

Effect of tea in cerebrovascular disease and diabetes: A study

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ABSTRACT: *Background:* Tea is the most widely consumed beverage next to water in the world. Tea is rich in flavonoids, a polyphenolic compound. Flavonoids have shown to have significant property of endothelium-dependent vasodilation. Catechins are one of the major components of tea and promising tool against cerebrovascular diseases and metabolic syndrome. Clinical and observational data on tea intake and stroke are found to have beneficial role in preventing the onset of ischemic stroke in human. *Aims:* To study the effect of tea-drinking in ischemic stroke and metabolic syndromes. *Methodology:* A total of 1082 stroke patients were recruited from in and out patients from Department of Ramakrishna Mission Seva Pratishthan. Detailed history and clinical examination based on stroke, diabetes, hypertension and tea-intake questionnaire were prepared. Biochemical examinations such as fasting and PP glucose, blood urea, creatinine, uric acid, blood for lipid profile (HDL, LDL, VLDL and triglyceride) in every individual and neuroimaging study such as CT Scan/ MRI of brain were done in selected cases and repeated at every 6-month interval. Individuals taking cholesterol-lowering agents were advised to continue the same doses unless advised. *Results:* Out of 917 patients, 661 were men and 256 were women. Clinician and senior neurologist carried out clinical and neurological examinations. The mean±SD age of the participants was 62.13 ±11.33 and had a mean ±SD education of 8.12±4.61 years. Total 94.98% patients were tea-drinker and mostly preferred type is decoction (53.54%). Considering the history of tea-intake habit, 300 ml is the highest amount taken by 39.69% patients. Regarding positive family history, hypertension is the most common (40.35%), and stroke is the second most common neurological disorder noticed in 28.89% of the family members. A paired *t*-test analysis revealed a significant result ($P\leq 0.01$) showing decrease in blood sugar level and increase in HDL level when compared with the first and second visit of the study participants. *Conclusion:* We observed that tea consumption may gives rise to better control of fasting hyperglycemia and help in raising the level of HDL (protective cholesterol).

KEYWORDS: Flavonoids; Stroke; Hyperglycemia; Cholesterol

Introduction

Tea is the most widely consumed beverage in the world.¹ Because of the high consumption of tea, even small effects in persons could have a large impact on public health. The polyphenolic flavonoids in tea are thought to have a protective effect on cerebrovascular disease.² Drinking at least three cups of green or black tea a day can significantly reduce the risk of stroke. New University of California-Los Angeles Study has observed that the more you drink tea, the better your odds of staving off a stroke as stated *Science Daily* in 2009. Available epidemiological evidence is equivocal, mainly due to the lack of accurate measurements on tea exposure.

Strokes are the second most common cause of death globally as well as a major cause of disability, with up to

20 million strokes occurs annually. Strokes occur either because of ischemic affection of intracranial blood vessels or hemorrhage from intracranial vessels. Ischemic strokes account for around 83% of all stroke cases, with hemorrhagic stroke being far less common.

Tea can be grouped into three types including Black tea, Oolong tea and Green tea, following different manipulations of the leaf. Green tea is not fermented and is a major beverage consumed in Asian countries, which contain water, proteins, carbohydrates, minerals, vitamins and polyphenols of the flavonoid type.³ Green tea is fermented to Oolong, and then to Black tea polyphenol compounds.⁴ Thus, Black tea generally refers to the fermented tea which is more popular in Iran, North America and Europe, specially United Kingdom.^{5,6}

Catechins are one of the major components of tea as they constitute 30% of the dry weight of green tea and 9% of the dry weight of black tea.⁷ Catechin is a promising tool against metabolic syndrome. It has been observed that it may decrease fasting blood glucose, tri-

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Table 1: Social and General Characteristics of Subjects (N = 728)

Variables (Age in Yr)	N (%)
30–39	14 (1.92)
40–49	76 (10.43)
50–59	193 (26.51)
60–69	204 (28.02)
70–80	241 (33.1)

glyceride levels, abdominal fat and insulin. Catechins may prevent low-density lipid (LDL) from oxidative damage, either through their free-radical or by recycling other antioxidants.

Epidemiological studies suggest that tea may reduce the risk of cardiovascular and cerebrovascular diseases.⁸ However, published data are not consistent. The prevention of cerebrovascular diseases or stroke by Green tea has been evidenced during a four-year follow-up study involving 5,910 individuals. Incidences of cerebral haemorrhage and stroke were two-fold higher in those people who took less than 5 cups of tea than those who took 5 cups or more daily.⁹ An inverse correlation between Black tea consumption and the incidence of stroke was also replicated with the Zutphen Study, in which 552 men aged between 50 and 69 were followed over 15 yr.¹⁰ However, this inverse association was not observed in Netherland-based study.¹¹ We aimed at determining the effect of tea-drinking in cases of proved cerebrovascular disease with or without diabetes mellitus, hypertension and ischemic heart disease, and the effect of tea-drinking in cases of diabetes mellitus, hypertension, dyslipidaemia and ischemic heart disease.

