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Meta-Analysis

Association Between Drinking of Different Types of Tea and Risk of Stroke: A Systematic Review and Meta-analysis

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Abstract

Background and aims: Cerebrovascular accidents, commonly known as stroke, are among the leading causes of disability and death worldwide. As the second most consumed beverage globally, tea has attracted research interest regarding its potential role in stroke risk. Hence, this research sought to investigate the relationship between consumption of different types of tea and the risk of stroke.

Methods: A comprehensive search was conducted in the Web of Science, Embase, ProQuest, Scopus, Cochrane, PubMed, Google Scholar databse, up to June 9, 2024. Data were analyzed using STATA 14, and statistical significance was set at $P<0.05$ for all tests.

Results: Analysis of 29 studies showed that tea consumption was associated with a 13% decreased risk of stroke. Specifically, drinking oolong tea (OR: 0.46, 95% CI: 0.25, 0.85), green tea (OR: 0.76, 95% CI: 0.70, 0.82), and black tea (OR: 0.92, 95% CI: 0.86, 0.98) significantly lowered stroke risk. Tea consumption also lowered the risk of ischemic stroke by 19%, intracerebral hemorrhage by 17%, cerebral hemorrhage by 15%, cerebral infarction by 7%, and mortality risk by 20%. Additionally, tea consumption exerted a protective effect in in men, lowering stroke risk by 14%.

Conclusion: Tea consumption was inversely associated with the risk of stroke. The likelihood of stroke decreased as the daily number of tea cups consumed increased. Among the different types, oolong tea had a greater effect against stroke compared to green and black teas.

Keywords: Tea, Black tea, Green tea, Stroke, Cerebral strokes, Brain vascular accident

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Introduction

Stroke is one of the leading causes of disability and death worldwide, and it imposes a significant financial burden on affected individuals, their families, and society.[1,2] The determinants associated with stroke include advanced racial background, familial predisposition, sex, age, prior occurrences of transient ischemic attack (TIA), previous cardiac events, hypertension, diabetes mellitus, alcohol consumption, atrial fibrillation, smoking, cardiovascular diseases (CVDs), arterial pathologies, sickle cell anemia, poor dietary habits, sedentary lifestyle, substance misuse, psychological stress, obesity, and geographic location.[3,4]

One of the most widely consumed beverages globally is tea, with approximately two billion cups consumed daily worldwide[5]. Empirical evidence indicates that the polyphenol content of tea can reduce atherosclerosis and inflammation, improve the function of the blood vessels' lining, and protect against stroke.[6,7]

Tea comes in three main varieties: black, green, and oolong. Among these, green tea is one of the most widely consumed beverages in Asia and has been extensively studied for its potential role in preventing chronic diseases, including CVD.[8,9] Rich in antioxidant compounds such as caffeine, free amino acids, and polyphenols, green tea is considered beneficial in reducing the risk of stroke as well as coronary heart disease (CHD).[8,10,11]

Some previous studies have reported that tea consumption is associated with a reduced risk of stroke, while others have found no such effect. According to some research, tea consumption lowers stroke risk,[12,13] while other studies indicate no direct correlation between tea consumption and stroke incidence.[14, 15] Hence,

the association between black, green, and oolong tea consumption and the risk of stroke and related mortality remains uncertain. Therefore, it seemed necessary to conduct a systematic review and meta-analysis in this field in order to provide up-to-date and comprehensive results by combining previously published studies. This also allowed us to examine the effect of tea type, gender, ethnicity, duration of consumption, amount of intake, and stroke subtype on the association between tea consumption and stroke risk, thereby yielding more detailed and accurate results.

Materials and Methods

This research was conducted according to the PRISMA checklist.[16] The protocol of this research was then registered on the PROSPERO database.

Search Strategy

Two authors independently conducted a comprehensive literature search in the Web of Science, Embase, ProQuest, Scopus, Cochrane, and PubMed databases, as well as the Google Scholar search engine, up to June 9, 2024. The keywords used in the search strategies included: *Tea*, *Black Tea*, *Green Tea*, *Stroke*, *Cerebrovascular Accident*, *Cerebral Strokes*, *Brain Vascular Accident*, *Acute Stroke*. For basic searches, Medical Subject Headings (MeSH) terms and their synonyms were used, while for advanced searches, keywords were combined with operators ("AND," "OR"). Additionally, manual searches of reference lists from primary studies were reviewed to minimize the risk of missing relevant sources and to reduce search-stage errors.

