Table 2.1. Cohort studies of 2-naphthylamine and cancer

Reference	Cohort description	Exposure assessment	Organ site	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Comments
Case et al. (1954) UK	Employees of the British chemical industry as of 1952.. 87.4% of them had had contact with 2-naphtylamine, benzidine or alpha-naphthylamine.	Nominal roll of firms	Bladder	3198 manufactured 2-naphthylamine and/or other substances. 1275 used but did not manufacture	127	SMR 86.7 (56.6-127.0)*	Reference population: UK
	Exposed to 2-Naphthylamine	Process reviews	Bladder	149 purified . 2-naphthylamine	26	86.7 (56.6-127.0)*	
Mancuso & el-Attar (1967) USA	639 male workers manufacturing 2-naphthylamine and benzidine in Ohio (USA)	Employment in companies manufacturing 2-naphth	Bladder	Overall	14	SMR: 17.7	Reference population: Ohio
			Prostate		5		
			Kidney		2		
			Pancreas		6	SMR: 5.2	
			Lung		8		
Rubino et al. (1982), Decarli et al. (1985), Piolatto et al. (1991) Italy	Cohort of 906 men employed in dye manufacturing >1 year during 1922-70 in Turin (Italy); mortality follow-up 1946-81	Occupational history from plant records				**SMR's**	Reference population: Italy
			Bladder	Manufactured benzidine or 2-naphthylamine	27	142.11	
				Handling BZ and 2-naphthylamine	3	16.67	
				Exposure to 2-naphthylamine alone	6	150	

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Reference	Cohort description	Exposure assessment	Organ site	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Comments
Morinaga et al. (1982) Japan	Cohort of 3322 workers manufacturing 2-naphthylamine and benzidine during 1950-1978. 244 had suffered bladder cancer.	Work records	Second primary cancer	Exposed to 2-naphtylamine	1 maxillary sinus cancer	Observed/ expected counts given for benzidine and 2-naphth. together	Reference population: Osaka
				Exposed to 2-naphtylamine and benzidine	1 prostate cancer		
Morinaga et al. (1990) Japan	Cohort of 604 male workers of two 2-naphthylamine and/or benzidine manufacturing plants in Osaka employed during 1945-71	No information	Several sites			**SMR's**	Reference population: Osaka
				2-naphthylamine alone	All cancers: 8	1.17	
					Urinary: 2	11.76**	
					Stomach: 2	0.78	
					Lung:2	1.73	
				benzidine and 2-naphthylamine	All cancers: 5	1.42	
					Urinary: 2	25**	
					Stomach. 1	0.76	
					Liver: 2	4.48	
Delzell et al. (1989) USA	Cohort of 89 men employed at least 6 months in a plant that produced or used benzidine and 2-naphthylamine	Complete work history	Several sites	benzidine and 2-naphthylamine		**SMR's**	Reference.population: White USA males
					All cancers:17	1.99	
					Bladder:3	12	
					Kidney: 2	9.52	
					CNS: 2	9.09	

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Reference	Cohort description	Exposure assessment	Organ site	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Comments
Szeszenia-Dabrowska *et al.* (1991) Poland	Cohort of 6978 male rubber goods production workers employed >3 months during 1945-73	Occupational history from plant records 2-naphthylamine was not studied separately	Bladder	Subcohort employed during 1945-53 when 2-naphthylamine was used	6	**SMR** 2.76 (p<0.05)	Reference population: Poland
Bulbulyan *et al.* (1995) Russia	Cohort of 4581 aniline dye production workers (2409 men, 2172 women) employed >1 month if ever exposed to benzidine or 2-naphthylamine, others employed for >2 years during 1930-75; 514 men, 287 women ever exposed to benzidine or 2-naphthylamine; mortality and incidence follow up 1975-89;	Limited industrial hygiene air and environmental measurements; jobs classified into 5 mutually exclusive groups based on benzidine or 2-naphtylamine production	Bladder			**SIR**	Reference population: Moscow. In this table, results are given for exposure to 2-naphthylamine only.
				≤ 3 years	1	15.1 (0.02-84.04)	
				>3 years	8	19.54 (8.42-38.51)	
				<10 y	1	5.51 (0.07-30.68)	
				10-19	2	21.93 (2.46-79.16)	
				20-29	3	25.85 (5.19-75.49)	
				30-39	3	45.62 (9.17-133.29)	
				40+	0	0 (-)	

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Reference	Cohort description	Exposure assessment	Organ site	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Comments
Naito *et al.* (1995) Japan	Cohort of 442 dyestuff workers (437 men, 5 women) during 1935-88; mortality and incidence follow-up 1935-92	Duration of employment or use facility as surrogate of duration of exposure				**SMR**	Population reference: Japan
			Urinary tract (188, 189)	2-naphthylamine manufacture	3	24.4 (5.0-71.4)	
			Bladder	2-naphthylamine manufacture	3	48.4 (10.0-141.5)	
			Liver	2-naphtylamine manufacture	2	3.4 (0.4-12.2)	
				2-naphthylamine use	1	1.4 (0.04-7.8)	
			All sites	2-naphtylamine manufacture	9	1.9 (0.9-3.7)	
				2-naphthylamine use	2	0.4 (0.1-1.4)	
Schulte et al. (1985, 1986) Stern et al., (1985) Axtell et al., (1998) USA	Cohort of 1384 (1385 in the first publications of the cohort) employed from 1940 to 1992 in a chemical plant in Georgia. Potentially exposed to 2-naphtylamine through 1979.	"Detailed exposure assessment was not done"				**SMR**	Population reference: USA and Georgia
			Bladder	Underlying cause of death	3	2.4 (0.5-7.0)	Only males were considered for final analysis
				Listed anywhere on the death certificate	8	5.6 (2.4-11.1)	
			Oesophagus	Not specified	7	2.0 (0.8-4.1)	
			Digestive	Not specified	21	1.06 (0.66-1.63)	
			Mouth and pharynx	Not specified	1	0.37 (0.01-2.05)	
			Lung	Not specified	41	1.67 (1.20-2.26)	
			Hematopoietic	Not specified	4	0.71 (0.19-1.81)	
			Prostate	Not specified	11	2.13 (1.06-3.80)	

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Reference	Cohort description	Exposure assessment	Organ site	Exposure categories	No. of cases/ deaths	Relative risk (95% CI)*	Comments
Budnick et al. (1984), Cassidy et al. (2003), Marsh & Cassidy (2003) USA	Cohort of 400 employees (374 males, 26 females) of the Drake Chemical Company employed from 1941 to 1981. The company produced 2-naphthylamine until 1962.	"workers with sufficient data for analysis" were included	All cancers		28	3.08 (2.05-4.46)	Reference population: USA and Local
			Bladder		4	16.83 (4.59-43.1)	
			Respiratory system		12	3.91 (2.02-6.83)	
Veys (1969, 2004) UK	Cohort of male workers of the British rubber industry. 2090 possibly exposed to 2-naphthylamine (before 1949) and 3028 not exposed (after 1950)	Exact work histories, personal details	Bladder			**SIR's**	Reference population: National and Local
				Exposed to 2-naphthylamine	58	1.71 (1.3-2.21)	
				Not exposed to 2-naphthylamine	39	1.02 (0.72-1.39)	

ND-not determined, OR-odds ratio, SIR-standardized incidence ratio, SMR-standardized mortality ratio
*Calculated from data, based on method of Byar Method in Boice for the programmable calculator