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Association between coffee or tea consumption and cardiovascular outcomes in patients with stable coronary artery disease: Analysis from the CLARIFY registry☆

Jeremie Abtan[a,l,m,*,1], Gregory Ducrocq[a], Yedid Elbez[a], Roberto Ferrari[b,c], Ian Ford[d], Kim M. Fox[e,n], Jean-Claude Tardif[f], Michal Tendera[g], Nicolas Danchin[h], Alexander Parkhomenko[i], Christopher M. Reid[j,k], P. Gabriel Steg[a]

[a] *Université de Paris, Hôpital Bichat, AP–HP, 75018 Paris, France*
[b] *Centro Cardiologico Universitario and LTTA Centre, University of Ferrara, 44124 Cona, Ferrara, Italy*
[c] *Maria Cecilia Hospital, GVM Care & Research, E.S. Health Science Foundation, 48033 Cotignola (RA), Italy*
[d] *Robertson Centre for Biostatistics, University of Glasgow, G12 8QQ Glasgow, UK*
[e] *National Heart and Lung Institute, Imperial College, SW3 6LY London, UK*
[f] *Montreal Heart Institute, Université de Montréal, QC H1T 1C8 Montreal, Canada*
[g] *Department of Cardiology and Structural Heart Disease, School of Medicine in Katowice, Medical University of Silesia, 40-055 Katowice, Poland*
[h] *Cardiology Department, Georges Pompidou European Hospital, 75015 Paris, France*
[i] *Institute of Cardiology, 03680 Kiev, Ukraine*
[j] *Centre of Clinical Research and Education in Therapeutics, Monash University, Melbourne, 3800 Victoria, Australia*
[k] *School of Public Health, Curtin University, 6102 Perth, Western Australia, Australia*
[l] *FACT (French Alliance for Cardiovascular Trials), Paris, France*
[m] *INSERM U-1148, 75018 Paris, France*
[n] *Institute of Cardiovascular Medicine and Science, Royal Brompton Hospital, SW3 6NP London, UK*

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ABSTRACT

Background: Conflicting data exist on the association between consumption of coffee or tea and cardiovascular outcomes, and few focus on patients with established coronary artery disease.
Aim: To describe the association between coffee or tea consumption and cardiovascular outcomes in patients with stable coronary artery disease, using an extensive contemporary international registry, allowing the identification of multiple potential confounders.
Methods: The Prospective Observational Longitudinal Registry of Patients With Stable Coronary Artery Disease (CLARIFY) registry enrolled in 2009 and 2010 in 45 countries, with a 5-year follow-up. Patients were categorized according to daily consumption of coffee or tea, and were compared with those declaring neither. The primary composite outcome of myocardial infarction, stroke or cardiovascular death was analysed at 5 years, as well as all-cause mortality. Sensitivity analyses were performed with a multivariable model.
Results: A total of 15,459 and 10,029 patients declared coffee or tea consumption, respectively. At 5 years, after full adjustment, no association was found between coffee consumption and the primary outcome: hazard ratio 1.04 (95% confidence interval 0.89–1.21) for 1 cup; 0.94 (0.82–1.08) for 2–3 cups; and 1.04 (0.86–1.27) for ≥ 4 cups ($P = 0.51$). Drinking tea was not associated with a different incidence of the primary outcome before or after adjustment, with fully adjusted hazard ratios of 1.08 (95% confidence interval 0.84–1.38) for 1 cup, 1.12 (0.96–1.31) for 2–3 cups and 0.95 (0.79–1.14) for ≥ 4 cups ($P = 0.30$). After full adjustment, neither coffee nor tea drinking was associated with all-cause mortality.
Conclusions: In outpatients with stable coronary artery disease, there was no association between coffee or tea consumption and ischaemic outcomes or all-cause mortality.

☆ Tweet: In outpatients with stable coronary artery disease, there was no association between coffee or tea consumption and ischaemic outcomes or all-cause mortality.

* Corresponding author. Hôpital Bichat, 46, rue Henri-Huchard, 75018 Paris, France.
E-mail address: jeremie.abtan@aphp.fr (J. Abtan).
[1] Twitter handle: @gabrielsteg.

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1. Abbreviations

CAD	coronary artery disease
CI	confidence interval
CLARIFY	Prospective Observational Longitudinal Registry of Patients With Stable Coronary Artery Disease
HR	hazard ratio
KME	Kaplan-Meier estimate
MI	myocardial infarction

2. Background

Coffee and tea are some of the most consumed beverages worldwide. Their effects on cardiovascular health have been investigated in primary prevention, with conflicting results [1–5]. For both beverages, in the general population, extensive studies have suggested an inverse correlation between consumption and cardiovascular outcomes, including cardiovascular death, with superior outcomes in heavy drinkers of coffee or tea [3,4,6,7]. However, residual confounding cannot be ruled out in these observational analyses. In patients with coronary artery disease (CAD), the evidence is scarce. Still, a possible detrimental effect on ischaemic outcomes has been reported, as well as a higher rate of sudden death for coffee drinkers [8]. In contrast, a small meta-analysis reported a reduced risk of death after acute myocardial infarction (MI) [9]. For tea consumption, there are conflicting data [10]. Given this uncertainty, physicians can be uncertain about the guidance to provide patients with CAD who drink either coffee or tea.

