

Table 2.5 Case-control studies of formaldehyde and lymphohematopoietic malignancies

Reference, study location, years of study	Characteristics of cases	Characteristics of controls	Exposure assessment	Organ site (ICD code)	Exposure categories	Number of exposed cases	Relative risk (95% CI)	Adjustment for potential confounders	Comments
Gérin <i>et al.</i> (1989), Canada, 1979–85	53 male incident cases	533 population-based	Lifetime job histories obtained by interview and translated into level of exposure to formaldehyde	Hodgkin lymphoma	Ever	8	0.5 (0.2–1.4)	Age, ethnic group, self-reported income, tobacco smoking, dirtiness of jobs held and potentially confounding occupational and non-occupational factors	Similar results were obtained when 2599 cases of other cancers were used as control group *average exposure index
	206 male incident cases			Non-Hodgkin lymphoma	< 10 years duration	13	0.7 (0.3–1.6)		
					≥ 10 years duration				
					Low*	15	1.1 (0.5–2.2)		
		Medium*	14	1.0 (0.5–2.1)					
			High*	5	0.5 (0.1–1.7)				
Linos <i>et al.</i> (1990), USA (years of study not given)	578 male incident cases	1245 population-based	Lifetime occupational history obtained	Leukaemia	Ever employed in funeral home or crematorium	4	2.1 [0.4–10.0]	Adjusted for age and state of residence	Significantly elevated relative risks of 6.7 and 6.7 for acute myeloid leukaemia and follicular non-Hodgkin lymphoma, but based on small numbers
	622 male incident cases			Non-Hodgkin lymphoma	Ever employed in funeral home or crematorium	6	3.2 [0.8–13.4]		

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Partanen <i>et al.</i> (1993), Finland, 1957–1982	12 male cases of leukemia, 4 male cases of Hodgkin lymphoma and 8 male cases of Non-Hodgkin lymphoma diagnosed among a cohort of 7307 production workers in wood industry	Randomly selected from cohort and matched by year of birth and vital status in 1983; 79 for leukemia, 21 for Hodgkin lymphoma and 52 for Non-Hodgkin lymphoma	Work history from company records complemented for cases only by interviews with plant personnel and questionnaires completed by subjects or next of kin; plant- and period-specific job–exposure matrix	Leukaemia	≥ 3 ppm–months	2	1.40 (0.25–7.91)	Matching factors accounted for by conditional logistic regression	Data collection was more exhaustive for cases than for controls, which could have led to bias. Relative risk for all three outcomes combined did not substantially change when adjusted for wood dust or for solvents.
				Hodgkin disease	≥ 3 ppm–months	1	NA		
				Non-Hodgkin lymphoma	≥ 3 ppm–months	4	4.24 (0.68–26.6)		
West <i>et al.</i> (1995), United Kingdom (years of study not given)	400 (216 men, 184 women) newly diagnosed, resident in study area and aged > 15 years	400 cancer-free patients from out-patient clinics and inpatient wards, matched 1:1 by age (± 3 years), sex, area of residence and hospital and year of diagnosis (± 2 years)	Personal interview on work history and for duration and intensity of exposure to formaldehyde, all questionnaires reviewed by team of experts	Myelodysplastic syndrome	> 10 h lifetime exposure of any intensity	15	1.17 [0.51–2.68]	No adjustment for smoking or other factors	
					> 50 h lifetime exposure of medium or high intensity	7	2.33 [0.55–11.35]		
					> 2500 h lifetime exposure of medium or high intensity	4	2.00 [0.32–15.67]		

