Unlocking the Cardiovascular Benefits of Tea

January 27, 2021
About Oldways

• Nutrition nonprofit founded in 1990

• **Mission**: To inspire people to embrace the healthy and sustainable joys of the old ways of cooking and eating

• Visit us online at [oldwayspt.org](http://oldwayspt.org)
Housekeeping

- Attendees will receive an email within ONE WEEK with CPEU certificate, slides, and recording
- Visit oldwayspt.org and click on “CPEU Library” in the top-right corner to register for upcoming webinars or view recordings of previous webinars
- Please submit any questions using the CHAT function in Zoom
Today’s Speakers

Alex White

Joy Dubost, PhD, RD, LD

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Unlocking the Cardiovascular Benefits of Unsweetened Tea

Unilever
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TEA: No Other Beverage is so Deeply Rooted in the Historical Heritage and Social Fabric of Humanity
The rituals: More than just a drink, different tea traditions are now famous around its preparation, presentation, and consumption and are deeply rooted in many world cultures.
What is tea? There are two broad categories:

**True Tea**
- Made with leaves of the *C. Sinensis* plant
- Two main varieties of the *C. Sinensis* plant exist: *var. assamica* and *var. sinensis*
- Thousands of different cultivars

**Tisanes & Non-Tea**
- Made from flowers, herbs and plants other than *C. Sinensis*
- Offer distinct flavors & some are thought to have medicinal properties

- Black Tea
- Green Tea
- White Tea
- Oolong Tea
- Chamomile
- Mint
- Mate
- Rooibos
Most Widely Consumed Beverage in The World Next to Water

60 Billion Servings of Tea, Over 2.8 Billion Gallons*

On any given day, 127 Million people in USA drink Tea

70% of Tea Consumed in America is ICED
The Camellia Sinensis is just one plant generating all teas (black, green, white, yellow, oolong, pu-her, Matcha, etc.). Farmed as a bush for easy harvest, it will grow into a tree in the wild.

LOVES:
- Well drained acid soil
- Proximity to the equator
- Lots of rain
- Clean air
- Sun

HATES:
- Soggy soil
- Alkali soil
- The R&D Lab
Tea propagation is achieved either from seed or from cuttings.

**CUTTINGS:**
Pros: One of the main reasons to take cuttings is that they are identical to the mother plant and can replicate their most vigorous, high yielding plants over and over again.
Cons: Problems can arise with fighting off environmental stresses, diseases and insects, as the genetics somewhat weaken.

**SEEDS:**
Pros: More biodiversity, growing from seed lessens the chances of inheriting any pests or diseases from a cutting.
Cons: germination rates vary by plant species, harvest times are longer than when starting from cuttings, and sometimes there are costs associated with purchasing them (whereas clones taken from plants are free).
One Plant, many types of tea Owing their definitive differences to:

- Where they are grown
- How they are picked
- How they are processed

**MAIN TEA TYPES:**
- White
- Green
- Oolong
- Black
- Pu Erh
- Matcha

**FLAVORED TEA:**
- Chai
- Earl Grey
- Jasmine tea
Tea estates are often nestled in beautiful pristine preserved environments, where soil properties, altitude, latitude, or even proximity to other vegetation, will impart the tea with a pure distinctive signature character, un-replicable anywhere else. Tea tasters call it “origin character”; it is essentially the passing on of those territories and environment into the tealeaf itself.
Where true tea is grown

Major Origins for Unilever NA:
- Argentina
- Malawi
- Indonesia
- India
- Kenya

A small plantation is present in US (SC) was Lipton owned till 1987. Currently property of Bigelow

World production approx. 5M tons
Tea Growing Elevations

- High Grown
  - Darjeeling
  - Kenya, Rwanda & Burundi
  - Tanzania & Uganda
  - South India (Nilgiris Hills, Munnar)
  - Indonesia
  - Malawi, Zimbabwe
  - Argentina
  - North India, Vietnam & Bangladesh

- Medium Grown
  - Sri Lanka

- Low Grown

- Flavor, Aroma
- Body, Colour
WHAT DOES EACH PROVENIENCE BRING TO THE TEA? AN EXAMPLE FROM A TYPICAL ICED TEA BLEND

<table>
<thead>
<tr>
<th>Country</th>
<th>TASTE</th>
<th>COLOR</th>
<th>BITTERNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>Mellowness, Clarity and sparkle</td>
<td><img src="image" alt="Color Scale" /></td>
<td><img src="image" alt="Bitterness Scale" /></td>
</tr>
<tr>
<td>Malawi</td>
<td>Color, deep red hues</td>
<td><img src="image" alt="Color Scale" /></td>
<td><img src="image" alt="Bitterness Scale" /></td>
</tr>
<tr>
<td>Kenya</td>
<td>Taste, “Briskyness”</td>
<td><img src="image" alt="Color Scale" /></td>
<td><img src="image" alt="Bitterness Scale" /></td>
</tr>
</tbody>
</table>
Tea Plucking is together hard work and a skill. Whether by hand or by machine, tea needs to be selectively plucked from an emerging flush, to give the desired results in the blend.
Tea Processing in factories is done in the immediate proximity of the field to maintain the leaf as fresh and intact as possible and occurs within 24h of picking. The process is really a craft, requiring nothing more than experience, air and heat.
Tea processing flow diagram

