Does coffee drinking increase the risk of coronary heart disease? Results from a meta-analysis

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Abstract

Background—The association between coffee drinking and risk of coronary heart disease remains controversial despite many epidemiological studies. A meta-analysis was carried out on these studies to resolve some of the uncertainties. Particular attention was paid to details of study design.

Methods—Eight case-control studies and 15 cohort studies were analysed. Weighted, fixed effects linear regression of log relative risks (or odds ratios) was used to pool the study results. The pooling procedures were performed separately by study design, sex, coronary heart disease end points, smoking habit, and period of study.

Results—The pooled case-control odds ratio (for the effect of drinking five cups of coffee/day v none) was 1.63 (95% confidence interval 95% CI) 1.50 to 1.78. The pooled cohort study relative risk (five cups/day v none) was 1.05 (95% CI 0.99 to 1.12). The discrepancy between the pooled case-control and cohort study results could not be attributed to differences in the end points chosen, period of study, or to confounding by smoking status or sex.

Conclusions—The cohort study data suggest very little excess risk of coronary heart disease among habitual coffee drinkers. The case-control data do not rule out an increased risk of heart disease among a subgroup of people who acutely increase their coffee intake. Further epidemiological studies are needed to assess the risk of drinking boiled or decaffeinated coffee.

The association between coffee drinking and risk of coronary heart disease (CHD) remains controversial despite many epidemiological studies. A relation of coffee drinking to CHD was first suspected because of the role of caffeine in inducing cardiac arrhythmias, and increases in plasma renin activity, catecholamine concentrations, and blood pressure. Although it seems now that these effects are not clinically significant in most habitual drinkers, renewed concern has arisen from cross sectional findings of an association between coffee drinking and serum total cholesterol concentrations. The inconsistent findings of epidemiological studies—for example, comparing the results of LaCroix et al with those of Grobbee et al—have resulted in conflicting policy advice. To resolve some of the existing uncertainties, we applied the techniques of meta-analysis to all published epidemiological studies of coffee consumption and CHD, paying particular attention to details of study design.
and 15 cohort studies10 11 24 26 27 29 37-45 (appendix 2) were used in the meta-analysis.

**Statistical methods**

The pooled method involved a weighted, fixed effects linear regression of the log relative risks (or odds ratios) from the individual studies, with the inverse of the variance of log relative risks as the weights. To convert 95% confidence intervals (95% CIs) into estimates of the variance of the log relative risk (or odds ratio), we transformed the interval to the log scale. The absolute difference between the upper and lower end points was then divided by 3.92 to obtain an approximate SEM. The procedure was modified in reports that gave 90% CIs. Where the original studies provided no SEMs or CIs for rates or relative risks, these were estimated with procedures described by Greenland.13 The weighted linear regressions were performed in SAS.47 As noted by Greenland,14 the SEMs computed by this program needed to be corrected by dividing the printed SEMs by the square root of the residual mean square.

**Assignment of exposures**

Virtually all the studies reported coffee consumption as categories— for example, two to four cups/day, more than five cups/day. We assigned category midpoints to each category. For open ended categories, we used Greenland’s suggestion14 and assigned the mean number of cups/day for a particular category based on the distribution of coffee consumption reported in the Framingham study.28 Thus we assigned 6.5 cups for the category five or more cups/day; 7.4 cups for the category six or more cups/day; 8.5 cups for the category seven or more cups/day; nine cups for the category eight or more cups/day; and so on.

**Meta-analyses**

The meta-analyses were performed separately for case-control and cohort studies. The studies used different end points of cardiovascular disease. For the overall pooled analysis, one end point was selected for each study. These were in order of priority: total CHD (fatal CHD and non-fatal myocardial infarction), myocardial infarction (fatal or non-fatal), or fatal CHD (including sudden coronary death). As well as the main pooled analysis, three separate meta-analyses of cohort studies were carried out with CHD death, fatal or non-fatal myocardial infarction, and total CHD as end points. Studies that reported results for all three end points24 40 contributed data to each subanalysis.