Search Strategies in Databases

Cochrane: Tea OR Oolong tea OR Black Tea OR Green Tea in Title Abstract Keyword AND Stroke OR Cerebrovascular Accident OR Cerebral Strokes OR Brain Vascular Accident OR Acute Stroke in Title Abstract Keyword - in Trials

PubMed: (Tea OR Oolong tea OR Black Tea OR Green Tea) AND (Stroke OR Cerebrovascular Accident OR Cerebral Strokes OR Brain Vascular Accident OR Acute Stroke)

Web of Science: Stroke OR Cerebrovascular Accident OR Cerebral Strokes OR Brain Vascular Accident OR Acute Stroke (Abstract) AND Tea OR Oolong tea OR Black Tea OR Green Tea (Abstract)

ProQuest: Stroke OR Cerebrovascular Accident OR Cerebral Strokes OR Brain Vascular Accident OR Acute Stroke (abstract) AND Tea OR Oolong tea OR Black Tea OR Green Tea (abstract)

Scopus: TITLE-ABS-KEY (Stroke OR Cerebrovascular Accident OR Cerebral Strokes OR Brain Vascular Accident OR Acute Stroke) AND TITLE-ABS-KEY (Tea OR Oolong tea OR Black Tea OR Green Tea)

Embase: (stroke:ti OR 'cerebrovascular accident':ti OR 'cerebral strokes':ti OR 'brain vascular accident':ti OR 'acute stroke':ti) AND (tea:ti OR 'oolong tea':ti OR 'black tea':ti OR 'green tea':ti)

Population, Exposure, Comparison, Outcomes (PECO)

Population: Research that focused on the association between the consumption of different types of tea and stroke occurrence.

Exposure: Consumption of different kinds of tea.

Comparison: People who did not consume tea

- The primary outcome: To determine the relationship between tea consumption and stroke risk
- The secondary outcome: To determine the probability of stroke-related mortality among tea consumers.

Inclusion Criteria

1. Cohort, case-control, cross-sectional, Mendelian Randomization (MR), and randomized, double-blind, placebo-controlled studies.
2. Studies exploring the relationship between tea consumption and stroke risk.
3. No language restrictions were applied.
4. To ensure quality of the studies, only those with Newcastle Ottawa Scale (NOS) quality score of ≥ were considered for analysis.
5. Studies published up to June 9, 2024.

Exclusion Criteria

The following items were excluded from the review process: duplicate studies, articles without full-text availability, papers lacking sufficient data for analysis, studies comparing tea consumption with the risk of myocardial infarction, studies with NOS scores ≤ 5, and studies reporting results only in qualitative form.

Quality Assessment

Two researchers independently assessed the quality of observational studies using the NOS tool. The scoring method of this 9-question tool is from 0-10 (0 = lowest quality and 10 = highest quality). A cut-off score of 5 was applied, with studies scoring ≥ 5 considered high quality.[17] The Cochrane Clinical Trial Quality Assessment Checklist was used for clinical trials. This checklist contains seven questions, each assessing a specific type of bias in clinical trials, with three possible responses: high risk of bias, low risk of bias, and unclear.[18] Any disagreements between reviewers were resolved through discussion until consensus was reached.

Data Extraction

Two researchers filled out a data checklist. Extracted data included the first author, sample size, year of publication, tea consumption level, duration of tea consumption, type of stroke, type of tea, participants' gender, mean age, study design, country, odds ratios (ORs) for the association between tea consumption and stroke types, ORs for the association between various types of tea and stroke risk, and ORs for the association between tea consumption and stroke mortality, along with their corresponding upper

and lower confidence intervals.

Statistical Analysis

ORs, hazard ratios (HRs), and risk ratios (RRs) were used to evaluate the effect of tea consumption on stroke risk. To evaluate the heterogeneity, the I^2 index was used. Subgroup analyses were conducted to examine the association between tea consumption and stroke based on variables such as type of tea, study design, dosage, duration of consumption, and country. Meta-regression analyses were conducted to investigate the relationship between the efficacy of tea intake and variables such as sample size and year of publication. Publication bias was assessed using Egger's test, and data were analyzed using STATA version 14. Statistical significance was defined as $P < 0.05$.

Results

Two reviewers independently screened each record and report retrieved. In cases where two reviewers disagreed on the selection of a study, a third reviewer resolved the conflict, and a final decision was made. The database search initially identified 672 articles, of which 321 articles were excluded as duplicates. After removing duplicates, 351 articles remained. At the abstract screening stage, 33 articles were excluded due to the unavailability of full texts. Of the 318 full-text articles, 84 were excluded due to a lack of sufficient data for analysis, leaving 234 articles. Subsequently, 205 articles were excluded due to other reasons for exclusion. Ultimately, 29 articles were included in the final analysis (Figure 1).

Of the 29 reviewed studies, 13 were classified as moderate quality and 16 as high quality. This meta-analysis included 20 cohort studies, six case-control studies, one cross-sectional study, one Mendelian Randomization (MR) study, and one randomized, double-blind, placebo-controlled trial. All studies were published between 1996 and 2024. Details of these studies are provided in Table 1.

