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Association of green tea consumption with risk of coronary heart disease in Chinese population

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Keywords

Green tea; Coronary heart disease; Chinese

Tea is a kind of popular beverage in the world [1,2]. According to the published researches, tea could be beneficial to one's health, such as reduction of the incidence of hyperlipidemia, atherosclerosis and anti-oxidant [3]. However, whether the green tea could be beneficial to reduce the risk of coronary heart disease (CHD) is pending in Chinese population, so our study is to find the association between the green tea consumption and CHD in Chinese general population.

We included 800 patients with or without CHD in the cardiology department in the First Hospital of Lanzhou University from January 2012 to February 2014. The coronary heart disease was diagnosed according to the international diagnostic criteria of CHD. 8 patients dropped out from the research. 34 patients with arrhythmia or cardiomyopathy were excluded. And 130 patients who drank black tea or oolong tea were excluded. Finally 628 patients were included. The mean ages were 65.4 ± 3.7 years old.

Before the research, we designed a basic information questionnaire, which includes the items such as age, body mass index (BMI), hypertension, diabetes mellitus, family history of

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Author contributions

Pang J, Zhang Z, and Yang JY designed the study, Pang J, Li N, and Peng Y were responsible for the data collection, Bai M, Zhang J, Li Q and Zhang B performed the analysis and drafted the manuscript and Pang J, Zhang Z and Zheng TZ revised and finalized the manuscript.

Conflict of interest

None declared.

CHD, physical activity, smoking, and alcohol. The trained nurses were responsible for collecting the messages in the questionnaires. And blood samples were drawn before breakfast. The indexes of creatine kinase isoenzyme (CK-MB), B type natriuretic peptide (BNP), triglycerides, lactate dehydrogenase (LDH), cholesterol, high-density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), homocysteine, PT prothrombin time, prothrombin activity, PT international standard ratio, fibrinogen and other indexes were measured in serum. Hyperlipidemia was defined as a serum TC concentration >220 mg/dl (5.698 mmol/l) or TG concentration >150 mg/dl (1.695 mmol/l), or the use of lipid-reduction therapy. Diabetes mellitus was judged if the patients were under hypoglycose treatment or if the fasting blood glucose concentration was >110 mg/dl (6.1 mmol/l). Hypertension was defined as systolic pressure ≥ 140 mm Hg or diastolic pressure ≥ 90 mm Hg, or under the hypotensive treatment.

Statistical analysis: odds ratios (ORs) and 95% confidence intervals (CIs) were used to evaluate the association between green tea consumption and CHD. $P < 0.05$ was considered statistically significant. SPSS 10.0 was used for statistical analysis.

There were a total of 628 patients with 423 male and 205 female patients (Table 1). Among the 423 male patients, there were 253 CHD patients, 51.3% (130/253) were found to be green tea drinkers. Male green tea drinkers had lower BMI than the male non-green tea drinkers [(24.1 $\pm$ 2.7) kg/m² vs (25.1 $\pm$ 3.8) kg/m², $P < 0.05$]. Male green tea drinkers also had low diastolic blood pressure (DBP) [(72.7 $\pm$ 11.7) mm Hg vs (74.8 $\pm$ 12.0) mm Hg, $P < 0.05$] and low LDH [(359.0 $\pm$ 195.2) IU/l vs (409.7 $\pm$ 231.2) IU/l, $P < 0.05$] compared to the male non-green tea drinkers. In addition, male green tea drinkers had lower hyperlipidemia and lower total cholesterol in comparison with non-male green tea drinkers, with significant difference [(42.2%, 54/130) vs (56.2%, 69/123), (4.8 $\pm$ 0.9) vs (4.4 $\pm$ 1.1), $P < 0.05$]. And the male green tea drinkers and non-male green tea drinkers had similar ages, BMI, hypertension, diabetes mellitus, family history of CHD, physical activity, smoking, alcohol, diastolic, diastolic blood pressure (DBP), the duration of CHD, blood sugar, triglycerides, HDL, LDL, PT prothrombin time, prothrombin activity, PTR, PT international standard ratio, fibrinogen, part of the thrombin time (APTT), and thrombin time TT-VS. Among the 117 female CHD patients, 65 (55.6%) were found to be green tea drinkers. And the features showed no significant difference between the female green tea drinkers and the female non-green tea drinkers ($P > 0.05$) (Table 2).

