Clustering of Atherogenic Behaviors in Coffee Drinkers

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Abstract: We studied the clustering of coffee consumption and selected atherogenic behaviors in older adults living in a southern California community. Men were somewhat more likely to drink caffeinated coffee while women were more likely to drink decaffeinated coffee. In men, but not women, caffeinated coffee drinking decreased with age and decaffeinated coffee drinking increased. Caffeinated coffee drinkers drank more alcohol, consumed more dietary saturated fats and cholesterol, were more likely to be current smokers and less likely to be current exercisers than were non-coffee drinkers. Smoking and exercise also showed a dose-response relationship to the amount of caffeinated coffee consumed. Risk factor levels among drinkers of decaffeinated coffee were more like those of caffeinated coffee than non-drinkers. These data illustrate the clustering of atherogenic behaviors with coffee drinking and highlight their potential importance in interpreting the growing body of literature about coffee and health. (*Am J Public Health* 1990; 80:1310–1313).

Introduction

Whether coffee drinking is a risk factor for coronary heart disease continues to be controversial. Some epidemiologic evidence has linked heavy coffee consumption to elevations in total serum cholesterol or low density lipoprotein cholesterol,[1–3] suggesting a mechanism for the association of coffee and coronary heart disease. Several investigators have reported an increased risk of coronary heart disease morbidity and mortality with heavy coffee intake,[4–8] but others have questioned whether this association is independent of cigarette smoking.[9–12] Only two previous studies[13,14] have examined coffee use in relation to multiple behaviors other than smoking, that could themselves be associated with hyperlipidemia and/or coronary heart disease. In this paper, the coffee drinking habits of a southern California population-based cohort of older men and women were examined in relation to multiple putative heart disease risk factors to determine the extent to which coffee drinking is associated with other atherogenic behaviors.

Methods

Participants were a part of the Rancho Bernardo Heart and Chronic Disease Study, a population-based study designed to examine lifestyle and chronic disease patterns in older adults. All surviving members of the cohort who were between 40 and 84 years of age when first seen in 1972-74 were invited to participate in 1984-87, and 80 percent did so. Height and weight were measured with participants in light clothing without shoes; obesity was estimated using body mass index (kg/m^2). Data on current exercise habits, current and past smoking history, current alcohol consumption, hours of nightly sleep, and use of non-contraceptive estrogens (women only) were determined by a standardized interview administered by trained personnel. Coffee intake and diet data were ascertained as part of a self-administered food frequency questionnaire. Participants were asked to estimate their average consumption of decaffeinated and regular coffee (in cups per day) and their usual intake (as an adult over 45 years of age) of 128 food items.

A crude index of dietary saturated fat and cholesterol intake was made based upon reported consumption of foods selected by the American Heart Association as food to limit in a fat-controlled, low-cholesterol diet.[15] Six responses for frequency of intake ranging from "never" to "daily" were transformed to ranks from "1" to "6" with "1" corresponding to "never" and "6" corresponding to "daily." The cholesterol and saturated fat index was created by computing an integer sum of the participants' coded estimates of consumption for the following 12 foods or food categories: beef, ham, hot dogs, eggs, milk, organ meats, cream, cheese, ice cream, butter, lard, dessert cakes.

Participants were grouped into four coffee drinking categories: those who drank no coffee, drinkers of caffeinated coffee only, drinkers of decaffeinated coffee only, or those who drank both caffeinated and decaffeinated coffee. Participants were also grouped according to whether or not they reported exercising at least three times a week, whether they currently smoked cigarettes, quit smoking, or never smoked, and for female participants, whether or not they reported having taken any oral estrogen within the past two weeks. The total number of bottles or cans of beer, glasses of wine, highballs, cocktails, mixed drinks, liqueurs or other alcoholic drinks consumed was used as an index of alcohol consumption; daily alcohol intake estimated from the past week or from usual intake from the diet questionnaire were nearly identical and only the former is shown. Reported hours of usual nightly sleep were estimated to the nearest hour.