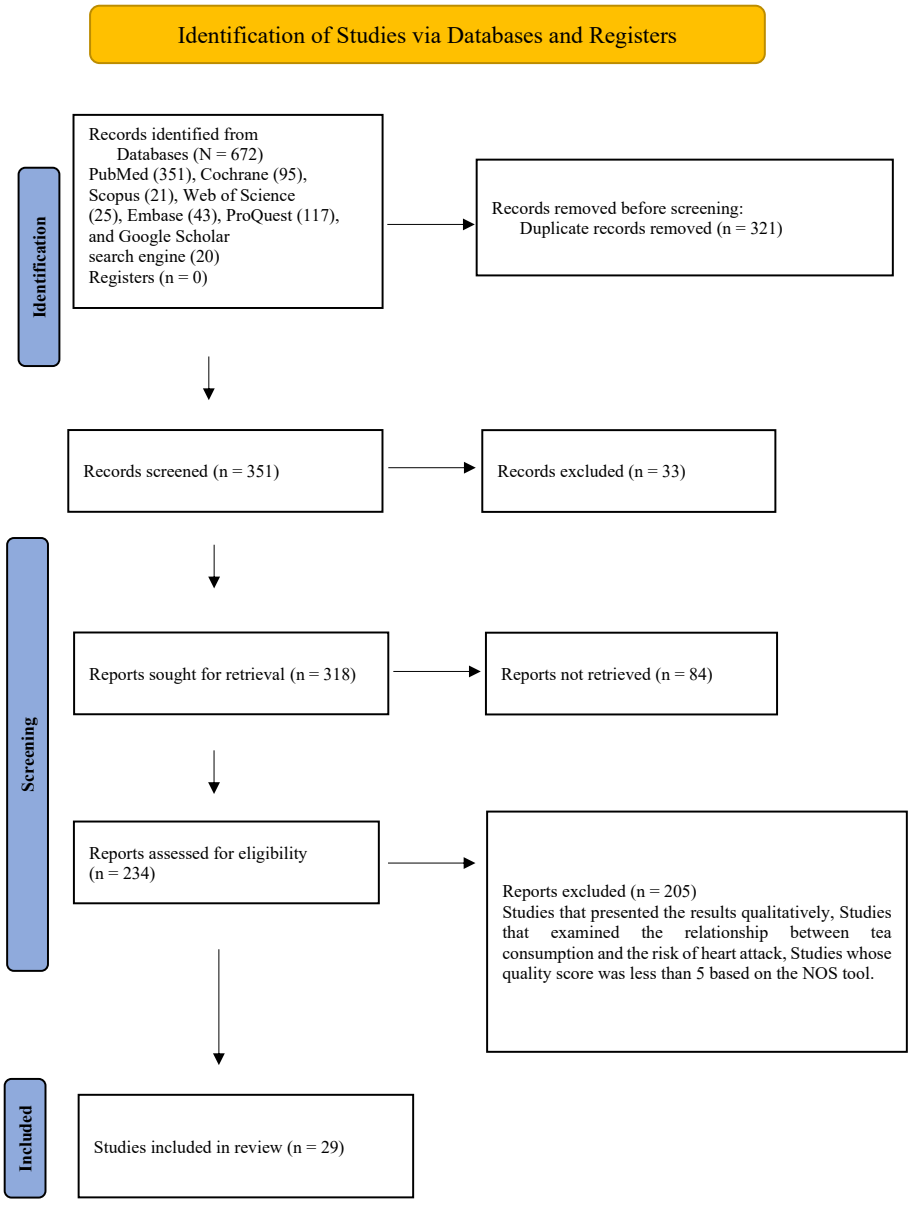

Figure 1. The Flow Chart of Study Selection (PRISMA). *Note.* NOS: Newcastle Ottawa scale

Table 1. Summarized Information of the Studies

Author (year)	Type of Study	Country	Population (Men or Women)	Type of Tea	Sample Size	Age Mean (year)	Dosage	Level of Quality
Liu[19]	Cohort	China	Both	Green	4756 NR NR	62.13 62.1 61.73	<2.5 g/d 2.5–5 g/d >5 g/d	Moderate
Gao[12]	MR	UK Biobank	Both	Green & Black	447485	NR	3.51(cup/day)	High
Inoue-Choi[20]	Cohort	UK Biobank	Both	Tea	498043	56.5	≤1 (cup/day) 2 to 3 (cup/day) 4 to 5 (cup/day) 6 to 7 (cup/day) 8 to 9 (cup/day) ≥10 (cup/day)	High
Nie[21]	Cohort	China	Both	Tea	34661 NR	NR NR	NR NR	High
Zhang[22]	Cohort	UK Biobank	Both	Green & Black	39311 107931 168431	60.18 60.59 60.55	0.5 to 1 (cup/day) 2 to 3 (cup/day) ≥4 (cup/day)	High
Wang[14]	Case-control	UK Biobank	Both	Green & Black	349376	NR	extra daily cup	Moderate
Teramoto[23]	Cohort	Japan	Both	Green	46213 NR	40-79 NR	NR 1 to 2 (cup/day) 3 to 4 (cup/day) 5 to 6 (cup/day) ≥7 (cup/day)	High
Tian[13]	Cohort	China	Both	Green, oolong, black	487377 NR	30-79 NR	<2 (cup/day) 2 to 4 (cup/day) >4 (cup/day)	Moderate
Wang[24]	Cohort	China	Both	Black	31885	50.46	NR	Moderate
Lee[25]	Cohort	Korea	Men	Green	50439	≥40	<1 (cup/day) 1 to<3 (cup/day) ≥3 (cup/day)	High
Wang[26]	Cohort	China	Both	Green & Black	53916	30-79	0.1 g/d 0.3 g/d ≥5.0 g/d	Moderate
Lee[27]	Case-control	Korea	Both	Green Green Green Black Black Black Oolong Oolong Oolong	1880 NR	30-84 NR	NR	Moderate
Shaikh[28]	Cohort	Japan	Both	Green	82369 NR	45-75 NR	2 to 3 (cup/day) ≥4 (cup/day)	Moderate
Larsson[29]	Cohort	Sweden	Both	Black	14284 12988 7979 2023	59.3 60.3 59.7 58.6	<1(cup/day) 1(cup/day) 2 to 3 (cup/day) ≥4(cup/day)	High