- **Non-oxidised**
  - Panning/Steaming
    - Rolling
    - Drying
  - Sweltering
  - Rolling
  - Drying

- **Semi-oxidised**
  - Withering
    - Drying
  - Sun Withering
    - Indoor Withering and Tossing
  - Withering
    - Rolling
    - Oxidizing
    - Drying
  - Panning

- **Fully-oxidised**
  - Withering
    - Rolling
    - Drying
  - Piling

- **Post-fermented**
  - Panning

Tea types:
- Green Tea
- Yellow Tea
- White Tea
- Oolong Tea
- Black Tea
- Dark Tea
CTC process from field to pack... in less than 24h

TRANSPORT

RECEPTION

WITHERING

ROTOVANE

CTC
OXIDATION (about 2h)

DRYING

FIBRE EXTRACTION
And finally grading to sort the quality leaves
Once made the Tea samples are lined up for auction. Thousands of cups are tasted and graded before each auction by tea tasters through a steamy and hectic ritual of slurping and spitting so that they may instruct the auctioneers and select the best.
Sustainability in Tea

Economic Focus
Providing jobs and paying a premium price for tea

Social Focus
Providing workers & families with housing, medical care, clean water

Environmental Focus
Conserving Biodiversity, Protecting soils and waterways
Rainforest Alliance

>700K estates
>2.7Mio acres
>99 evaluation criteria

RA COVERS ALL THREE SUSTAINABILITY PILLARS

ENVIRONMENTAL PROTECTION

SOCIAL EQUITY

ECONOMIC VIABILITY
EMERGING TRENDS IN TEA

Organic
Cold Brew
Matcha
New unconventional origins: Australia, U.S., Colombia, etc
Health-led benefits
Cheese teas/ Boba /Lattes at home café experience
New cultivars: Purple tea
Cult teas: Pu-her, HeiCha, Kukicha, Hojicha
Tea and food: food pairings, cooking with tea
Tea - Health and Nutrition
TEA FACTS

Most Widely Consumed Beverage in The World Next to Water

- 60 Billion Servings of Tea, Over 2.8 Billion Gallons

Naturally contains:
- **Caffeine** (28 -47mg/8 oz) - USDA
- **Theanine** (20mg/8 oz)
- **Flavonoids** *(levels vary)*
What are Flavonoids?

- Naturally occurring polyphenolic compounds
- Flavonoids refer to a collective term that includes six groups of molecules: flavonols, flavones, flavanones, flavan-3-ols, anthocyanidins, isoflavones
- Flavonoids are present in fruits, vegetables, and certain beverages
- Sources of flavonoids include tea, apples, grapes, red wine and cocoa
• Tea is one of the top sources of flavonoids in the diet
• Flavonoids are responsible for key sensory attributes of tea – color, taste, and astringency
• Flavonoids in tea can be absorbed into the body regardless of whether or not milk is added (up to 25% of milk added)
CARDIOVASCULAR DISEASE

• Refers to a number of conditions:
  • Heart and Blood Vessel Disease (Heart Disease)
    • Heart Attack
    • Stroke

• Prevalence*
  • Heart Disease remains the No. 1 cause of death in the U.S.
  
  • 48% of all adults in the U.S. have some form of cardiovascular disease
  
  • Cardiovascular disease, listed as the underlying cause of death, accounts for nearly 837,000 deaths in the US. That’s about 1 of every 3 deaths in the U.S.
  
  • Direct and indirect costs of total cardiovascular diseases and stroke are estimated to total more than $329.7 billion; that includes both health expenditures and lost productivity.
  
  • Cardiovascular disease is the leading global cause of death, accounting for more than 17.9 million deaths per year in 2015, a number that is expected to grow to more than 23.6 million by 2030.

