

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
OPCS (1958) United Kingdom 1949-53	Registered deaths of 221,941 men and women aged 20-64 yrs in the broad occupational category of painters and decorators	Occupation at time of death or last occupation from death certificates; Occupations coded according to the Census 1951, Classification of Occupations	Lung, bronchus, trachea, primary cancer (ICD6 162)	Other painters & decorators	912	SMR (95% CI) [1.49 (1.40-1.59)]	Age, sex	Reference, population of England and Wales
				Men & women	909	[1.49 (1.40-1.59)]		
				Men	94	[1.49 (1.21-1.83)]		
				age 20-44 yrs	297	[1.47 (1.31-1.65)]		
				age 45-54 yrs	518	[1.51 (1.38-1.64)]		
				age 55-64 yrs	3	3.00 [0.62-8.77]		
				Single women	57	[1.42 (1.08-1.84)]		
				Sign writers, paint sprayers, aerographers				
				Sign writers	21	[1.62 (1.00-2.47)]		
				Aerographers, paint sprayers	36	[1.33 (0.93-1.85)]		
Enterline & McKiever (1963); Guralnick (1963) USA 1950	Men aged 20-64 who died in the USA in 1950	Usual occupation and industry recorded from death certificates, coded using International Occupational Classification	Lung, bronchus, trachea, primary cancer (ICD6 162) primary and unspecified primary or secondary cancer (ICD6 162, 163)	Painters and plasterers	118	SMR (95% CI) 1.51 [1.25- 1.81]	Age, race	Reference, 1950 US census population
				White	113	1.57 [1.29-1.89]		
				Non-white	5	NG		
				Painters (construction), paperhangers, glaziers	212	1.67 [1.45-1.91]		
				White	200	1.65 [1.43-1.90]		
				Non-white	12	NG		

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Dunn & Weir (1965) USA 1954-62	Prospective study of >68,000 men working in 'suspicious' occupations (12,512 painters and decorators) followed for an average of 7 years to determine causes of mortality, as assessed by linkage to California death records; unexposed group = public utility electric workers, excluding workers employed in suspect jobs	Men were enrolled based on their occupation, identified through unions and mailed questionnaire (85% response rate)	Lung	Painters & decorators smoking adjusted	91 91	SMR (95% CI) 1.29 [1.04-1.59] 1.14 [0.92-1.40]	age age, smoking	Reference, total male population of California; Public utility employees not engaged in suspect job classes were used as a smoking control group because their smoking pattern closely resembled the general California male population; Specific occupations studied had fewer nonsmokers and more heavy smokers than did the smoking control group.
OPCS (1971) United Kingdom 1959-63	Registered deaths of men and women aged 15-64 in England and Wales	Last occupation recorded on the death certificate?	Lung, bronchus, trachea, primary and unspecified primary or secondary (ICD7 162, 163)	Painters & decorators Age 15-64 yrs men & women men single women Aerographers, paint sprayers Men (15-64 yrs)	1506 1502 4 98	SMR (95% CI) 1.43 [1.36-1.51] 1.43 [1.36-1.50] 4.00 [1.09-10.24] 1.62 [1.32-1.97]	Age, sex	Reference, population of England and Wales

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Menck & Henderson (1976) USA 1968-70	Pooled mortality and morbidity data of 2,161 deaths from lung cancer in and 1,777 incident cases of lung cancer among white males aged 20-64, identified from the LA County Cancer Surveillance Program Records	Last occupation from death certificates and surveillance registry files, coded using the 1970 US Census occupational classification system	Lung, bronchus, trachea	Painter	87	SMR (95% CI) 1.58 [1.27-1.95]	age	Reference, all occupations; Morbidity and mortality data were pooled because of the high mortality rate of lung cancer and the relatively high accuracy of death certification regarding lung cancer (45 deaths + 42 incident cases)
OPCS (1978), no.1 United Kingdom 1970-72	Registered deaths of 273,129 men aged 15-64	Last occupation recorded on the death certificate, as coded by the 1970 <i>Classification of Occupations</i>	Lung, bronchus, trachea (ICD8 162)	Painters & decorators Northern region South West region Painters, decorators n.e.c.	847 53 45 728	SMR (95% CI) 1.39 [1.30-1.49] 1.69 [1.27-2.21] 0.91 [0.66-1.22] 1.22 [1.13-1.31]	Age, sex	Reference, population of England and Wales; The occupation unit of 'painters and decorators' was comprised of aerographers, paint sprayers, painters, decorators n.e.c., coach painters

