What are the potential health benefits of tea consumption?

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A recent review by Ruxton sought to update a previous systematic review and highlight new evidence from epidemiological and intervention studies examining the effects of black tea on various aspects of human health.

Different classes of flavonoids are found in green and black tea. Those in black tea include thearubigins and theaflavins. Assessing the dietary intake of flavonoids has proved challenging for researchers due to the large number of flavonoids and a lack of compositional data. However this is now being addressed by the US Department of Agriculture flavonoids database and expert groups. Other sources of flavonoids include onions, red wine, chocolate and fruit. But black tea consumption provides the majority (60-84%) of flavonoid intake in Western populations with tea drinkers consuming 20 times more flavonoids the non-drinkers.

Flavonoids are reported to have antioxidant, anti-inflammatory, anti-proliferative and other bioactive effects in the body. Because of this, there has been a large body of research examining the potential health benefits of dietary flavonoids on conditions associated with antioxidant damage, inflammation and uncontrolled cell proliferation, amongst others. Many of these studies have investigated tea because of its large contribution to overall flavonoid intake in Western populations.

Coronary Heart Disease and Stroke: The previous systematic review found that the majority of epidemiological studies reported positive heart-health outcomes including reduced coronary heart disease (CHD) mortality, CHD prevalence, risk of myocardial infarction and lower plasma cholesterol. More recent observational studies have found a 21% reduced risk of stroke in men drinking 2 cups of tea per day and a 32% lower risk of developing carotid artery plaques in women who drunk 3 cups of tea per day.

Four new intervention trials have also contributed to the evidence of tea drinking and CHD risk. The longest trial (6 months) found no effect on inflammatory markers or blood pressure although the trial used powdered tea leaves which differ from standard tea infusions in their nutritional composition. The other three intervention trials, although shorter in duration, all found positive effects on triglycerides, markers of inflammation or flow mediated dilatation (a marker for vascular health). Furthermore a recent meta-analysis of intervention trials calculated that black tea consumption increased flow

mediated dilatation by 3.4%, which maybe of clinical significance in lowering heart disease risk.

Although tea appears to lower CHD risk in observational studies and improve biomarkers of CHD risk in the majority of intervention studies, there are still gaps in knowledge concerning how flavonoids exert their effects. Whilst in vitro experiments demonstrate the powerful antioxidant effect of black tea, these effects are not always observed in vivo. This may be due to methodological difficulties or as some have proposed be due to factors other than flavonoids in tea.

Cancer: The chronic and progressive nature of cancer, and the likelihood that different sites have different aetiological factors, creates problems when relating dietary factors to risk of cancer.

This was acknowledged in the previous systematic review because findings were too inconsistent to make firm conclusions. However tea drinking was found not to be harmful. The current situation still seems unclear. Whilst in vitro studies demonstrate potential mechanistic effects of inhibiting cancer development, epidemiological studies of tea drinking (or consumption of other flavonoids rich foods) do not always relate to a reduced incidence of cancer. However a reduced incidence or protective effect has been reported for ovarian, endometrial and skin cancer with tea intakes at around 2 cups per day.

The authors concluded that further large observational studies are required before firm conclusions could be drawn.

Cognitive function: Study into the effects of tea drinking and cognitive function are in their infancy. The interest arises because tea contains biologically active constituents such as caffeine, theophylline, theanine and flavonoids which may affect neurotransmitters in the brain.

A previous review by Ruxton found caffeine had positive effects on mood, alertness and mental performance at intakes of 37.5mg to 450mg (equivalent to 1-9 cups of tea a day).

Neurological conditions like Parkinson's disease (PD) have generated much research in this area. A case-control scenario of more than 29,000 Finnish adults showed that those who drunk more than 3 cups of tea per day were significantly less likely to develop PD. A similar effect was also observed in a Chinese population, although this was independent of caffeine suggesting that other components in tea may be responsible for the benefit. In another observational study tea also appears to improve cognitive

scores in healthy older people.

Intervention trials have shown tea to reduce stress and promote relaxation following a challenging task.

Studies on tea consumption, tea constituents and cognitive function are in their infancy and more evidence is needed to confirm whether tea has a consistent positive impact on cognitive function and what dose might be required.

Bioavailability and bioactivity: Flavonoids differ in how effectively they reach the tissue of the body and the subsequent effect they may exert. This has considerable public health importance when communicating health messages about tea drinking.

The catechins in green tea are oxidized into less bioavailable theaflavins and thearubigins when processing black tea. But it seems, at least in vivo, despite containing different classes of flavonoids, green and black teas display similar antioxidant potential. Thus it is assumed that at least some of the theaflavins and thearubigins are absorbed. Indeed evidence from some human studies suggests that the flavonoids in black tea are sufficiently bioavailable to stimulate the heart and cognitive benefits described earlier. Studies have measured catechin levels in the blood 2 hours after consumption of one cup and after 4 weeks of drinking 2 cups of black tea per day. Levels were 29-33% higher than baseline suggesting that chronic consumption has no effect on bioavailability.

