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The Effect of Green Coffee Consumption on High Blood Pressure

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ABSTRACT

Background: Hypertension is a major risk factor for the development of coronary, cerebrovascular, and peripheral vascular diseases, which lead to myocardial infarction, stroke, and vascular death. Green coffee extract is particularly producer a great deal of chlorogenic acids (CGA) that may reduce the risk of high blood pressure. Therefore, the target of the study was to summarize the available publications on the effect of green coffee consumption on high blood pressure.

Methods: The systematic review was done with a search in PubMed-Medline and Scopus. The search strategy included keywords related to blood pressure and green coffee. Inclusion criteria were randomized controlled clinical trials conducted on people aged between 18 and 70 years. The publication date of articles was from 2004 to 2018. Exclusion criteria were articles not published in English.

Results: We discussed five articles that included our criteria. Green coffee had moderate effects on high blood pressure. It sounds that the effect of green coffee on reducing blood pressure is because of its phenolic compounds, as well as caffeine and chlorogenic acids, coffee's roasting status, participants' ethnicity, and even gender.

Conclusion: Green coffee intake for a long time might moderately decrease blood pressure. However, there is still a need for further clinical trials.

Keywords: High blood pressure, Chlorogenic acids, Green coffee, Hypertension.

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Introduction

Hypertension is a major public health difficulty defined in adults with an average SBP of 140 mmHg or greater and DBP of 90 mmHg or greater. those with an SBP of 130 to 139 mmHg or DBP of 80 to 89 mmHg are regarded as prehypertensive *[1]*. In the past four decades, the prevalence of hypertension has reduced in high-income countries (HICs), whereas it has increased in low-income countries (LICs) settled in Sub-Saharan Africa and southern Asia *[2]*. Today,

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hypertention is regarded as a significant cause of death and disability in developing countries. One-quarter of the world's adult population has hypertension, which is likely to increase to 29% by 2025 *[3]*. The highest prevalence was observed in countries with good economic status in 2000, but it is estimated that in 2025, the highest prevalence will be in developing continents or in low- and middle-income countries *[4]*. Each 2 mmHg rise in systolic BP is associated with a 7% increased risk of mortality from ischaemic heart disease and 10% increase in stroke *[5]*.

Coffee is widely available around the world. A large number of in-vitro, epidemiological, animal, and human clinical studies showed that coffee is a functional food and its regular consumption could decrease the risk of cardiovascular diseases, type 2 diabetes mellitus, liver diseases, neurodegenerative diseases, and several cancer types, and their mortality *[6]*. Sarria et al. showed that systolic and diastolic blood pressure (BP) significantly decreases after green coffee consumption *[7]*. Revuelta-Iniesta et al. showed that green coffee consumption decreases BP *[5]*.

Green coffee contains a large amount of phytochemicals with potential health effects, including methylxanthines (mostly caffeine), dietary fiber, and minor components such as the diterpenes cafestol and kahweol or trigonelline *[8]*. However, phenolic compounds are one of the most plenty phytochemicals in coffee, largely hydroxycinnamoyl-quinic acids, also known as chlorogenic acids or caffeoylquinic acids *[9]*. Several animal and human intervention studies about polyphenol-rich green coffee have shown promising results on body weight, serum glucose, plasma lipids, BP, and vascular function. There is shown that unfiltered coffee with more caffeine increases BP and other endothelial disorders, and its diterpenoids have hyperlipidemic effects *[3]*. Therefore, green coffee has become popular in recent years. It is rich in chlorogenic acids and has near the same caffeine content (60–72 mg/100 g) as instant coffee. However, it is reported that unprocessed green coffee on average contains 70% more polyphenol components (free and conjugated hydrocinnamic acid) than roasted coffee *[10]*.

There are no conclusive results from clinical trials studing the effects of green coffee on BP. Therefore, the goal of this systematic review was to explore the effects of this functional food on blood pressure in adults.

