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Pattern and Model Makers, Proportionate Mortality 1972-1978

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A proportionate mortality study of deceased white male workers in the pattern and model making trades was conducted. Death certificates were obtained for 1257 death benefit-eligible members of the Pattern Makers' League of North America who had died in the years 1972–1978, and age-adjusted proportionate mortality was calculated using 1975 United States white male death rates. For the entire nationwide union, statistically significant excess proportions of deaths were observed due to colon cancer (proportionate mortality ratio, PMR = 167) and to brain tumors (PMR = 211). A statistically significant excess proportion of deaths due to colon cancer (PMR = 163) and to leukemia (PMR = 200) were observed among the members of the predominantly wood shop locals.

Nonsignificant excess proportions of cancer deaths occurred at a number of other anatomical sites. Predominant occupational exposures included wood and plastic dusts and epoxy resins in wood shops and cutting oil mists and solvent vapors in the metal shops. These results suggest the need for better work practices in this industry while more definitive studies are completed.

Key words: pattern maker, colon cancer, brain tumors, wood, metal, mortality, model makers

INTRODUCTION

Pattern and model makers and other wood and metal workers have been found in previous epidemiologic studies to experience unusual distributions of excess cancer mortality. The Registrar General's decennial supplement [Office of Population Censuses and Surveys, 1978], on occupational mortality in England and Wales, reported excessive but not statistically significant risks of death due to cancer of the stomach and lung among pattern makers. In a proportionate mortality ratio (PMR) study of deaths occurring in the years 1950–1971 in Washington State, it was found that pattern and model makers had experienced slightly elevated proportionate mortality due to cancer of the prostate, digestive system, and respiratory system [Milham, 1976]. Studies in the United States and Europe of workers employed in

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various wood-related industries have reported excess cancer of the nasal cavity and sinuses, esophagus, stomach, small intestine, respiratory system, skin, kidney, bladder, and brain as well as leukemia, Hodgkin disease, and multiple myeloma [Office of Population Censuses and Surveys, 1978; Milham, 1976; Acheson et al, 1968; Brinton et al, 1976; Gignoux et al, 1969; and Guralnik, 1963]. Machinists and workers in allied metal trades have been found to have excesses of deaths due to nasopharyngeal cancer and to cancer of the buccal cavity, tongue, stomach, small intestine, colon, rectum, respiratory system, skin, kidney, bladder, and brain, as well as to leukemia and lymphosarcoma [Office of Population Censuses and Surveys, 1978; Guralnik, 1963; Decoufle, 1978; Milham, 1976].

Although the particular pattern makers' union under study did not begin until 1887, pattern and model makers in the United States have historically worked with woods (predominantly hard woods such as mahogany, maple, birch, and cherry) as well as with glues, varnishes, and paints. Exposure to wood dust, with particles ranging in size from 0.01 to 100 microns, has long been an occupational hazard in woodworking trades and has resulted in a variety of adverse health effects including allergic and toxic reactions and illnesses [Hanslian et al, 1964]. Environmental sampling in some pattern shops indicated that 60% of the airborne particles collected were respirable (less than 10 microns in diameter). In the mid 1950s, wood pattern and model shops began to use plastics, solvents, and epoxy resin glue systems. In the 1940s, the union began to include metal pattern shops. Workers in these shops are exposed to metal dusts, cutting oil mists, and solvents.

POPULATION AND METHODS

The present study was based on the death benefit files maintained by the Pattern Makers' League of North America. Under the League's bylaws, a member was eligible for death benefits if he had been actively employed in the trade, had belonged to the League for a minimum of five years, and had died either while employed or after retirement. Of 1,286 eligible United States members who had died in the years 1972 through 1978, death certificates were obtained for 1,257 (97.7%). Causes of death were coded by a nosologist into the Eighth Revision of the International Classification of Diseases, Adapted (ICDA). Using a NIOSH computer program for determination of proportionate mortality ratios (PMRs), cause-specific expected deaths for each five-year age group were calculated. This was done by multiplying the cause- and age-specific proportionate mortality of United States white males for 1975 by the total number of deceased pattern and model makers within each age group. These cause-specific expected deaths were then summed over all five-year age groups. The PMR for each cause is defined as one hundred times the observed deaths divided by the expected deaths. Statistical significance was determined by a two-tailed poisson test. All p values less than 0.05 are listed. Because multiple comparisons were made and because no site-specific cancer excess was hypothesized a priori, the p values were used in the context of hypothesis generation. The 82 local unions across the United States were classified as wood or metal by their predominant type of work during the years 1940–1960.