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Englund (1980); Engholm and Englund (1982) Sweden 1966-74	30,580 members of the painters' union were followed up (through 1971 for cancer incidence and through 1974 for mortality) by record linkage with the Swedish Cancer Registry and the yearly death registers of the Swedish Central Bureau of Statistics, respectively. Cancer incidence was also assessed through linkage of 1960-73 Cancer Registry data with the 1960 Population Census. 25,805 of these painters reported being in the building trade in the 1960 population census.	Membership in the painters' union; 1960 population census	Lung, bronchus, trachea (ICD7&8, 162)	Painters	124	SMR (95% CI) 1.27 [1.06-1.51]	Age, calendar year	Reference, Swedish males; There is substantial overlap between these cohorts. <i>Excluded from meta-analysis because of overlap with Pukkala et al. (2009).</i>
			Lung, bronchus, trachea (ICD7, 162-162.1)	Painters/house-building only	81	SIR (95% CI) 1.28 [1.01-1.59]		
					202	1.30 [1.13-1.49]		
Mikkelsen (1980) Denmark 1971-75	2601 male painters belonging to two Copenhagen painters' unions followed for lung cancer incidence	Membership in painters' union	Lung, bronchus, trachea (ICD8 [162])	Painters	NG	SIR (95% CI) 1.1 (NG)	Age	Reference, all Copenhagen males > 30 years of age Excluded from meta-analysis because of overlap with Pukkala et al. (2009).
Petersen & Milham (1980) USA 1959-61	Death certificates of 3558 painters in California	Occupation from death certificate	Lung	Painters, except construction and maintenance	NG	NG; Excess of lung cancers observed compared to expected.	Age, year of death	Excluded from the meta-analysis due to lack of information and possible overlap with Dunn & Weir (1965).

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Logan (1982) United Kingdom 1851-1971	Mortality of men and women in 1931-71, ages 15-64	Occupation recorded at the time of cancer registration/death and coded using various methods	Lung, bronchus, trachea (ICD 2,3,4,6,7,8 47b, 162-164)	Painters & decorators Men 20-64 yrs (1931) 20-64 yrs (1951) 15-64 yrs (1961) 15-64 yrs (1971) Single women 15-64 yrs (1961) 15-64 yrs (1971)	NG NG NG NG NG NG NG	SMR (95% CI) 1.17 (NG) 1.49 (NG) 1.43 (NG) 1.39 (NG) 4.00 (NG) 4.08 (NG)	Age, sex, calendar year	Reference = all men, single women in the 3 or 5 year period under review; Based upon decennial occupational mortality analyses of the Registrar General of England and Wales (1851-1971); Excluded from meta-analysis because of overlap with OPCS 1958, 1971, 1978 and lack of data to calculate confidence intervals for 1931 data
Whorton <i>et al.</i> (1983) USA 1976-1978	2200 painting union members (2197 men, 3 women) linked to the California Tumor Registry	1976-77 union membership files	Lung, bronchus, trachea and pleura (ICDO1 162)	Painter	15	SIR (95% CI) 1.99 [1.12-3.30]	Age, sex, year	Reference, mid-year SMSA California population
Dubrow & Wegman (1984) USA 1971-73	34,879 white men > 20 years old	Usual occupation from death certificate, coded using SIC codes	Lung, bronchus, trachea (ICD8 162)	Painters grouped shipyard	110 9	SMOR (95% CI) 1.31 [1.08-1.58] 2.61 [1.19-4.95]	age	Reference, 25% random sample of death files, excluding cancer and liver & liver cirrhosis; SMOR is equivalent to an exposure odds ratio from a case-control study using dead controls, standardized by age

