Table 2.3 Cohort studies of workers in the rubber industry and respiratory cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Adjustment factors	Comments
Lung								
Ietri *et al.* (1997), Italy	925 workers (578 men, 347 women) employed >6 months in 20 factories, from mid-50s to 70s to 1989, mortality follow up through 1989; vital status 100%; cause of death 99%	Individual data abstracted from payroll records. Considered exposed if employed at any of the facilities >1 year	Lung	Overall Men *Latency* <20 years >20 years	9 9 6 3	**SMR** 2.1 (p<0.1) 2.2 (90% CI: 1.1-3.8) 1.9 3.3		Local reference. No statistically significant increased risks for stomach and lymphatic cancers (small number of deaths)
Mundt *et al* (1999), Germany	2871 female workers employed >1 year in 5 rubber plants and actively employed from 1976-1980; mortality follow up 1976-91; vital status 99%; cause of death 94%	Work history reconstructed from archived cost center codes. Classified into 6 work areas by type and stage of manufacturing process	Lung	Overall *Year of hire* <1950 1950-59 ≥1960	7 4 1 2	**SMR** 1.4 (0.6-2.9) 3.7 (1.0-9.4) 0.6 0.9 (0.1-3.3)		Local reference. No excess due to leukemia was observed

Table 2.3 Cohort studies of workers in the rubber industry and respiratory cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Adjustment factors	Comments
Weiland *et al.* (1996); Weiland *et al.* (1998); Straif *et al.* (1998); Straif *et al.* (1999); Straif *et al.* (2000a); Straif *et al.* (2000b), Germany	8933 male workers aged <85 years, employed >1 year in 5 rubber plants from 1950-1981; mortality follow up 1981-91; vital status 99%; cause of death 97%	Retrospective semi-quantitative exposure reconstruction of nitrosamines, asbestos, talc and carbon black using individual work histories and limited IH air measurements; low exposure workers were employed <0.5 year in high/medium exposures, high exposure were employed >10 years in high exposures	Lung	Overall	154	**SMR** 1.2 (1.0-1.4)	HRR adjusted for age and all other exposures; 10-year lagging	Local reference. No increased risk by exposure to nitrosamines and carbon black
				HRR				
				Work area (≥1 year)				
				Material preparation	48	1.7 (1.2-2.3)		
				Technical rubber	63	1.5 (1.1-2.1)		
				Tires	37	1.3 (0.9-1.8)		
				Storage	12	1.0 (0.6-1.8)		
				Maintenance	32	1.0 (0.7-1.5)		
				Asbestos/talc				
				Low	69	1.0		
				Medium	65	1.1 (0.8-1.6)		
				High	13	2.0 (0.8-5.4)		
Szeszenia-Dabrowska *et al* (1991, Szeszenia-Dabrowska *et al* (1995), Szymczak *et al.* (2003), Poland	11342 workers (5472 men, 5870 women) employed >1 year during 1945-85 in a rubber footwear plant; mortality follow up until 1997	Occupational history from company records	Lung	Men	157	**SMR** 1.3 (1.1-1.5)		National reference
				Duration of exposure (years)		RR		Non-exposed workers as a reference group.
				1-2	24	1.4 (0.8-2.4)		
				2-5	32	1.4 (0.9-2.4)		
				5-10	19	1.3 (0.7-2.3)		
				10-20	33	1.7 (1.1-2.9)		
				20+	21	0.6 (0.3-1.1)		
				Women	35	1.4 (1.0-2.0)		