The debate over the addition of milk to tea and the subsequent effect on the bioavailability of flavonoids finally seems to have been laid to rest. Many studies have found tea with milk has similar antioxidant potential to tea without milk.

Optimal intake: Black tea is the most commonly consumed beverage, after water, in the UK; with 77% of British adults consuming on average 2.3 cups of black tea per day. Concern has been expressed by some over the effects of tea drinking on hydration given that it is a caffeinated beverage. A review of the effects of caffeine-containing pills concluded that intakes of less than 420mg per day had no effect on hydration; hydration may be adversely affected by intakes in the region of 600mg. An intake of caffeine below 500mg also produces no measurable disturbance of blood pressure or sleep quality.

From the evidence presented in this review an optimal range of tea consumption is 1-8 cups per day (or

5-6 mugs). This amount would provide sufficient bioactive constituents to increase the likelihood of cardiovascular and potentially cancer and cognitive health benefits without exceeding a daily caffeine intake of 400mg per day and adversely affect hydration, sleep quality and blood pressure.

Ruxton C (2009) The health effects of black tea and flavonoids. Nutrition and Food Science; 39 (3):283-294

Can tea help you live longer?

Researchers in Hong Kong have shown that regular tea drinking may protect DNA from the accumulation of damage as we age.

Chans group focused on telomeres - short DNA sequences at the end of chromosomes that are critical for maintaining chromosome stability, preventing atypical recombination and are essential for cell division. Telomeres become shorter with aging, most likely as a result of oxidative stress associated with environmental and lifestyle factors such as smoking, physical activity and life stress. Telomere shortening has been associated with coronary heart disease, hypertension, dementia, obesity, insulin resistance, cigarette smoking and bone mineral density. It has therefore been suggested that telomere shortening could be used as an ageing biomarker.

There is however, limited data on the link between diet and telomere shortening. It is well established that diets rich in fruits, vegetables and whole grains are associated with reduced mortality from chronic diseases. Furthermore a higher consumption of fruits, vegetables, whole grains, legumes, nuts and fish is associated with lower concentrations of biomarkers of inflammation. The authors of the current study speculate the dietary components associated with oxidative stress and inflammation may influence telomere length.

The present cross-sectional study included data on 976 men and 1030 women aged 65 and over who participated in a community health survey between 2001and 2003. Data were collected on education, history of chronic disease including heart disease, diabetes and hypertension, smoking habit, alcohol use, physical activity and dietary intake.

Dietary intake was assessed using a validated food frequency questionnaire; 13 food groups formed part

of the questionnaire, including Chinese tea. Subjects were asked to record the food item, portion size and frequency of consumption (each day or each week). For items consumed less than once per week, information was obtained for consumption pattern over one year. In the case of Chinese tea consumption, participants were asked to quantify the amount of tea drunk, using 250ml as one cup portion.

DNA was extracted from peripheral blood using quantitative real-time PCR techniques.

Mean age was 72.8 years for men and 72.0 years for women. There was a tendency for telomere shortening with age in men but this did not reach statistical significance. Men with a history of heart disease had shorter telomere length than those without (P=0.034). In women there was no difference in telomere length according to demographic or lifestyle characteristics.

In men Chinese tea consumption was significantly associated with higher telomere length after adjustment for age, BMI, energy intake, education, alcohol consumption, smoking status, physical activity, and history of heart disease, diabetes or hypertension (P=0.002). The mean telomere length was highest in men who consumed >3 cups per day and lowest in those who consumed ¡Ü0.28 cups per day. The mean difference in telomere length between the highest and lower tea consumers was 0.46 kilobases which, the authors claim, corresponds to a 5 year shorter life-span for the lowest consumers.

In women, only intake of fats and oils was negatively associated with telomere length after adjustment for age, BMI, energy intake, education, alcohol consumption, smoking status, physical activity, and history of heart disease, diabetes or hypertension (P=0.003).

The present cross-sectional study has shown that despite a large number of foods studied, only the consumption of Chinese tea by older men is associated with higher telomere length. In women a higher intake of fats and oils is associated with shorter telomere length.

The authors speculate that the antioxidant properties of tea and its constituent nutrients may protect telomeres from oxidative damage in the normal aging process. Intervention and experimental studies would be required to confirm whether this is the case.

Both green and oolong constitute what has been described as Chinese tea in this study. Whilst this study

cannot be directly applied to a UK population, similar observational studies in western populations would reveal whether black tea displays similar properties to that of green and oolong teas in relation to telomere length.

Chan, Ruth; Woo, Jean; Suen, Eddie; Leung, Jason and Tang, Nelson. (2009). Chinese tea consumption is associated with longer telomere length in elderly Chinese men. Br. J. Nutr. Aug 12:1-7. [Epud ahead of print]

Drinking three cups of tea per day may lower the risk of type 2 diabetes

Researchers from the Netherlands have reported that drinking at least three cups of tea or coffee per day can reduced the risk of diabetes by approximately 42%; this effect is independent of constituents like magnesium, potassium and caffeine.