**Sensitivity analyses**

We examined the sensitivity of the pooled results to the method of assigning cups/day to the open ended categories used for the highest intake of coffee. In this sensitivity analysis, we assigned the lowest number of cups in a particular category instead of the mean number of cups based on the Framingham distribution. Thus we assigned six cups to the category six or more cups/day (instead of 7-4 cups), and seven cups to the category seven or more cups/day (instead of 8-5 cups). Two studies reported on total cardiovascular disease events rather than coronary heart disease events.29 45 The pooled analyses were repeated both including and excluding these two studies to examine the sensitivity of the results of studies with different end points.

As cigarette smoking is positively associated with coffee consumption,46 49 failure to adjust for smoking results in a biased estimate of the risk of coronary heart disease. In our study, we performed a meta-analysis restricted to non-smokers, with data from a subsample of studies that reported data separately for smokers and non-smokers.

We next carried out a pooled analysis of the three case-control studies32 34 that included data on decaffeinated coffee. Only one cohort study provided data on decaffeinated coffee intake.11 We also carried out separate analyses for men and women to look for any sex differences in the effect of coffee on heart disease.

**Results**

**GENERAL FINDINGS**

Appendices to tables 1 and 2 show the characteristics of the case-control and cohort studies included in the meta-analysis. Of the eight case-control studies selected for meta-analysis, seven7 9 11 12 18 27 39 42 reported a positive association (or a significant trend in risk) between coffee consumption and coronary heart disease. Of the 15 cohort studies included in the meta-analysis, five10 26 27 39 42 reported a positive association between coffee intake and risk of heart disease.

**REGRESSION RESULTS**

Unless otherwise stated, all the pooled odds ratios (or relative risks) given are for the comparison of five cups of coffee/day v none. A log linear assumption was made, in which the
estimated relative risk for five cups/day is the
antilog of five times the coefficient for one
(cup none) shown on appendices to tables 1
and 2.

The pooled odds ratio for case-control
studies was 1.63 (95% CI 1.50 to 1.78). The
$\chi^2$ for heterogeneity among case-control
studies was 10.3 (degrees of freedom (df) 7,
P > 0.1). For cohort studies, the pooled rela-
tive risk was 1.05 (95% CI 0.99 to 1.12).
Due to the extremely high heterogeneity
among the cohort studies ($\chi^2 = 85.4$, df 14,
P < 0.0001), the SEM for the pooled coeffi-
cients is almost certainly an underestimate.
When the regression procedures were
repeated with the more conservative assign-
ment of cups/day in the open ended cate-
gories, the pooled odds ratios or relative risks
were virtually unchanged (table 1).
We carried out separate pooled procedures
for each of the end points: CHD death,
myocardial infarction (fatal and non-fatal),
and total CHD (table 2). These analyses
were done only for cohort studies, as all the case-
control studies used myocardial infarction as
their end point (with the exception of the
study by Hennekens et al,\textsuperscript{36} which used fatal
CHD as the end point). The pooled relative
risks were 0.97 (95% CI 0.94–1.01) for CHD
death, 1.16 (95% CI 1.02 to 1.30) for
myocardial infarction, and 1.25 (95% CI 1.08 to
1.41) for total CHD. These results suggest
a possible slight increase in risk of
coronary heart disease, although the magni-
tude of the effect is such that confounding—
for example, by smoking—could not be ruled
out.

To compensate for confounding by smok-
ing we next performed a pooled analysis
restricted to data on non-smokers. Three
case-control studies,\textsuperscript{25,34,35} and six cohort studies,
\textsuperscript{17,38,41,42,48} included such data (table 3).
Among cohort studies there was no sugges-
tion of increased risk (pooled relative risk =
1.04; 95% CI 0.71 to 1.52). The pooled result
among case-control studies was again discrepant
from the cohort data with a sum-
mmary odds ratio among non-smokers of 1.85
(95% CI 1.42 to 2.42).

The pooled odds ratio from the three case-
control studies that examined decaffeinated
coffee was 1.42 (95% CI 1.01 to 1.99, $\chi^2$
for heterogeneity = 0.9). This point estimate was
not substantially different from the pooled
odds ratio for caffeinated coffee (odds ratio =
1.65, 95% CI 1.52 to 1.81).