Materials and Methods

We have taken the sample population from in and out patients department of the Ramakrishna Mission Seva Pratishthan Institute. The study is a descriptive longitudinal study.

Inclusion Criteria

Cases of established cerebrovascular disease (with or without neuro-radiological confirmation, age range 40–80 yrs, with or without coexisting hypertension (HTN), diabetes mellitus (DM) and ischemic heart disease (IHD) were selected.

Exclusion Criteria

Patients with history of transient ischemic attack, cases with in obvious stroke and stroke mimicking cases were excluded.

Elucidation of the Terms

Stroke

Stroke is defined as a rapidly developing clinical sign of focal or global disturbance of cerebral function, with symptoms lasting 24 hr or more or leading to death with no apparent cause other than due to vascular origin.¹¹

Diabetes

Diabetes will be defined as fasting plasma glucose ≥ 126 mg dl⁻¹ and 2 hr plasma glucose ≥ 200 mg dl⁻¹. Hyperglycemia will be defined as FPG of 110–125 mg dl⁻¹ and 2 hr plasma glucose as 140–199 mg dl⁻¹.¹²

Data Collection

Stroke patients (N = 893) were recruited from in and out patients department of this hospital. Detailed history was taken from them with emphasis on stroke, diabetes, hypertension and tea intake questionnaire. Clinician and senior neurologist carried out clinical and neurological examination. Information on frequency and duration of tea-drinking and types of tea consumed, together with habitual diet and lifestyle characteristics, was obtained from participants, using a validated and reliable questionnaire and later these were integrated in a patient's database. Biochemical examination at the time of the entry was performed in all cases from a standard and accredited laboratory. These investigations were fasting and post-prandial (PP) glucose, blood urea, creatinine, uric acid, blood for lipid profile (HDL, LDL, very low

Table 2: Type of Food Consumption of the Study Participants

Diet (Food Consumption)	N (%)
Vegetarians	31 (4.25)
Non-vegetarians	697 (95.74)
<i>Egg consumption</i>	
Daily	3 (0.41)
None	183 (25.13)
Rare	46 (6.32)
<i>Fish Consumption</i>	
Daily	71 (9.75)
None	37 (5.08)
Rare	2 (0.27)
<i>Meat Consumption</i>	
1 day/week	36 (4.94)
None	232 (31.86)
Rare	52 (7.14)

Table 3: Characteristics of the Study Participants by Tea Consumption

Characteristics	N (%)
<i>Tea-drinking status</i>	
Yes	693 (95.19)
No	35 (4.80)
<i>Tea drinking type</i>	
With milk and sugar	149 (20.46)
Only decoction	406 (55.76)
Without milk but with sugar	111 (15.24)
With milk but no sugar	27 (3.57)
<i>Tea drinking concentration</i>	
Standard	665 (91.34)
Strong	28 (4.04)
<i>Tea drinking daily amount</i>	
100	44 (6.04)
200	163 (22.39)
300	274 (37.64)
400	154 (21.15)
500	37 (5.08)
600	11 (1.51)

density lipid, VLDL and triglyceride). Patients were advised to come on empty stomach before giving blood sample in order to avoid the possible acute effects. Other examinations are CT scan/ MRI of brain, ECG and NCV study in selected cases. During the study period, patients were instructed not to make any changes to their usual food intake, alcohol consumption and physical activity and were asked to continue hypoglycemic agents/ insulin without dosage modification unless situation demands. Patients taking cholesterol-lowering agents were advised to continue the same dosage unless advised.

The routine clinical biochemical analyses in every individual and neuroimaging study in selected cases were performed at every 6-months interval.

Tea Preparation

The method of tea preparation was standardized, and participants were asked to prepare tea according to the

Table 4: Positive Family History of Stroke Patients

Family History	Count (%)
Stroke	223 (30.63)
Hypertension	296 (40.65)
Ischemic Heart Disease	70 (9.61)
Diabetes	130 (17.85)

Note: Cumulative count (Cumulative %) = 728 (100%).

standard norm as far as possible.

Tea leaves (2 g) were placed into a spring-handled infuser, then infused into approx. 250 ml of boiled water for 1 min with constant movement. Tea was consumed without additives, including milk and sugar. A consistent weight of tea was achieved by providing subjects with a container that, when filled, contained 2 g of tea leaves. The control drink was the same volume of boiled water consumed hot. Subjects were instructed to use a standard tea cup, which holds approx. 250 ml of water, to prepare the tea and hot water. Subjects did not drink tea on the morning before each blood sample in order to avoid the possibility of acute effects.