The present study aims to describe the association between coffee or tea consumption and cardiovascular outcomes in patients with stable CAD, using an extensive contemporary international registry, allowing the identification of multiple potential confounders.

3. Methods

3.1. Study design and patients

The Prospective Observational Longitudinal Registry of Patients With Stable Coronary Artery Disease (CLARIFY) registry recruited 32,703 patients with stable CAD in 45 countries worldwide. The rationale and design of the registry have been published previously [11], and are available online at http://www.clarify-registry.com. Briefly, outpatients were eligible for enrolment in the registry if they met at least one of the following non-mutually exclusive inclusion criteria: documented MI more than 3 months before inclusion; coronary revascularization procedure either by coronary artery bypass graft or percutaneous coronary intervention more than 3 months before inclusion; chest pain with stress testing or imaging indicating myocardial ischaemia; or significant (> 50%) coronary stenosis on previous coronary angiography in at least one artery. Patients were excluded if they had required hospitalization for cardiovascular disease in the 3months before enrolment, if revascularization was planned or if they had severe co-morbidities (cardiovascular or not) likely to impair life expectancy.

Data were collected through an electronic report form at baseline, and annually for 5 years. The most consumed beverage between coffee and tea, and the amount (cups/day) were reported at baseline only. The case record form only allowed consumption of the most frequently consumed beverage (either coffee or tea, but not both) to be reported. All patients with data on coffee/tea consumption were included in this analysis. The dataset contained detailed information on risk factors, past medical history, lifestyle, education level and medication.

The study was purely observational, and patient care was left to the physician's decision after enrolment. Data quality was monitored with an on-site audit of 100% of the data at 5% of randomly selected sites. CLARIFY was conducted in accordance with the Declaration of Helsinki, and local ethical approval was obtained in each of the 45 countries. In the UK, the study was approved by the national Research Ethics Service, Isle of Wight, Portsmouth, and Southeast Hampshire Research Ethics Committee. CLARIFY is registered at the ISRCTN registry of clinical trials (ISRCTN43070564). Written informed consent was collected for every patient.

3.2. Outcomes

The primary ischaemic outcome was defined as the composite of MI, stroke or cardiovascular death. Secondary outcomes included every component of the primary outcome analysed separately, as well as all-cause death, atrial fibrillation and implantation of a cardiac defibrillator, each analysed separately. Cardiovascular death was defined as any cardiovascular event leading to death, including MI, stroke, heart failure, pulmonary embolism, any cardiac or vascular surgery or any death without a proven non-cardiovascular cause. Outcomes were reported by investigators and were not adjudicated.

3.3. Statistical analyses

Patients were stratified according to daily consumption of the most consumed energizing drink, either coffee or tea: 1 cup (light drinkers), 2–3 cups (moderate drinkers), ≥ 4 cups (heavy drinkers). The group that declared no coffee or tea consumption was used as a control. Descriptive statistics, including frequencies and percentages for categorical variables and means ± standard deviations for continuous variables, are presented to describe the study population. Comparative statistics were used to analyse and compare baseline patient characteristics, medical history and treatment patterns. Categorical variables were compared with χ^2 tests, and continuous variables by analysis of variance (ANOVA). Cumulative incidences of study cardiovascular disease outcomes stratified by subgroups were calculated using the Kaplan-Meier approach. Cox models were performed for survival analysis. *P* values were reported from these models to estimate the overall effect of tea and coffee consumption on the study outcomes. A level of 0.05 was considered as the cut-off of significance for the estimated *P* values.

To account for potential cofounders, a multivariable analysis was conducted. Because the amount and the type of coffee and tea consumption are potentially associated with many cofounders, the most comprehensive list of variables was chose arbitrarily. The model included age, sex, medical history (body mass index, hypertension, diabetes, dyslipidaemia, history of MI, history of percutaneous coronary intervention, history of coronary artery bypass grafting, history of stroke or transient ischaemic attack, history of congestive heart failure, history of atrial fibrillation or flutter, history of peripheral artery disease and left ventricular function), lifestyle information (alcohol consumption/week, smoking status, physical activity), education level (primary school, high school, college/university), geographical region (Western/Central Europe, Eastern Europe, Middle East, Asia, Central/South America, Australia/Canada/South Africa/UK) and medication use (aspirin, dual antiplatelet therapy, oral anticoagulants, beta-blockers, angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers, lipid-lowering medicine and diuretics).

