Int. J. Cancer: 67, 498–503 (1996)

Publication of the International Union Against Cancer
Publication de l'Union Internationale Contre le Cancer

LYMPHOMA, MYELOMA AND OCCUPATION: RESULTS OF A CASE-CONTROL STUDY

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The known risk factors for lymphoma and myeloma cannot account for the current incidence rates of these cancers, and there is increasing interest in exploring occupational causes. We present results regarding lymphoma and myeloma from a large case-control study of hundreds of occupational exposures and 19 cancer sites. We examine in more detail those exposures previously considered to be related to these cancers, as well as exposures which were strongly related in our initial analyses. Lymphoma was not associated in our data with exposure to solvents or pesticides, or employment in agriculture or wood-related occupations, although numbers of exposed cases were sometimes small. Hodgkin's lymphoma was associated with exposure to fabric dust, and non-Hodgkin's lymphoma was associated with exposure to copper dust, ammonia and a number of fabric and textile-related occupations and exposures. Employment as a sheet metal worker was associated with development of myeloma.

The aetiology of myeloma and lymphoma are still unknown, although there are several suspected risk factors for these cancers. The incidence of non-Hodgkin's lymphoma (NHL) appears to be increasing in most developed countries (Hartge *et al.*, 1994), and established risk factors such as HIV infection, rare genetic syndromes and immunosuppressant therapy cannot account for the magnitude of this increase (Hartge and Devesa, 1992). Similarly, a proportion of Hodgkin's lymphomas are associated with viruses, particularly the Epstein-Barr virus (Jarret, 1992), but this virus is less commonly associated with the subtypes of Hodgkin's lymphoma which have been increasing in incidence (Hartge *et al.*, 1994). The aetiology of multiple myeloma also remains elusive, although a number of occupational factors are being considered (Riedel and Pottern, 1992).

We carried out a large case-control study of 19 cancer sites, including lymphoma and myeloma (Siemiatycki, 1991) to generate hypotheses about the occupational causes of cancer. Information was obtained on exposure to each of a large number of occupational substances using a new method of assessing occupational exposures which decreases misclassification of exposure status. We have previously published initial analyses from this study. In this report we present further and more detailed examination of positive findings from our study regarding occupational risk factors for lymphoma and myeloma.

MATERIAL AND METHODS

The design and data collection methods of the case-control study of occupational exposures and 19 cancer sites have been described previously (Siemiatycki, 1991; Siemiatycki *et al.*, 1994) and will be summarized here. Subjects were males aged 35–70 years, resident in Montreal, and with a new, histologically confirmed cancer. There were 4,576 eligible cancer patients between 1979 and 1985, and 3,730 of these (82%) were successfully interviewed. Eighty-one percent of subjects responded for themselves, and proxies provided information for the rest. There were 215 NHL cases interviewed out of 258 eligible cases (83% response rate), 54 Hodgkin's lymphoma cases interviewed out of 59 eligible cases (92% response rate) and 23 myeloma cases interviewed out of 27 eligible cases (85% response rate). A pool of potential controls (2,357 subjects) was constituted from among all the other cancer patients, excluding lung cancer patients.

During the same period, 740 population controls were selected, in some years from electoral lists and in some years by random digit dialing. Of these, 533 (71%) were successfully interviewed and constituted a second control group. We also created a pooled control group made up of population and cancer controls. So as to weight the two control groups equally, we selected a random sample of 533 subjects from among the set of cancer controls. These included subjects with cancers of the following sites (number of cases in parentheses): colorectum (118), bladder (101), prostate (101), stomach (52), kidney (46), melanoma (29), pancreas (25) and oesophagus (24).

A structured questionnaire was used to obtain information on a number of potential confounders. These included age, ethnic origin, father's and mother's origin, birthplace, residence for first 15 years of life, height and weight, years of schooling, present income, smoking and alcohol habits, and current family income. For the 40% of subjects who refused to divulge family income, this was inferred on the basis of the relationship between self-reported income and mean income in the census tract of residence, available for all subjects.