The relationship between green tea consumption and CHD was shown in male and female patients separately (Tables 3–4). In men's group, a decreased tendency was observed between green tea drinking and the risk of CHD, with an adjusted OR of 0.61 (95% CI, 0.40–0.91) compared with non-tea drinkers ($P = 0.02$). The risk of CHD for male patients tended to decline with an increase in the cups of green tea consumed, with a statistically significant test for trend ($P < 0.01$). The adjusted ORs for those consumption of tea per months (<100 g, 100–200 g, ≥ 200 g) were 1.17 (95% CI, 0.70–1.95), 0.85 (95% CI, 0.52–1.40) and 0.51 (95% CI, 0.29–0.92), respectively, and drinking tea compared with non-tea drinkers, which showed green tea consumption ≥ 200 g could reduce the CHD risk significantly ($P < 0.05$). Similar dose–response relationships were also observed for frequency of ≥ 3 days/week (OR = 0.48, 95% CI: 0.30–0.76). Moreover, the risk for CHD

was significantly reduced in male patients who drunk green tea 30 years ($P < 0.05$). While in female group, the results showed that drinking green tea 3 cups/day could reduce the female CHD risk, and there were no obvious CHD risk association with the tea consumption amounts and years ($P > 0.05$) (Tables 3–4).

The results showed that drinking green tea could reduce the risk of coronary heart disease incidence in male patients, while in the female group, drinking green tea 3 cups/day could reduce the CHD risk. Several published researches showed that green tea could be beneficial to the patients to reduce the risk of suffering several chronic diseases, such as heart disease, cancer, lung disease and stroke [4–7,14–19]. And some published researches had similar results with our research showing that green tea consumption could reduce the CHD risk, especially in men [8,9]. In analyzing the reason, the major active constituents of tea is catechins, which could prevent the oxidation process and atherosclerotic plaque formation in CHD [10–13]. In addition, green tea consumption could decrease the triglycerides and cholesterol, so it could help in reducing the serum lipid concentration. And the reason why the female group didn't have as good reaction as men could be attribute to the limited women number in our study. In addition, some studies also reported that, as the protective role of estrogen in endothelium, women has less CHD incidence risk, so the lower CHD incidence risk may lead to less CHD exposure probability [8].

Study limitations: this research was a single-center research, so it could just reflect the association between tea and CHD in the patients in our center. Second, we only focused on the patients in hospital, so it could not represent all the CHD. We suggest the following researches should better carry out multi-center researches, and also research the CHD patients outside the hospital to get better representative outcomes.

In sum, this study showed that green tea could help in reducing the total cholesterol, the incidence of hyperlipidemia, and diastolic blood pressure (DBP) in male Chinese patients. And there exist a negative association between CHD risk with the frequency, amount and time of green tea consumption in male population. In female population, 3 cups/day tea consumption could significantly reduce the CHD risk, however we didn't observe there was obvious association in CHD risk and the amounts, time of green tea consumption in female Chinese population.

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Table 1

Baseline characteristics of the included population.

	Male patients		Female patients	
	CHD (n = 253)	Non-CHD (n = 170)	CHD (n = 117)	Non-CHD (n = 88)
Age (years)	65.1 ± 12.1	63.2 ± 10.2	67.2 ± 13.1	65.1 ± 12.1
Body mass index (BMI)	23.1 ± 3.2	23.8 ± 2.7	25.4 ± 2.2	24.2 ± 2.1
Hypertension	62.3%	60.2%	60.1%	58.2%
Diabetes mellitus	35.0%	34.7%	32.2%	30.1%
Hyperlipidemia	49.2%	42.7%	48.2%	43.1%
Family history of CHD	32.1%	27.2%	33.2%	31.7%
Physical activity	51.4%	53.4%	53.2%	54.2%
Smoking	42.7%	34.1%	17.2%	14.1%
Alcohol	35.6%	38.1%	18.2%	17.1%
Systolic blood pressure (SBP)	126.8 ± 22.0	121.2 ± 18.1	139.4 ± 24.5	128.2 ± 19.8
Diastolic blood pressure (DBP)	73.3 ± 11.8	72.1 ± 12.1	81.1 ± 13.7	79.2 ± 11.3
The duration of CHD	5.65 ± 4.3	–	5.8 ± 3.8	–
Blood sugar	5.4 ± 1.4	5.5 ± 1.7	5.5 ± 1.2	5.2 ± 0.9
Total cholesterol	4.4 ± 1.0	4.2 ± 1.3	5.1 ± 1.2	4.5 ± 1.1
Triglycerides	1.4 ± 0.8	1.2 ± 0.7	1.7 ± 0.2	1.3 ± 0.5
HDL	1.2 ± 0.2	1.2 ± 0.3	1.5 ± 0.3	1.3 ± 0.4
LDL	2.7 ± 0.8	2.6 ± 0.9	3.3 ± 1.0	2.9 ± 1.1
LDH	384.3 ± 214.4	324.2 ± 120.2	238.9 ± 158.6	254.2 ± 145.2
Homocysteine	18.8 ± 7.3	16.2 ± 6.2	15.5 ± 13.7	16.2 ± 10.1
PT prothrombin time	12.8 ± 3.3	11.7 ± 2.8	10.4 ± 0.8	10.7 ± 0.9
Prothrombin activity	101.1 ± 28.5	102.1 ± 21.2	124.5 ± 19.3	119.1 ± 14.5
PTR	1.1 ± 0.3	1.0 ± 0.3	0.9 ± 0.1	1.0 ± 0.2
PT international standard ratio	1.1 ± 0.3	1.0 ± 0.3	0.9 ± 0.1	1.0 ± 0.2
Fibrinogen	3.0 ± 0.8	2.9 ± 0.7	2.9 ± 0.4	2.8 ± 0.5
Part of the thrombin time	35.0 ± 5.7	35.1 ± 4.2	33.3 ± 3.4	32.7 ± 2.1
Thrombin time	14.0 ± 0.9	13.4 ± 1.0	15.0 ± 0.7	13.8 ± 0.8