*American Heart Association
INCREASED CONSUMPTION OF FLAVONOIDS FROM ALL DIETARY SOURCES IS ASSOCIATED WITH A LOWER RISK OF CVD

Compared with lower intake, high consumption of total flavonoids was associated with decreased risk of all-cause mortality (RR= 0.74,), while a 100-mg/day increment in intake led to a (linear) decreased risk of 6% and 4% of all-cause and CVD mortality, respectively.\(^1\)

Higher dietary flavonoid intake is associated with a significantly reduced risk of stroke. Dose-response analyses indicated a 9% lower risk of stroke per 100 mg/day increment in flavonoids.\(^2\)

\(^1\)Grosso Am J Epidemiol. 2017;185(12):1304–1316
A substantial amount of consistent scientific evidence demonstrates an inverse relationship between overall flavonoid consumption and at least one or more cardiovascular endpoints.

Front of Pack Claim - “Can Help Support a Healthy Heart”

Back of Pack Claim – Daily consumption of 2-3 cups of unsweetened brewed tea providing between 200-500mg of flavonoids can help support a healthy heart as part of a diet consistent with dietary guidelines.

• One cup of Lipton brewed green and black tea provide 150 and 170 mg flavonoid, respectively
• Zero Calories
• No added sugar
• Flavonoid content can range among tea products
Do unsweetened tea drinkers have healthier diets?

The results indicated the diets of daily consumers of unsweetened tea are significantly higher in protein, dietary fiber, and select vitamins and minerals, but lower in added sugars and alcohol.

Daily unsweetened tea consumption is associated with higher good cholesterol (HDL) and lower body mass index (BMI) values (lower body weight) in adults.

Relative to those who do not consume tea, unsweetened tea consumers generally have healthier beverage choices, including less high calorie sugar sweetened beverages.
When choosing beverages in a healthy dietary pattern, both the calories and nutrients they provide are important considerations.

<table>
<thead>
<tr>
<th>Drink (12-ounce serving)</th>
<th>Total Calories</th>
<th>Added Sugars (Grams)</th>
<th>Added Sugars (Teaspoons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain Water</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unsweetened Tea</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sports Drinks</td>
<td>97</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>Cafe Mocha</td>
<td>290</td>
<td>21</td>
<td>5</td>
</tr>
<tr>
<td>Chai Tea Latte</td>
<td>180</td>
<td>23</td>
<td>5 1/2</td>
</tr>
<tr>
<td>Sweetened Tea</td>
<td>115</td>
<td>29</td>
<td>7</td>
</tr>
<tr>
<td>Regular Soda</td>
<td>156</td>
<td>37</td>
<td>9</td>
</tr>
<tr>
<td>Lemonade</td>
<td>171</td>
<td>43</td>
<td>10</td>
</tr>
<tr>
<td>Fruit Drinks</td>
<td>238</td>
<td>59</td>
<td>14</td>
</tr>
</tbody>
</table>

CONCLUSIONS

• Unsweetened tea (green or black, hot or cold) may be considered a primary beverage option as noted in the USDA 2020-2025 Dietary Guidelines for Americans.

• Scientific evidence illustrates an inverse linear dose-response relationship between consumption of flavonoids and all-cause and CVD mortality.

• Tea is a great option for hydration & can help support a healthy heart.

For additional resources – https://www.unileverusa.com/about/nutrition-and-health/
THANK YOU
The Cardiovascular Benefits of Black and Green Tea

Taylor C. Wallace, PhD
Think Healthy Group
George Mason University
Disclosures

A few conflicts of interest related to the presentation up front:

- Think Healthy Group
- George Mason University
- Journal of Dietary Supplements
- Journal of the American College of Nutrition
- Annals of Medicine
- Research funding from Unilever (owns Lipton®)

www.drtaylorwallace.com
Tea (Camellia sinensis)

A little background on tea:

Tea is a beverage commonly prepared by pouring hot water over fermented or fresh leaves of the plant *Camellia sinensis*.

Second most widely consumed beverage in the world, next to water.

Consumption documented as early as the 3rd century AD in medical texts written by Chinese physician, Hua Tuo.

The plant is native to East Asia and likely originated in the borderlands of north Burma and southwestern China.
Tea has been used in traditional eastern medicine for centuries

- Tea drinking is popular in traditional Chinese medicine. It is also believed that the people of Sichuan used the brewed tea as a stimulating beverage, rather than a medicinal concoction.
- Tea is a major source of flavonoids in the diet. American tea drinkers have been shown to have ~20 times higher flavonoid intakes compared to those who do not consume tea.

What are flavonoids and flavanols?

Flavonoids are healthy polyphenolic compounds found in plant-derived foods. There are six groups of flavonoids and each is broken down by the body in a different way: flavonols, flavanols, flavones, flavanones, anthocyanins, and isoflavones.

Flavanols (also known as flavan-3-ols) in products like tea, cocoa, and cranberry have an abundance research demonstrating their potential heart-health effects.

Structure of a flavanol.

Tea Consumption and CVD

What’s all the fuss about tea and CVD?