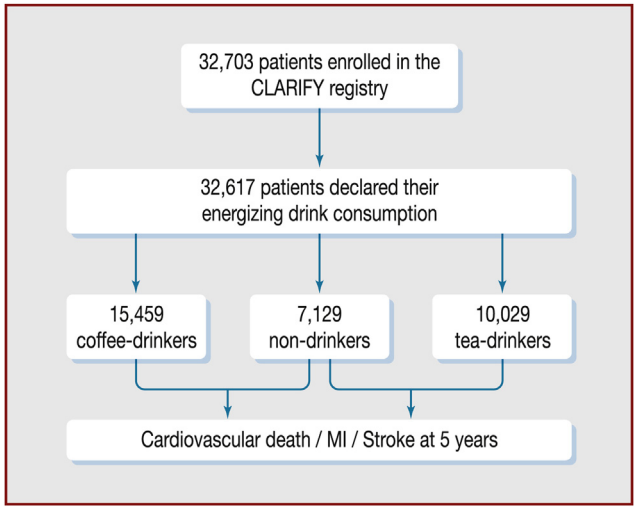


Fig. 1. Flow-chart. CLARIFY: Prospective Observational Longitudinal Registry of Patients With Stable Coronary Artery Disease; MI: myocardial infarction.

3.4. Patient and public involvement

In this study, patients were not involved in the design, conduct, reporting or dissemination plans of our research.

3.5. Data sharing statement

The datasets generated, analysed or both during this study are not publicly available because of ethical restrictions.

4. Results

4.1. Population

Among the 32,703 patients enrolled in the CLARIFY registry, coffee or tea consumption was captured in 32,617, who were included in this analysis. Of these, 15,459 (47.4%) patients were mostly coffee drinkers, 10,029 (30.7%) patients were mostly tea drinkers, and 7129 (21.9%) declared no consumption of either, and constituted the control group (Fig. 1).

Compared with the control group, coffee drinkers were younger ($P < 0001$) and more frequently male (from 72.8% for non-drinkers up to 84.0% for ≥ drinkers of 4 cups/day; $P < 0.001$). The proportion of smokers (from 7.6 for non-drinkers up to 25.1% for drinkers of ≥ 4 cups/day) was continuously correlated with coffee consumption ($P < 0.001$). By contrast, the proportions of patients with hypertension and diabetes were inversely correlated with the number of cups/day ($P < 0.001$ for both). The level of education was also associated with coffee consumption: 23.4% of non-drinkers had a college or university degree and 33.8% went to elementary school or less, compared with 26.9% and 24.6%, respectively, for drinkers of ≥ 4 cups/day ($P < 0.001$). Demographic characteristics and other baseline factors for coffee drinkers are presented in Table 1.

Similar observations were made regarding tea drinkers, who were also younger ($P < 0.001$) and more often male ($P < 0.001$), compared with non-drinkers. Tea drinking was strongly associated with smoking ($P < 0.001$). Tea drinkers more frequently had hypertension ($P < 0.001$) and dyslipidaemia ($P < 0.001$), but less often had diabetes ($P < 0.001$). As with coffee drinkers, the level of education had a strong association with the daily number of cups of tea ($P < 0.001$). Demographic characteristics and other baseline factors for tea drinkers according to consumption are presented in Table 1. Complete baseline characteristics for coffee consumption are reported in the Appendix (Table A.1 and A.2).

4.2. Outcomes

4.2.1. Coffee

Before adjustment, there was a lower rate of the primary ischaemic outcome at 5 years compared with non-drinkers: hazard ratio (HR) 0.98 (95% confidence interval [CI] 0.86–1.12) for 1 cup/day, HR 0.82 (95% CI 0.73–0.91) for 2–3 cups/day and HR 0.89 (95% CI 0.76–1.04) for ≥ 4 cups/day ($P = 0.002$). After full adjustment, the difference disappeared: HR 1.04 (95% CI 0.89–1.21) for 1 cup/day, HR 0.94 (95% CI 0.82–1.08) for 2–3 cups/day and HR 1.04 (95% CI 0.86–1.27) ($P = 0.51$); Kaplan-Meier estimate (KME) 9.90%

Table 1
Baseline characteristics, according to coffee and tea consumption.