We performed separate pooling procedures
for men and women (table 4). The results for
both case-control and cohort studies indi-
cated similar magnitudes of effect of coffee
drinking on risk of heart disease for men and
women. The discrepancy between the results
of case-control and cohort studies persisted.

Discussion
Our meta-analysis supersedes previous stud-
ies\textsuperscript{12,14} because it includes case-control studies
(omitted in the study of Myers and Basinski\textsuperscript{13}); pools data from a more compre-
prehensive set of studies (15 cohort studies
compared with 11 analysed in Myers and
Basinski,\textsuperscript{12} and five by Greenland\textsuperscript{4}); and
stratifies the analyses by disease end point,
smoking, and sex.

Assessment of Causality
Bradford Hill proposed a set of criteria by
which to assess causality—namely, the
strength, consistency, and specificity of the
association found, the time relation between
exposure and outcome, the existence of a bio-
logical gradient, and biological plausibility.\textsuperscript{50}
We consider each of these in turn.

Strength of association
The pooled cohort study data suggest, at
most, a very weak association (relative risk <
1.2) between coffee intake and risk of CHD.
Even the pooled case-control data do not
suggest a relative risk of CHD greater than
about 1.6 for drinking five or more cups/day.
Relative risk of this magnitude could easily
rise from residual confounding by factors
such as smoking, diet, and other cardiovascu-
lar risk factors.\textsuperscript{50} Coffee drinkers are more
likely to smoke than those who do not drink
coffee.\textsuperscript{44,49} Failure to adjust for cigarette
smoking may thus lead to spurious associa-
tions between coffee drinking and CHD.
Among studies that adjusted for smoking,
sometimes substantial differences have been
found between the crude age adjusted relative
risks and the multivariate relative risks. For
example, in the study by LaVecchia et al,\textsuperscript{32}
the age adjusted odds ratio for drinking four
or more cups/day was 2.65 (95% CI 1.56 to
4.52) compared with 1.72 (95% CI 0.92 to
3.23) after adjustment for smoking and a
range of other CHD risk factors.

Some of the earlier case-control studies
that reported a positive association between
coffee intake and CHD did not control for
smoking—for example, those of Jack et al,\textsuperscript{30}
the Boston collaborative drug surveillance
program,\textsuperscript{38} and Mann and Thorogood.\textsuperscript{33}
Alternatively, failure to control for smoking
cannot entirely account for the discrepancy
between the pooled case-control and cohort
study results, as the analyses restricted to data

Table 3 Pooled odds ratios (ORs) and relative risks (RRs) (for the effect of five cups/day v
none) from case-control and cohort studies of coffee consumption and CHD, restricted to
non-smokers

<table>
<thead>
<tr>
<th>Type of study</th>
<th>No. of studies</th>
<th>OR or RR (95% CI)</th>
<th>$\chi^2$ for heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case-control</td>
<td>3</td>
<td>1.85 (1.42 to 2.42)</td>
<td>7.2</td>
</tr>
<tr>
<td>Cohort</td>
<td>6</td>
<td>1.04 (0.71 to 1.52)</td>
<td>11.2</td>
</tr>
</tbody>
</table>

Table 4 Pooled odds ratios (ORs) and relative risks (RRs) (for the effect of five cups v
none) from case-control studies and cohort studies of coffee consumption and CHD, by sex

<table>
<thead>
<tr>
<th>Type of study</th>
<th>No. of studies</th>
<th>OR or RR (95% CI)</th>
<th>$\chi^2$ for heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case-control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men only</td>
<td>3</td>
<td>1.69 (1.50 to 1.90)</td>
<td>4.3</td>
</tr>
<tr>
<td>Women only</td>
<td>3</td>
<td>1.54 (1.33 to 1.77)</td>
<td>2.6</td>
</tr>
<tr>
<td>Men and women</td>
<td>2</td>
<td>1.79 (1.49 to 2.14)</td>
<td>0.1</td>
</tr>
<tr>
<td>Cohort</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men only</td>
<td>13</td>
<td>1.15 (1.07 to 1.25)</td>
<td>40.9</td>
</tr>
<tr>
<td>Women only</td>
<td>4</td>
<td>1.21 (0.90 to 1.63)</td>
<td>4.4</td>
</tr>
<tr>
<td>Men and women</td>
<td>7</td>
<td>0.91 (0.83 to 0.99)</td>
<td>38.7</td>
</tr>
</tbody>
</table>
on non-smokers continued to show an excess risk among case-control studies (pooled odds ratio = 1.85, 95% CI 1.42 to 2.42) but no increased risk among cohort studies (pooled risk ratio = 1.04, 95% CI 0.71 to 1.52).