- 48% of adults in the United States have some form of cardiovascular disease (CVD) according to the American Heart Association.
- Consumers describe cardiovascular health as a top desired benefit from food.
- Consumers prefer to be told what to eat vs. what not to eat. Therefore, tea consumption may be a practical means of preventing the onset of CVD, the leading cause of death among Americans.

Systematic reviews of the entire body of research:

- First systematic review assessed the role of tea consumption in relation to all cause mortality, CVD mortality, CVD events (e.g., heart attack), and stroke events.

- Second systematic review assessed the role of tea consumption in relation to blood lipids (i.e., total cholesterol, LDL-cholesterol, HDL-cholesterol, and triglycerides) and blood pressure.

- We used the National Academies of Medicine’s standards for conducting systematic reviews.

Results:

39 prospective cohort studies included in the systematic review: all cause mortality (N=15), CVD mortality (N=19), CVD-events (N=7), and stroke events (N=13).

Most studies reported multiple outcomes of interest. 8 studies did not report sufficient data to be included in our meta-analyses.

Each cup of daily tea consumption was associated with an average 1.5% lower risk of all cause mortality, 4% lower risk of CVD mortality, 2% lower risk of CVD events, and 4% lower risk of stoke events.
SR 1 – Results – All Cause Mortality

### SR 1 – Results – CVD Mortality

#### Female

<table>
<thead>
<tr>
<th>Study (Reference)</th>
<th>Age group</th>
<th>Region</th>
<th>Tea type</th>
<th>Followup (yr)</th>
<th>incidence</th>
<th>RR (95% CI)</th>
<th>Adjusted RR (95% CI)</th>
<th>Exposure</th>
<th>Adequate start</th>
<th>Adequate followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodward et al. 1999 (77)</td>
<td>adults Europe black</td>
<td>7.7</td>
<td>0.00056</td>
<td>0.0082, 1.17</td>
<td>C</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>A</td>
<td></td>
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<tr>
<td>van den Brandt et al. 2019 (56)</td>
<td>adults Europe black</td>
<td>10</td>
<td>0.0079</td>
<td>0.005, 1.16</td>
<td>B</td>
<td>A</td>
<td>B</td>
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<tr>
<td>Mineharu et al. 2011 (46)</td>
<td>adults Asia green</td>
<td>13</td>
<td>0.0035</td>
<td>0.005, 1.08</td>
<td>C</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Anderson et al. 2005 (25)</td>
<td>adults USA black</td>
<td>15</td>
<td>0.00367</td>
<td>0.003, 1.09</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Saito et al. 2015 (52)</td>
<td>adults Asia green</td>
<td>16.7</td>
<td>0.01198</td>
<td>0.0087, 1.09</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Subtotal (I² 73.9%, P = 0.001)</td>
<td></td>
<td></td>
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<td></td>
<td>0.07 (0.03, 1.20)</td>
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</table>

#### Male

<table>
<thead>
<tr>
<th>Study (Reference)</th>
<th>Age group</th>
<th>Region</th>
<th>Tea type</th>
<th>Followup (yr)</th>
<th>incidence</th>
<th>RR (95% CI)</th>
<th>Adjusted RR (95% CI)</th>
<th>Exposure</th>
<th>Adequate start</th>
<th>Adequate followup</th>
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<td>0.00342</td>
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<td>van den Brandt et al. 2019 (56)</td>
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<td>10</td>
<td>0.10087</td>
<td>0.005, 1.08</td>
<td>B</td>
<td>A</td>
<td>B</td>
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<tr>
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<td>adults Asia green</td>
<td>11</td>
<td>0.07277</td>
<td>0.007, 1.06</td>
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<td>A</td>
<td>B</td>
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<tr>
<td>Mineharu et al. 2011 (46)</td>
<td>adults Asia green</td>
<td>13</td>
<td>0.00368</td>
<td>0.005, 1.08</td>
<td>C</td>
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<td>B</td>
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<td>Hetong et al. 2007 (31)</td>
<td>adults Europe black</td>
<td>14</td>
<td>0.00301</td>
<td>0.003, 1.08</td>
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<td>16.7</td>
<td>0.02349</td>
<td>0.008, 1.08</td>
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<td>A</td>
<td>B</td>
<td>A</td>
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<tr>
<td>Hetong et al. 1999 (30)</td>
<td>elderly Europe black</td>
<td>5</td>
<td>0.01197</td>
<td>0.005, 1.08</td>
<td>A</td>
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<td>A</td>
<td>A</td>
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<tr>
<td>Subtotal (I² 73.9%, P = 0.001)</td>
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<td></td>
<td></td>
<td></td>
<td>0.06 (0.02, 1.20)</td>
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<tr>
<td>Overall (I² 73.9%, P = 0.001)</td>
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<td></td>
<td></td>
<td></td>
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<td>0.06 (0.02, 1.20)</td>
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</tbody>
</table>