	< 1 cup	Coffee				Tea			
	(n = 7129)	1 cup (n = 4200)	2–3 cups (n = 8353)	≥ 4 cups (n = 2906)	P_{trend}	1 cup (n = 1301)	2–3 cups (n = 4601)	≥ 4 cups (n = 4127)	P_{trend}
Age (years)	65.73 ± 10.62	65.36 ± 10.28	64.06 ± 10.23	61.89 ± 10.09	< 0.001	63.97 ± 10.74	63.22 ± 10.53	63.24 ± 10.39	< 0.001
Male sex	5218 (72.83)	3226 (76.83)	6847 (81.99)	2442 (84.03)	< 0.001	982 (75.54)	3397 (73.85)	3215 (77.90)	< 0.001
BMI (kg/m^2)	27.04 ± 4.35	27.78 ± 4.35	28.21 ± 4.38	28.54 ± 4.79	< 0.001	27.37 ± 4.86	27.94 ± 4.67	28.35 ± 4.97	< 0.001
Smoking status	542 (7.56)	370 (8.81)	1192 (14.27)	729 (25.09)	NA	118 (9.07)	467 (10.15)	657 (15.92)	NA
Hypertension	5043 (70.34)	3074 (73.19)	5903 (70.69)	1904 (65.52)	< 0.001	953 (73.25)	3416 (74.24)	2885 (69.91)	0.38
Diabetes	2237 (31.20)	1248 (29.71)	2486 (29.77)	779 (26.81)	< 0.001	371 (28.52)	1349 (29.32)	1015 (24.59)	< 0.001
Dyslipidaemia	4929 (68.75)	3356 (79.90)	6647 (79.59)	2219 (76.36)	< 0.001	919 (70.64)	3475 (75.53)	2920 (70.75)	< 0.001
Myocardial infarction	3941 (54.97)	2572 (61.24)	4800 (57.48)	1785 (61.45)	< 0.001	785 (60.34)	2939 (63.88)	2754 (66.73)	< 0.001
PCI	4665 (65.07)	2544 (60.57)	5139 (61.53)	1769 (60.92)	< 0.001	764 (58.72)	2196 (47.73)	2058 (49.87)	< 0.001
CABG	1406 (19.61)	1064 (25.34)	2178 (26.08)	712 (24.50)	< 0.001	248 (19.08)	1139 (24.76)	945 (22.90)	< 0.001
Stroke/TIA	504 (7.03)	308 (7.33)	472 (5.65)	172 (5.92)	< 0.001	104 (7.99)	299 (6.50)	254 (6.15)	0.044
Congestive heart failure	383 (5.34)	224 (5.33)	313 (3.75)	118 (4.06)	< 0.001	70 (5.38)	245 (5.32)	177 (4.29)	0.049
Atrial fibrillation/flutter	499 (6.96)	347 (8.26)	531 (6.36)	178 (6.13)	0.021	95 (7.30)	375 (8.15)	284 (6.88)	0.45
Pacemaker	197 (2.75)	125 (2.98)	204 (2.44)	61 (2.10)	0.037	25 (1.92)	100 (2.17)	72 (1.74)	< 0.001
Peripheral artery disease	736 (10.26)	462 (11.00)	1009 (12.08)	352 (12.11)	< 0.001	112 (8.61)	411 (8.93)	415 (10.06)	0.36
Aspirin	6204 (86.59)	3659 (87.16)	7294 (87.35)	2609 (89.81)	< 0.001	1129 (86.78)	4059 (88.24)	3694 (89.51)	< 0.001
Dual antiplatelet therapy	2549 (35.57)	1170 (27.87)	2263 (27.10)	708 (24.37)	< 0.001	412 (31.67)	1126 (24.47)	901 (21.83)	< 0.001
Oral anticoagulant	679 (9.48)	371 (8.84)	662 (7.93)	227 (7.83)	< 0.001	99 (7.63)	375 (8.15)	253 (6.13)	< 0.001
Beta-blocker	5203 (72.61)	3224 (76.78)	6289 (75.32)	2142 (73.73)	0.022	943 (72.48)	3625 (78.79)	3159 (76.54)	< 0.001
ACE inhibitor/ARB	5247 (73.18)	3230 (76.90)	6500 (77.82)	2185 (75.19)	< 0.001	980 (75.33)	3613 (78.53)	3144 (76.18)	< 0.001
Lipid-lowering agent	6467 (90.25)	3907 (93.05)	7789 (93.28)	2748 (94.60)	< 0.001	1191 (91.54)	4236 (92.07)	3811 (92.34)	< 0.001

Data are expressed as mean ± standard deviation or number (%). ACE: angiotensin-converting enzyme; ARB: angiotensin II receptor blocker; BMI: body mass index; CABG: coronary artery bypass graft; PCI: percutaneous coronary intervention; TIA: transient ischaemic attack.

Table 2
Outcomes at 5 years according to coffee and tea consumption.