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Tatham <i>et al.</i> (1997), USA, 1984–88	1048 men (185 small-cell diffuse lymphoma, 268 follicular lymphoma, 526 large-cell diffuse lymphoma) from population-based cancer registries, born 1929–53	1659 selected by random-digit dialling, matched by area of registry and 5-year categories of date of birth	Telephone interview including questions on specific materials participants may have worked with	Non-Hodgkin lymphoma and subgroups	<i>Ever exposed</i> All combined Small-cell diffuse Follicular Large-cell diffuse	93 21 17 46	1.20 (0.86–1.50) 1.40 (0.87–2.40) 0.71 (0.41–1.20) 1.10 (0.79–1.70)	Matching factors, age at diagnosis, year entered the study, ethnicity, education, Jewish religion, never having married, AIDS risk behaviours, use of seizure medication, service in or off the coast of Viet Nam and cigarette smoking	

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Blair <i>et al.</i> (2001), USA, 1980–83	513 white men, 30 years or older, identified from the Cancer Registry of Iowa and among all men from a surveillance network of hospitals in Minnesota; 214 chronic lymphoid, 132 acute myeloid, 46 chronic myeloid, 13 acute lymphoid, 58 myelodysplasia and 50 others	1087 selected by random-digit dialling from Health Care Financing Administration lists and from state death certificate files, frequency-matched by 5-year age group, vital status at time of interview and state of residence	Personal interviews including lifetime occupational history; formaldehyde assessed in a blinded fashion in terms of probability and intensity, each on a 4-point scale based on job title and industry	Leukaemia and myelodysplasia	<i>Acute myeloid</i>	14	0.9 (0.5–1.6)	Matching factors, post-secondary education, hair dye use, tobacco smoking, first degree relative with hematolymphopoietic tumour and agricultural use of pesticides	None of the acute lymphocytic lymphoma cases was exposed.
					Low-medium	0	–		
					<i>Chronic myeloid</i>	7	1.3 (0.6–3.1)		
					Low-medium	1	2.9 (0.3–24.5)		
					<i>Chronic lymphoid</i>	29	1.2 (0.7–1.8)		
					Low-medium	1	0.6 (0.1–5.3)		
					<i>Myelodysplasia</i>	6	0.8 (0.3–1.9)		
Low-medium	0	–							
<i>All combined</i>	61	1.0 (0.7–1.4)							
Low-medium	3	0.7 (0.2–2.6)							
					High				

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Wang <i>et al.</i> (2009), Connecticut, USA, 1996-2000	601 women, ages 21-84, histologically confirmed and diagnosed in Connecticut	717 women, selected by random digit dialing (<65 years) and Health Care Financing Administration (≥65 years) frequency matched on age (5-years)	Standardized, structured questionnaire with lifetime occupational history, previously developed job exposure matrix to assign average exposure intensity and probability	Non-Hodgkin lymphoma	Ever	203	1.3 (1.0-1.7)	Age, family history of hematopoietic cancers, alcohol consumption and race	Risk highest for diffuse large B-cell lymphoma	
					<i>Intensity</i>					
					Low	129	1.4 (1.0-1.8)			
					Medium-high	74	1.2 (0.8-1.7)			p-trend=0.05
					<i>Probability</i>					
					Low	165	1.3 (1.0-1.7)			
					Medium-high	38	1.4 (0.9-2.3)		p-trend=0.05	
Heineman <i>et al.</i> (1992), Denmark, 1970-1984	835 men diagnosed between 1970 and 1984 with multiple myeloma	2,979 men randomly chosen from Danish Population Registry, matched on sex and year of birth	Record linkage with pension fund with compulsory membership; job title from Central Pension Registry. Exposure assessed blindly as non, possible, probable, unknown	Multiple myeloma	Possible	144	1.0 (0.8-1.3)	Age		
					Probable	41	1.1 (0.7-1.6)			

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Pottern <i>et al</i> (1992), Denmark, 1970-1984	607 women diagnosed between 1970 and 1984 with multiple myeloma	2,596 women randomly chosen from Danish Population Registry, matched on sex and year of birth	Record linkage with pension fund with compulsory membership; job title from Central Pension Registry. Exposure assessed blindly as non, possible, probable, unknown	Multiple myeloma	Possible Probable	56 4	1.1 (0.8-1.6) 1.6 (0.4-5.3)	Age	