International Journal of Cardiology 202 (2016) 967–974

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Green tea consumption and risk of cardiovascular and ischemic related diseases: A meta-analysis

Jun Pang [a,e], Zheng Zhang [a,*], Tong-zhang Zheng [b,**], Bryan A. Bassig [c], Chen Mao [e], Xingbin Liu [e], Yong Zhu [c], Kunchong Shi [d], Junbo Ge [f], Yue-jin Yang [g], Dejia-Huang [e], Ming Bai [a], Yu Peng [a]

[a] Department of Cardiology, The First Hospital of Lanzhou University, Lanzhou, China
[b] Department of Epidemiology, School of Public Health, Brown University, Providence, RI, USA
[c] Yale School of Public Health, Yale University, USA
[d] Brown-China Center for Environmental Health Sciences, Brown School of Public Health, Providence, USA
[e] Department of Cardiology, Huaxi Hospital of Sichuan University, Chengdu, China
[f] Department of Cardiology, Shanghai Institute of Cardiovascular Diseases, Zhongshan Hospital, Fudan University, Shanghai, China
[g] Fu Wai Hospital, National Center for Cardiovascular Disease, Chinese Academy of Medical Sciences, Beijing, China

ARTICLE INFO

Article history:
Received 25 November 2014
Received in revised form 16 December 2014
Accepted 31 December 2014
Available online 4 January 2015

Keywords:
Green tea
Cardiovascular disease
Ischemic related disease
Meta-analysis

ABSTRACT

Background: The effects of green tea intake on risk of cardiovascular disease (CVD) have not been well-defined. The aim of this meta-analysis was to evaluate the association between green tea consumption, CVD, and ischemic related diseases.

Methods: All observational studies and randomized trials that were published through October 2014 and that examined the association between green tea consumption and risk of cardiovascular and ischemic related diseases as the primary outcome were included in this meta-analysis. The quality of the included studies was evaluated according to the Cochrane Handbook 5.0.2 quality evaluation criteria.

Results: A total of 9 studies including 259,267 individuals were included in the meta-analysis. The results showed that those who didn't consume green tea had higher risks of CVD (OR = 1.19, 95% CI: 1.09–1.29), intracerebral hemorrhage (OR = 1.24, 95% CI: 1.03–1.49), and cerebral infarction (OR = 1.15, 95% CI: 1.01–1.30) compared to <1 cup green tea per day. Those who drank 1–3 cups of green tea per day 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 drank <1 cup/day. Similarly, those who drank ≥4 cups/day had a reduced risk of myocardial infarction compared to those who drank <1 cup/day (OR = 0.68, 95% CI: 0.56–0.84). Those who consumed ≥10 cups/day of green tea were also shown to have lower LDL compared to the <3 cups/day group (MD = −0.90, 95% CI: −0.95 to −0.85).

Conclusions: Our meta-analysis provides evidence that consumption of green tea is associated with favorable outcomes with respect to risk of cardiovascular and ischemic related diseases.

1. Introduction

Cardiovascular diseases (CVD), which include cerebrovascular disease, coronary heart disease, and peripheral arterial diseases, are major contributors to the global disease burden. The overall incidence rate of CVD was 235.5 per 100,000 in 2010 in the United States [1]. Previous research has provided evidence that several dietary factors are related to the risk of CVD, such as diets high in sodium and fat, which have been associated with higher risk of CVD [1]. It is of interest to identify associations with other dietary factors that may reduce the risk of CVD.

Green tea is a common beverage that has been demonstrated to be an antioxidant and that has also been associated with antiatherosclerosis in clinical trials [2,3]. Polyphenols, which are considered the effective ingredient in tea, have important roles in preventing coronary artery disease [3]. There have been several clinical trials evaluating the association between green tea consumption and coronary artery disease and ischemic related diseases [4–6]. The main results have showed that drinking green tea could be beneficial in CVD; however, the associations between clinical outcomes and green tea consumption are inconsistent. In order to review and synthesize the current evidence for associations between green tea consumption and risk of coronary artery disease and ischemic related diseases, we conducted a meta-analysis of all available studies that were published by October 2014.

* Correspondence to: Z. Zhang, Department of Cardiology, The First Hospital of Lanzhou University, Lanzhou 730000, China.
** Correspondence to: T.Z. Zheng, Department of Epidemiology, School of Public Health, Brown University, Providence, RI, 02912, USA.
E-mail addresses: Zhangccu@163.com (Z. Zhang), tongzhang_zheng@brown.edu (T. Zheng).