	< 1 cup (ref)	Coffee consumption				Tea consumption			
	(n = 7129)	1 cup (n = 4200)	2–3 cups (n = 8353)	≥ 4 cups (n = 2906)	P	1 cup (n = 1301)	2–3 cups (n = 4601)	≥ 4 cups (n = 4127)	P
CV death/MI/stroke									
Number of events	618	366	601	227		117	438	377	
KME	10.06 (9.33–10.85)	9.90 (8.97–10.92)	8.31 (7.69–8.98)	8.95 (7.89–10.14)	0.002	10.11 (8.50–12.01)	10.37 (9.49–11.34)	9.83 (8.93–10.82)	0.81
Unadjusted analysis	1	0.98 (0.86–1.12)	0.82 (0.73–0.91)	0.89 (0.76–1.04)	0.002	1.06 (0.87–1.30)	1.14 (1.01–1.29)	1.05 (0.93–1.20)	0.23
Full adjustment (model 5)	1	1.04 (0.89–1.21)	0.94 (0.82–1.08)	1.04 (0.86–1.27)	0.51	1.08 (0.84–1.38)	1.12 (0.96–1.31)	0.95 (0.79–1.14)	0.30
All-cause mortality									
Number of events	580	372	557	203		93	367	304	
KME	9.35 (8.64–10.11)	9.94 (9.02–10.95)	7.73 (7.13–8.38)	8.04 (7.03–9.18)	< 0.001	7.98 (6.56–9.70)	8.66 (7.85–9.55)	7.86 (7.05–8.76)	0.06
Unadjusted analysis	1	1.07 (0.94–1.22)	0.81 (0.72–0.91)	0.85 (0.72–0.99)	< 0.001	0.85 (0.68–1.06)	0.92 (0.81–1.05)	0.83 (0.72–0.96)	0.06
Full adjustment (model 5)	1	1.10 (0.94–1.28)	0.92 (0.80–1.07)	1.05 (0.86–1.29)	0.13	0.91 (0.69–1.21)	1.08 (0.91–1.27)	0.83 (0.68–1.02)	0.10
MI									
Number of events	145	92	178	71		32	129	132	
KME	2.42 (2.06–2.85)	2.68 (2.19–3.29)	2.50 (2.16–2.90)	2.89 (2.29–3.64)	0.68	2.80 (1.99–3.95)	3.14 (2.65–3.73)	3.52 (2.98–4.17)	0.012
Unadjusted analysis	1	1.05 (0.81–1.37)	1.03 (0.83–1.28)	1.19 (0.90–1.58)	0.68	1.18 (0.80–1.72)	1.31 (1.03–1.66)	1.46 (1.16–1.85)	0.013
Full adjustment (model 5)	1	1.02 (0.75–1.40)	1.02 (0.77–1.33)	1.00 (0.69–1.45)	1.00	1.22 (0.77–1.93)	1.12 (0.82–1.52)	1.15 (0.83–1.60)	0.76
Stroke									
Number of events	114	59	117	39		24	92	74	
KME	1.92 (1.60–2.30)	1.63 (1.26–2.10)	1.64 (1.37–1.97)	1.59 (1.16–2.18)	0.60	2.14 (1.44–3.18)	2.21 (1.81–2.71)	2.02 (1.61–2.54)	0.66
Unadjusted analysis	1	0.86 (0.63–1.18)	0.86 (0.66–1.11)	0.83 (0.57–1.19)	0.59	1.11 (0.72–1.73)	1.18 (0.90–1.56)	1.03 (0.77–1.38)	0.66
Full adjustment (model 5)	1	1.04 (0.71–1.52)	1.09 (0.78–1.53)	1.00 (0.61–1.64)	0.95	1.38 (0.79–2.40)	1.36 (0.94–1.96)	1.13 (0.74–1.72)	0.36
CV death									
Number of events	383	231	335	133		67	237	195	
KME	6.28 (5.70–6.93)	6.22 (5.48–7.05)	4.72 (4.24–5.24)	5.31 (4.49–6.27)	< 0.001	5.83 (4.61–7.35)	5.67 (5.00–6.42)	5.09 (4.43–5.83)	0.11
Unadjusted analysis	1	1.00 (0.85–1.18)	0.74 (0.64–0.85)	0.84 (0.69–1.02)	< 0.001	0.93 (0.71–1.20)	0.90 (0.77–1.06)	0.81 (0.68–0.96)	0.11
Full adjustment (model 5)	1	1.05 (0.86–1.27)	0.86 (0.72–1.03)	1.14 (0.89–1.45)	0.07	0.95 (0.68–1.33)	1.07 (0.88–1.32)	0.87 (0.68–1.11)	0.43
Atrial fibrillation/flutter									
Number of events	477	278	505	178		77	293	236	
KME	7.77 (7.12–8.48)	7.71 (6.87–8.64)	6.97 (6.40–7.58)	7.26 (6.29–8.37)	0.24	6.82 (5.48–8.46)	7.09 (6.34–7.92)	6.24 (5.51–7.06)	0.025
Unadjusted analysis	1	0.97 (0.84–1.13)	0.89 (0.78–1.01)	0.90 (0.76–1.07)	0.25	0.85 (0.67–1.09)	0.91 (0.78–1.05)	0.79 (0.68–0.92)	0.027
Full adjustment (model 5)	1	0.80 (0.67–0.95)	0.80 (0.69–0.93)	0.99 (0.80–1.22)	0.007	0.89 (0.67–1.17)	0.85 (0.71–1.02)	0.78 (0.63–0.96)	0.09
Implantation of internal cardiac defibrillator									
Number of events	74	52	111	29		12	33	24	
KME	1.24 (0.98–1.56)	1.44 (1.09–1.89)	1.58 (1.31–1.91)	1.16 (0.80–1.66)	0.33	1.11 (0.63–1.96)	0.80 (0.57–1.13)	0.63 (0.42–0.94)	0.018
Unadjusted analysis	1	1.17 (0.82–1.67)	1.26 (0.94–1.69)	0.95 (0.62–1.46)	0.34	0.86 (0.47–1.58)	0.65 (0.43–0.98)	0.52 (0.33–0.82)	0.021
Full adjustment (model 5)	1	0.98 (0.66–1.43)	1.07 (0.77–1.49)	1.06 (0.66–1.71)	0.96	0.99 (0.52–1.89)	0.58 (0.35–0.95)	0.61 (0.35–1.08)	0.09

KMEs are expressed as % (95% confidence interval); other data are expressed as hazard ratio (95% confidence interval). CV: cardiovascular; KME: Kaplan-Meier estimate; MI: myocardial infarction.