Table 1. Continued.

Author (year)	Type of Study	Country	Population (Men or Women)	Type of Tea	Sample Size	Age Mean (year)	Dosage	Level of Quality
Kokubo[30]	Cohort	Japan	Both	Green	8497	45-74	NR	High
					7490		NR	
					8103		1(cup/day)	
					17426		2 to 3 (cup/day)	
					23247		≥4(cup/day)	
Mineharu[8]	Cohort	Japan	Men	Green	34345	40-79	NR	Moderate
							1 to 2(cup/day)	
							3 to 5(cup/day)	
							≥6(cup/day)	
			Women	Green	48310		NR	
							1 to 2(cup/day)	
							3 to 5(cup/day)	
							≥6 (cup/day)	
de Koning Gans[15]	Cohort	Netherlands	Both	Black	11425	49.2	1–2(cup/day)	High
					4159	50.4	2.1–3.0 (cup/day)	
					4410	52.4	3.1–4.0(cup/day)	
					4028	51.3	4.1–6.0(cup/day)	
					1839	49.2	6(cup/day)	
					NR	NR	1 to 3(cup/day)	
					NR	NR	3.1 to 6(cup/day)	
					NR	NR	≥6(cup/day)	
Liang[31]	Case-control	China	Both	Green	838	69	NR	High
					NR	NR	1 to 2(cup/day)	
					NR	NR	>2(cup/day)	
				Black	NR	NR	NR	
							1 to 2(cup/day)	
							>2(cup/day)	
				Oolong	NR	NR	NR	
							1 to 2(cup/day)	
							>2(cup/day)	
Tanabe[32]	Cohort	Japan	Both	Green	2087	40-89	<5(cup/day)	Moderate
							≥5(cup/day)	
Larsson[33]	Cohort	Finland	Men	Black	26556	50-69	<0.5(cup/day)	High
							0.5 to 1.9(cup/day)	
							≥2(cup/day)	
					NR	NR	<0.5(cup/day)	
							0.5 to 1.9(cup/day)	
							≥2(cup/day)	
							<0.5(cup/day)	
							0.5 to 1.9(cup/day)	
							≥2(cup/day)	
Wen[34]	Case-control	China	Men	Tea	11562	65.9	NR	High
					1998	62.3		
Okamoto[35]	Case-control	Japan	Both	Green	402	59.2	≥1 times	Moderate
					NR	NR	<1 times	

Table 1. Continued.

Author (year)	Type of Study	Country	Population (Men or Women)	Type of Tea	Sample Size	Age Mean (year)	Dosage	Level of Quality
Kuriyama[36]	Cohort	Japan	Both	Green	4325 3895 5039	57.8 60.3 61.8	1 to 2(cup/day) 3 to 4(cup/day) ≥5(cup/day)	High
Chen[37]	Cross-sectional	China	Both	Green Black	14212 NR	35-60 NR	over 150 grams per month NR	High
Sesso[38]	Randomized, double-blind, placebo-controlled	USA	Women	Tea	38445 NR	53.9 NR	<1(cup/day) 1 to 3(cup/day) ≥4(cup/day)	Moderate
Sesso[39]	Cohort	USA	Both	Black	1828 3939 2526 678 894	60 60.2 59.4 59.7 58.9	<1(cup/day) 1(cup/day) 2(cup/day) 3(cup/day) ≥4(cup/day)	High
Hirvonen[40]	Cohort	Finland	Men	Tea	26593 NR NR	50-69 NR 50-69	≥1(cup/day) ≥1(cup/day) ≥1(cup/day)	Moderate
Keli[41]	Cohort	Netherlands	Men	Black	552	50-69	≥4.7(cup/day)	High
Thrift[42]	Case-control	Australia	Both	Tea	662	18-80	NR	Moderate

Note. NR: Not reported.