Materials and Methods

We searched all English language literature published in PubMed-Medline and Scopus Databases. The main search keywords were as follows: ("Blood pressure" OR "Arterial pressure" OR "pulmonary pressure" OR "venous pressure" OR "central venous pressure" OR "portal pressure") AND (" Green coffee"). Inclusion criteria were randomized controlled clinical trials conducted on people aged between 18 and 70 with more than 15 participants. The publication date of articles was from 2004 until 2018. Exclusion criteria were the articles not published in English.

A total of 1485 articles were gathered, of which 20 were duplicates. Titles and abstracts of the remaining articles were checked for their relations to the effect of green coffee consumption on high BP . If the articles were potentially relevant, we regained their full texts (45 papers). After the reviewer determined an article did not meet the eligibility criteria, the article would have been rejected on initial screening. Finally, 35 articles were excluded because they did not include the eligibility criteria. After reading the full texts, ten articles remained. Finally, we discussed five articles (Figure 1). All titles and abstracts were studied by one reviewer, but the assay of the full texts was conducted by a reviews team. Atleast 2 reviewers evaluated the full articles independently.

Moreover, after retrieval of articles from the search, all articles' references were checked for potentially

relevant articles. We extracted the sex of participants, age range, amount of green coffee, period of intervention, age range, publication year and country, and systolic blood pressure (SBP) and diastolic blood pressure (DBP) as the outcomes. Quality assessment was assayeded through Cochrane Collaboration's tool, which considers random sequence generation, allocation concealment, blinding of outcome assessment or personnel, incomplete outcome data, selective reporting. The quality of articles is as follows: Good (low risk for more than 2 items), Fair (low risk for 2 items), and Weak (low risk for less than 2 items). Figure 1 shows the flow chart for the study included in the review.

Table 1. of the risk of bias in studies included in the systematic review

First author	Random sequence generation	Allocation concealment	blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	score	Overall quality
Acar-tek N.	-	-	-	-	✓	✓	2	Fair
Martinez-opezl S.	✓	-	-	-	✓	✓	3	Good
Revuelta –Iniesta	✓	✓	-	-	✓	✓	4	Good
Roshani H.	✓	✓	✓	✓	✓	✓	6	Good
watanabe T.	✓	-	✓	-	✓	✓	4	Good

Results

We identified 45 articles after the screening of articles based on titles and abstracts. Then we excluded one article in non-English language and five articles which did not address the association between green coffee and BP, and finally, one article was retracted by the journal (**Figure 1**).

Finally, four articles were selected. The quality of the three final articles was assessed and was categorized as good, and one of them was fair (table 1). Studies which used different doses and duration for intervention led to different results. For example, in a study on postprandial glucose levels, green coffee could not decrease BP after 180 minutes. However, the study done by Martinez Lopez *et al.*, with more follow-up time (8 weeks) and more sample size (52 people) a coffee drink containing 35% green coffee significantly decreased both systolic and DBP. However, in the study by Roshan *et al.*, 400 mg green coffee extract only reduced SBP. Besides, Revuelta et al. designed a randomized pilot cross-over study with black and green coffee groups for two weeks. They observed that SBP was significantly decreased only after green coffee consumption. In a double-blind, randomized controlled clinical trial, participants with mild essential hypertension received 0.48 g green coffee extract (GCE) mixed with 125 mL/day vegetable and fruit juice. SBP and DBP was reduced after 4-month, but it was not significant. The main difference between this study and the others was that the age of the participants in this study was more than 50 years, while in other studies that shown a decrease in BP, the age of participants was 18 to 45 years.

The characteristics of eligible studies including sex and age of participants, amount of green coffee, period of intervention, publication year, country, and SBP and DBP of participants are provided in **Table 2.**

Table 2. Characteristics of eligible studies.