**Consistency of the association**

The cohort studies included in our meta-analysis were inconsistent in suggesting a lack of (or, at most, a very weak) association between coffee intake and risk of coronary heart disease. By contrast, the case-control studies consistently pointed to an excess risk. Among the possible explanations for this discrepancy is that some earlier hospital based case-control studies included patients among the controls who may have reduced their intake of coffee after a diagnosis of chronic illness—for example, digestive diseases.30 38 Rosenberg et al examined the extent of this bias by including two types of control subjects in a hospital based case-control study: those admitted with acute emergencies and those with chronic diseases.20 25 Coffee intake was significantly lower among patients admitted to hospitals with chronic compared with acute conditions. Thus case-control studies that included control patients admitted for chronic conditions may have overestimated the association between coffee consumption and risk of heart disease.30 35

**Specificity of the association**

With one exception,36 all of the case-control studies used non-fatal myocardial infarction as the disease end point. By comparison, cohort studies looked at various end points, including non-fatal myocardial infarction, fatal CHD, and angina. When we stratified the cohort data according to type of end point (table 2) there was no evidence to suggest that the effect of coffee drinking was specific to a particular category of CHD. Moreover, the discrepancy between the results of case-control studies and cohort studies could not be explained by differences in the choice of end points. The pooled odds ratio for case-control studies with myocardial infarction as the end point was 1.66 (95% CI 1.52 to 1.81); whereas the pooled relative risk for cohort studies with myocardial infarction as the end point was 1.16 (95% CI 1.02 to 1.30).

**Time relation between exposure and outcome**

Retrospective ascertainment of exposure in case-control studies may pose a problem in the form of recall bias—that is, the experience of having had a coronary event selectively affects patients’ recall of coffee consumption and smoking habit before the event.26 This problem is compounded by ascertainment of coffee intake by interviewers who were not blinded with respect to the case-control state of patients.30 32 35 In theory, a prospective study design is more capable of making reliable assessments of both coffee intake and smoking habits.

Empirical evidence needs to be gathered to quantify the degree of recall bias, if any, in retrospective assessments of coffee intake. Data from cohort studies have shown the existence of recall bias when intake of other beverages (such as alcohol) are assessed retrospectively in relation to the onset of disease.31

One limitation of the prospective study design is the lag time between exposure assessment and outcome, which might potentially obscure acute effects of coffee intake on risk of heart disease.14 In cohort studies with repeated measurements of exposure assessment, the association between heart disease and coffee intake was strongest when the exposure measurement used was nearest to the outcome.10 42 In the study by LaCroix et al the relative risk for five or more cups/day compared with none increased from 1.8 (95% CI 0.8 to 4.0) when intake was assessed 10 or more years previously, to 2.5 (95% CI 1.1 to 5.8) when the intake within the past five years was used.10 Grobbee et al however, found no association between coffee intake and risk of heart disease, even though the mean lag time between exposure assessment and outcome was less than two years.11

Evidence from the Nurses' Health Study suggests that coffee intake in an individual subject stays stable over time.52 In this study, which assessed the reproducibility of food and beverage intake nine months apart, the Spearman correlation coefficient for coffee intake was 0.71, the highest recorded of all the items in the diet.