The present study revealed that tea consumption was inversely related to the risk of ischemic stroke (OR: 0.81, 95% CI: 0.74-0.87), intracerebral hemorrhage (OR: 0.83, 95% CI: 0.76-0.91), cerebral hemorrhage (OR: 0.85, 95% CI: 0.80-0.90), and cerebral infarction (OR: 0.93, 95% CI: 0.87-0.99), corresponding to a relative risk reduction of 19%, 17%, 15%, and 7%, respectively, as depicted in Figures 2, 3, 4, and S1. However, no significant correlation was identified between tea consumption and the risk of subarachnoid hemorrhage (OR: 0.83, 95% CI: 0.58-1.18), as illustrated in Figure S2.

In the gender-based analysis, tea consumption was not significantly associated with stroke risk among women (OR: 0.93, 95% CI: 0.83-1.04), as depicted in Figure S3. Conversely, a 14% decrease was observed in stroke risk in men (OR: 0.86, 95% CI: 0.82-0.91), as noted in Figure S4. Moreover, Figure S5 showed that tea consumption was inversely related to stroke mortality, showing a 20% risk reduction (OR: 0.80, 95% CI: 0.74-0.87).

In conclusion, regular tea consumption was inversely related to the risk of stroke, with an estimated 13% reduction in stroke risk. Specifically, drinking tea reduced the risk of stroke by 22% in China, 11% in England, 16% in Japan, 19% in Korea, and 12% in Finland. In contrast, no statistically significant relationship was observed in Sweden, the Netherlands, Australia, and the United States between tea intake and the risk of stroke. This could be due to various factors such as differences in tea type, ethnicity, duration of consumption, and amount of tea consumed.

Additionally, individuals who consumed tea for less than ten years experienced a 15% reduction in stroke risk, while those who consumed tea for ten years or more had a 9% reduction. Drinking less than one cup of tea per day was not significantly associated with stroke risk. In contrast, consuming 1-3 cups per day decreased the risk by 12%, whereas four or more cups per day lowered the risk by 17% (Table 2).

Drinking tea reduced the risk of stroke by 11% in cohort studies, 29% in case-control studies, 62% in cross-sectional studies, and 29% in MR studies. However, the relationship between tea consumption and the risk of stroke in randomized, double-blind, placebo-controlled studies was not statistically significant. Further analysis based on tea type showed that green tea reduced the risk by 24%, black tea by 8%, and oolong tea by 54% (Table 2). It should be noted that among the 29 studies reviewed, only one was an MR study and one was a randomized, double-blind, placebo-controlled trial, while the remaining 27 were observational. This may partly explain the variability in results across study types.

Meta-regression analyses, illustrated in Figures S6 and S7, indicated that the association between tea consumption and stroke risk was not statistically significant in relation to the publication year of the studies ($P=0.942$) or sample size ($P=0.689$).

Figure S8 showed a significant distribution bias plot ($P=0.001$), suggesting that studies that reported a statistically insignificant effect of tea consumption on stroke risk and those reporting a significant relationship did not have the same chance of being published.

Sensitivity analysis evaluates how the overall result of a meta-analysis changes when individual studies are excluded. Figure S9 shows that the studies by Sesso HD (2003, randomized, double-blind, placebo-controlled)