First author Year country	Study population	Design intervention	duration	Results
Nilüfer Acar-Tek 2018/Turkey	24 female 18.5 <BMI<24.9 kg/m2 Age: 20 to 30	Pilot study given 1 cup of green coffee contain 6 mg caffeine per kg of lean body mass	180 minutes	Baseline Systolic & diastolic blood pressure value increased at 30 minutes, 60 minutes, 120 minutes, and 180 minutes after green coffee consumption. However, their changes was not statistically significant.
Sarria Martinez-Lopez 2018/Spain	25 normo & 27 hyper cholesterolemic Age: 18 to 45	A randomized, cross-over, controlled trial consumed 6 g/day soluble green/roasted containing 35% green coffee beans	8 weeks	Systolic and diastolic were reduced in both normo- and hyper- cholesterolemic groups
Hanieh Roshan 2017/Iran	43 subjects were diagnosed with the MetS and had BMI of over 25 kg/m2 Age: 18 to 70	A double-blind, controlled, randomized clinical trial Subjects were randomly allocated to consume 400 mg green coffee bean extract or placebo capsules twice per day for 8 weeks.	8 weeks	After supplementation, systolic blood pressure (SBP) significantly reduced compared with the placebo group
Revuelta-Iniesta/2014 UK	18 healthy subjects Age: 25-41	A randomized pilot cross-over study Subjects were allocated into 2 groups: Black Coffee & Green Coffee, Then vice versa	2weeks	Systolic blood pressure was significantly reduced after Green Coffee.
Takuya Watanabe/2009 Japan	28 men with mild essential hypertension Age: 50-55	A double-blind, controlled, randomized trial The subjects received 125 mL/day fruit and vegetable juice mixed with GCE (0.48 g)	12weeks	Even though an average reduction in SBP and DBP, It did not find any significant changes in a 4-month study performed.