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Stockwell & Matanoski (1985) USA, 1975-79	124 incident male lung cancer cases identified from the New York State Cancer Registry and 371 non-cancer controls randomly selected from union membership files and stratified by birth date and geographical region	Occupation from union records and questionnaire	Lung, bronchus, trachea (ICD8, 162)	Painter ever/never	52	RR (95% CI) 2.57 (1.34-4.94)	none	Nested case-control analysis. No significant differences in smoking habits were found when comparing smoking characteristics in painters and non-painters; Excluded from meta-analysis because overlaps with Matanoski et al. (1986) and later updated by Steenland & Palu (1999); *Calculated using a fixed effects model.
				usual trade	51	2.75 (1.45-5.21)	none	
				union specialty	37	3.17 (1.43-7.05)	none	
				never wore a respirator	NG	5.45 (1.01-29.33)	Age, education, smoking, beer drinking, asbestos exposure, geographical region	
				wore a respirator	NG	1.14 (0.34-3.79)		
yes or no respirator	NG	[1.94 (0.73-5.16)]*						
Matanoski <i>et al.</i> (1986) USA 1975-79	Mortality of 57175 white male painters and allied tradesmen currently or formerly members of a painters' union for ≥ 1 year during 1975-79; 33,098 men from "mixed" locals were primarily or exclusively painters	Painters' union records from local chapters	Lung, bronchus, trachea (ICD8, 162)	Painters, construction and maintenance	448	SMR (95% CI) 1.18 (1.06-1.32)	Age	Reference, US white males; The union represents most unionized painters in the US; members of "mixed" locals consisted primarily or exclusively of painters; <i>Excluded from meta-analysis because later updated by Steenland & Palu (1999)</i>

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
OPCS (1986), no.6 United Kingdom 1979-80, 1982-83	Men aged 20-64 in Great Britain who died during 1979-80 and 1982-83	Last full-time occupation recorded on the death certificate, coded by the OPCS 1980 occupational classification	Lung, bronchus, trachea (ICD9,162)	Painters, decorators, french polishers Men	779	SMR (95% CI) 1.44 [1.34-1.54]	Age, sex	Reference, populations of Great Britain, England & Wales, or Scotland as appropriate; Female mortality was from England & Wales only; Data from 1981 were questionable and thus excluded
	Male painters & decorators			NG	1.39 (NG)			
Olsen & Jensen (1987) Denmark 1970-79	12,166 male incident cancer cases from the Danish Cancer Registry were linked with employment records	Longest employment held from pension fund registries, coded using ISIC	Lung, bronchus, trachea, primary cancer (ICD7 162)	Painters in the construction industry	79	SIR (95% CI) 1.49 (1.19-1.85)	Age, calendar time	Reference, Danish population; No information on smoking habits available. An earlier study showed that 60-80% of Danish men, aged 30-59 years, smoked; SPIR approximates the SIR when the cancer under investigation constitutes a minor part of all the malignancies included in the study and when exposure has no effect on cancer risk in general. Excluded from meta-analysis because of large overlap with Pukkala et al. (2009).

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Carstensen <i>et al.</i> (1988) Sweden 1961-79	1 622 547 Swedish men in the 1960 national census, aged 30-64 years and gainfully employed, were linked to the Swedish Cancer Registry and followed for cancer incidence from 1961-79	Occupations and industries were obtained from the 1960 census and coded using ILO standards. Smoking data were obtained from a large survey among an age-stratified random sample of the Swedish population in 1963	Trachea, bronchus, lung (ICD7 162.0, 162.1, 163)	Painters and paperhangers	425	SIR (95% CI) 1.01 (0.88-1.16)	Age, place of residence, smoking (indirect adjustment)	Reference; Swedish males; It is likely that paperhangers work in the same job environment as painters or may also paint, and it is reasonable to consider this category as a whole as “painters”. Excluded from meta-analysis because of overlap with Pukkala <i>et al.</i> (2009).
Gubéran <i>et al.</i> (1989) Switzerland 1971-84	1916 male painters from the 1970 Geneva census were linked to the Geneva Cancer Registry and followed for cancer incidence during 1971-84	Occupational classifications were obtained from the 1970 census	Lung, bronchus, trachea (ICD8 162)	Painters	40	SIR (95% CI) 1.47 [1.05-2.00]	Age, sex, matrimonial status, calendar year	Reference = Swiss population; Painters showed excess mortality from alcoholism (SMR, 6.25; 90%CI, 2.46–13.14; 5 deaths) and from cirrhosis (SMR, 1.59; 90%CI, 0.96–2.49; 14 deaths), suggesting excess alcohol consumption among painters.