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<table>
<thead>
<tr>
<th>Study (Reference)</th>
<th>Age group</th>
<th>Region</th>
<th>Tea type</th>
<th>Followup (year)</th>
<th>Incidence</th>
<th>Risk Ratio (95% CI)</th>
<th>Adjusted RR (95% CI)</th>
<th>Exposure</th>
<th>Comparability</th>
<th>No outcome at start</th>
<th>Adequate followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li et al. 2017 (43)</td>
<td>adults</td>
<td>Asia</td>
<td>all</td>
<td>7.2</td>
<td>0.00836</td>
<td>0.99 (0.96, 1.00)</td>
<td>1.04 (1.01, 1.09)</td>
<td>B</td>
<td>AB</td>
<td>A</td>
<td>C</td>
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<tr>
<td>Miller et al. 2017 (47)</td>
<td>adults</td>
<td>USA</td>
<td>all</td>
<td>11.1</td>
<td>0.01165</td>
<td>0.83 (0.86, 1.00)</td>
<td>0.99 (0.96, 1.00)</td>
<td>B</td>
<td>AB</td>
<td>A</td>
<td>D</td>
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<tr>
<td>de Koning et al. 2010 (26)</td>
<td>adults</td>
<td>Europe</td>
<td>black</td>
<td>13</td>
<td>0.00404</td>
<td>0.66 (0.65, 0.99)</td>
<td>0.96 (0.93, 0.99)</td>
<td>A</td>
<td>AB</td>
<td>A</td>
<td>B</td>
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<tr>
<td>Kokubo et al. 2013 (38)</td>
<td>adults</td>
<td>Asia</td>
<td>green</td>
<td>13</td>
<td>0.00468</td>
<td>0.97 (0.95, 0.99)</td>
<td>0.97 (0.95, 0.99)</td>
<td>B</td>
<td>AB</td>
<td>A</td>
<td>B</td>
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<tr>
<td>Sesso et al. 2005 (50)</td>
<td>adults</td>
<td>USA</td>
<td>black</td>
<td>15</td>
<td>0.00332</td>
<td>0.96 (0.96, 1.01)</td>
<td>0.96 (0.96, 1.01)</td>
<td>C</td>
<td>AB</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Gak.movae et al. 2002 (29)</td>
<td>elderly</td>
<td>Europe</td>
<td>black</td>
<td>5.8</td>
<td>0.00732</td>
<td>0.75 (0.57, 0.98)</td>
<td>0.75 (0.57, 0.98)</td>
<td>B</td>
<td>AB</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Overall ($I^2 = 76.5%, P = 0.001$)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>0.98 (0.96, 1.00)</td>
<td>0.98 (0.96, 1.00)</td>
<td>P = 0.385</td>
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</tbody>
</table>

### SR 1 – Results – Stroke Events

![Predictive RR of stroke events or mortality vs Total tea flavonoids, mg/day](image)