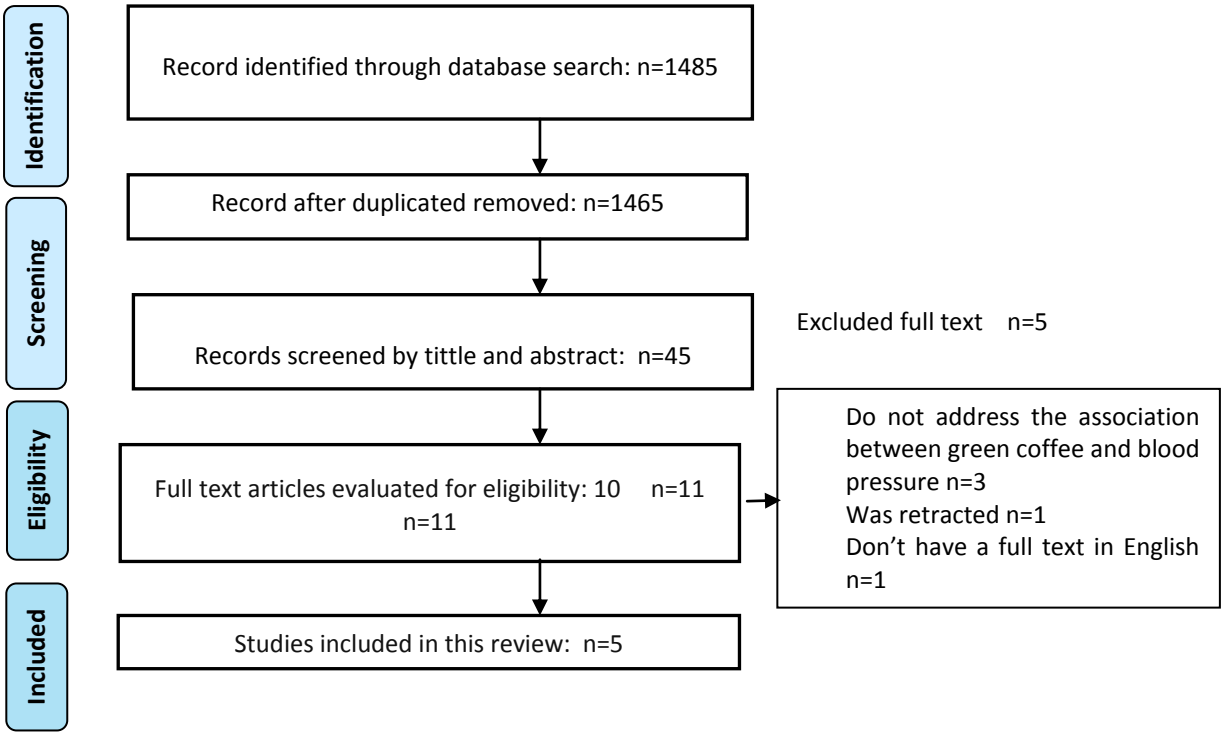

Figure 1. Flowchart of the procedure used to select the relevant articles

Discussion

Our review revealed that the effect of green coffee on BP depends on the dose of green coffee and the duration of intervention as well as individuals' habitual dietary caffeine intake. The results of previous meta-analyses show that chlorogenic acids or CGA supplementation results in a statistically significant reduction in SBP, and CGA administration causes small, statistically significant reductions in DBP [10]. So, this study considered the effects of green coffee as a natural base of chlorogenic acids. It sounds that the lowering effect of green coffee is for its chlorogenic acids, and it may depend on individuals' dietary caffeine intake.

Nurminen et al. reported that coffee and caffeine intake can increase BP *[12]*. Coffee consumption for many years has been related to increased cardiovascular risk. Two meta-analyses found a hypertensive effect of caffeine *[13, 14]*; however, it might be due to the increase in norepinephrine along with arterial stiffness that resulted in distorted endothelium-dependent vasodilation. In addition, blockage of adenosine receptors and phosphodiesterase inhibition by caffeine is a potential mechanism related to cardiovascular disease *[12]*. The different literature results are considered to be the differences in forms (coffee or caffeine extract), coffee type (roasting status), caffeine/coffee doses, gender and ethnicity. In addition, conditions of hypertension or prone to hypertension and conditions of normal consumption of a dose are also important in the effects of coffee and caffeine on blood pressure. Besides, hypertensive or hypertensive-prone conditions and single dose-habitual consumption conditions of the individuals are also important in the hypertensive effect of [15]. However, we gathered pieces of evidence that show the hypotension effects of green coffee. It is worth mentioning that Baizhi Han et al. did a meta-analysis. The results of the meta-analysis study reinforcement GCBE supplementation to improve

BP indices only in hypertensive patients [16]. This study was done after our study, so we can rely on the results, especially since the meta-analysis findings confirm the findings of our study.

We can attribute the positive relationship to the chlorogenic acids (CGA), which is justified as follows. The hypotensive effect of CGA might vasodilate because of nitric oxide . Patients with uncontrolled hypertension are exposed to increased levels of superoxide anions and hydrogen peroxide. Superoxide anions will discharge nitric oxide (NO) and decrease bioavailability in endothelial by reacting with NO to produce peroxy-nitrite. Many investigators have proposed that NO deficiency is a cause of hypertension and suggested that NO-mediated dilation is reduced in hypertensive patients *[17]*

CGA is known to forbid HSD1 and its activity that could reduce urinary free cortisol levels. Cortisol might reduce the production and bioavailability of nitric oxide *[18]*

Hypertension is related to oxidant stress *[19, 20]*. Increased Oxidant stress is accompanied by reduced antioxidant mechanism activities in hypertensive patients. Ascorbic acid scavenges the free radicals of oxygen and improves endothelium-dependent vasodilatation using remand nitric oxide activity in essential hypertension *[21, 22]*. Chlorogenic acid, caffeic acid, and ferulic acid have antioxidant potencies that are the same or a little weaker than ascorbic acid *[23, 24]*.

Limitations

A small sample sizes in majority of the studies may have biased the study. The external validity of the results is also limited as the results may apply more to Asian participants.

Conclusion

Some studies support the positive effects of green coffee and its extract on high blood pressure. However, we do not know enough about the hypotensive effect of green coffee on blood pressure especially in normotensive people. Also, more research is needed to get results in different populations with other age groups.

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Nothing to declare

Authors' contributions

All authors contributed to this project and article equally. All authors read and approved the final version of the manuscript.

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Conflict of Interest

The authors declare that there is no potential conflict of interests in this review.

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