Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Agudo et al. (2000) Barcelona and Cadiz, Spain	132 cases (77% males) of histologically con®rmed malignant pleural mesothelioma identified from hospital in the region between 1/1/1993 and 12/31/1996.	257 controls frequency matched on age and gender to cases from area hospitals. Individuals with asbestos related diseases were excluded.	Interview administered questionnaire.	Intensity Low Medium High Probability Low Possible/High Exposure Certain Exposure Unknown	 3.4 (1.7–6.5) 10.0 (4.4–22.7) 27.1 (9.3–79.3) 1.9 (0.87–4.13) 4.1 (1.97–8.30) 13.2 (6.4–27.3) 17.9 (4.1–77.9)	Center, sex, and age	
Cicioni et al. (1991), Los Angeles County, California, USA	143 male cases aged 16–64 identified from the tumour registry between 1972–1988.	35 751 other male cancers (excluding lung) ages 16–64 identified from the tumour registry between 1972–1988.	Occupation and industry at time time of diagnosis was used to characterize exposure with: 1) NOHS-JEM data 2) Review by two of the authors	1) NOHS-JEM, Probability of Exposure 0 0- 0.1 > 0.1 2) Authors Classification None Low High	 1.0 2.0(1.2–3.4) 2.4(1.2–3.3) 1.0 1.6(1.1–2.3) 6.4(2.5–15.2)	Age, race & ethnicity Age, race & ethnicity	
Cristaudo et al. (2005), Italy	19 cases diagnosed at 2 hospitals in Italy.	18 bladder urotheliomas diagnosed at the same hospitals	Personal interviews conducted using a questionnaire. SV40 determined based on analysis of tumour samples.	Asbestos/SV40(RReg) Asb-/SV40- Asb-/SV40+ Asb+/SV40- Asb+/SV40+	 1.0 0.4(0.3–4.0) 3.6(0.6–21.0) 12.6(1.2–133.9)	none	

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Hessel et al. (2004), USA	208 cases diagnosed between 1975–1980 from the LA County Cancer Surveillance Program, New York State Cancer Registry, & 39 VA hospitals.	533 controls were identified from death certificates for LA and NY. For cases from VA hospitals were selected from those who had died and received medical and financial benefits from the VA. Controls were matched to cases by date of birth, race, sex, year of death, and county of residence (for those in NY and LA County) or hospital (for those from the VA) to the larger group of cases.	Interviews of next of kin by interviewers. This paper was focused on analysis of occupational exposure to asbestos in brake work.	Occupational Brake Work Any < 10 years ≥ 10 years	 0.8(0.4–1.8) 1.0(0.3–3.2) 0.7(0.2–2.0)	Age, and employment in other activities involving asbestos exposure.	Primarily exposed to short chrysotile fibres. Only 1 case had only been exposed to asbestos from brakes.

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Howel et al. (1997), Northern England	185 cases identified from the HSE National Mesothelioma Registry, the Yorkshire Regional Cancer Registry & local postmortem records. Subjects were included who died between 1979–1991 it the address at death was in a Yorkshire district of several urban areas.	159 controls were identified from necropsy records and matched to cases for age at death, year of death, and sex. Controls were excluded that died from mesothelioma, lung or ovarian cancer.	Interviews were conducted of next of kin using a semistructured questionnaire that included occupational, para-occupational (i.e. from household members) & residential exposures.	Occupational exposure: Likely vs possible & unlikely Likely & possible vs unlikely Para-Occupational (excluding individual with occupational exposures): Likely vs possible & unlikely Likely & possible vs unlikely Residential (excluding individual with occupational or para-occupational exposures): Likely vs possible & unlikely Likely & possible vs unlikely	 9.1(4.8–17.1) 5.6(3.1–10.1) 61.7(3.4–1104) 5.8(1.7–19.2) 6.6(0.9–50) 2.3(0.5–9.7)	Age, year of death and district.	