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Skov <i>et al.</i> (1993) Denmark 1970-80, Finland 1971-80, Norway 1961-84, Sweden 1961-79	87 004 economically active, male painters and lacquerers included in the national census of 4 Scandinavian countries were followed-up for cancer incidence by linking individual records with national cancer registries	Painters were identified by combining census codes for occupation and industry	Lung, bronchus, trachea (ICD7 162.0,1)	Painter	1043	SIR (95% CI) [1.30 (1.22-1.38)]	Birth cohort, sex, site	Reference, economically active census population or total population in same region (Sweden only); Excluded from meta-analysis because of overlap with Pukkala <i>et al.</i> (2009).
Hrubec <i>et al.</i> (1995) USA 1954-80	1178 painters were followed during 1954-80 within a cohort assembled from a roster of approximately 300 000 white male WWI veterans who served in the US Armed Forces some time during 1917-40 and who held active government life insurance policies	Mailed questionnaire that inquired about tobacco use, usual industry of employment and occupation, coded using 1950 Census Occupation and Industry codes	Respiratory system (ICD7)	Painters, Construction and maintenance Not construction and maintenance	36 4	SMR (95% CI) 1.1 [0.77-1.43] 1.2 [0.33-3.07]	Smoking, age, calendar time	Reference, US white males
OPCS (1995), no. 10 Bethune <i>et al.</i> (1995) United Kingdom 1976-89	Men from the 1971 & 1981 census cohorts who died between 1976-89	Occupation from death certificates linked to census data and coded using the 1970 Classification of Occupations and the University of Southampton 'job groups'	Lung, bronchus, trachea (ICD8,9 162)	Painters & decorators age 20-64 yrs age 65-74 yrs age ≥ 75 yrs	NG NG NG NG	SMR (95% CI) 1.51 (1.22-1.85) 1.55 (1.05-2.20) 1.42 (1.00-1.95) 1.64 (1.06-2.42)	Age, sex, calendar year	Reference, general population

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Alexander <i>et al.</i> (1996) USA 1974-94	2429 chromate exposed workers employed ≥ 6 months in the aerospace industry during 1974-94 were assembled from company work-history records; 62% had ever worked as a painter; incidence follow-up 1974-94 with linkage to the SEER registry; median 42 yrs of age	Exposure to chromium [VI] was estimated from industrial hygiene measurements and work-history records; cumulative exposure to chromium [VI] = years in each job x TWA for each exposure category	Lung	Entire cohort Painter (years worked) 0 < 5 ≥ 5	15 9 3 3	SIR (95% CI) 0.8 (0.4-1.3) 1.1 (0.5-2.0) 0.8 (0.2-2.4) 0.4 (0.1-1.2)	Age, sex, race, calendar year	Reference, Puget Sound population during 1974-94; No information on smoking; no trend with cumulative exposure to chromium VI but slightly positive trend with duration of employment as a sander/polisher; small numbers preclude conclusions
van Loon <i>et al.</i> (1997) the Netherlands 1986-90	58 729 men, aged 55-69 yrs, were enrolled from the general Dutch population and followed for lung cancer incidence from 1986-90 by linkage to national and regional registries	Paint exposure was obtained from job history as part of a self-administered questionnaire and case by case expert assessment	Lung	Paint dust exposure None Any* Low High <i>p</i> value for trend	506 18 4 14	RR (95% CI) 1.00 (ref) [2.41 (1.07-5.44)] 2.29 (0.61-8.63) 2.48 (0.88-6.97) < 0.01	Age, other occupational exposures, smoking habits, dietary intake of vitamin C, B-carotene and retinol	Cumulative probability of exposure = probability x duration of exposure; *calculated using a fixed effects model
Andersen <i>et al.</i> (1999) Denmark 1971-87, Finland 1971-90, Norway 1971-91, Sweden 1971-89	65 868 male and 2121 female painters and wallpaper hangers, aged 25-64 years at 1970 censuses, were followed-up for cancer incidence during 1987-91 by linkage to national cancer registries	Occupation was obtained from census data and coded according to national adaptations of the Nordic Occupational Classification or according to a special Danish nomenclature.	Lung, bronchus, trachea (ICD7 162)	Painters and wall paper hangers Men Women	[1463] 1450 13	SIR (95%CI) [1.22 (1.16-1.29)] 1.22 (1.16-1.28) 1.55 (0.83-2.65)	Age, sex, time period	Reference, national populations; The Swedish component partly overlaps Brown <i>et al.</i> (2002) who also included painters from the 1960 Swedish census. Excluded from meta-analysis because of overlap with Pukkala <i>et al.</i> (2009).