**Biological gradient**

The case-control data consistently suggest a monotonic dose-response gradient between daily coffee intake and risk of myocardial infarction. Compared with non-drinkers, those who drink five or six cups of coffee have about double the risk of myocardial infarction (relative risks of 2.2 reported by Rosenberg et al27; 2.1 by Rosenberg et al28; 2.2 by Jick et al,30 2.1 by the Boston collaborative drug surveillance program31; and 1.86 by Mann and Thorogood32). In contrast, there was no overall suggestion of a biological gradient in the cohort data. In their meta-analysis of 11 cohort studies Myers and Basinski reported relative risks of 1.01 among drinkers of one to four cups/day, 1.01 for four to six cups/day, and 1.09 for six or more cups/day (with drinkers of less than one cup/day as the reference category).12

**Biological plausibility**

The biological plausibility of the association between coffee drinking and CHD is based, in part, on the effects of caffeine on the cardiovascular system. The available evidence, however, fails to implicate caffeine as such as a significant contributor to risk of cardiovascular disease.3 Although the acute effects of caffeine on the cardiovascular system are well documented, it is doubtful that these are of sufficient clinical significance to produce CHD. Clinical data indicate that moderate caffeine consumption (< 500 mg/day—equivalent to four to six cups of coffee) does not increase the frequency or severity of car-
diac arrhythmias, even among people with ischaemic heart disease or patients with pre-existing ventricular extrasystoles. Nor does regular ingestion of caffeine seem to lead to an increase in blood pressure (although infrequent use among people who have not developed tolerance does seem to cause a small, but clinically unimportant rise in blood pressure). Clinical trial evidence suggests that caffeine itself is unrelated to adverse effects on lipids. No studies to date have shown a positive association between tea intake and CHD even though tea contains caffeine (64 mg/cup of tea, compared with 136 mg/cup for coffee). Both the prospective data by Grobbee et al., and a pooled analysis of the three case-control studies that included data on decaffeinated coffee, suggest a marginally increased risk of CHD with decaffeinated coffee consumption. In the study by Grobbee et al. the relative risk of total CHD with four or more cups of decaffeinated coffee consumed/day was 1.63 (95% CI 1.02 to 2.60), which may be attributable to an adverse effect of decaffeinated coffee on serum lipids. In one randomised trial, the consumption of three to six cups of decaffeinated coffee/day raised the concentrations of low density lipoprotein cholesterol.

Boiled \( v \) filtered coffee

A biologically plausible hypothesis, not assessed by any of the epidemiological studies to date, is that the method of preparing coffee (boiling \( v \) filtering) affects the risk of cardiovascular disease. In a meta-analysis of 21 cross sectional studies, Bak found that filtered coffee was associated with an average increase in total cholesterol of 0.008 mmol/l/daily cup consumed, compared with an increase of 0.038 mmol/l for boiled (unfiltered) coffee.

The studies from Sweden and Norway present an interesting comparison in this regard. In Norway, boiled coffee is the most common form of preparation, whereas in Sweden the predominant method of preparation is filtration. The Norwegian study by Tverdal et al. found relative risks of CHD death (comparing more than nine \( v \) less than one cup/day) of 2.2 (95% CI 1.1 to 4.5) for men, and 5.1 (95% CI 0.4 to 60.3) for women. By contrast, the Swedish study reported a relative risk of CHD death (again comparing more than nine \( v \) less than one cup/day) of 1.1 (95% CI 0.5 to 2.4) for men. (A Norwegian cohort study that found no association between coffee drinking and CHD death has also been reported. Unlike the study by Tverdal et al. this failed to exclude CHD cases at baseline; also, mortality data were obtained solely by linkage to the Norwegian Bureau of Statistics).

The adverse effect of coffee consumption on the lipid profile is now believed to stem from an as yet unidentified lipid soluble substance that is present in boiled preparations, but seems to be removed during the filtering process. Thus the precise measurement of coffee intake may be less relevant than the ascertainment of brewing method (filtered \( v \) boiled) in future epidemiological investigations of coffee intake and CHD.

Secular trends in coffee preparation method

In the USA, there has been a considerable shift in the method of coffee preparation from percolated to filtered between 1975 and 1985. In 1975, 75% of Americans drank percolated coffee and only 20% filtered, whereas by 1985, 25% drank percolated coffee and 66% filtered (International Coffee Organization, 1989—quoted by Bak). Percolation involves boiling coffee, which has been shown to have adverse effects on serum lipids.