A semi-structured probing interview was used to obtain detailed descriptions of all jobs the subject had had in the working lifetime. A team of chemists and industrial hygienists examined each completed questionnaire and translated each job into a list of potential substance exposures by means of a checklist form which included 294 substances. For each substance, the chemists noted their degree of confidence that the exposure had actually occurred (possible, probable, definite), the frequency of exposure during a normal workweek (< 5%, 5–30% or > 30%) and the level of concentration of the agent in the working environment. The 3 dimensions were combined as previously described (Siemiatycki *et al.*, 1994) to produce 3 groups: unexposed, non-substantial exposure and substantial exposure. The unexposed group comprised those never exposed to a substance. The substantially exposed group comprised those whom the chemists were confident had been exposed (probable or definite exposure) and who also had more than 5 years of exposure at a high frequency and concentration. The rest were considered non-substantially exposed. Each job was also categorized as to the Canadian classifications of occupations and industries.

Unconditional logistic regression was used to model the risk of developing each of the 3 cancers (myeloma, Hodgkin's lymphoma and NHL) using each of the 3 control groups (cancer, population and pooled). Age, proxy status, income (quintiles) and ethnic group (French/Anglo/other) were entered into all models as *a priori* confounders. Each of the other non-occupational covariates were added to the model in turn, and if there was a significant ($p < 0.10$) change in the fit of the model with any of the 3 control groups, that covariate was

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Received: January 22, 1996 and in revised form March 30, 1996.

included in the final model and used for all 3 control groups. For Hodgkin's lymphoma. a variable for ever regularly drinking alcoholic spirits was added to the model. For myeloma and non-Hodgkin's lymphoma. no additional covariates attained the level of significance required for inclusion.

There were 469 occupational variables in our study: 294 substances. 98 occupations and 77 industries. For the present analysis. we concentrated on occupational variables which satisfied either of the following two conditions. First we included suspected risk factors for lymphoma or myeloma, based on the IARC Monograph program and published reviews (Pearce and Bethwaite. 1992; Hartge *et al.*, 1994: Riedel and Pottern, 1992). Among these, we included only those suspected risk factors for which there were 4 or more exposed cases in our data. Because of the small numbers of cases of myeloma and Hodgkin's lymphoma, this represented a fairly stringent inclusion criterion: only one variable (the occupation of farmers and horticulturists) satisfied the criteria. For NHL. which had a larger number of subjects. the following exposure circumstances satisfied the inclusion criteria and could be examined: the substances pesticides, wood dust, benzene and solvents; the occupations farmers and horticulturists and carpenters: and the industries agriculture and production of household furniture.

The second group of occupational variables included were those which had been associated with lymphoma or myeloma in our initial screening analyses (Siemiatycki. 1991). These analyses had evaluated the risk of each type of cancer in relation to each of the 469 exposure circumstances using the Mantel-Haenszel method. For each possible association. 8 different odds ratios (ORs) were calculated. being defined by: levels of exposure (any exposure or high exposure): type of control group used (population or cancer): and type of target population (all subjects or French-Canadians only). The criteria for selection of variables for this report were the following: the occupational circumstance was associated with the cancer with an OR of at least 1.3 and a one-sided p value < 0.10 in at least 4 of the 8 ORs. and there were at least 4 exposed cases. Using these criteria, for myeloma. we earmarked for evaluation the substance cleaning agents. the occupations of janitors and cleaners (the broad group of other personal service workers was dropped as most of these subjects were janitors and cleaners) and sheet metal workers and the industry of defence services. For Hodgkin's lymphoma, we included the substances cooking fumes, fabric dust, cellulose, and waxes and polishes. the occupations of performing and graphic artists, chefs and cooks, and leather workers, and the industries government as well as flour, feed and bakery products. For NHL, we examined the substances bronze dust, copper dust, alkali and caustic solutions, ammonia, hydrogen chloride, plastics pyrolysis products, fur dust, cotton dust, plastic dust, formic acid, and fluorocarbons. We also included the occupations salesmen, janitors and cleaners, textile processors, textile makers, and rubber and plastics workers. and the industries textiles and non-ferrous casting and rolling.

RESULTS

Table I shows selected characteristics of the 3 case series and 2 control series used in the various analyses. Myeloma and Hodgkin's lymphoma cases had. on average. lower incomes than the other groups. and Hodgkin's lymphoma cases were significantly younger than the others. Population controls were less likely to have a proxy respond for them. There were significantly more population controls and significantly fewer cancer controls who had never regularly drunk beer or spirits.