#### Adjusted RR (95% CI)

<table>
<thead>
<tr>
<th>Study</th>
<th>Age</th>
<th>Region</th>
<th>Tea type</th>
<th>Followup</th>
<th>Incidence</th>
<th>Exposure</th>
<th>Comparability</th>
<th>Start</th>
<th>Outcome at followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both sexes</td>
<td></td>
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</tr>
<tr>
<td>Tanihara et al. 2009 (35)</td>
<td>adults</td>
<td>Asia</td>
<td>green</td>
<td>5</td>
<td>0.00515</td>
<td>0.85 (0.77, 0.94)</td>
<td>C</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Larsson et al. 2013 (40)</td>
<td>adults</td>
<td>Europe</td>
<td>black</td>
<td>10.2</td>
<td>0.00681</td>
<td>0.89 (0.86, 1.02)</td>
<td>B</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>Kurysa et al. 2006 (36)</td>
<td>adults</td>
<td>Asia</td>
<td>green</td>
<td>11</td>
<td>0.0146</td>
<td>0.92 (0.88, 0.97)</td>
<td>B</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>de Koning et al. 2010 (26)</td>
<td>adults</td>
<td>Europe</td>
<td>black</td>
<td>13</td>
<td>0.0083</td>
<td>1.02 (0.87, 1.07)</td>
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<td>AB</td>
<td>A</td>
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<tr>
<td>Kokubo et al. 2013 (38)</td>
<td>adults</td>
<td>Asia</td>
<td>green</td>
<td>13</td>
<td>0.00371</td>
<td>0.95 (0.94, 0.97)</td>
<td>B</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>Kii et al. 1996 (35)</td>
<td>adults</td>
<td>Europe</td>
<td>black</td>
<td>15</td>
<td>0.00771</td>
<td>0.90 (0.81, 0.99)</td>
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<td>AB</td>
<td>A</td>
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<tr>
<td>Sesso et al. 2003 (53)</td>
<td>adults</td>
<td>USA</td>
<td>black</td>
<td>15</td>
<td>0.0076</td>
<td>0.89 (0.80, 0.99)</td>
<td>C</td>
<td>AB</td>
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<tr>
<td>Subtotal (I² = 74.3%, P = 0.001)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>0.96 (0.90, 0.99)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Leear et al. 2010 (42)</td>
<td>adults</td>
<td>Europe</td>
<td>black</td>
<td>10</td>
<td>0.0149</td>
<td>1.00 (0.88, 1.12)</td>
<td>B</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>Minoiwa et al. 2011 (48)</td>
<td>adults</td>
<td>Asia</td>
<td>green</td>
<td>13.1</td>
<td>0.01362</td>
<td>0.94 (0.86, 1.01)</td>
<td>A</td>
<td>AB</td>
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<tr>
<td>Lopez-Gonzalez et al. 2009 (46)</td>
<td>adults</td>
<td>USA</td>
<td>black</td>
<td>24</td>
<td>0.0103</td>
<td>0.95 (0.89, 1.02)</td>
<td>A</td>
<td>AB</td>
<td>A</td>
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<td>Subtotal (I² = 0.0%, P = 0.596)</td>
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<td>0.96 (0.91, 1.00)</td>
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</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>Leear et al. 2010 (42)</td>
<td>adults</td>
<td>Europe</td>
<td>black</td>
<td>10</td>
<td>0.02261</td>
<td>0.90 (0.80, 1.04)</td>
<td>B</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>Minoiwa et al. 2011 (48)</td>
<td>adults</td>
<td>Asia</td>
<td>green</td>
<td>13.1</td>
<td>0.01853</td>
<td>1.04 (0.86, 1.23)</td>
<td>A</td>
<td>AB</td>
<td>A</td>
</tr>
<tr>
<td>Larsson et al. 2009 (40)</td>
<td>adults</td>
<td>Europe</td>
<td>black</td>
<td>13.6</td>
<td>0.00764</td>
<td>0.91 (0.86, 0.96)</td>
<td>B</td>
<td>B</td>
<td>A</td>
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<tr>
<td>Subtotal (I² = 77.1%, P = 0.013)</td>
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<td>0.97 (0.69, 1.38)</td>
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<tr>
<td>Overall</td>
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<td></td>
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<td></td>
<td></td>
<td>0.96 (0.90, 0.99)</td>
<td></td>
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</tr>
</tbody>
</table>

Strength of Evidence Grading

- Based on the evidence-to-date.
- Single components of the diet are likely to show only minute effects.
- Dietary patterns (e.g., consuming tea along with a healthy diet rich in fruits, vegetables, whole grains, lean protein, and low/non-fat dairy) show much larger effects.
- It's hard to tease out confounders in observational studies.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Strength of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Cause Mortality</td>
<td></td>
</tr>
<tr>
<td>Adults</td>
<td>Low</td>
</tr>
<tr>
<td>Elderly (≥65)</td>
<td>Low</td>
</tr>
<tr>
<td>CVD Mortality</td>
<td></td>
</tr>
<tr>
<td>Adults</td>
<td>Low</td>
</tr>
<tr>
<td>Elderly (≥65)</td>
<td>Moderate</td>
</tr>
<tr>
<td>CVD Events</td>
<td>Low</td>
</tr>
<tr>
<td>Stroke Events</td>
<td>Low</td>
</tr>
</tbody>
</table>

Let’s talk mechanisms:

Tea may influence multiple biological processes that impact development of CVD, including but not limited to effects on:

- Blood lipids
- Blood pressure
- Endothelial function and improvements in blood flow
- Cross-communicating proteins that regulate inflammation
- Microbiome
Results:

14 randomized controlled trials included in the systematic review: total cholesterol (N=), LDL-cholesterol (N=), HDL-cholesterol (N=), triglycerides (N=), systolic blood pressure (N=), and diastolic blood pressure (N=).

Most studies reported multiple outcomes of interest and had insufficient sample sizes and statistical power to observe changes.