The secular trends in method of coffee preparation may be consistent with the generally positive associations between coffee intake and heart disease found in the United States case-control studies, all but one of which were completed during the 1970s—Jick et al. in 1972; Boston collaborative drug surveillance program in 1972; and Rosenberg et al. (female subjects) between 1976 and 1979. Conversely, among cohort studies, there seems to be no consistent pattern whereby studies conducted before 1975 (the period during which there was relatively high prevalence of percolated coffee consumption) show a positive association between coffee intake and heart disease. The seven studies completed before 1975 show no association between coffee drinking and heart disease (pooled relative risk = 1.03, 95% CI 0.94 to 1.12); whereas the four studies that assessed coffee drinking during the 1980s reported a slightly positive association (pooled relative risk = 1.21, 95% CI 1.05 to 1.40).

In conclusion the pooled cohort data suggest very little association between coffee intake and risk of CHD. The pooled case-control data suggest an excess risk of the order of 60% for drinking five cups/day. The higher risk estimates from individual case-control studies may have resulted from a combination of bias in control selection, recall bias; or be confounded by cigarette smoking, although it is unlikely that the discrepancy between cohort and case-control data could be wholly explained by bias and confounding. It is possible that cohort studies may have missed an acute effect of coffee drinking on CHD risk, although the evidence for this hypothesis is sparse and inconsistent. Further studies are needed to assess the risk of drinking boiled coffee and decaffeinated coffee, as there are biologically plausible reasons to hypothesise an association with CHD.
Appendix 1: Summarised characteristics of the case-control studies used in the meta-analysis

<table>
<thead>
<tr>
<th>Author</th>
<th>No cases (sex/age)</th>
<th>Outcomes</th>
<th>Coefficient (SEM)</th>
<th>Adjustments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jick, et al</td>
<td>440 (M + F)/20-75</td>
<td>MI</td>
<td>0.120 (0.022)</td>
<td>Age, sex</td>
</tr>
<tr>
<td>LaVecchia, et al</td>
<td>262 (F/24-69)</td>
<td>MI</td>
<td>0.061 (0.048)</td>
<td>Age, sex, DM, BP, CHOL, BMI, other</td>
</tr>
<tr>
<td>Rosenberg, et al</td>
<td>491 (F/30-44)</td>
<td>MI</td>
<td>0.068 (0.021)</td>
<td>Age, SMK, DM, BP, CHOL, BMI</td>
</tr>
<tr>
<td>Mann and Thorogood</td>
<td>64 (F)</td>
<td>&lt;5</td>
<td>0.0001 (0.070)</td>
<td>Age</td>
</tr>
<tr>
<td>Rosenberg, et al</td>
<td>1,867 (M+55)</td>
<td>MI</td>
<td>0.103 (0.015)</td>
<td>Age, SMK, DM, BP, CHOL, BMI, other</td>
</tr>
<tr>
<td>Boston Collaborative Drug Surveillance Program</td>
<td>276 (M + F)</td>
<td>MI</td>
<td>0.108 (0.032)</td>
<td>Age, sex</td>
</tr>
<tr>
<td>Hennekens, et al</td>
<td>649 (M/30-70)</td>
<td>Fatal CHD</td>
<td>0.030 (0.043)</td>
<td>Age, SMK, BP, DM, other</td>
</tr>
<tr>
<td>Wilhelmsen, et al</td>
<td>230 (M+40-57)</td>
<td>MI</td>
<td>0.131 (0.023)</td>
<td>Age, SMK, BP, CHOL, ALCL</td>
</tr>
</tbody>
</table>

* SMK: smoking; DM: diabetes mellitus; BP: blood pressure; CHOL: serum cholesterol concentration; BMI: body mass index; ALCL: alcohol intake; MI: myocardial infarction.