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Boice <i>et al.</i> (1999) USA 1960-96	1216 painters (1139 men, 77 women) employed \geq 1yr in the aircraft industry, followed-up retrospectively for mortality	Detailed job history was obtained from work history cards	Lung, bronchus, trachea (ICD9, 162)	Painter	41	SMR (95% CI) 1.11 [0.80-1.51]	Age, sex, race, calendar year	Reference, California worker and general US populations; Other cancer causes non-informative due to small numbers of deaths; painting not described in detail except that paints contained chromates. There is a possible small overlap with Dunn & Weir (1965) and Menck & Henderson (1976)
Steenland & Palu (1999) USA 1975-94	42 170 painters and 14 316 non-painters with \geq 1 yr union membership were identified from union records and followed from 1975-94 by linkage to national and local registers; Restricted to white men (98% of the cohort).	Job titles were inferred from union membership records which identified the specialty affiliation and trade of the local union for all members	Lung	Painter	1746	SMR (95% CI) 1.23 (1.17-1.29)	Age, calendar time.	Update of Matanoski <i>et al.</i> (1986) Reference, general US population; No information on trade of individual members; SRRs compared painters to non-painters;

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Brown <i>et al.</i> (2002) Sweden 1971-89	People in the painting trades or painting industry (42 433 male painters and 6662 male and 2136 female pictorial artists) obtained from 1960 and 1970 Swedish census data were linked to the Cancer Environment Register to follow-up for cancer incidence from 1971-89	Job title and industry were obtained from census data and coded using Swedish occupational codes.	Lung	Male painters (classified either in 1960 or 1970)	548	SIR (95%CI) 1.2 (1.1-1.3)	Age, sex, calendar year	Reference, national population; Lung cancer risk was not increased among artists; Excluded from meta-analysis because of overlap with Pukkala <i>et al.</i> (2009)
Pronk <i>et al.</i> (2009) PR China 1996-2005	71,067 never smoking women that held a job outside the home; aged 40-70 years; identified through resident offices in 7 representative urban communities; average 4.1 years prospective follow-up for mortality & cancer incidence by linkage to Shanghai Cancer Registry and in-person biennial contact; 219 lung cancer diagnoses; >92% participation rate	In-person interview to obtain detailed lifetime occupational histories for each job held >1 year; coded according to the 1986 Chinese National Standard Occupational and Industry Codes Manual	Bronchus or lung (ICD-9 162.0-162.9)	Painter (construction, automotive industry, and other users) ≥ 26 years since 1 st employment Years employment* 0 <10 ≥ 10 <20 ≥ 20	6 NG 213 1 5 5 1	HR (95% CI) 2.0 (0.9-4.5) 3.1 (1.4-7.0) 1.0 (ref) 0.83 (0.12-5.90) 2.75 (1.12-6.73) 2.17 (0.89-5.31) 1.36 (0.19-9.75)	Passive smoking, family history of cancer, education age, passive smoking (smokers excluded), education level, family history of lung cancer	Risk increased with duration of employment & time since 1 st employment. *information obtained by contacting authors

Table 2.1 Cohort studies of lung and respiratory cancer among persons with occupation as a painter

Reference, location, time period	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/deaths	RR/SIR/SMR (95% CI)	Adjustment for potential confounders	Comments
Pukkala et al. (2009) Denmark 1971-2003, Finland 1971-2005, Iceland 1982-2004, Norway 1961-2003, Sweden 1961-2005	15 million people aged 30-64 years in the 1960, 1970, 1980/1981 and/or 1990 censuses and the 2.8 million incident cancer cases diagnosed in these people in a follow-up until about 2005 were linked to Nordic national registries	Occupation from self-administered census questionnaire, coded using ISCO codes adapted to Nordic countries	Lung, bronchus, trachea (ICD7, ICD9, ICD-O-1-3)	Painters Men Norway 1971-1991 smoking adjusted Women	[3465] 3418 260 47	SIR (95% CI) [1.24 (1.20-1.28)] 1.23 (1.19—1.28) 1.38 [1.22-1.56] 1.52 (1.34-1.72) 1.90 (1.40—2.53)	Country, sex, age, period smoking adjusted	Reference, national populations; Estimated 69.1% of Norwegian male painters smoked; Nordic Occupational Cancer (NOCCA) project; Update of Andersen et al. (1999)

Abbreviations: CI, confidence interval; HR, hazard ratio; ICD, International Classification of Diseases; RR, relative risk; SIR, standardized incidence ratio; SMR, standardized mortality ratio; n.e.c., not elsewhere classified