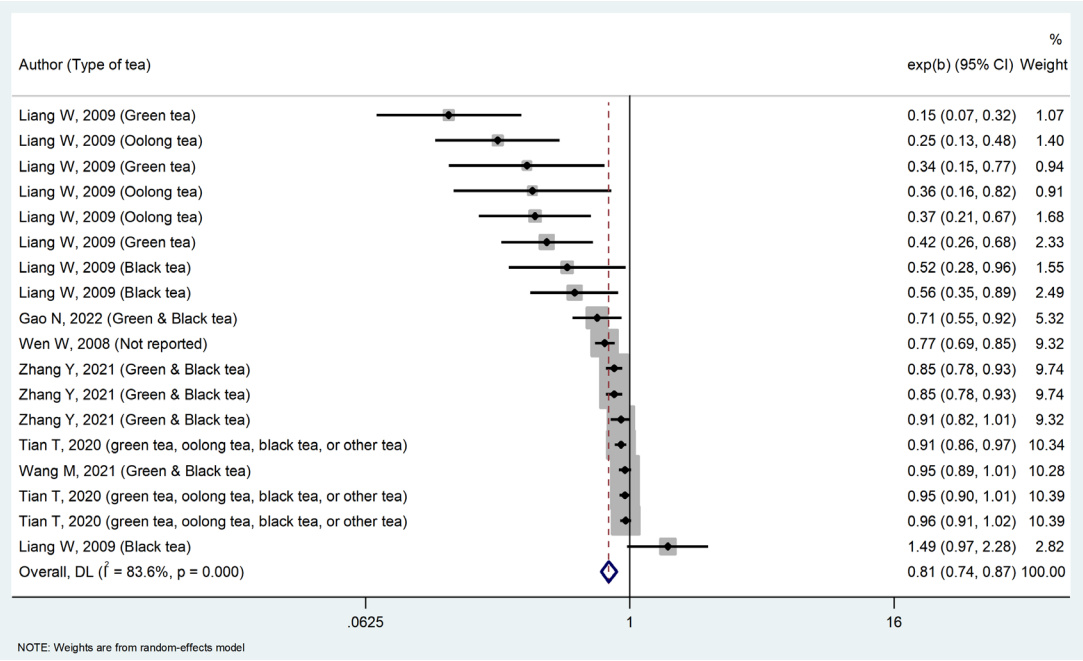

Figure 2. The Association Between Tea Consumption and Risk of Ischemic Stroke

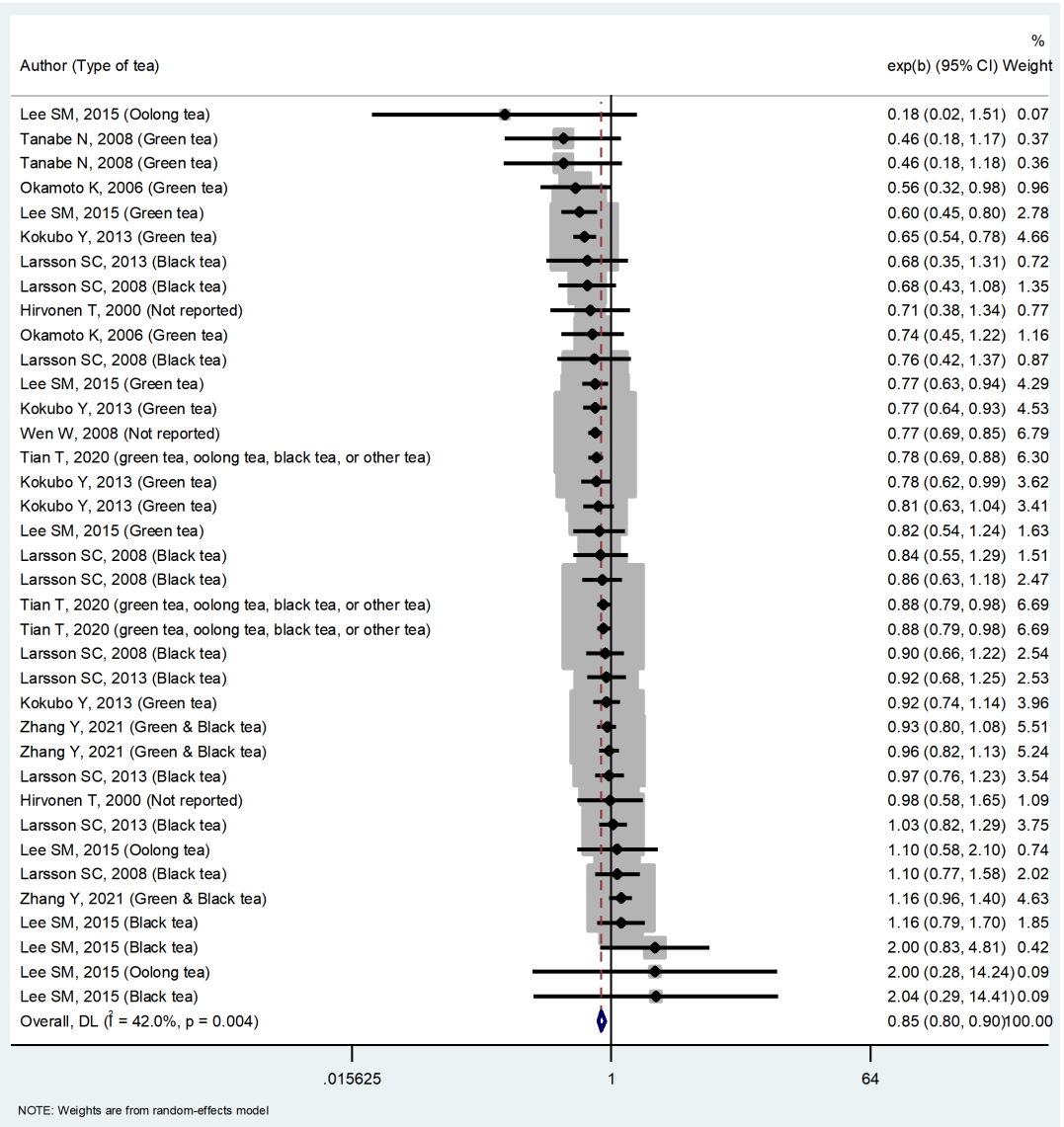

Figure 3. The Association Between Tea Consumption and Risk of Cerebral Hemorrhage

