

Risk of heart disease in relation to type of cigarette smoked

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This is an updated version of a review conducted in 2002.

Table 1 summarizes information on the relative risk of heart disease in relation to type of cigarette smoked for 20 studies, all from the USA, UK or Western Europe. Except that the Tang et al., 1995 results include some data from studies considered separately by Hawthorne & Fry, 1978 and by Higenbottam et al., 1982 the studies appear to provide independent data.

The table provides information on:

1. First author and location - see references for the full author list;
2. Study design and period of deaths (or cases) - there are three study designs:  
CC = case-control, P(D) = prospective study of deaths, P(I) = prospective study of incidence;
3. Comparison and test group the comparison group has always been taken as plain rather than filter or the group with the highest tar, nicotine or tar/nicotine (T/N) for which data are available; the test group has conversely always been taken as filter rather than plain or the lowest yield available;
4. Sex - some studies only provide results for one sex or for the sexes combined;
5. Numbers of deaths (or cases) - the number included in the specific comparison, on occasion estimated approximately;
6. RR (95% CI) - the relative risk and 95% CI comparing the test group (numerator) with the comparison group. . Where a study provides estimates adjusted for various sets of adjustment factors, RRs and CIs are, if possible, presented (a) adjusted for as many factors as possible including cigarettes/day and (b) adjusted for as many factors as possible excluding cigarettes/day. RRs and CIs are sometimes given by age or other data subset, and have often had to be estimated (see notes);
7. Adjustment factors - see key at the end of the table; and

8. Notes - see key at the end of the table.

Of the 48 relative risks in the table, 30 are below 1.00 (12 statistically significantly), 1 is equal to 1.00 and 16 are above 1.00 (none significantly). It should be noted that the four largest studies, the ACS first million person study of Hammond et al., 1976, the huge case-control study of Parish et al., 1995, the combined analysis of four cohorts by Tang et al., 1995, and the case-control study of Sauer et al., 2002, all show significant decreases.

In attempting to carry out meta-analyses, it seems sensible to avoid dependence between estimates by (i) considering estimates unadjusted and adjusted for cigs/day separately, (ii) omitting estimates on a per mg tar reduction basis, which are not really comparable, and (iii) by only choosing estimates for one exposure index for a given study/sex/period (so choosing tar rather than CO estimates in the Higenbottam (1982) study and tar rather than nicotine estimates for the Kuller (1991) study). One must also exclude estimates without confidence limits. This gives 21 adjusted estimates and 19 unadjusted estimates for meta-analysis.

The data adjusted for cigs/day give an overall fixed-effects relative risk estimate of 0.88 (95% CI 0.83-0.92), with significant heterogeneity ( $\chi^2 = 39.55$  on 20 d.f.,  $p=0.006$ ) and a random-effects estimate of 0.86 (0.79-0.94). The largest contributor to the heterogeneity is the low estimate of 0.45 in the Sauer et al., 2002 study. Removing this substantially reduced the heterogeneity (to  $\chi^2 = 29.22$  on 19 d.f.,  $p = 0.06$ ) but did not change the estimates much (fixed-effects 0.88 (0.84-0.93) and random-effects 0.88 (0.82-0.95)).

The data unadjusted for cigs/day give a similar overall fixed-effects relative risk estimate of 0.87 (0.81-0.94), with significant heterogeneity ( $\chi^2 = 41.81$  on 18 d.f.,  $p = 0.001$ ) and a random-effects estimate of 0.89 (0.77-1.03). Here the major contributors to the heterogeneity were the low estimates of 0.39 in the Dean et al., 1977 study and of 0.53 in the Sauer et al., 2002 study. Removing these eliminated the significant heterogeneity ( $\chi^2 = 22.63$  on 16 d.f.,  $p=0.12$ ) and slightly increased the estimates (fixed-effects 0.91 (0.85-0.99) and random-effects 0.95 (0.85-1.07)). Note that restricting attention to unadjusted data means that the large Hammond et al., 1976 study is no longer included.