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Howel et al. (1999), Northern England	147 cases identified from the HSE National Mesothelioma Registry, the Yorkshire Regional Cancer Registry & local postmortem records. Subjects were included who died between 1979–1991 it the address at death was in a Yorkshire district of several urban areas.	122 controls were identified from necropsy records and matched to cases for age at death, year of death, and sex. Controls were excluded that died from mesothelioma, lung or ovarian cancer.	Interviews were conducted of next of kin using a semistructured questionnaire that included occupational, para-occupational (i.e. from household members) & residential exposures. Electron microscopy of normal lung tissue was conducted to determine mineral specific fibre counts.	High Levels of Lung Asbestos Fibres Non-asbestos Chrysotile Amosite Crocidolite Amphiboles	 1.4(0.7–2.8) 1.9(1.0–3.8) 3.0(1.4–6.5) 13.9(5.6–34)	Age, year, district and other fibre concentrations.	
Imbernon et al. (1995), France	12 cases that occurred between 1978 and 1989 in a cohort of active male workers in a French gas and electric utility company (EDF-GDF).	47 controls randomly selected from the cohort who were active and cancer free were matched to cases on year of birth.	A Job Exposure Matrix was developed based on expert opinion	Exposed (yes/no) Duration ≥ 20 years	4.8(1.2–19.7) 7.1(1.0–50.1)	SES	

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Iwatsubo et al. (1998), France	405 histologically confirmed cases of pleural mesothelioma from 5 administrative regions of France that occurred between 1987–1993 and who were alive at time of interview..	287 hospital controls matched to cases on age, sex, administrative region, racial/ethnic origin.	Interviewer administered standardized questionnaire. Work histories reviewed by a panel of 5 industrial hygienists to determine asbestos exposure.	**Men** Cumulative Exposure (fibre/ml*years) 0.001–0.049 0.5- 0.99 1–9.9 ≥ 10 **Women** Possibly or Definitely Exposed	 1.2(0.8–1.8) 4.2(2.0–8.8) 5.2(3.1–8.8) 8.7(4.1–18.5) 18.8(4.1–86.2)	Age & SES	
Luce et al. (2000), New Caledonia	15 pleural mesothelioma cases identified from the cancer registry of New Caledonia diagnosed between 1993 and 1995 who were older than 18 and had lived in New Caledonia for at least 5 years.	305 population controls randomly selected from the census rolls. Controls were frequency matched to age and sex distribution of cases.	In person interviews were conducted with a questionnaire that included questions on use and living in homes of whitewash (“po”) containing tremolite.	Ever vs Never Duration < 20 years ≥ 20 years	40.9(5.2–325) 22.2(2.3–211) 65.1(7.7–551)	Age & sex	

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Magnani et al. (2000), Italy, Spain & Switzerland	53 pleural mesothelioma identified from cancer registries or hospital pathology departments in 1) Italy – Torino, Casale Monferato, Florence & Prato, 2) Spain – Barcelona & Cadiz, and 3) Geneva, Switzerland. Cases diagnosed between 1995–1996 except in Barcelona that included cases from 1993 & 1994, and in Torino where recruitment ended in 1997. Analysis was limited to cases without history of occupational asbestos exposure	232 controls were randomly selected from population in Italy, and Switzerland. In Spain controls randomly selected from hospital patients excluding those with asbestos related diseases. Analysis was limited to controls without history of occupational asbestos exposure	Interviews of cases and controls or next of kin using questionnaire on work histories that were reviewed by a panel of industrial hygienists for asbestos.	1) Probability of Exposure Domestic Never Low Medium or High Environmental Never Low Medium or High 2) Intensity of Exposure Domestic Never Low Medium High Environmental Never Low Medium High	 1 2.1(0.8–5.1) 4.8(1.8–13.1) 1 2.7(0.9–8.4) 11.5(3.5–28.2) 1 2.0(0.8–5.1) 5.7(1.4–23.3) 7.8(1.7–36.2) 1 2.2(0.7–7.6) 9.5(2.5–36.5) 45.0(6.4–318)	Center, sex and age; Domestic and environmental are mutually controlled for.	