No significant effects of tea consumption were found on total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides, systolic blood pressure, and diastolic blood pressure.
SR 2 – Results – Blood Lipids

<table>
<thead>
<tr>
<th>Study (Reference)</th>
<th>Year</th>
<th>Tea Intervention n</th>
<th>Control n</th>
<th>Blood Lipids (mg/dL)</th>
<th>Duration</th>
<th>Net Change (95% CI)</th>
<th>Overall Quality Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDL Cholesterol</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Princen et al. (black tea)</td>
<td>1998</td>
<td>16</td>
<td>15</td>
<td>40.21</td>
<td>4 wk</td>
<td>0.00 (~3.00, 3.00)</td>
<td>Medium</td>
</tr>
<tr>
<td>Baharin et al. (male)</td>
<td>2012</td>
<td>29</td>
<td>0</td>
<td>42.6</td>
<td>12 wk</td>
<td>10.10 (~6.94, 14.27)</td>
<td>Medium</td>
</tr>
<tr>
<td>Baharin et al. (female)</td>
<td>2012</td>
<td>22</td>
<td>12</td>
<td>43.6</td>
<td>12 wk</td>
<td>-7.30 (~17.68, 3.28)</td>
<td>Medium</td>
</tr>
<tr>
<td>Ishikawa et al. (16)</td>
<td>1997</td>
<td>14</td>
<td>8</td>
<td>64.19</td>
<td>4 wk</td>
<td>-5.80 (~20.08, 8.48)</td>
<td>Medium</td>
</tr>
<tr>
<td>Subtotal (I² - squared = 19.1%, P = 0.295)</td>
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<td>-1.02 (~5.65, 3.61)</td>
<td></td>
</tr>
<tr>
<td>LDL Cholesterol</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baharin et al. (female)</td>
<td>2012</td>
<td>22</td>
<td>11</td>
<td>96</td>
<td>12 wk</td>
<td>2.80 (~27.60, 33.20)</td>
<td>Medium</td>
</tr>
<tr>
<td>Baharin et al. (male)</td>
<td>2012</td>
<td>31</td>
<td>8</td>
<td>107.7</td>
<td>12 wk</td>
<td>-14.30 (~-62.84, 24.24)</td>
<td>Medium</td>
</tr>
<tr>
<td>Princen et al. (black tea)</td>
<td>1998</td>
<td>16</td>
<td>15</td>
<td>137.3</td>
<td>4 wk</td>
<td>5.80 (~6.31, 17.91)</td>
<td>Medium</td>
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<tr>
<td>Subtotal (I² - squared = 0.0%, P = 0.620)</td>
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<td></td>
<td></td>
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<td>3.84 (~6.96, 14.64)</td>
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<tr>
<td>Total Cholesterol</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Baharin et al. (female)</td>
<td>2012</td>
<td>22</td>
<td>12</td>
<td>157.9</td>
<td>12 wk</td>
<td>17.50 (~11.98, 46.98)</td>
<td>Medium</td>
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<tr>
<td>Baharin et al. (male)</td>
<td>2012</td>
<td>30</td>
<td>8</td>
<td>161.8</td>
<td>12 wk</td>
<td>-0.10 (~27.51, 27.31)</td>
<td>Medium</td>
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<tr>
<td>Ishikawa et al. (16)</td>
<td>1997</td>
<td>14</td>
<td>8</td>
<td>180.2</td>
<td>4 wk</td>
<td>8.12 (~21.20, 37.44)</td>
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<tr>
<td>Princen et al. (black tea)</td>
<td>1998</td>
<td>16</td>
<td>15</td>
<td>206.1</td>
<td>4 wk</td>
<td>6.19 (~5.62, 17.99)</td>
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<td>Subtotal (I² - squared = 0.0%, P = 0.857)</td>
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<td></td>
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<td>6.82 (~2.79, 10.44)</td>
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<tr>
<td>Triglycerides</td>
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</tr>
<tr>
<td>Ishikawa et al. (16)</td>
<td>1997</td>
<td>14</td>
<td>8</td>
<td>80.60</td>
<td>4 wk</td>
<td>11.51 (~28.04, 48.07)</td>
<td>Medium</td>
</tr>
<tr>
<td>Baharin et al. (female)</td>
<td>2012</td>
<td>21</td>
<td>12</td>
<td>102.4</td>
<td>12 wk</td>
<td>48.80 (~50.05, 106.25)</td>
<td>Medium</td>
</tr>
<tr>
<td>Princen et al. (black tea)</td>
<td>1998</td>
<td>16</td>
<td>15</td>
<td>146.1</td>
<td>4 wk</td>
<td>19.48 (~5.67, 44.85)</td>
<td>Medium</td>
</tr>
<tr>
<td>Baharin et al. (male)</td>
<td>2012</td>
<td>33</td>
<td>8</td>
<td>166.6</td>
<td>12 wk</td>
<td>-27.70 (~102.39, 46.99)</td>
<td>Medium</td>
</tr>
<tr>
<td>Subtotal (I² - squared = 0.0%, P = 0.440)</td>
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<td>17.47 (~1.40, 36.34)</td>
<td></td>
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</table>

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SR 2 – Results – Blood Pressure