Relative risk of heart disease in relation to type of cigarette smoked

<u>First author (year)/location</u>	<u>Study design/ Period of deaths (or cases)</u>	<u>Comparison group</u>	<u>Test group</u>	<u>Sex</u>	<u>Number of deaths (or cases)</u>	<u>RR (95% CI)</u>	<u>Adjustment factors</u>	<u>Notes</u>
Hammond et al., 1976 and Lee & Garfinkel, 1981, USA	P(D) 1960-72	High T/N	Low T/N	M	1342	(1) 0.93(0.84-1.04)	age, cigs, race, ages, res, occ, educ, hlc, hhd, hst, dia, bp, exer, oi, bev, alc, asp, sc	c, 1
				F	610	(2) 0.82(0.70-0.96)		
					576	(1) 0.81(0.69-0.95)		
					481	(2) 0.81(0.68-0.97)		
Dean et al., 1977, NE England	CC 1971-72	Plain 1954, 1964, 1969	Filter 1954, 1964, 1969	M	143	0.49(0.31-0.77)	age, cigs	c
					143	0.39(0.23-0.64)	none	r, c
Hawthorne & Fry, 1978, WC Scotland	P(D) 1968-77	Plain	Filter	M	≈200	1.05(0.78-1.41)	age, cigs, stud	c
Castelli et al., 1981 and Lee, 1981, Framingham, USA	P(D) 1963-77	Plain	Filter	M	60	0.92(0.55-1.50)	age, bp, chol	-
Lee & Garfinkel, 1981 Migrants, UK/USA	P(D) 1964-77	Plain	Filter	M	253	0.84(0.65-1.08)	age, cigs, ages, inh	c, 2
				F	76	0.91(0.57-1.46)		
Higenbottam et al., 1982 and Borland et al., 1983, Whitehall, UK	P(D) 1967-77	Tar ≥33 mg CO >20 mg	Tar 18-23 mg CO ≤18 mg	M	315	0.84(0.65-1.08)	age, inh, occ	r, c
					255	1.47(0.91-2.38)	age, cigs, occ, tar	r, c
					255	1.50(0.93-2.43)	age, occ	r, c
Sorlie et al., 1982, Puerto Rico	P(I) 1965-73	Plain	Filter	M	114	1.02(0.68-1.53)	age, inh	r, c
Kaufman et al., 1983, NE USA	CC 1980-81	Nic ≥1.5 mg	Nic <0.8 mg	M	100	1.19(0.74-1.91)	age, res, bp, chol, dia, fhis, pers, alc, rel, mars	r, c

TABLE 1 (continued)

<u>First author (year)/location</u>	<u>Study design/ Period of deaths (or cases)</u>	<u>Comparison group</u>	<u>Test group</u>	<u>Sex</u>	<u>Number of deaths (or cases)</u>	<u>RR (95% CI)</u>	<u>Adjustment Factors</u>	<u>Notes</u>
Alderson et al., 1985, UK	CC 1977-82	Always plain	Always filter	M	41	(1) 1.78(0.77-4.10)	age, cigs	c, 3
					41	(1) 1.50(0.65-3.45)	none	r, c, 3
					34	(2) 2.67(0.91-7.83)	age, cigs	c, 3
					34	(2) 2.87(0.98-8.41)	none	r, c, 3
				F	96	(1) 0.24(0.08-0.73)	age, cigs	c, 3
					96	(1) 0.21(0.07-0.63)	none	r, c 3
					72	(2) 1.32(0.64-2.73)	age, cigs	c, 3
					72	(2) 1.19(0.57-2.46)	none	r, c, 3
Petitti & Friedman, 1985, Oakland or San Francisco, USA	P(I) 1979-82	Risk per 5 mg tar decrease		M+F	63	(1) 0.80(0.63-1.01)	age, sex, race cigs, oi, chol, bp,	4, c
					78	(2) 0.85(0.68-1.06)	alc	
Palmer et al., 1989, NE USA	CC 1985-88	Nic $\geq$ 1.30 mg	Nic $<$ 0.40 mg	F	70	1.12(0.60-2.11)	age, bp, hhd, dia, chol, meno, oi, pers, exer, educ, res, oc, oe, cof, alc	c
Kuller et al., 1991 and Ockene et al., 1990, USA	P(D) 1973-85	Tar $\geq$ 20 mg	Tar $\leq$ 15 mg	M	288	0.84(0.61-1.16)	age, chol, bp, cigs	r, c
					288	0.93(0.64-1.35)	none	r, c
		Nic $\geq$ 1.5 mg	Nic $\leq$ 1.0 mg		128	0.79(0.56-1.09)	age, chol, bp, cigs	r, c
					128	0.83(0.59-1.18)	none	r, c
		Plain	Filter		384	0.72(0.44-1.16)	age, chol, bp, cigs, ages, tar, nic,	r, c
					384		alc, thio	
Nyboe et al., 1991, Copenhagen, Dk	P(I) 1976-83	Plain	Filter	M+F	$\approx$ 215	0.67 (Not significant)	age, sex, educ, bp, chol, oi, alc, exer, inc, educ, fhis, cigs, inh	c, 5
Negri et al., 1993, Italy	CC 1988-89	High T/N	Low T/N	M+F	126	1.00(0.56-2.00)	age, sex, educ, cigs, chol, dia, bp, fhis, oi, cof	r, c
					126	1.03(0.56-1.87)	age, sex, educ, chol, dia, bp, fhis, oi, cof	r, c