Results are presented for 2,304 men and women ages 50-89. One-way analysis of covariance was used to compare mean age-adjusted risk factor levels among those who drank caffeinated coffee only, decaffeinated coffee only, or both caffeinated and decaffeinated coffee to those who drank no coffee. In addition, mean risk factors for caffeinated coffee drinkers were compared to decaffeinated coffee drinkers. Age-adjusted rates of categorical risk factors were computed by the direct method and differences in age-adjusted rates were tested using the Mantel-Haenszel summary chi-square with one degree of freedom. No adjustments were made to account for the effects of multiple comparisons.

Coffee consumption in those who drank caffeinated coffee only (464 men, 514 women) was divided into three categories as follows: one to two cups per day, three to four cups per day, and

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five or more cups per day. Trends in age-adjusted behavioral risk factor with increasing coffee consumption were tested by analysis of covariance for continuous variables and by the Mantel extension test[16] for categorical variables. Because there were very few heavy drinkers of decaffeinated coffee only, analysis of trends could not be performed.

Results

As shown in Table 1, the 1,028 men and 1,276 women ages 50-89 years were similar with regard to the proportion who drank no coffee (11 percent) or caffeinated and decaffeinated coffee combined (28 percent). Men were somewhat more likely to drink caffeinated coffee only and women to drink decaffeinated coffee only, although both sex differences were small. The proportion of men who drank only decaffeinated coffee increased with age (p for trend <0.001) while the proportion who drank only caffeinated decreased (p for trend = 0.002); similar trends were not observed in women.

Mean age and sex-adjusted behaviorial risk factors for coronary heart disease (CHD) by coffee consumption category are summarized in Table 2. In both men and women, caffeinated coffee drinkers were significantly more likely to be current cigarette smokers and to consume more alcohol and saturated fats and cholesterol than non-coffee drinkers. The percent of women who exercised at least three times per week was lower in all types of coffee drinkers as compared to non-coffee drinkers; the reverse was true for men (data not shown). Neither difference was statistically significant. BMI and hours of nightly sleep did not differ significantly in coffee drinkers as compared to non-drinkers in either sex.

Age-adjusted levels of many risk factors among decaffeinated coffee drinkers were more similar to those who drank caffeinated coffee than to those who drank no coffee (Table 2). However, dietary consumption of saturated fats and cholesterol was significantly higher in caffeinated coffee drinkers as compared to decaffeinated coffee drinkers in both men and women. Women who drank caffeinated coffee had a significantly lower use of replacement estrogen than decaffeinated coffee drinkers (data not shown). Drinkers of caffeinated coffee consumed more alcohol and were more likely to be current cigarette smokers than those who drank decaffeinated coffee.

Among those who drank caffeinated coffee only, the proportion of men and women who currently smoke cigarettes increased with increasing caffeinated coffee consumption (p for trend in age-adjusted rates <0.01 for men, <0.001 for women) (Table 3). The frequency of current exercise decreased with increasing coffee consumption in both men and women although the trend was significant only among men. There were no other clear associations between the amount of coffee consumed and alcohol, dietary cholesterol, hours of nightly sleep, or post-menopausal estrogen use (among women only). The range of decaffeinated coffee drinking (one to two cups) was too narrow to be considered in a similar analysis.

Discussion

Coffee drinking may be a marker for an atherogenic diet, cigarette smoking, or sedentary lifestyle, rather than an etiologic factor in heart disease outcomes. For example, Hennekens, *et al.*,[10] reported a positive association between coffee drinking and mortality from coronary heart disease, independent of cigarette smoking, that disappeared with adjustment for daily alcohol consumption, level of physical activity, and use of coffee additives.

In the present study, there was an increased occurrence of three habits in caffeinated coffee drinkers: use of cigarettes, excess consumption of alcohol, and an atherogenic diet. There was a dose-response relationship in the extent to which some of these behaviors were practiced among drinkers of caffeinated coffee.