For each of the 3 site series and each exposure variable. separate analyses were carried out with the cancer controls (n = 533). the population controls (n = 533) and the pooled controls (n = 1.066). Also, separate analyses were carried out with a univariate model and a multivariate model. In general, the results did not differ much by control group: we therefore present in the tables only the results using the pooled controls and discuss selected results from the separate control groups in the text.

Myeloma

There were only 23 cases of myeloma: consequently. the numbers of cases exposed to any individual occupational variables were very low. Table II shows the estimates of relative risk of myeloma in relation to the selected exposures controlling for age. proxy status. income and ethnicity and using the pooled controls. The only exposure chosen on the basis of literature was work as a farmer or horticulturist and there were only 4 cases with this history. None of the ORs for this occupation were significantly raised. and there was no suggestion of increasing risk with increasing duration.

Of the empirically chosen exposures. work as a sheet metal worker for 10 or more years was the only exposure for which the ORs were significantly above 1.0 in this model. Although there were only 3 exposed cases, all of them were long-duration workers. and in this exposure category the OR was 6.5. This association remained significant irrespective of whether cancer or population controls were used, and irrespective of whether univariate or multivariate models were used. These sheet metal workers had been exposed to complex environments. including iron compounds, metallic dust, metal oxide fumes, chlorine dioxides, arc welding fumes, abrasives dust, alumina, aluminium compounds, mild steel dust and polycyclic aromatic hydrocarbons.

The only other exposure variables which manifested evidence of an association with myeloma were exposure to cleaning agents and work as a janitor or cleaner. However, these associations were not quite statistically significant. Three of the 4 janitors and cleaners with myeloma had been heavily exposed to cleaning agents such as hypochlorites and ammo-

TABLE I – DISTRIBUTION OF NON-OCCUPATIONAL VARIABLES BETWEEN CASES AND CONTROLS

Variable	Myeloma (n = 23)	Hodgkin's disease (n = 54)	NHL (n = 215)	Cancer controls (n = 533)	Population controls (n = 533)	p value[1]
Age (mean)	61.1	48.0	55.2	59.5	59.6	< 0.01
Years schooling (mean)	9.1	11.2	10.1	9.6	10.1	> 0.05
Income (mean, Canadian $)	23,518	22,736	26,120	25,264	26,430	< 0.01
Proxy respondents (%)	39	19	22	19	13	< 0.01
Ethnic group (%)						> 0.05
French	52	69	62	58	64	
Anglo	17	11	12	18	14	
Never regular smoker (%)	13	20	17	20	17	> 0.05
Never drank beer regularly (%)	57	63	70	71	70	< 0.05
Never drank spirits regularly (%)	74	80	81	85	81	< 0.05

[1]p value for test of the null hypothesis of equality of the 5 groups on this parameter.

TABLE II – ODDS RATIOS (OR) AND 95% CONFIDENCE INTERVALS (95% CI) FOR DEVELOPING MYELOMA, FROM A CASE-CONTROL STUDY IN MONTREAL

Exposure	Level (years)	No.	OR[1]	95% CI
Substances				
Cleaning agents	Non-substantial	2	1.5	0.3–7.0
	Substantial	5	2.3	0.8–6.5
Occupations				
Janitors, cleaners	1–9	2	2.9	0.6–13.4
	10+	2	3.8	0.8–18.3
Sheet metal workers	1–9	0		
	10+	4	6.5	2.0–21.9
Farmers, horticulturists	1–9	2	1.4	0.3–6.6
	10+	2	1.2	0.3–5.4
Industries				
Defence services	1–9	7	1.9	0.7–4.9
	10+	1	3.1	0.4–26.4

[1]Adjusted for age, proxy status, income (quintiles), ethnicity (French/Anglo/other).