Table 2.3 Cohort studies of workers in the rubber industry and respiratory cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Adjustment factors	Comments
Straughan and Sorahan (2000); Dost *et al.* (2007), United Kingdom, BRMA health research project II	8651 workers of 41 rubber manufacturing plants (7561 men, 1090 women) employed >1 year during 1982-1991, office workers were excluded; mortality and incidence follow-up 1983-2004; vital status 98%	Workers considered exposed if employed in rubber manufacture; period from hire as surrogate for cumulative exposure	Lung and bronchus	Men Women Men Women	22 2 27 2	**SMR** 0.9 (0.6-1.4) 0.7 (0.1-2.5) **SRR** 1.0 (0.7-1.4) 0.6 (0.1-2.1)	Stratification by industry sector (tire manufacture or general rubber goods)	Local reference
Wilczyńska et al. (2001), de Vocht *et al.* (2009), Poland	17636 workers (11582 men, 6054 women) employed >3 months during 1950-95 in a rubber tire plant; mortality follow-up 1950-2001; vital status 97%; cause of death 88%	JEM for exposure to aromatic amines, inhalable aerosols and rubber fumes from a database of exposure data for the European rubber industry	Lung	*Men* Overall	 82	**SMR** 0.7 (0.6-0.9)	5-year lagging, gender-specific analyses	No association by work area or with exposure to aromatic amines or inhalable aerosol

Table 2.3 Cohort studies of workers in the rubber industry and respiratory cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Adjustment factors	Comments
Larynx								
Weiland *et al.* (1996); Weiland *et al.* (1998); Straif *et al.* (1998); Straif *et al.* (1999); Straif *et al.* (2000a); Straif *et al.* (2000b), Germany	8933 German male workers aged <85 years, employed >1 year in 5 rubber plants from 1950-1981; mortality follow up 1981-91; vital status 99%; cause of death 97%	Retrospective semi-quantitative exposure reconstruction of nitrosamines, asbestos, talc and carbon black using individual work histories and limited IH air measurements; low exposure workers were employed <0.5 year in high/medium exposures, high exposure were employed >10 years in high exposures	Larynx	Overall *Asbestos* Low Medium High *Talc* Low Medium High *Carbon black* Unexposed Exposed	8 4 3 1 3 2 3 4 4	**SMR** 1.2 (0.5-2.3) 1.0 2.3 (0.5-10.2) 4.7 (0.5-42.8) 1.0 2.8 (0.5-16.7) 5.4 (1.1-27.0) 1.0 5.3 (1.3-21.4)	HRR adjusted for age and all other exposures; 10-year lagging	Local reference
Wilczyńska et al. (2001), de Vocht *et al.* (2009), Poland	17636 workers (11582 men, 6054 women) employed >3 months during 1950-95 in a rubber tire plant; mortality follow-up 1950-2001; vital status 97%; cause of death 88%	JEM for exposure to aromatic amines, inhalable aerosols and rubber fumes from a database of exposure data for the European rubber industry	Larynx	Men Overall *Quartiles* Inhalable aerosol I II III IV	 11 18	**SMR** 0.8 (0.4-1.4) **RR** 1.0 0.8 (0.2-3.1) 0.3 (0.1-1.7) 0.2 (0.0-0.9)	Sex specific analyses	No increased mortality risk of leukemia or multiple myelomas

Table 2.3 Cohort studies of workers in the rubber industry and respiratory cancer

Reference, location, name of study	Cohort description	Exposure assessment	Organ site (ICD code)	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Adjustment factors	Comments
Other respiratory cancer sites								
Weiland *et al.* (1996); Weiland *et al.* (1998), Straif *et al* (1998), Germany	11663 German male workers aged <85 years, employed >1 year in 5 rubber plants from 1950-1981; mortality follow up 1981-91; vital status 100%; cause of death 97%	Work history reconstructed from archived cost center codes. Classified into 6 work areas by type and stage of manufacturing process	Pleura (163)	Overall	17	**SMR** 4.0 (2.3-6.4)	Stratified analyses by year of hire and years of employment	Local reference
				Work area				
				Material preparation	4	4.5 (1.1-11.5)		
				Technical rubber	7	5.0 (2.0-10.4)		
				Tires	3	2.9 (0.6-8.4)		
				Storage	1	3.8		
				Maintenance	5	5.5 (1.8-12.9)		

HRR-hazard rate ratio, IH-industrial hygiene, JEM-job-exposure matrix, , OR-odds ratio, RR-relative risk, SIR-standardized incidence ratio, SMR-standardized mortality ratio, SRR-standardized registration ratio