Note: values expressed as mean ± SD or n (%). Current smokers were defined as those who smoked more than 10 cigarettes during the previous 12 months. Alcohol intake was defined as 30 g alcohol in the past months. Physical activity was defined as aerobic activities for 30 min, at least 3 times per week.

Table 2

Characteristics of participants with coronary heart disease according to green tea drinking status.

	Male CHD patients		Female CHD patients	
	Green tea drinkers (n = 130)	Non-green tea drinkers (n = 123)	Green tea drinkers (n = 65)	Non-green tea drinkers (n = 52)
Age (years)	66.0 ± 13.8	64.2 ± 10.1	68.3 ± 13.8	66.1 ± 12.1
Body mass index (BMI)	24.1 ± 2.7 ^a	25.1 ± 3.8 ^a	25.6 ± 2.2	25.2 ± 2.3
Hypertension	61.2%	65.2%	55.0%	65.2%
Diabetes mellitus	34.0%	36.0%	29.4%	35.0%
Hyperlipidemia	42.2% ^a	56.2% ^a	44.3%	52.1%
Family history of CHD	32.1%	35.1%	32.3%	34.1%
Physical activity	54.6%	48.2%	54.2%	52.2%
Smoking	40.2%	45.2%	17.9%	16.5%
Alcohol	35.0%	36.2%	18.5%	17.9%
Systolic blood pressure (SBP)	124.7 ± 20.3	128.9 ± 23.7	136.3 ± 23.7	142.3 ± 25.3
Diastolic blood pressure (DBP)	72.7 ± 11.7 ^a	74.8 ± 12.0 ^a	80.6 ± 13.1	81.7 ± 14.4
The duration of CHD	5.6 ± 4.7	5.7 ± 3.8	5.4 ± 3.7	6.1 ± 3.9
Blood sugar	5.4 ± 1.3	5.5 ± 1.6	5.5 ± 1.2	5.6 ± 1.2
Total cholesterol	4.8 ± 0.9 ^a	4.4 ± 1.1 ^a	5.0 ± 1.1	5.3 ± 1.2
Triglycerides	1.4 ± 0.7	1.4 ± 0.8	1.7 ± 0.2	1.7 ± 0.2
HDL	1.2 ± 0.2	1.2 ± 0.2	1.5 ± 0.3	1.5 ± 0.3
LDL	2.7 ± 0.7	2.8 ± 0.8	3.3 ± 1.0	3.3 ± 1.0
LDH	359.0 ± 195.2 ^a	409.7 ± 231.2 ^a	243.6 ± 167.6	234.4 ± 150.8
Homocysteine	18.4 ± 7.2	19.2 ± 7.4	15.8 ± 13.8	15.2 ± 13.8
PT prothrombin time	12.5 ± 3.0	13.2 ± 3.7	10.3 ± 0.8	10.4 ± 0.8
Prothrombin activity	96.0 ± 30.2	101.2 ± 26.0	125.8 ± 19.8	123.3 ± 18.9
PTR	1.1 ± 0.3	1.1 ± 0.3	0.9 ± 0.1	0.9 ± 0.1
PT international standard ratio	1.1 ± 0.3	1.0 ± 0.2	0.9 ± 0.1	0.9 ± 0.1
Fibrinogen FIB	3.0 ± 0.8	3.1 ± 0.9	2.9 ± 0.5	2.9 ± 0.4
Part of the thrombin time APTT	34.4 ± 4.9	35.5 ± 6.3	33.4 ± 3.4	33.1 ± 3.7
Thrombin time TT-VS	13.9 ± 0.7	14.1 ± 1.0	15.0 ± 0.7	15.0 ± 0.7

Note: values expressed as mean ± SD or n (%).