http://dx.doi.org/10.1016/j.ijcard.2014.12.176
0167-5273/

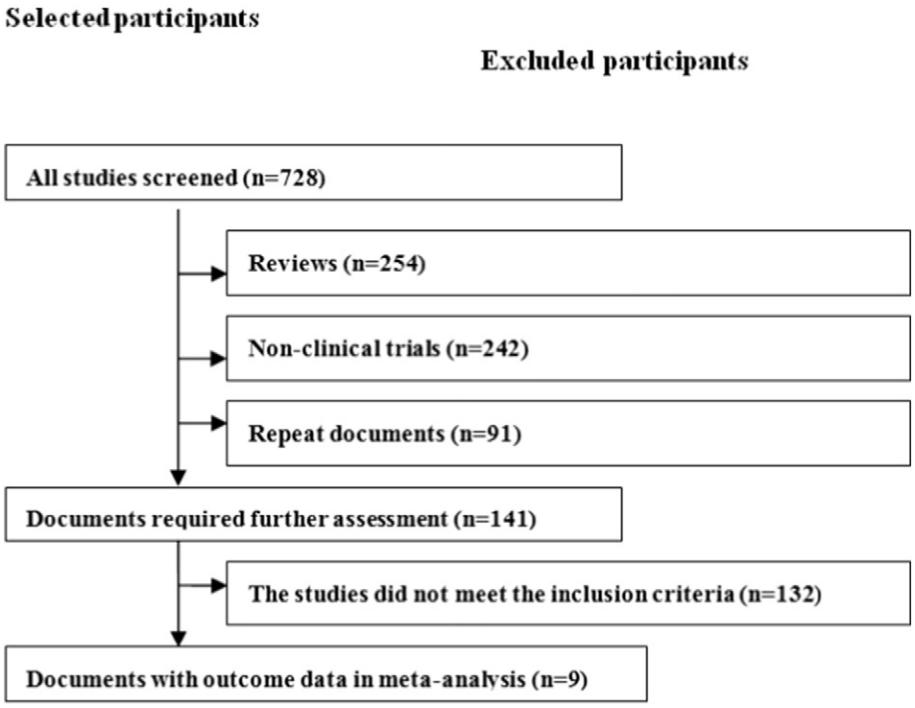

Fig. 1. Flow chart of article screening and selection process.

2. Materials and methods

2.1. Search strategy and study selection

A flow diagram describing the process we used to identify and include relevant studies is shown in Fig. 1. We searched the following electronic databases for relevant studies: PubMed, EMBASE, Web of Science, the Chinese Biomedical Medical Literature database, and the Cochrane Library. The following search terms were used: green tea, cardiovascular disease, coronary heart disease, cerebral infarction, intracerebral hemorrhage, and ischemic related disease. We also reviewed the references in the included studies in order to identify additional relevant articles. In addition, manual searches of conference abstracts were also carried out to identify studies that met the inclusion criteria. Articles published in these databases through October 2014 were included in the study.

All trials that examined the association between green tea consumption and risk of cardiovascular disease and ischemic related diseases as the primary outcome were included in the meta-analysis. Cardiovascular diseases were diagnosed based on the criteria defined by the American Heart Association. Studies were excluded if they were review articles, animal experiments, molecular biological experiments, or if there was significant heterogeneity in the baseline information of the study populations with respect to factors such as age, gender, and primary diseases.

2.2. Data extraction and quality assessment

Two evaluators performed literature searches independently. When there were disagreements about whether to include studies or about the quality assessment of identified studies, the two evaluators met to discuss and resolve the discrepancies. The primary endpoints that were evaluated in the meta-analysis included risk of CVD, all cause death, cardiovascular death, and myocardial infarction. Secondary endpoints included hypertension, stroke, cerebral infarction, intracerebral hemorrhage, hyperlipidemia, diabetes, systolic blood pressure (SBP), diastolic blood pressure (DBP), serum total cholesterol, and low density lipoprotein (LDL). In order to reduce the influence of confounding factors on the associations, we excluded papers in which the baseline characteristics of subjects were incomparable. We selected studies with similar baseline characteristics across groups such as similar concomitant medications, concomitant diseases, age, and gender in order to make sure the two groups were comparable. Subgroup analyses were carried out according to different amounts of tea consumption in order to reduce the heterogeneity that existed among the different studies. The green tea consumption subgroups were divided as follows: none, <1 cup/day, 1–3 cups/day, and ≥4 cups/day.

2.3. Data synthesis and meta-analysis

Data analyses were carried out following the Cochrane handbook. The odds ratios (ORs) and corresponding 95% confidence intervals (CI) for each endpoint were

Table 1
Basic characteristics of included studies.

Study	Study type	Total subjects	Age (years)	Female	Outcome indicators	Follow-up	Years range
Yoshihiro Kokubo—2013	Cohort study	100,938	45–74	28.0%	Cardiovascular disease, stroke, cerebral infarction, intracerebral hemorrhage, coronary heart disease	13 years	1995–2007
Etsuji Suzuki—2009	Prospective cohort study	14,001	65–84	49.3%	All-cause mortality, cardiovascular disease mortality	6 years	1999–2006
Yohei Mineharu—2009	Prospective	76,979	40–79	55.4%	CVD, CHD	2 years	1988–1990
Shinichi Kuriyama—2006	Prospective cohort study	40,530	40–79	53.0%	Cardiovascular disease mortality, coronary heart disease, stroke, cerebral infarction, cerebral hemorrhage	11 years	1995–2005
Toshimasa Sone—2001	Randomized controlled trial (RCT)	51	45.3 ± 13.2	63.5%	LDL	9 weeks	June 2007–September 2007
Shizuka Sasazuki—2000	Prospective	512	58.5 ± 1.0	41.0%	Hypertension, hyperlipidemia, myocardial infarction, diabetes mellitus, cardiovascular disease	1 year	1996–1997
Tanabe N—2008 stroke	Prospective	6358	40–89	67.0%	Systolic blood pressure, diastolic blood pressure, serum total cholesterol	6 years	1998–2003
Yasutake Tomata—2012	Prospective	13,988	73.9 ± 6.1	46.8%	Incident functional disability, stroke, myocardial infarction, dyslipidemia, diabetes	3 years	2006–2009
Yoshikazu Sato—1989	Prospective	5910	≥40	100.0%	Stroke, hypertension	4 years	1985–1989