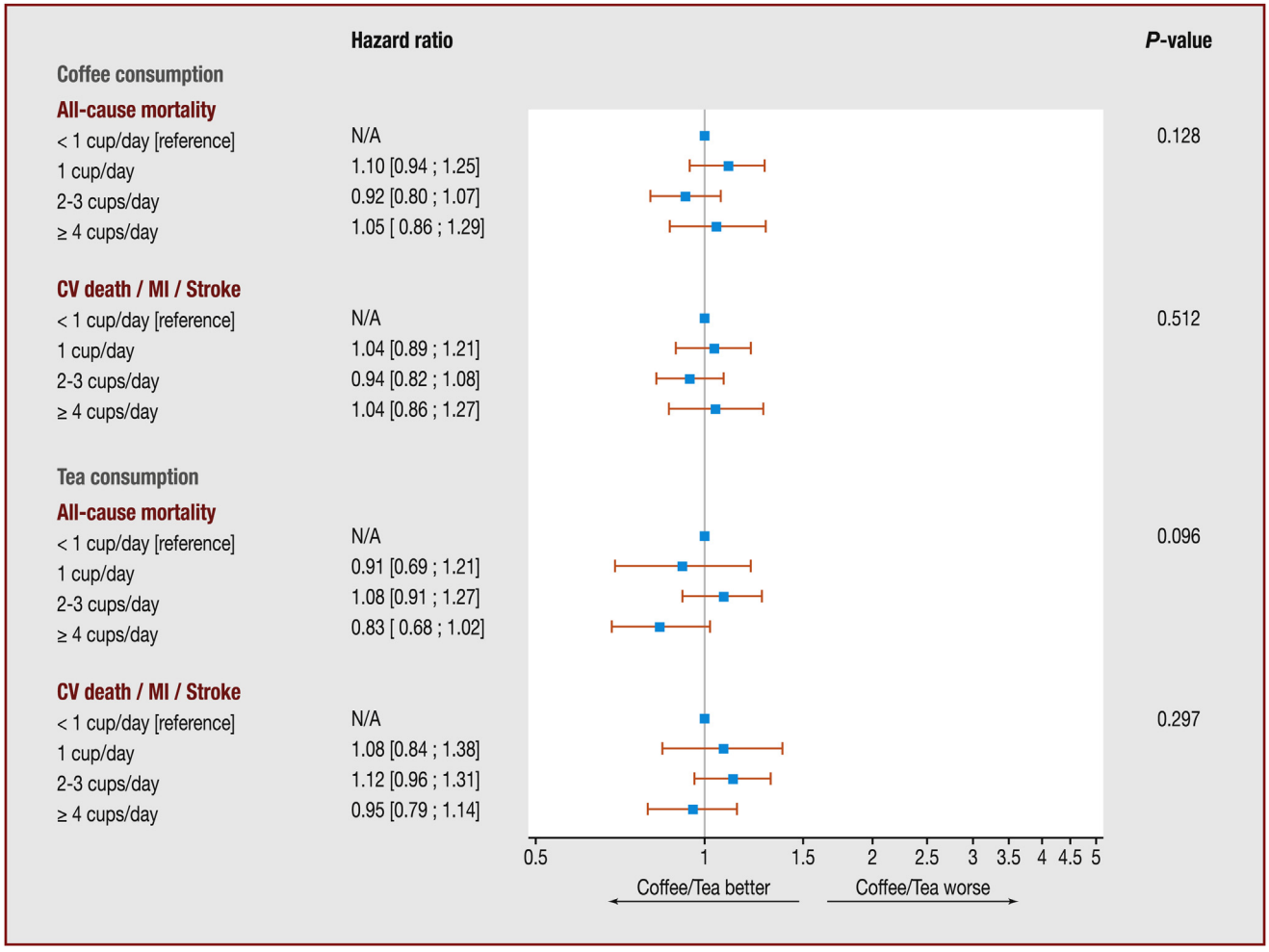


Fig. 2. Forest plots of the primary outcome (cardiovascular disease [CV] death, myocardial infarction [MI] or stroke) and all-cause mortality, according to coffee and tea consumption, after full adjustment at 5 years. N/A: not applicable.

(95% CI 8.97–10.92) for 1 cup/day, KME 8.31% (95% CI 7.69–8.98) for 2–3 cups/day and KME 8.95% (95% CI 7.89–10.14) for ≥ 4 cups/day ($P = 0.002$). Likewise, whereas unadjusted all-cause mortality was lower in moderate to heavy coffee drinkers, this difference disappeared after full adjustment: HR 1.10 (95% CI 0.94–1.28) for 1 cup/day, HR 0.92 (95% CI 0.80–1.07) for 2–3 cups/day and HR 1.05 (95% CI 0.86–1.29) for ≥ 4 cups/day ($P = 0.13$); KME 9.94% (95% CI 9.02–10.95) for 1 cup/day, KME 7.73% (95% CI 7.13–8.38) for 2–3 cups/day and KME 8.04% (95% CI 7.03–9.18) for ≥ 4 cups/day ($P < 0.001$). After full adjustment, relative to non-drinkers of coffee or tea, the risk of developing atrial fibrillation was lower for drinkers of 1 cup/day (HR 0.80, 95% CI 0.67–0.95) and 2–3 cups/day (HR 0.80, 95% CI 0.69–0.93), but not for drinkers of ≥ 4 cups/day (HR 0.99, 95% CI 0.80–1.22) ($P = 0.007$); KME 7.71% (95% CI 6.87–8.64) for 1 cup/day, KME 6.97% (95% CI 6.40–7.58) for 2–3 cups/day and KME 7.26% (95% CI 6.29–8.37) for ≥ 4 cups/day ($P = 0.24$). Results for secondary outcomes are presented in Table 2. Complete outcomes for coffee consumption at 5 years and the geographical analysis are reported in the Appendix.