TABLE III – ODDS RATIOS (OR) AND 95% CONFIDENCE INTERVALS (95% CI) FOR DEVELOPING HODGKIN'S LYMPHOMA, FROM A CASE-CONTROL STUDY IN MONTREAL

Exposure	Level (years)	No.	OR[1]	95% CI
Substances				
Cooking fumes	Non-substantial	4	2.0	0.6–7.3
	Substantial	3	2.1	0.5–9.4
Fabric dust	Non-substantial	2	0.6	0.1–3.1
	Substantial	5	6.0	1.9–19.2
Cellulose	Non-substantial	5	1.2	0.4–3.7
	Substantial	3	4.0	0.9–17.7
Waxes or polishes	Non-substantial	3	2.0	0.5–7.7
	Substantial	2	7.2	1.2–43.0
Occupations				
Performing or graphic artists	1–9	1	1.7	0.1–19.6
	10+	3	5.6	1.0–32.5
Chefs or cooks	1–9	4	1.6	0.4–6.2
	10+	1	2.1	0.2–17.2
Leather workers	1–9	4	7.8	2.2–28.0
	10+	2	3.2	0.5–19.7
Farmers or horticulturists	1–9	5	2.2	0.7–6.6
	10+	1	0.5	0.1–4.1
Industries				
Flour, feed or bakery products	1–9	1	1.4	0.2–11.6
	10+	3	4.0	0.9–17.3
Government	1–9	4	1.3	0.4–4.5
	10+	5	2.4	0.8–7.0

[1]Adjusted for age, proxy status, income (quintiles), ethnicity (French/Anglo/other) and spirit drinking (yes/no).

nia. The 8 cases who had worked in the defence industry included 3 subjects who had also worked in occupations of janitors and cleaners.

Hodgkin's lymphoma

There were 54 cases of Hodgkin's lymphoma. The multivariate model contained age, proxy status, income, ethnicity and spirits drinking. Table III shows the relative risk estimates for selected exposure variables, based on the multivariate model, and using the pooled cancer and population controls. There were only 6 cases who had worked as farmers or horticulturists. None of the ORs were significantly raised, and there was no suggestion of increasing risk with increasing time in the occupation.

Of the empirically chosen exposures, there were ORs significantly greater than 1.0 for substantial exposure to the substances fabric dust as well as waxes or polishes, and the occupation of leather workers. These statistically significant ORs remained when using different control groups and in the univariate as well as the multivariate models. Dose-response patterns were seen in all 6 models for each of the 2 substances, but there was no increase in risk with increasing time in the occupation of leather worker. Four of the 7 cases exposed to fabric dust had been leather workers and 3 of these same 7 cases had been exposed to cellulose (including 2 leather workers).

There were 4 performing and graphic artists with Hodgkin's lymphoma. The risk increased with increasing duration of time in the occupation. The ORs were significantly above 1.0 in the unadjusted models, but after adjustment for possible confounders the confidence intervals included 1.0. There were 4 cases who had worked in the industry producing flour, feed and bakery products. There was a consistent duration-response pattern, but only 2 of the 6 ORs were significantly above 1.0. For the substance cooking fumes, the occupation chef or cook and the industry government there were no significantly raised ORs in any of the 6 models.

TABLE IV – ODDS RATIOS (ORs) AND 95% CONFIDENCE INTERVALS (95% CI) FOR DEVELOPING NON-HODGKIN'S LYMPHOMA, FROM A CASE-CONTROL STUDY IN MONTREAL (EXPOSURES FROM LITERATURE)

Exposure	Level (years)	No.	OR[1]	95% CI
Substances				
Vinyl chloride	Non-substantial	3	3.7	0.8–17.4
	Substantial	0		
Pesticides	Non-substantial	9	1.2	0.6–2.6
	Substantial	6	0.9	0.4–2.3
Wood dust	Non-substantial	17	0.5	0.3–0.8
	Substantial	22	0.8	0.5–1.3
Benzene	Non-substantial	20	0.7	0.4–1.1
	Substantial	6	0.8	0.3–2.1
Solvents	Non-substantial	26	0.6	0.4–1.0
	Substantial	48	0.9	0.6–1.3
Occupations				
Farmers and horticulturists	1–9	8	0.7	0.3–1.5
	10+	10	0.8	0.4–1.7
Carpenters	1–9	0		
	10+	4	0.8	0.3–2.2
Industries				
Agriculture	1–9	10	0.8	0.3–1.6
	10+	1	0.9	0.4–1.7
Household furniture	1–9	1	0.4	0.1–3.4
	10+	3	1.6	0.4–6.1

[1]Adjusted for age, proxy status, income (quintiles), ethnicity (French/Anglo/other).