Table 2. Relationship Between Tea Intake and Stroke by Subgroups

Subgroups (Risk of Stroke)		OR	Low	Up	*P*-value	I^2 (%)	Significant
Total		0.87	0.84	0.90	<0.001	70.4	Yes
Country	China	0.78	0.72	0.84	<0.001	82	Yes
	UK	0.89	0.81	0.98	<0.001	86.3	Yes
	Japan	0.84	0.78	0.91	0.003	62.1	Yes
	Korea	0.81	0.70	0.93	0.084	38.5	Yes
	Sweden	1	0.93	1.08	0.138	45.5	No
	Netherlands	0.99	0.84	1.17	0.196	31.9	No
	Finland	0.88	0.83	0.94	0.833	0	Yes
	USA	1.02	0.93	1.12	0.373	7.4	No
	Australia	1.35	0.93	1.96	---	0	No
Time of Consumption (year)	<10	0.85	0.78	0.93	<0.001	66.3	Yes
	>=10	0.91	0.87	0.94	<0.001	50.4	Yes
Dosage of Tea (cup per day)	<1	0.96	0.91	1.02	0.216	26.6	No
	1-3	0.88	0.80	0.96	<0.001	79.5	Yes
	>=4	0.83	0.77	0.90	0.004	61.6	Yes
Type of Tea	Green	0.76	0.70	0.82	<0.001	69.2	Yes
	Black	0.92	0.86	0.98	<0.001	59.1	Yes
	Oolong	0.46	0.25	0.85	0.015	64.6	Yes
Design	Cohort	0.89	0.86	0.92	<0.001	54.5	Yes
	Case-control	0.71	0.61	0.82	<0.001	82.9	Yes
	Cross-sectional	0.38	0.17	0.61	0.638	0	Yes
	Randomized, double-blind, placebo-controlled	1.10	0.94	1.29	0.285	20.3	No
	MR	0.71	0.55	0.92	---	0	Yes

*Note.*OR: Odds ratio; MR: Mendelian randomization.

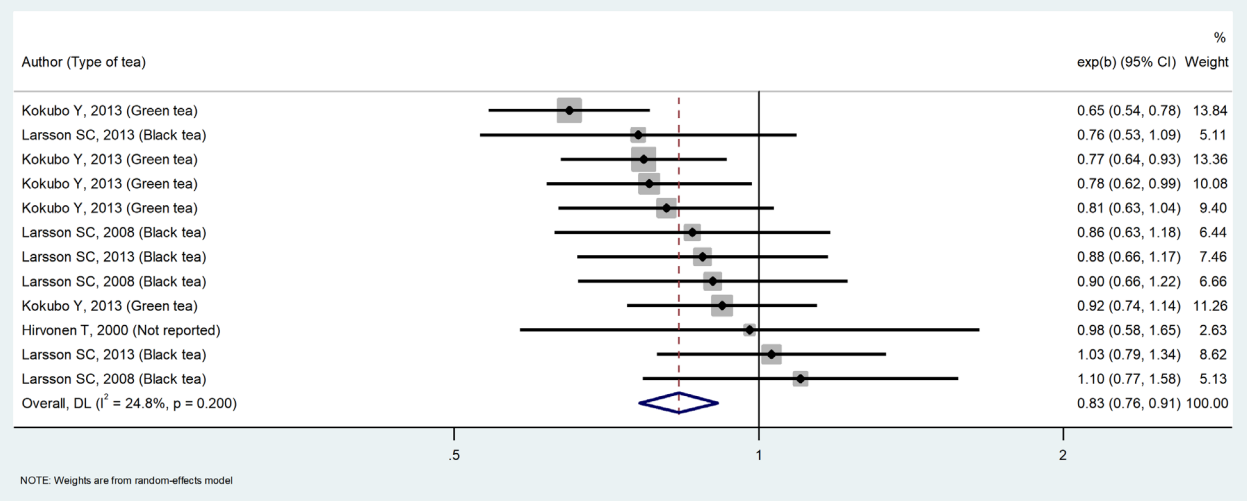

Figure 4. The Association Between Tea Consumption and Risk of Intracerebral Hemorrhage

and Wen W (2008, case-control) were the most influential in the final results of the current meta-analysis.

Discussion

This study demonstrated that tea consumption was associated with a 13% reduction in stroke risk and a 20% reduction in mortality risk. Specifically, green tea was linked to a 24% decrease in stroke risk, black tea to an 8% decrease, and oolong tea to a 54% decrease. Consuming 1-3 cups of tea per day was linked with a 12% reduction in stroke risk, while four or more cups per day were associated with a 17% reduction. In addition, tea drinking was inversely related to stroke incidence in men, with a 14% reduction in risk, while no significant relationship was found in women.