4.2.2. Tea

The primary outcome did not differ between drinkers and non-drinkers of tea, regardless of daily consumption, and this lack of difference persisted after full adjustment: HR 1.08 (95% CI 0.84–1.38) for 1 cup/day, HR 1.12 (95% CI 0.96–1.31) for 2–3 cups/day and HR 0.95 (95% CI 0.79–1.14) for ≥ 4 cups/day ($P = 0.30$); KME 10.11% (95% CI 8.50–12.01) for 1 cup/day, KME 10.37% (95% CI 9.49–11.34) for 2–3 cups/day and KME 9.83% (8.93–10.82) for ≥ 4 cups/day ($P = 0.81$). Likewise, there was no significant difference in all-cause mortality between drinkers and non-drinkers of tea. The risk of atrial fibrillation was not affected by tea consumption ($P = 0.09$). Secondary outcomes as a function of drinking tea are presented in Table 2. Results of the primary outcome and all-cause mortality for tea and coffee drinkers are summarized in Fig. 2. Complete outcomes for tea and for coffee consumption at 5 years and geographical analysis are reported in the Appendix. consumption at 5 years and geographical analysis are reported in Appendix.

5. Discussion

In patients with stable CAD, daily consumption of coffee or tea had no association with the 5-year adjusted risk of adverse cardiac events (the composite outcome of cardiovascular death, MI or stroke). Likewise, all-cause mortality did not differ according to coffee or tea drinking, regardless of daily consumption.

The effects of coffee and tea consumption on health, and cardiovascular disease in particular, have been studied previously [1–6,12]. However, few studies have focused on patients with established CAD [12–16]. For coffee consumption, a linear dose-dependent inverse association between long-term coffee consumption and cardiovascular death, MI or stroke has been suggested in extensive cohort studies [1–3,17]. In patients with CAD, older studies suggested a possible detrimental effect [8], whereas

more recent studies have failed to prove any association after acute MI [12] or in women with proven CAD [14].

Several studies have suggested an inverse correlation between tea consumption and cardiovascular disease and mortality [4,5,18–20]. However, multiple confounders, such as smoking status and geographical distribution, affected the observed relationship [10]. In patients with CAD, there are conflicting data, and the inverse correlation is unclear once confounding lifestyle factors, such as smoking, are accounted for [13,15,16]. One study even suggests a worse prognosis, especially in female subjects [13]. To the best of our knowledge, the present analysis addresses the largest cohort of patients with stable CAD; whereas caution is warranted given potential residual confounding, it suggests no reason to deprive patients with stable CAD of coffee or tea.

The strength of our analysis pertains to the quality of the dataset and the important amount of information collected, which allowed multiple levels of adjustment. Lifestyle factors, such as coffee or tea consumption, are associated with numerous demographic, lifestyle and clinical variables that can confound outcomes. In this analysis, the daily intake of coffee and tea was significantly different according to smoking status and other lifestyle markers, such as physical activity, level of education and geographical distribution.