Non-Hodgkin's lymphoma

There were 215 cases of NHL. Results using the pooled controls and adjusting for age, proxy status, income and ethnicity are presented in Table IV for exposures selected from a basis in literature and in Tables V and VI for empirically chosen exposures. For the exposures chosen on the basis of the literature (Table IV), there were no significantly raised ORs.

It has been suggested that solvents may have a late-stage effect on non-Hodgkin's lymphoma (Vineis *et al.*, 1992); we consequently examined this hypothesis in our data set by estimating the risk of NHL for those with recent exposure to solvents. Exposure to solvents in the 5 years before diagnosis of cancer (or interview time) was not associated with NHL (OR = 0.8; 95% CI, 0.6–1.3). Restricting the exposure period to 2 years prior to diagnosis gave almost identical results.

Of the empirically chosen exposures (Tables V and VI), significantly raised ORs were seen in the adjusted model and using the pooled controls for substantial exposure to the substances copper dust, ammonia, plastics pyrolysis products, fur dust, and cotton dust, in the occupations of textile processor and textile maker and in those with long exposure in the textiles industry. A dose-response pattern was present for all the substances except plastic dust and formic acid. For the

TABLE V - ODDS RATIOS (ORs) AND 95% CONFIDENCE INTERVALS (95% CI) FOR DEVELOPING NON-HODGKIN'S LYMPHOMA. FROM A CASE-CONTROL STUDY IN MONTREAL

Substance exposure	Level	No.	OR[1]	95% CI
Bronze dust	Non-substantial	1	1.2	0.1–10.1
	Substantial	5	2.8	0.8–9.1
Copper dust	Non-substantial	8	1.1	0.5–2.5
	Substantial	8	5.5	1.9–16.0
Alkali. caustic solutions	Non-substantial	15	1.5	0.8–2.8
	Substantial	7	1.8	0.7–4.5
Ammonia	Non-substantial	12	0.8	0.4–1.5
	Substantial	14	3.4	1.7–6.9
Hydrogen chloride	Non-substantial	16	1.6	0.9–3.0
	Substantial	6	1.3	0.5–3.4
Plastics pyrolysis products	Non-substantial	8	2.0	0.8–4.9
	Substantial	6	2.6	1.0–7.1
Fur dust	Non-substantial	3	1.7	0.5–6.6
	Substantial	5	3.1	1.0–9.3
Cotton dust	Non-substantial	8	1.0	0.4–2.1
	Substantial	13	2.6	1.3–5.4
Plastic dust	Non-substantial	14	1.7	0.9–3.3
	Substantial	3	1.0	0.3–3.4
Formic acid	Non-substantial	2	2.2	0.4–1 13
	Substantial	2	1.5	0.3–8.0
Fluorocarbons	Non-substantial	5	1.3	0.5–3.6
	Substantial	5	2.6	0.8–8.0

[1]Adjusted for age. proxy status. income (quintiles), ethnicity (French/Anglo/other).

TABLE VI - ODDS RATIOS (ORs) AND 95% CONFIDENCE INTERVALS (95% CI) FOR DEVELOPING NON-HODGKIN'S LYMPHOMA FROM A CASE-CONTROL STUDY IN MONTREAL

Exposure	Level (years)	No.	OR[1]	95% CI
Occupation?,				
Salesmen	1–9	23	1.3	0.8–2.2
	10+	35	1.4	0.Y–2.1
Janitors and cleaners	1–9	7	1.1	0.5–2.6
	10+	6	1.6	0.6–4.2
Textile processors	1–9	3	0.9	0.2–3.3
	10+	8	**12.2**	3.5–42.2
Textile makers	1–9	3	2.0	0.5–8.0
	10+	4	15.7	2.9–87.5
Rubber and plastic workers	1–9	4	3.6	0.9–15.0
	10+	1	9.0	0.6–148
Industries				
Textiles	1–9	5	0.6	0.2–1.5
	10+	9	3.9	1.6–9.5
Non-ferrous casting and rolling	1–9	2	1.3	0.3–6.4
	10+	3	4.1	0.9–18.9

[1]Adjusted for age, proxy status, income (quintiles), ethnicity (French/Anglo/other).

substances copper dust, ammonia, and cotton dust and the textile industry, the ORs for substantial exposure in all 6 models were significantly raised.