Results

A total of 893 ischemic stroke patients were recruited from in and out patients department of this hospital with mean age of 61.99 yrs (range 40–80 yrs). Detailed analysis was done in 728 patients, in which 512 were men and 216 were women. Table 1 identifies information regarding the social and general characteristics of the sample. The mean±SD age of the participants was 63.17±10.94. Types of food consumption of the study participants are shown in Table 2. Compared to vegetarians, non-vegetarians were more in numbers 95.74%, and fish consumption are the highest in the stroke population.

Characteristics of the study participants across categories of tea consumption are shown in Table 3. Out of 728 subjects, 95.19% were tea-drinker, and mostly preferred type is decoction. Considering the history of tea-intake habit, 300 ml is the highest amount taken by 37.63% individuals.

Family history of hypertension was found in 40.65% cases among parents, siblings and in first-degree rela-

Table 5: Frequency Distribution of the Blood Pressure Measurement of the Stroke Patients

Blood Pressure	Valid N				Quartile		SD	SE
	Mean	Median	Minimum	Maximum	Lower	Upper		
Systolic BP	137.35	140	90	230	120	150	20.31	0.82
Diastolic BP	92.33	90	60	155	80	98	16.06	0.65

Table 6: Past History of the Stroke Patients

Past History	Count (%)
HTN	570 (78.29)
DM	188 (25.82)
IHD	99 (13.59)

tives. Stroke was the most common neurological disorder noticed in 30.63% of the family members (as given in Table 4).

Blood pressure measurement was done in all the stroke patients, as provided in Table 5. Frequency of hypertension, diabetes and ischemic heart disease has been shown in Table 6, respectively.

A paired *t*-test analysis revealed a significant result ($P < 0.01$) in fasting blood sugar and HDL when compared with the first and second visit of the study participants, as shown in Table 7.

Discussion

In spite of different drinking patterns and a broad range of death due to stroke, across the six countries studied, a consistent association has been noted.² Drinking ≥ 3 cups of tea a day, the risk of a stroke was reduced by 21%. The type of tea, i.e. Green tea or Black tea made no difference. Though no one is certain which compounds in tea

are responsible for this effect, the antioxidant epigallocatechin gallate (EGCG) or the amino acid theanine may be responsible for this effect.

Flavonoids, the target class of polyphenols, is mainly found in citrus fruits, vegetables and beverages. The main flavanols are catechins.⁴ These compounds are abundant in tea. Among many beverages, the most popular ones are tea. Most of the study participants consumed tea though differing the type and amount of tea being consumed. We have analysed the data, and a positive effect of tea was seen in fasting glucose and HDL cholesterol. We also evaluated eating and drinking patterns by a food frequency questionnaire. Though, this is our one-year report, and we could not comment on food patterns but regarding tea-drinking habits, the positive effects of liquor tea among stroke patients are evident.

The association of tea with stroke risk varied across the geographic region. Findings from the United Kingdom and Australia indicated a positive correlation whereas a negative association with stroke risk was found in studies conducted in United States, continental Europe and Asia. One explanation for the marked heterogeneity of the association may be due to residual confounding of socio-economic status.^{6, 10} A recent study in Japan found that tea consumption was associated with reduced mortality due to stroke.¹²⁻¹³

Table 7: Comparison Between Biochemical Parameters at First and Second Visits by Paired *t*-Test

Biochemical Parameters	Mean	SD	Diff.	SD	<i>t</i>	<i>df</i>	<i>P</i> value
FBS	106.21	17.95					
FBS_2	102.86	16.78	3.34	7.11	2.25	22	0.03
PPBS	176.71	56.23					
PPBS_2	176.71	56.23	0.00			6	
TG	144.66	64.31					
TG_2	155.87	80.66	-11.21	49.94	-1.09	23	0.28
CH	181.07	51.83					
CH_2	181.81	46.34	-0.73	23.32991	-0.15	25	0.87
HDL	46.7500	7.68539					
HDL_2	50.25	4.99	1.41	3.2	2.16	23	0.04
LDL	115.6	45.65					
LDL_2	110.92	40.37	4.68	31.07	0.75	24	0.45
VLDL	23.52	11.96					
VLDL_2	25.34	11.36	-1.82	7.01	-1.24	22	0.22
Urea	30.98	23.6					
Urea_2	28.76	20.76	2.22	8.6	1.28	24	0.21
Cr	1.14	0.33					
Cr_2	1.11	0.32	0.03	0.16	0.91	24	0.37

The mechanism of action by which tea may protect against stroke remains speculative. Although antioxidants functions and anti-inflammatory actions are often mentioned, but it has also been shown that tea reduces blood pressure in stroke-prone individuals.¹⁴

Conclusion

In conclusion, we may say that in our study population, tea is found to have a positive association in decreasing the fasting blood glucose and helps in improving the lipid profile. More epidemiological research is needed to confirm the effect of tea-intake in lowering the metabolic syndrome.

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