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Original Research

Tea, but not coffee consumption, is associated with components of arterial pressure. The Observation of Cardiovascular Risk Factors study in Luxembourg

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ABSTRACT

There is uncertainty regarding the impact of tea and coffee consumption on arterial blood pressure. The present study aimed to examine the association between blood pressure (BP) components, namely, systolic BP (SBP), diastolic BP, mean arterial pressure, and pulse pressure (PP), and tea or coffee consumption, taking into account simultaneous consumption. The study population was derived from a national cross-sectional stratified sample of 1352 individuals aged 18 to 69 years, recruited between November 2007 and January 2009 to participate in the Observation of Cardiovascular Risk Factors in Luxembourg study. We hypothesized that greater tea consumption would be independently associated with lower BP. Tea and coffee consumptions in deciliters per day were obtained from a semiquantitative food frequency questionnaire. Participants were classified into 3 groups: nonconsumers, ≤3-dL/d consumers, and >3-dL/d consumers of each beverage separately. After exclusion of subjects taking antihypertensive medications, several general linear models were performed to investigate the independent relationship between tea/coffee consumption and BP components. Tea consumers (36.3%) were more likely to be younger women, nonsmokers, with better cardiometabolic profiles, and less frequent chronic pathologies, whereas the reverse was true for coffee consumers (88%). Greater tea consumption was associated with lower SBP and PP values, after adjustment for age, sex, education, lifestyle, and dietary confounding factors, including coffee drinking. No association between BP components and coffee consumption was observed. Daily consumption of 1 dL of tea was associated with a significant reduction of SBP by 0.6 mm Hg and PP by 0.5 mm Hg. Given the widespread consumption of tea and coffee throughout the world, together with the major cardiovascular disease risk, our findings have important implications for human health.

Abbreviations: BMI, body mass index; BP, blood pressure; CVD, cardiovascular disease; DBP, diastolic blood pressure; FPG, fasting plasma glucose; HDL, high-density lipoprotein; IPAQ, International Physical Activity Questionnaire; LDL, low-density lipoprotein; MAP, mean arterial pressure; ORISCAV-LUX, Observation of Cardiovascular Risk Factors in Luxembourg; PP, pulse pressure; SBP, systolic blood pressure.

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1. Introduction

Hypertension is a major modifiable risk factor in coronary heart disease (CHD) and stroke [1], affecting millions of people throughout the world and about 35% of the adult population in Luxembourg [2]. The deleterious effects of elevated blood pressure (BP) on the cardiovascular system have been largely attributed to the remodeling of the arterial wall and accelerated atherosclerosis occurring in hypertensive patients [3]. Traditionally, systolic BP (SBP) and diastolic BP (DBP) are the exclusive mechanical factors applied to predict cardiovascular risk in normotensive and hypertensive individuals [4]. More recently, findings from the Framingham Heart Study reported that the use of physiological components of BP, pulse pressure (PP) and mean arterial pressure (MAP), provide broader insight in predicting cardiovascular events [5]. Pulse pressure serves as an indicator of large-artery stiffness (pulsatile load) and MAP as an indicator of peripheral resistance and cardiac output (steady flow load) [5].

An association between tea or coffee consumption and cardiovascular health, in particular BP reduction, has been postulated for decades. A plethora of animal experiments, small-size clinical trials, and epidemiologic studies have examined tea consumption–BP relationships, with conflicting findings; some studies have reported significant reductions in SBP[6,7], BP variation [8], and improvement in vasodilator function of brachial artery[9], whereas others have found no effects [10–12]. Similarly, short-term and chronic coffee consumption has not been associated with incident hypertension in women [13], but may have detrimental effects on aortic stiffness and wave reflections in healthy adults [14–16].

Discrepancies in the tea and coffee literature may be due to potential biases related to confounding lifestyle and dietary factors that are poorly controlled in most intervention and epidemiologic studies. In addition, in most communities, both tea and coffee are consumed together, although in differing quantities. So far, it is unclear if any adverse effect of one beverage may be, in part, counterbalanced by any favorable effect of the other. Based on the literature to date, we hypothesized that greater tea consumption would be independently associated with lower BP. We did not advance a hypothesis with regard to coffee intake and BP components. Therefore, the purpose of the present study was to examine BP components, namely, SBP, DBP, MAP, and PP, with tea and coffee consumption, taking into account the simultaneous consumption of both beverages, in addition to potential confounding lifestyle and dietary factors. To examine our hypothesis, we used data that were collected from 1352 adult participants from the Observation of Cardiovascular Risk Factors (ORISCAV-LUX) study.

2. Methods and materials

2.1. *Study population*

The subjects were participants in the ORISCAV-LUX survey, a nationwide population-based study carried out in Luxembourg between November 2007 and January 2009. Detailed information about the study design, sampling methods, and representativeness has been published elsewhere [2,17]. Briefly, selected persons were invited via a letter and then contacted by telephone. The trained research nurses either visited participants in their households or invited them to the nearest study investigation center. At the time of interview, participants completed an auto-administered questionnaire, underwent BP and anthropometric examinations, and gave a blood sample [17]. A random sample stratified by age (18-69 years), sex, and district of residence was selected from the national health insurance registry. A total of 1432 participants were recruited, with a participation rate (32.2%) corresponding to the theoretically expected rate upon which the sample size was calculated [17]. After data cleaning, particularly for poorly completed dietary questionnaires, data from a total of 1352 participants were available for the present analyses. An abbreviated subject flowchart for this study is shown in Fig. 1, adapted from the primary study of all subjects [17].

2.2. *Tea and coffee consumption (exposure independent variables)*

A semiquantitative food frequency questionnaire was completed by the participants, including questions on habitual daily consumption of 134 food and beverage items during the previous 3 months [18]. For tea and coffee consumption, the participants reported the number of cups consumed per day, from 6 response options, ranging from "rarely or never" (ie, less than once per month) to "two or more times per day." They also selected the serving size of each beverage based on a photographic manual [19], provided to participants as a reference (eg, 1 medium cup [125 mL] of tea or coffee). Frequency of consumption (times per day) * number of cups consumed per day * amount of beverage consumed (in mL) represented daily tea or coffee consumption in mL/day. To facilitate data interpretation, daily tea and coffee consumption was then divided by 100 to convert to dL/d.

2.3. *Blood pressure components (dependent variables)*

Systolic BP (in mm Hg) and DBP (in mm Hg) were measured at least 3 times with a minimum 5-minute interval, by using Omrom MX3 plus automated oscillometric Blood Pressure Monitor (O-HEM-742-E; Matsusaka, Japan)[20], according to standard operating procedures, by a well-trained research nurse. Measurements were performed after participants had been seated for at least 5 minutes after questionnaire completion and at least 30 minutes after blood sampling and had refrained from smoking. The average of the last 2 readings was used in the analysis. *Hypertension* was defined as a mean SBP ≥ 140 mm Hg and/or DBP ≥ 90 mm Hg, and/or the use of antihypertensive medications [21]. *Pulse pressure* was defined as the difference between SBP and DBP in mm Hg. MAP was calculated according to the formula MAP = (2 * DBP + SBP)/3 (in mm Hg) [22].

2.4. *Main covariates*

Demographic and socioeconomic data were obtained from a self-administered questionnaire (age, sex, education). Education was