The results shown in Tables **IV** to VI are adjusted for a number of relevant non-occupational covariates, but the results for each occupational exposure are not adjusted for other occupational exposures. However, some pairs of exposure were highly correlated. Approximately half of the cases who had been exposed to bronze dust, copper dust, alkalis and caustic solutions or ammonia had also been exposed to hydrogen chloride. Similarly, about half the cases exposed to alkalis and caustic solutions had also been exposed to ammonia. Cases who had been employed as janitors and cleaners were likely to have been exposed to alkali and caustic solutions and to ammonia. Six of the **7** cases who had been employed as textile makers and 8 of the 14 cases who had worked in the textile industry had been exposed to cotton dust. Attempts were made to carry out some multivariate analyses with several occupational variables at **a** time. but the results were difficult to interpret with some unstable estimates due to small numbers of data points and large numbers of variables. Consequently. we prefer to present and interpret the more stable estimates based on adjustment for non-occupational factors only.

DISCUSSION

Many different classification systems have been used to group lymphoproliferative cancers. and there is considerable controversy over which system is most appropriate for epidemiological studies (Weisenburger. 1992; Vineis *et al.*, 1992). There is inevitably a trade-off between specificity of the classification system and numbers of subjects available for statistical analysis. This is the conventional dilemma between "lumping" or "splitting". For our data, we had information on diagnosis as it came from medical records. The data from this source were limited by the prevailing diagnostic technology and medical opinion during the era in which cases were accrued (1979–1986) and by the fact that cases were accrued from 19 different hospitals. There is doubt about the validity of classification systems for non-Hodgkin's lymphoma. One prominent textbook of pathology states that ". . . until the recent past there were more classifications than experts", defining *recently* as after the time frame of our study (Cotran *et al.*, 1994). It might nonetheless be useful to examine histologic subgroups of NHL separately, since this is **a** large and heterogeneous category with respect to pathology. clinical features, treatment and aetiology. The state of the art does not allow us to do so. On the other hand, the classifcation of Hodgkin's disease is sound and has not changed since the Rye Classification of 1966 (Lukes *et al.*, 1966). There is no overlap between the two disease groups. with the possible exception of some follicular (nodular) well-differentiated NHLs and the rarest subtype of Hodgkin's disease. the nodular variant of the lymphocyte-predominant subtype. Patients with Hodgkin's disease. especially following treatment. may develop second primary cancers at any site, including NHLs. but this is not an issue for newly diagnosed cases.

Several substances. occupations and industries were included in this analysis because previous research had indicated a possible increased risk. None **of** these gave significant results in our data. although the numbers **of** cases exposed to most **of** these circumstances were quite small. For solvents. we had large numbers of exposed cases, but there was no suggestion of any effect in our data.

It is conceivable that some substances are dangerous in one work environment but not in others, because of the nature **of** the substance or because of cofactors. To evaluate this possibility, we carried out some analyses looking at joint effects of substances and occupations. Because this requires relatively large numbers, it was only feasible to do it for 2 fairly prevalent exposures, solvents and wood dust. For each of these substances, we assessed the risk among those exposed to the substance in particular occupations. There was no evidence that solvent or wood dust exposure in any of the main occupation groups carried excess risk of NHL.