These results support the findings of Jacobsen and Thelle,[13] Haffner, *et al.*,[14] and others[17,*] who found that coffee drinkers consume a more atherogenic diet than their non-coffee drinking counterparts. Carmody, *et al.*,[18] also reported that smokers and ex-smokers were more likely than non-smokers to drink greater amounts of alcohol and coffee; most individuals who reported drinking more alcohol also reported drinking more coffee, regardless of smoking habit. In a study of an industrial population, Phillips, *et al.*,[19] noted that smokers drank an average of 1.5 to 2 more cups of coffee per day and drank more alcohol weekly than non-smokers.

Others have reported that coffee drinkers have a decreased body mass relative to non-coffee drinkers.[20] In this cohort, body mass index did not differ by coffee intake, but those who drank five or more cups of caffeinated coffee per day exercised significantly less than those who drank less. Leon, *et al.*,[21] found that the use of caffeine-containing

*Shekelle RB, Dyer AR, Stamler J: Coffee, serum total cholesterol and risk of coronary heart disease in a population of employed, middle-aged men: The Western Electric Study. Presented at a Workshop on Coffee, Plasma Lipids and Coronary Heart Disease, Goteborg, Sweden, May 8–10, 1989.

TABLE 1—Distribution of Coffee Consumption According to Age and Sex, Rancho Bernardo, 1984–87

		No Coffee		Decaffeinated Only		Caffeinated Only		Both	
Sex, Age (years)	N	n	%	n	%	n	%	n	%
Men									
50–59	166	27	16.3	16	9.6	83	50.0	40	24.1
60–69	254	30	11.8	31	12.2	129	50.8	64	25.2
70–79	404	30	7.4	63	15.6	175	43.3	136	33.7
80–89	204	24	11.8	56	27.4	77	37.7	47	23.0
Total	1028	111	10.8	166	16.1	464	45.1	287	27.9
Women									
50–59	209	29	13.9	42	20.1	86	41.1	52	24.9
60–69	339	34	10.0	76	22.4	134	39.5	95	28.0
70–79	539	52	9.6	114	21.2	215	39.9	158	29.3
80–89	189	23	12.2	41	21.7	80	42.3	45	23.8
Total	1276	138	10.8	273	21.4	515	40.2	350	27.6

TABLE 2—Age and Sex-Adjusted Means and Standard Errors of CHD Risk Factors and Proportions of Smokers, Exercisers, and Estrogen Users by Coffee Consumption, Rancho Bernardo 1984–87

	No Coffee mean (se) (n = 249)	Decaffeinated Only mean (se) (n = 439)	Caffeinated Only mean (se) (n = 979)	Both mean (se) (n = 637)
Age (sex-adjusted)	68.94 (.590)	71.79 (.444)	70.15 (.298)	70.68 (.369)
Obesity (kg/m^2)	24.99 (.230)	25.39 (.175)	25.11 (.116)	25.09 (.144)
Alcohol (# drinks in past week)	4.08 (.495)	6.19 (.374)	7.08 (.250)	5.99 (.309)
Dietary Fat and Cholesterol index	33.97 (.388)	34.02 (.293)	35.86 (.195)	35.26 (.242)
Night Sleep (hours)	7.17 (0.79)	7.20 (.059)	7.27 (0.40)	7.23 (.050)
Smokers (% current)	5.40 (8.71)	11.16 (13.0)	15.05 (14.9)	11.69 (13.0)
Exercisers (% current)	82.49 (35.1)	82.07 (34.6)	80.23 (34.4)	80.91 (34.5)
Estrogen (women only)	26.34 (27.2)	34.11 (31.0)	27.17 (28.2)	27.54 (27.8)

TABLE 3—Age and Sex-Adjusted Means and Standard Errors of CHD by Consumption of Caffeinated Coffee, Rancho Bernardo, 1984–87