A meta-analysis by Wang et al., which combined five studies examining the relationship between green tea consumption and stroke risk, found that increased green tea consumption was significantly associated with lower risk of stroke (RR: 0.74, 95% CI, 0.66-0.83).[43] Likewise,

Cheng et al investigated the association between tea consumption and cerebral hemorrhage risk, revealing that increased tea consumption was associated with a 23% reduction in cerebral hemorrhage risk (RR: 0.77, 95% CI 0.66-0.89). Dose-response analysis indicated that each additional cup of tea or green tea consumption was associated with a 2% (RR: 0.98, 95% CI 0.976-0.990) and 6% (RR: 0.94, 95% CI 0.92-0.97) reduction in cerebral hemorrhage risk, respectively.[44] Similarly, Chung et al reported that each additional cup of daily tea was associated with an average 4% reduction in CVD mortality risk, 2% reduction in CVD risk, 4% reduction in stroke risk (RR: 0.96, 95% CI: 0.93-0.99), and 1.5% reduction in all-cause mortality risk.[45] These findings corroborated the findings of the present study.

However, Yi et al, in an umbrella review, observed that a rise in tea consumption by two to three cups per day was linked to an increased risk of stroke (OR: 1.57, 95% CI: 1.17-2.12).[46] This finding contrasts with our reults. However, it should be noted that this difference may be due to the difference in the type of review conducted in the umbrella review as compared to the meta-analysis cited in other studies.

Pang et al, in a meta-analysis, observed that people who consumed 1-3 cups of green tea daily had a reduced risk of myocardial infarction (OR: 0.81, 95% CI: 0.67–0.98) and stroke (OR: 0.64, 95% CI: 0.47–0.86) compared to those who consumed less than one cup per day.[47] Zhang et al, in their meta-analysis, found that an additional three cups of tea per day lowered the risk of stroke (RR: 0.82, 95% CI: 0.73–0.92) and cerebral hemorrhage (RR: 0.79, 95% CI: 0.72–0.87) but not stroke-related mortality (RR: 0.93, 95% CI: 0.83–1.05).[48] These studies are consistent with the current study in affirming that tea consumption lowers the risk of stroke and cerebral hemorrhage. Furthermore, the present study also revealed that tea consumption lowers stroke-related mortality.

In a meta-analysis study conducted by Rui et al, the objective was to examine the relationship between coffee or tea intake and the occurrence of subarachnoid hemorrhage. The comparison of the highest versus lowest tea consumption did not reveal any significant relationship with subarachnoid hemorrhage risk (RR: 0.83, 95% CI, 0.65-1.08).[49] Similarly, Shen et al, in their meta-analysis, concluded that an increase of three cups of tea per day was linked with a 13% reduction in stroke risk (RR: 0.87, 95% CI, 0.81–0.94) and 24% reduction in ischemic stroke risk (RR: 0.76, 95% CI, 0.69–0.84). However, no significant relationship was observed for cerebral hemorrhage or subarachnoid hemorrhage (RR: 0.81, 95% CI, 0.57–1.16).[50] The current meta-analysis is consistent with these findings concerning the reduction in stroke and ischemic stroke risk, as well as the absence of an association with subarachnoid hemorrhage. Nevertheless, the present analysis differed from Shen's study in that tea consumption was found to have a protective effect against cerebral hemorrhage risk, which may be attributed to differences in the types and quantities of tea consumed by the populations.

Arab et al, in a meta-analysis of nine studies, reported that individuals consuming three or more cups of green or black tea daily had a 21% lower risk of stroke compared to those consuming only one cup daily (RR: 0.79, 95% CI: 0.73-0.85). The results for black and green tea were (RR: 0.76, 95% CI: 0.67-0.86) and (RR: 0.79, 95% CI: 0.72-0.86), respectively.[51] Interestingly, this study identified a higher impact of black tea on the risk of stroke than green tea, which is contrary to the results of the current study. Nevertheless, both studies concluded that the intake of black and green tea can decrease the risk of stroke.

Limitations of the Study

Some of the reviewed investigations did not distinguish between different types of tea consumed and were therefore omitted from the tea type analysis. The overlapping age ranges in the studies made it impossible to conduct a subgroup analysis based on age. Additionally, some studies did not report sample sizes, so the actual number of samples across the individual studies could not be determined. Variations in the units of tea consumption across studies also led to the exclusion of some of the studies from the subgroup analysis based on consumption level. Fewer studies examined the relationship between tea consumption and the risk of stroke by gender, resulting in limited data for gender-specific comparisons compared to those available for the general population.

Conclusion

It was observed that tea consumption was associated with a lower incidence of stroke and stroke mortality. Among the three types of tea, oolong tea demonstrated the most significant protective impact against stroke, followed by green and black tea. Furthermore, the research also found that tea consumption exerted the strongest protective effect against ischemic stroke, with a stronger effect on ischemic stroke than on cerebral hemorrhage and cerebral infarction. Additionally, it was also noted that the preventive effect of tea consumption on stroke risk was higher with higher daily consumption and shorter duration of tea consumption. Overall, tea consumption was found to be beneficial, especially for males and the high-risk stroke group.

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Competing Interests
The authors declare no competing interests.

Ethical Approval
The present study was approved by the Ethics Committee of Shahrekord University of Medical Sciences (Ethical Code IR.SKUMS.REC.1403.145).

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Supplementary File
Supplementary File contains Figures S1-S9.

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