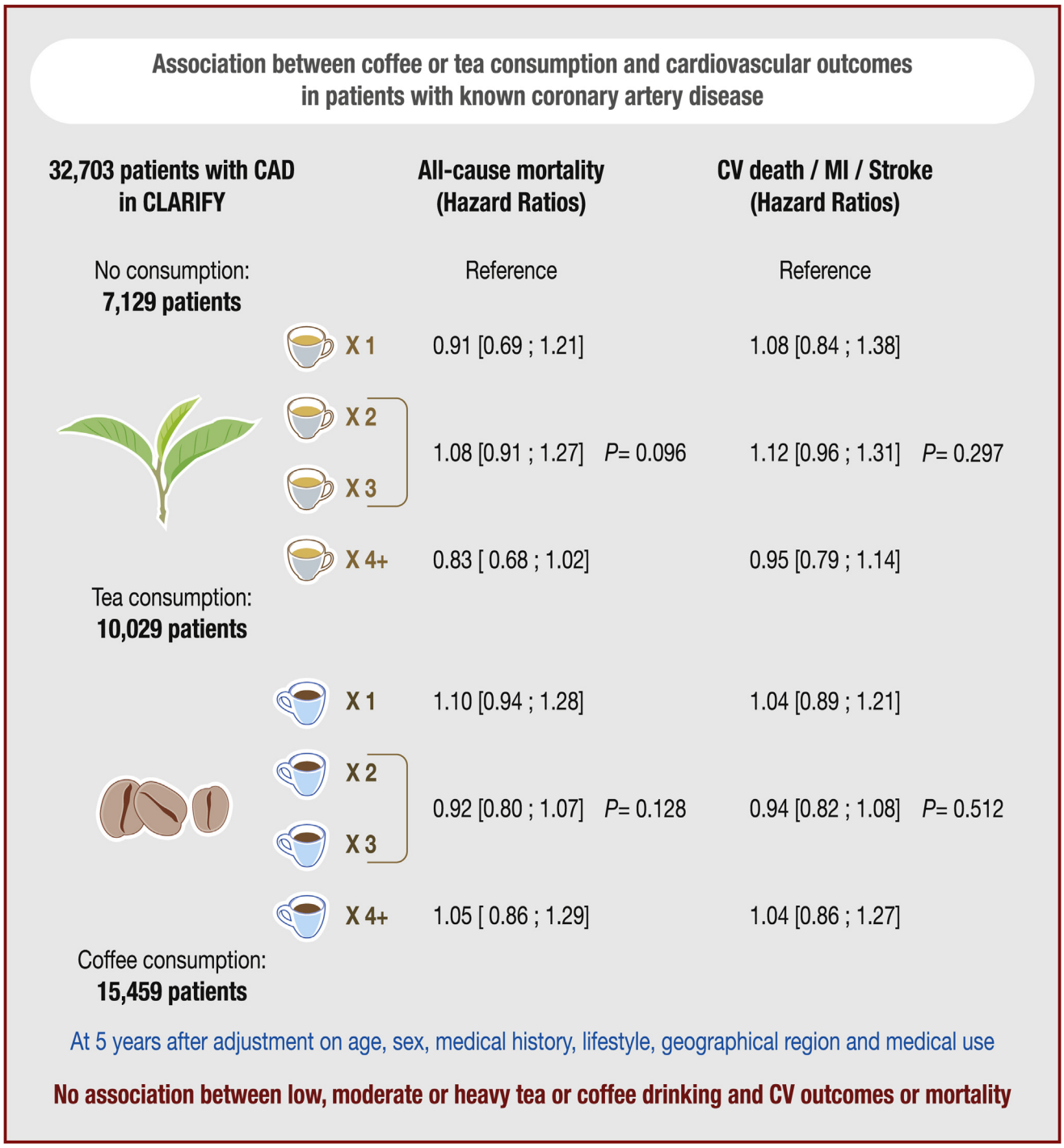
Some have suggested that coffee or tea consumption might lead to an increased risk of cardiac arrhythmias (either supraventricular or ventricular) and cardiac death [8]. In the present analysis, we found no association between coffee or tea drinking and the need for a cardiac defibrillator or cardiovascular mortality. However, the cohort design of our analysis captures long-term effects better than acute effects. We cannot rule out that coffee or tea consumption may trigger cardiovascular events, as suggested by case-crossover studies [21–23]. Regarding atrial fibrillation, there was no hint of increased risk with tea or coffee. In fact, after full adjustment, there was a significantly lower incidence of atrial fibrillation in patients with low or moderate coffee consumption (1–3 cups/day) compared with non-drinkers, and, if anything, the incidence of atrial fibrillation was numerically lower in heavy tea drinkers than in non-drinkers. These observations are in line with previous studies [24]. Overall, these data are reassuring regarding coffee or tea consumption for patients with CAD, and allow physicians to answer a very practical daily clinical question.

5.1. Study limitations

This analysis has several limitations. First, the study treated coffee and tea consumption as mutually exclusive variables, focusing on the most frequently consumed beverage; however, many patients consume both, and in that case, their consumption of the second beverage was not considered. The consumption of drink and the number of cups/day were self-reported at the time of enrolment in the registry, without metabolite measurement, and potential changes in patients' habits were not taken into account in this analysis. Therefore, the potential association between cardiovascular outcomes and changes in coffee and/or tea consumption cannot be assessed. The quality of the beverage was not captured, and the type of tea (e.g. green or black) or coffee (e.g. filter, espresso, robusta, arabica, etc.) is unknown. Outcomes were investigator reported, but not adjudicated. Whereas some reports have suggested an association between variants of CYP1A2 and cardiovascular outcomes in coffee drinkers [6,25], our analysis does not include genetic data. Although the incidences of implantable cardioverter defibrillator implantation and mortality were captured, we have no direct data on ventricular arrhythmias. Finally, this is an observational study, and regardless of the size and comprehensiveness of the dataset, residual confounding cannot be ruled out. Specifically, reverse causation cannot be ruled out.

6. Conclusions

In patients with stable CAD, coffee or tea consumption did not appear to be independently associated with major cardiovascular outcomes (such as cardiovascular death, MI or stroke) or all-cause mortality at 5 years. There is no reason to deprive patients with stable CAD of drinking coffee or tea (Central Illustration).



Central illustration. Association between coffee or tea consumption and cardiovascular outcomes in patients with known coronary artery disease. CV: cardiovascular; CLARIFY: Prospective Observational Longitudinal Registry of Patients With Stable Coronary Artery Disease; MI: myocardial infarction.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.acvd.2023.05.007.

Disclosure of interest

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The other authors declare that they have no competing interest.

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