^a Means there exists a significant difference between the “green tea drinkers” group and the “non-green tea drinkers” group.

Table 3

Association between green tea consumption and CHD risk in male patients.

Green tea consumption	Male CHD (n = 253)	Male non-CHD (n = 170)	Crude OR (95% CI)	P	Adjusted OR (95% CI)	P
<i>Green tea drink</i>						
No	123	60	1	–	1	–
Yes	130	110	0.62 [0.42, 0.93]	0.02	0.61 [0.40, 0.91]	0.02
<i>Cups of green tea daily</i>						
None	123	60	1	–	1	–
1–2 cups/day	88	60	0.98 [0.65, 1.47]	0.91	0.97 [0.64, 1.47]	0.89
3 cups/day	42	50	0.48 [0.30, 0.76]	0.002	0.48 [0.30, 0.77]	0.002
<i>Frequency</i>						
None	123	60	1	–	1	–
1–2 days/week	82	56	0.98 [0.65, 1.48]	0.91	0.99 [0.65, 1.50]	0.95
3 days/week	48	54	0.50 [0.32, 0.79]	0.003	0.48 [0.30, 0.76]	0.002
<i>Consumption of tea per months</i>						
None	123	60	1	–	1	–
<100 g	52	41	0.81 [0.51, 1.30]	0.31	1.17 [0.70, 1.95]	0.56
100–200 g	49	37	0.86 [0.53, 1.39]	0.55	0.85 [0.52, 1.40]	0.52
200 g	29	32	0.56 [0.32, 0.96]	0.04	0.51 [0.29, 0.92]	0.02
<i>Years</i>						
None	123	60	1	–	1	–
0–15 years	52	42	0.79 [0.50, 1.25]	0.31	0.77 [0.48, 1.24]	0.28
16–30 years	47	33	0.95 [0.58, 1.55]	0.83	0.93 [0.56, 1.56]	0.79
30 years	31	35	0.54 [0.32, 0.91]	0.02	0.49 [0.28, 0.86]	0.01

Table 4

Association between green tea consumption and CHD risk in female patients.

Green tea consumption	Female CHD (n = 117)	Female non-CHD (n = 88)	Crude OR (95% CI)	P	Adjusted OR (95% CI)	P
<i>Green tea drink</i>						
No	52	37	1	–	1	–
Yes	65	51	0.91 [0.52, 1.59]	0.73	0.91 [0.52, 1.61]	0.75
<i>Cups of green tea daily</i>						
None	52	37	1	–	1	–
1–2 cups/day	43	23	1.64 [0.90, 3.01]	0.11	1.65 [0.88, 3.08]	0.12
3 cups/day	22	28	0.50 [0.26, 0.95]	0.03	0.46 [0.23, 0.90]	0.02
<i>Frequency</i>						
None	52	37	1	–	1	–
1–2 days/week	33	26	0.94 [0.51, 1.72]	0.83	0.91 [0.49, 1.71]	0.77
3 days/week	32	25	0.95 [0.51, 1.76]	0.87	0.92 [0.49, 1.75]	0.81
<i>Consumption of tea per months</i>						
None	52	37	1	–	1	–
<100 g	25	18	1.06 [0.53, 2.09]	0.87	1.03 [0.51, 2.12]	0.92
100–200 g	23	19	0.89 [0.45, 1.76]	0.73	0.85 [0.42, 1.75]	0.67
200 g	17	14	0.90 [0.42, 1.94]	0.79	0.85 [0.37, 1.96]	0.71
<i>Years</i>						
None	52	37	1	–	1	–
0–15 years	48	39	0.87 [0.50, 1.53]	0.64	0.85 [0.48, 1.50]	0.58
16–30 years	12	9	1.00 [0.40, 2.50]	0.99	1.00 [0.40, 2.48]	0.99
30 years	5	3	1.26 [0.29, 5.44]	0.75	1.52 [0.27, 8.48]	0.63