TABLE 1 (continued/2)

<u>First author (year)/location</u>	<u>Study design/ Period of deaths (or cases)</u>	<u>Comparison group</u>	<u>Test group</u>	<u>Sex</u>	<u>Number of deaths (or cases)</u>	<u>RR (95% CI)</u>	<u>Adjustment Factors</u>	<u>Notes</u>
Parish et al., 1995, UK	CC Early 90s	Medium Tar	Low Tar	M+F	3341	(1) 0.86(0.75-0.98)	age, sex, cigs	r, c, 6
					3341	(1) 0.83(0.73-0.94)	age, sex	r, c, 6
					1582	(2) 0.99(0.84-1.17)	age, sex, cigs	r, c, 6
					1582	(2) 0.96(0.81-1.12)	age, sex	r, c, 6
Tang et al., 1995, 4 UK studies	P(D) 1967-90	Risk per 15 mg tar decrease Current plain	Current filter	M	917	0.77(0.61-0.97)	age, cigs, stud	-
					917	0.93(0.80-1.07)	age, cigs, stud	
Bosetti et al., 1999, Italy	CC 1983-92	Tar >15 mg	Tar <10 mg	M	441	1.15(0.77-1.72)	age, educ, chol, dia, bp, fhis, cof,	r, c
				F	174	0.71(0.39-1.30)	alc, oi	
Tavani et al., 2001, Italy	CC 1995-99	High tar	Low tar	M+F	228	1.34(0.82-2.21)	none	r, c
					228	1.15(0.65-2.04)	age, sex, educ, oi, chol, cof, alc, exer, hypl, dia, bp, fhis	r, c
Woodward, 2001, Scotland	P(D) 1984-99	Tar $\geq$ 15 mg	Tar <10 mg	M+F	91	0.79(0.46-1.37)	age, sex	r, c
					91	0.96(0.46-2.04)	age, sex, sc, cigs, dur, Bor, car, vit C, vit E, bmi, pot	r, c
Sauer et al., 2002, USA	CC 1995-97	Tar >12 mg	Tar $\leq$ 6 mg	M+F	587	0.45(0.30-0.68)	age, sex, race, educ, exer, dur, cigs, oi, hhd, dia, bp, chol, vit, fhis	r, c
					587	0.53(0.38-0.75)	none	r, c

Key to adjustment factors

age = age  
ages = age started to smoke  
alc = alcohol  
bev = beverage (tea, coffee)  
Bor = Bortner score  
bp = blood pressure  
car = beta-carotene  
chol = cholesterol  
cigs = number of cigarettes per day  
cof = coffee  
dia = diabetes  
dur = duration of smoking  
educ = education  
exer = exercise  
fhis = family history of MI or stroke

hhd = history of heart disease  
hlc = history of lung cancer  
hst = history of stroke  
hyp = hyperlipidaemia  
inc = income  
inh = inhalation  
mars = marital status  
meno = menopausal status  
nic = nicotine  
oc = oral contraceptives  
occ = occupation  
oe = oestrogen  
oi = obesity (body mass) index  
pers = personality

pot = urinary potassium  
quit = attempts to quit  
race = race  
rel = religion  
res = area of residence  
sc = social class  
sex = gender  
sc = social class  
stud = study  
tar = tar yield  
thio = thiocyanate  
vit = vitamin use  
vit C = vitamin C  
vit E = vitamin E

Key to notes

- c confidence limits estimated from data provided  
r relative risk estimated from data provided  
1 numbers of deaths are "adjusted deaths" as described by Hammond et al., 1976; numbers of deaths and RR (CI) given separately for two periods, (1) 1960-66 and (2) 1966-72  
2 combined analysis of British population random sample plus sample of siblings of UK migrants to USA  
3 numbers of cases and RR (CI) given separately for two age groups, (1) 35-54 and (2) 55-74  
4 numbers of cases and RR (CI) given separately for (1) acute myocardial infarction and (2) other ischaemic heart disease  
5 confidence limits cannot be estimated from data provided  
6 numbers of cases and RR (CI) given separately for two age groups, (1) 30-59 and (2) 60-79

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