* Coefficient for one cup v none (SEM).
Appendix 2: Summarised characteristics of the cohort studies used in the meta-analysis

<table>
<thead>
<tr>
<th>Author</th>
<th>Cohort (sex/age)</th>
<th>Outcomes</th>
<th>Coefficient (SEM) *</th>
<th>Adjustments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yan, et al.</td>
<td>7,705 (M/46-65)</td>
<td>MI</td>
<td>0.016 (0.039)</td>
<td>Age, sex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHD death</td>
<td>0.049 (0.070)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total CHD</td>
<td>0.058 (0.026)</td>
<td></td>
</tr>
<tr>
<td>Wilhelmsen, et al.</td>
<td>834 (M/50)</td>
<td>Total CHD</td>
<td>0.113 (0.153)</td>
<td>Age, sex, CHOL, BP, ALC</td>
</tr>
<tr>
<td>Murray, et al.</td>
<td>16 911 (M/ &gt;35)</td>
<td>CHD death</td>
<td>0.008 (0.017)</td>
<td>Age, SMK, other</td>
</tr>
<tr>
<td>LaCroix, et al.</td>
<td>1130 (M/19-49)</td>
<td>Total CHD</td>
<td>0.103 (0.043)</td>
<td>Age, SMK, BP, CHOL</td>
</tr>
<tr>
<td>Jacobsen, et al.</td>
<td>16 555 (M + F)</td>
<td>CHD death</td>
<td>0.023 (0.016)</td>
<td>Age, sex</td>
</tr>
<tr>
<td>LeGrady, et al.</td>
<td>1910 (M/40-56)</td>
<td>CHD death</td>
<td>0.119 (0.031)</td>
<td>Age, SMK, BP, CHOL</td>
</tr>
<tr>
<td>Martin, et al.</td>
<td>10 064 (M + F/30-69)</td>
<td>Total CVD</td>
<td>0.051 (0.040)</td>
<td>Age, sex, race</td>
</tr>
<tr>
<td>Grobbee, et al.</td>
<td>45 589 (M/40-75)</td>
<td>Total CHD</td>
<td>0.004 (0.032)</td>
<td>Age, SMK, BMI, ALC, DIET, DM, other</td>
</tr>
<tr>
<td>Tverdal, et al.</td>
<td>38 564 (M + F/35-54)</td>
<td>CHD death</td>
<td>0.104 (0.055)</td>
<td>Age, SMK</td>
</tr>
<tr>
<td>Rosengren, Wilhelmsen</td>
<td>6765 (M/51-59)</td>
<td>MI</td>
<td>0.050 (0.036)</td>
<td>Age, SMK, BP, BMI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHD death</td>
<td>0.010 (0.042)</td>
<td>ALC, DM, other</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total CHD</td>
<td>0.035 (0.030)</td>
<td></td>
</tr>
<tr>
<td>Lindsted, et al.</td>
<td>9484 (M/ &gt;30)</td>
<td>CHD death</td>
<td>0.090 (0.022)</td>
<td>SMK, BMI, BP, DIET, other</td>
</tr>
<tr>
<td>Klatsky, et al.</td>
<td>464 (M + F/59)</td>
<td>MI</td>
<td>0.007 (0.023)</td>
<td>Age, sex, SMK, race, BP, CHOL, other</td>
</tr>
<tr>
<td>Klatsky, et al.</td>
<td>101 774 (M + F)</td>
<td>MI</td>
<td>0.062 (0.021)</td>
<td>Age, sex, SMK, race, ALC, other</td>
</tr>
<tr>
<td>Wilson, et al.</td>
<td>6214 (M + F/30-67)</td>
<td>Total CHD</td>
<td>0.094 (0.018)</td>
<td>Age</td>
</tr>
<tr>
<td>Heyden, et al.</td>
<td>2530 (M + F)</td>
<td>CHD death</td>
<td>0.022 (0.088)</td>
<td>Age</td>
</tr>
</tbody>
</table>

* Coefficient for one cup vs none (SEM).
SMK, smoking; DM, diabetes mellitus; BP, blood pressure; CHOL, serum cholesterol concentration; BMI, body mass index; ALC, alcohol intake; MI, myocardial infarction.
Does coffee drinking increase the risk of coronary heart disease? Results from a meta-analysis.
I Kawachi, G A Colditz and C B Stone

Br Heart J 1994 72: 269-275
doi: 10.1136/hrt.72.3.269

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