The present prospective cohort study is a combination of data collected from 2 separate studies both carried out in the Netherlands. Prospect is a population-based study of 17,357 women aged 49-70 years who participated in breast cancer screening between 1993 and 1997. The MORGEN cohort consists of 22,654 men and women aged 20-59 years recruited to a study examining risk factors for chronic diseases.

At baseline the same general questionnaire and validated food frequency questionnaire were mailed to all participants and returned at a subsequent medical examination. Those with diabetes or without information on tea and coffee consumption were excluded from the study, leaving 38,176 participants for the analysis. The general questionnaire assessed demographic characteristics as well as risk factors for the presence of chronic disease. Body weight, height, waist and hip circumference along with blood pressure were assessed during a medical examination. Participants were followed-up after a mean of 10 years.

The food frequency questionnaire included the consumption of 77 main food groups over the preceding year; allowing the estimation of the average daily consumption of 178 foods. Consumption of caffeinated tea and coffee, de-caffeinated coffee and caffeinated soft drinks were assessed. Tea consumption was divided into 5 groups: 0-1 cup (reference group); 1.1-2.0 cups; 2.1-3.0 cups; 3.1-5.0 cups; and >5.0 cups per day. Coffee consumption was divided into 6 categories; 0-1 cup (reference group); 1.1-2.0 cups; 2.1-3.0 cups; 3.1-4.0 cups; 4.1-6.0 cups and >6.0 cups per day. The combined

consumption of tea and coffee was also divided into categories: 0-1.0 cup (reference group); 1.1-3.0 cups; 3.1-5.0 cups; 5.1-7.0 cups; and >7.0 cups of coffee and tea per day.

In a random sample of 6.5% of the cohort (n=2,064) and in incident cases of type 2 diabetes, several biomarkers of type 2 diabetes were measured - alanine aminotransferase, aspartate aminotransferase, gamma-glutamyltransferase, HbA1C, C-reactive protein, triacylglycerol and total, HDL and LDL cholesterol.

Increasing tea consumption was associated with positive lifestyle factors including reduced alcohol consumption, lower BMI, lower energy intake and increased physical activity. In contrast, as coffee consumption increased so did BMI, alcohol consumption, energy intake and prevalence of smoking; tea consumption also decreased.

During the 10-year follow up 918 cases of diabetes were documented. A strong inverse association was observed between tea consumption and type 2 diabetes; The lowest hazard ratio was when 5 or more cups of tea per day were consumed (0.68 [95%CI 0.52-0.89], ptrens=0.014). Thus drinking more than5 cups of tea per day reduced the risk of type 2 diabetes by 32% independent of gender, age, BMI, education, physical activity, family history of diabetes, smoking, alcohol intake, energy intake, energy-adjusted saturated fat intake and coffee consumption.

A U-shaped association between coffee consumption and type 2 diabetes was observed; the lowest hazard ratio was when 4.1-6.0 cups of coffee per day were consumed (0.74 [95%CI 0.61-0.91], ptrens=0.019).

By combining data for tea and coffee consumption the hazard ratio was lowered further such that drinking at least 3 cups of tea and/ or coffee reduced the risk of type 2 diabetes by approximately 42% (HR 0.58 [95%CI 0.42-0.80], ptrens<0.001). Drinking more than 3 cups of tea and/or coffee did not confer any additional benefit. The relative amount of coffee versus tea did not affect the associations for total consumption.

Adjusting for systolic blood pressure, magnesium intake and caffeine reduced the hazard ratio for the consumption of more than 6 cups of tea to 0.61 (95%CI 0.42-0.90). There were no significant associations between coffee or tea consumption and any of the examined biomarkers. Nor were there any associations between drinking decaffeinated coffee or caffeinated soft drinks and the risk of type 2

diabetes.

This large prospective cohort study has shown a trend for positive lifestyle choices in people who drink increasing amounts of tea. Drinking 5 or more cups of tea was associated with a 32% reduced risk of type 2 diabetes. Furthermore the consumption of at least 3 cups of tea and/or coffee was associated with a 42% reduced risk of type 2 diabetes. These effects were independent of demographic and lifestyle variables and biomarkers for type 2 diabetes. These observed effects could not be explained by the presence of potassium or caffeine in tea, but may be explained by the antioxidant properties of tea and coffee.

Given the large study population, its prospective design and comprehensive data collection about diet and lifestyle, this study adds considerable weight to already published studies that have linked tea consumption to reduced risk of chronic health conditions. The authors concluded that daily consumption of at least three cups of tea and/or coffee may be associated with a lowered risk of type 2 diabetes.

Van Dieren, S., Uiterwaal, C. S. P. M., van der Schouw, Y. T., van der A, D. L., Boer, J. M. A., Spijkerman, A., Grobbee, D. E. and Beulens, J. W.J. (2009). Coffee and Tea consumption and risk of type 2 diabetes. Diabetologia Sep 1.

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