	Cups per Day			
Mean (SE)	1–2 (n = 216)	3–4 (n = 447)	≥5 (n = 953)	p-value (trend)
Age (sex-adjusted)	71.49 (.293)	69.62 (.428)	67.01 (.617)	<.01
Obesity	24.89 (.116)	25.53 (.169)	25.45 (.246)	.04
Alcohol (past week)	6.44 (.261)	7.08 (.380)	7.14 (.552)	.26
Dietary Fat and Cholesterol index	35.29 (.198)	36.46 (.288)	35.61 (.419)	.49
Night Sleep (hours)	7.24 (.041)	7.26 (.059)	7.32 (.086)	.42
Smokers (% current)	10.19 (12.3)	15.31 (15.11)	23.73 (19.2)	<0.1
Exercisers (% current)	82.38 (34.9)	80.27 (34.5)	72.45 (33.1)	<.01
Estrogen (women only % current)	25.80 (27.0)	30.63 (30.0)	25.63 (28.3)	.06

beverages, particularly coffee, showed a negative correlation with treadmill exercise capacity which persisted after cigarette smoking and other variables were partitioned out.

Coffee consumption could be an important link in the association between hours of nightly sleep and mortality. Karacan, *et al.*,[22] reported sleep disturbances in coffee drinkers while several other investigations of health-related practices have addressed the association between reported hours of nightly sleep and subsequent all cause mortality.[23–26] In this cohort, hours of nightly sleep were no different in coffee drinkers compared to non-drinkers and sleep hours did not vary with amount of caffeinated coffee consumed in either men or women. It is possible that older adults who found that caffeinated coffee disturbed their sleep patterns had discontinued its use.

In this cohort, 44 percent of men and 49 percent of women drank at least one cup of decaffeinated coffee per day. Behavior patterns in those who drank only decaffeinated coffee were more similar like those of caffeinated coffee drinkers than non-coffee drinkers. These findings suggest that decaffeinated coffee consumption should be considered in studies of the relationship beween coffee drinking and disease whenever a significant proportion of the study population drinks decaffeinated coffee.

In this study, coffee drinking was determined at the same time as all other behaviors, although the period of use for different behaviors varied from current to usual. Others have shown that current diet is a strong predictor of past or usual diet,[27] and we have found a strong correlation between usual and recent alcohol intake in this cohort. It seems unlikely that differences in the period of use explain the observed associations, unless one postulates that drinkers of coffee (with or without caffeine) have a better memory for unhealthy behavior than non-drinkers.

The diet data reported here were not directly validated; we know of no way to confirm dietary fat and saturated/unsaturated fat ratios short of direct observation or a fat biopsy.[28] Indirect validation of both food frequency and 24-hour diet recall was obtained in this cohort by demonstrating expected diet-disease associations. We have reported the expected cross-sectional associations of sodium, calcium, and potassium with blood pressure,[29,30] and inverse associations of fiber with heart attack;[31] potassium with stroke[32] and calcium with hip fracture in prospective studies.[33] Other attributes were also indirectly validated: smoking was inversely associated with HDL and directly with waist-hip-ratio;[34] alcohol was associated directly with waist-hip-ratio, aspartate aminotransferase and HDL;[35] exercise was positively associated with HDL and inversely associated with obesity, pulse rate, and plasma insulin.[36] Any misclassification of self-reported behaviors would be expected to reduce these associations, and not have caused them.

Because caffeinated and decaffeinated coffee consumption were both associated with more atherogenic behaviors, studies which seek to demonstrate the relationship between coffee consumption and morbidity or mortality must consider these other potential behavioral risk factors in the coffee-disease association. The concordance of heavy coffee intake with several lifestyles known to be related to heart disease risk implies a high level of potential confoundng in studies linking coffee consumption to hyperlipidemia and/or coronary heart disease.

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