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Magnani et al. (2001), Italy	102 cases of pleural mesothelioma between 1 January 1987 and 30 June 1993 in residents in the Local Health Authority (LHA) of Casale through the Pathology units serving the area. This area is the site of an asbestos cement (AC) factory.	243 controls were randomly selected either from the files of residents in the LHA of Casale (if the corresponding case was alive) or from the mortality files (for deceased cases). Controls were individually matched by sex, birth date, vital status, and date of death.	Standardized questionnaires administered by trained interviewer of the study subjects or family members (if deceased).	Working in AC Living with an AC worker Living in Casale < 500 m 500–1499 m 1 500–2499 m > 2 500 m	52.5(12.5–220.0) 4.5(1.8–11.1) 20.6(6.2–68.6) 27.7(3.1–247.7) 22.0(6.3–76.5) 21.0(4.9–91.8) 11.1(1.8–67.2)	Matching variables Matching variables and AC work.	
McDonald et al. (1997), Quebec, Canada	21 mesothelioma deaths from a cohort of 10 198 miners and millers born 1 891–1920 who had worked for a month or more in the asbestos mines or mills of Quebec and were followed up to 1992.	Approximately 10 referents for each case were randomly selected from the same cohort matched to cases on survival to the same age, year of birth and year first employed in the industry	Areas with higher potential exposure to tremolite (central mines) were compared with areas with lower potential (peripheral areas).	OR for 20 years of employment: Central mines (high tremolite) Peripheral mines (low tremolite)	 2.6(1.5–4.3) 1.1(0.5–2.6) LRT = 4.5 (P = 0.03)	Matching variables.	A previous pathologic study showed tremolite levels to be 4 times higher in the lungs of workers from the Central mines than those from the peripheral mines.

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
McDonald et al. (2001b), United Kingdom	69 males cases who were reported to a national work related surveillance program who had died ate age 35 to 52 and had an autopsy.	57 controls who had died from accidents or sudden cardiac events were obtained to the extent possible obtained from the same pathologists as the cases.. Controls were similar age, gender and region as the cases.	Lung fibre concentrations in pathologic samples were determined for different fibre types.	Lung fibre concentrations **All amphiboles** 0 0.1–0.9 1.0–9.9 10.0- Linear model (OR per unit of exposure) **Chrysotile** 0 0.1–0.9 1.0–9.9 10.0- Linear model (OR per unit of exposure)	 1.0 9.2(1.9–44.5) 64.7(9.8–425) 55.8(3.9–792) 19.4(4.2–137) 1 1.5(0.6–3.9) 2.2(0.8–6.2) - 0.1(< 0–1.2)	Age and region	
Muscat and Wynder (1991), New York City	124 histologically confirmed cases diagnosed primarily at New York city hospitals between 1981 and 1990.	267 hospital controls with non-tobacco related diseases were randomly selected and matched on age, hospital, race and month of interview.	Interview administered structured questionnaire with questions on smoking, occupation and self reported exposure to asbestos.	Work in asbestos related occupations Duration of asbestos exposure (non-shipyards) 0 1–9 10–19 20–29 30+	8.1(4.9–13.5) 1 4.3(1.9–9.7) 4.6(2.0–10.9) 8.3(3.0–22.8) 9.2(4.4–19.9)	None	

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Pan et al. (2005), California	1133 incident cases age ≥ 35 diagnosed between 1988 and 1997 were identified from the California Cancer Registry (CCR) with complete data on residence, occupation, age and sex.	890 pancreatic cancer cases matched to cases on age and sex were identified from the CCR in the same time period with complete data on residence, occupation, age and sex.	Addresses of the cases and controls were mapped for distances from known deposits of asbestos containing ores. Longest held occupation was ranked for probability of exposure to asbestos.	**Men** Probability of Occupational Exposure None Medium Low High **Women** Probability of Occupational Exposure None Medium Low High **All subjects** Distance (decrease in OR for every 10 km) p value for trend	 1 1.9(1.6–2.3) 2.8(2.3–3.4) 14.2(9.5–21.3) 1 2.2(0.9–5.1) 4.7(1.3–16.3) 5.9(0.7–49.6) 0.95(0.85–1.06) 0.006	 Age Age, sex and occupational exposure	