The occupation of sheet metal worker appears to be related to myeloma in our data, with high and statistically significant ORs despite small numbers of cases. A Danish case-control study which linked industrial history records with over 1,000 cases of myeloma and 4,000 controls (Heineman *et al.*, 1992) found raised risks for precision metal working as most recent occupation (OR = 1.4; 95% CI, 1.0–2.1). Among industries, there was a raised risk associated with employment in fabricating structural metal and stationary tanks (OR = 2.0; 95% CI, 1.0–4.0), and those in this occupation for 5 or more years were significantly more likely to have myeloma than those employed for less than 5 years. A number of metal-related occupations have been linked to myeloma including smelter and metallurgy workers in a study linking cancer registry and occupational data from the census (McLaughlin *et al.*, 1988), as well as workers in the composing room of printing plants (Greene *et al.*, 1979). Case-control studies have linked myeloma with self-reported exposure to metals (Morris *et al.*, 1986) and have linked occupation as a metal worker with myeloproliferative cancers (Giles *et al.*, 1984). A study of over 10.000 men with occupation recorded as metal worker on the death certificate (Gallagher and Threlfall, 1983) found no increase in PMR from myeloma for all metal workers combined but a raised risk (PMR = 209; 95% CI. 108–366) for machinists (based on 12 deaths). The risk of myeloma for sheet metal workers was not raised in a large study which linked data from the Canadian Labour Force 10% Sample Study with death certificate information (Lindsay *et al.*, 1993).

Our findings suggest a raised risk in occupations relating to the manufacture of textiles for both Hodgkin's and non-Hodgkin's lymphoma. For Hodgkin's lymphoma. risks were raised for exposure to the substances fabric dust and cellulose. while for NHL. there were high ORs with exposure to cotton dust and work in the textile industry, especially in the occupation of textile making. The textile industry has been examined in a number of previous studies. Textile workers were found to be at increased risks of death from NHL in one study using death certificate information (Delzell and Grufferman, 1983). but not in others (O'Brien and Decouflé, 1988; Dubrow and Gute. 1988: Schumacher and Delzell. 1988). A retrospective cohort of synthetic textiles workers (Goldberg and Thériault, 1994) found an increased risk of one type of NHL only (reticulum cell sarcoma). Case-control studies have shown no increased risk of NHL in textile workers (Scherr *et al.*, 1992) and a non-significant increased risk in workers in textile mill products and apparel (Blair *et al.*, 1993). It is also worth noting that studies have shown an increase in risk of multiple myeloma in textile workers (Linet *et al.*, 1994) and in the manufacture of synthetic yarns (Heineman *et al.*, 1992).

A related finding in our study was the increased risk of NHL with exposure to fur dust. No increases in SMR for lymphoma were found in 2 retrospective cohort studies of fur workers (Sweeney *et al.*, 1985: Guay and Siemiatycki. 1987) but numbers of deaths were very small in both studies.

The occupation of leather worker was linked to Hodgkin's lymphoma in our data. A review of the leather industry by IARC did not find convincing evidence of a link between the industry and lymphoma (IARC. 1981). Since then there have been several reports on cohorts of leather workers. especially shoe manufacturers (Garabrant and Wegman. 1984: Walrath *et al.*, 1987: Stern *et al.*, 1987: Seniori-Constantini *et al.*, 1989; Walker *et al.*, 1993; Mikoczy *et al.*. 1994). These studies have not demonstrated any raised risk for leather workers. but they have been based on small numbers of deaths from lymphoma and usually do not subdivide the group further. A registry study in Swedish women found no increase in the incidence of NHL in leather workers (Linet *et al.*, 1994), but a case-control study in Boston (Scherr *et al.*, 1992) found a slightly increased risk of NHL in workers in the leather industry (OR = 2.1: 95% CI, 0.9–4.8).

Other substances consistently and significantly associated with NHL in our data were copper dust and ammonia. No increase in the incidence of blood. bone marrow and lymphatic system cancers was found in copper smeltery workers in Sweden (Sandstrom and Wall. 1993).

In conclusion. we have found a number of possible risk factors for lymphoma and myeloma. However. for some of them the risks are not strong or the issue has previously been examined and no supporting evidence has been found. The relationships which seem most worthy of further study are those between myeloma and sheet metal workers. and between lymphoma and the textile industry.

ACKNOWLEDGEMENTS

This study was funded by grants from the Institut de recherche en santé et en sécurité du travail du Québec, the Fonds de recherche en santé du Québec, the National Health Research and Development Program, and the National Cancer Institute of Canada. J.S. is a National Health Scholar. The fieldwork was supervised by Ms. L. Richardson, and the chemical coding was carried out by Dr. M. Gérin, Dr. L. Nadon, Mr. D. Bégin and Mr. R. Lakhani. Dr. B. Case provided helpful advice regarding pathologic classification.

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