strongest evidence for the claim arises from Wu et al., which calculated a P trend of 0. 03 when considering green tea drinkers versus non-green tea drinkers – but this data was collected from a much smaller sample size.

Overall, it seems there is more conclusive evidence arguing against the claim that tea plays a significant role in reducing breast cancer risk. Even so, the potential gains to society in finding such a relationship could be so immense that it is worth conducting further studies to isolate the reason why certain studies do find a benefit to drinking tea.

References

- Arthur, R., Kirsh V. A., & Rohan, T. E. (2018). Associations of coffee, tea and caffeine intake with risk of breast, endometrial and ovarian cancer among Canadian women. *Cancer epidemiology* . 56: 75-82.

- Iwasaki, M., Inoue, M., Sasazuki, S., Sawada, N., Yamaji, T., Shimazu, T., Willett, C. W., & Tsugane, S. (2010). Green tea drinking and subsequent risk of breast cancer in a population to based cohort of Japanese women. *Breast Cancer Research, 12* (5).

- Kumar N., Titus-Ernstoff L., Newcomb P. A., Trentham-Dietz A., Anic G., & Egan K. M. (2009). Tea consumption and risk of breast cancer. *Cancer Epidemiol. Biomarkers Prev* . 18, 341–345.

- Wu A. H., Yu M. C., Tseng C. C., Hankin J., & Pike MC. (2003). Green tea and risk of breast cancer in Asian Americans. *Int J Cancer* . 106: 574–579

- Worldwide Cancer Data. (2018, September 12). Retrieved from https://www. wcrf. org/dietandcancer/cancer-trends/worldwide-cancer-data