<table>
<thead>
<tr>
<th>Study (Reference)</th>
<th>Year</th>
<th>Control n</th>
<th>Intervention n</th>
<th>Baseline Blood Pressure (mm Hg)</th>
<th>Duration</th>
<th>Net Change (95% CI)</th>
<th>Overall Quality Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diastolic Blood Pressure</td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Hodgson et al. (20)</td>
<td>2012</td>
<td>46</td>
<td>49</td>
<td>71.5</td>
<td>24 wk</td>
<td>-2.10 (-3.50, -0.70)</td>
<td>High</td>
</tr>
<tr>
<td>Hodgson et al. (19)</td>
<td>2002</td>
<td>10</td>
<td>11</td>
<td>73</td>
<td>4 wk</td>
<td>0.00 (-8.29, 8.29)</td>
<td>High</td>
</tr>
<tr>
<td>Vieira Senger et al. (23)</td>
<td>2012</td>
<td>24</td>
<td>21</td>
<td>76.2</td>
<td>8 wk</td>
<td>3.00 (-2.63, 10.23)</td>
<td>Medium</td>
</tr>
<tr>
<td>Orem et al. (21)</td>
<td>2017</td>
<td>34</td>
<td>33</td>
<td>78</td>
<td>4 wk</td>
<td>3.97 (-0.78, 8.72)</td>
<td>Medium</td>
</tr>
<tr>
<td>Basu et al. (17)</td>
<td>2010</td>
<td>11</td>
<td>12</td>
<td>83</td>
<td>8 wk</td>
<td>-3.00 (-9.47, 3.47)</td>
<td>High</td>
</tr>
<tr>
<td>Subtotal (I²-squared = 54.2%, P = 0.068)</td>
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<td>0.18 (-3.00, 3.36)</td>
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<tr>
<td>Systolic Blood Pressure</td>
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<td>Orem et al. (21)</td>
<td>2017</td>
<td>34</td>
<td>33</td>
<td>117</td>
<td>4 wk</td>
<td>6.00 (-0.94, 12.84)</td>
<td>Medium</td>
</tr>
<tr>
<td>Hodgson et al. (20)</td>
<td>2012</td>
<td>46</td>
<td>49</td>
<td>121.2</td>
<td>24 wk</td>
<td>-2.00 (-4.00, -0.00)</td>
<td>High</td>
</tr>
<tr>
<td>Hodgson et al. (19)</td>
<td>2002</td>
<td>10</td>
<td>11</td>
<td>123</td>
<td>4 wk</td>
<td>1.00 (-15.40, 17.40)</td>
<td>High</td>
</tr>
<tr>
<td>Vieira Senger et al. (23)</td>
<td>2012</td>
<td>24</td>
<td>21</td>
<td>126.7</td>
<td>8 wk</td>
<td>1.90 (-6.11, 9.91)</td>
<td>Medium</td>
</tr>
<tr>
<td>Basu et al. (17)</td>
<td>2010</td>
<td>11</td>
<td>12</td>
<td>132</td>
<td>8 wk</td>
<td>0.40 (-9.20, 10.00)</td>
<td>High</td>
</tr>
<tr>
<td>Subtotal (I²-squared = 28.7%, P = 0.230)</td>
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<td></td>
<td></td>
<td></td>
<td>0.95 (-3.04, 3.75)</td>
<td></td>
</tr>
</tbody>
</table>

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Dilation of the arteries

Endothelial cells line the inside of the arteries (known as the endothelium) and produce endothelial nitric oxide (eNOS) in response to flavanols and other healthy dietary components. eNOS dilates the arteries and helps to promote healthy blood flow. This is biological process is termed “flow-mediated dilation” or FMD.

Tea consumption has been shown in a recent systematic review to improve FMD by about 2.6%. Just a 1% change in FMD has been shown to reduce the risk of CVD by ~10%

Inflammation refers to the body’s process of fighting things off that harm it. When something damages your cells, cross-communicating proteins trigger a response from the immune system. Flavonoids are known to positively influence CVD risk by acting on these cross-communicating proteins that regulate the anti-inflammatory Nrf2 and proinflammatory nuclear factor-\(\text{K}\beta\) (NF-\(\text{K}\beta\)) pathways.

The microbiome is known to metabolize flavanols efficiently into small-molecular weight compounds that exert biological effects in relation to CVD and overall health.

At the same time, a diet rich in foods containing flavonoids has been shown to promote the growth of probiotic bacteria.

Effects On The Microbiome

Conclusion:

Unsweet tea consumption seems to decrease the incidence of CVD-related mortality and events, but the biological mechanisms are likely multifactorial and still under investigation.

Thank You!

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PhD, CFS, FACN

Think Healthy Group
George Mason University

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Website: www.DrTaylorWallace.com
Text FOOD to 202-410-4202 to join my email list.

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