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Rees et al. (1999), South Africa	122 histologically confirmed cases from all hospitals in 6 major industrial areas of South Africa.	Two controls, one with a medical condition (n = 103) and the other with cancer (n = 119) were selected and matched to each case on hospital, skin colour, gender and age. Individuals were excluded if they had an asbestos related disease.	Study subjects were interviewed by an interviewer using a structured questionnaire. Sputum samples were evaluated for the presence of coated fibres.	**Probability of Exposure** (medical and cancer controls combined) Possible Probable Definite **Nature of Exposure** Occupational Environmental **Environmental Exposure by Region** NW Cape (Crocidolite) NE Transvaal (Amosite or Crocidolite) E Transvaal (Chrysotile)	 4.4(1.0–20.5) 5.5(1.4–22.5) 58.7(14.0–246) 80.6(15.7–414) 19.6(3.7–105) 32.7(8.1–131) 12.7(1.9–84.7) – (0 cases)	Matching variables	

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Rödelsperger et al. (2001), Germany	125 male confirmed cases were recruited between 1988 and 1991 from clinics Hamburg.	125 population controls randomly selected from registries matched to cases on region of residence and year of birth.	Interviewer administered structured questionnaire with detailed questions on exposure to asbestos and other mineral fibres.	**Duration of Exposure** Not Exposed > 0–10 years > 10–20 years > 20–30 years 30 years **Highest Intensity of Exposure** Not Exposed Low Medium High **Cumulative Exposure (fibre years)** Not Exposed > 0–0.15 > 0.15–1.5 > 1.5–15 > 15	 1 10.4(2.9–37.1) 16.5(4.1–65.6) 27.7(5.8–132) 43.7(10.8–177) 1 9.2(2.3–35.9) 17.9(5.0–64.4) 46.3(12.1–178) 1 7.9(2.1–30.0) 21.9(5.7–83.8) 47.1(11.5–193) 45.4(8.1–257)	Age and region of residence	

Table 2.4. Summary of design and findings from mesothelioma case-control studies

Reference, study location and period	Characteristics of cases	Characteristics of controls	Exposure assessment	Exposure categories	Relative risk (95% CI)*	Adjustment for potential confounders	Comments
Rogers et al. (1991), Australia	221 histologically confirmed cases identified from the Australian Mesothelioma Surveillance Program from 1980 to 1985 with available lung tissue material.	359 deceased individuals with necroscopy or lung resection specimens that were collected during the same time period as a part of another study at a hospital in Sydney, Australia. Cases with pneumoconiosis, emphysema, pneumonia, or gastrointestinal cancer were excluded.	Lung tissue fibre content was measured with PCM and TEM.	**Based on Best Fitting Logistic Multivariable Model** **Crocidolite, length ≥ 10 µm** OR for increase of 10 fb/µg p-value trend **Amosite, length < 10 µm** OR for increase of 10 fb/µg p-value trend **Chrysotile, length < 10 µm** OR for increase of 10 fb/µg p-value trend **Subgroup Cases & Controls with only chrysotile fibres (all lengths)** p-value trend	 29.4(3.6–241) 0.002 2.3(1.0–5.3) 0.05 15.7(6.1–40) 0.00001 $P < 0.0005$	Age	
Welch et al. (2005), Washington DC	40 peritoneal mesothelioma cases treated at the Washington Cancer Institute between 1989 and 2001	Appendiceal cancer cases treated at the WCI between 1990 and 2000. Controls were matched to cases on age and sex.	Cases and controls were interviewed by telephone using a questionnaire designed for a mesothelioma study.	Overall exposure to asbestos	5.0(1.2–21.5)	Matching variables.	