RESULTS

For the entire group of 1,257 deceased pattern and model makers, statistically significant increases in PMRs were seen for colon cancer (167) and for malignant

and unspecified brain tumors (211) (Table I). When the workers were divided into predominantly wood shop and metal shop categories, those same excesses were seen in both groups (colon cancer PMRs, 163 and 183, respectively, and brain tumor PMRs, 175 and 294), although with the resulting smaller numbers, only the colon cancer excess in the wood shop category was statistically significant. (Table II). A statistically significant excess of leukemia deaths (PMR 200) was observed only in the wood shop category. Both categories also had elevated, but not statistically significant, PMRs for deaths due to various other sites of cancer.

DISCUSSION

The major findings in this study are those of excess proportionate mortality due to brain tumors and colon cancer in pattern and model makers in general, and excess proportionate colon cancer and leukemia mortality among wood shop category workers. Although previous studies have associated wood dust exposures with nasal cancers [Acheson et al, 1968; Brinton et al, 1976], no death certificates mentioning this cause of death were found in this analysis.

TABLE I. Observed and Expected Deaths Among Deceased National Pattern Makers' League Members

Cause of death	8th Revision (ICDA)	Obs.	PMR
All malignant neoplasms	(140–209)	281	111
digestive system	(150–159)	88	127*
esophagus	(150)	5	89
stomach	(151)	9	80
colon	(153)	43	167**
rectum	(154)	10	135
gall bladder	(156)	5	238
all other digestive system	(152,155,157–159)	16	94
nose, nasal sinuses	(160)	0	0
lung	(162)	74	93
skin	(172–173)	5	139
urinary bladder	(188)	14	140
kidney	(189)	8	143
lymphatic and hematopoietic system	(200–209)	31	138
hodgkin disease	(201)	0	0
other lymphomas	(200,202)	9	134
multiple myeloma	(203)	4	111
leukemia	(204–207)	15	153
other lymphatic and hematopoietic	(208–209)	3	250
other malignant neoplasms		61	97
brain tumors, both malignant and unspecified	(191–192, 238)	(12)[b]	211[a]
Diseases of circulatory system	(390–458)	723	100
ischemic heart disease	(400–414)	514	102
vascular lesions of the CNS	(430–438)	120	101
Diseases of respiratory system	(460–519)	89	90
All accidents and violence	(800–999)	43	77
All other causes		121	95
All causes		1257	100

*p=0.03 Observed deaths below five were not tested.
**p=0.002
[a]p=0.03
[b]Parentheses indicate that both malignant and unspecified tumors were grouped together.

TABLE II. Observed and Expected Deaths Among Deceased National Pattern Makers' League Members by Predominant Work Between 1940–1960*

Cause of death	8th Revision ICDA	Predominantly wood		Predominantly metal	
		Obs.	PMR	Obs.	PMR
All malignant neoplasms	(140–209)	205	113	73	102
digestive system	(150–159)	63	127	25	130
esophagus	(150)	4	100	1	62
stomach	(151)	5	62	4	129
colon	(153)	30	163**	13	183
rectum	(154)	9	170	1	50
gall bladder	(156)	2	133	3	500
all other digestive system	(152,155,157–159)	13	107	3	61
nose, nasal sinuses	(160)	0	0	0	0
lung	(162)	48	85	23	99
skin	(172–173)	5	200	0	0
urinary bladder	(188)	11	151	3	111
kidney	(189)	5	128	3	188
lymphatic and hematopoietic system	(200–209)	24	149	7	109
hodgkin disease	(201)	0	0	0	0
other lymphomas	(200–202)	7	149	2	105
multiple myeloma	(203)	3	120	1	100
leukemia	(204–207)	14	200[a]	1	37
other lymphatic and hematopoietic	(208–209)	0	0	3	1000
other malignant neoplasms		49	109	12	69
brain tumors, both malignant and unspecified	(191–192,238)	(7)[b]	175	(5)[b]	294
Diseases of circulatory system	(390–458)	520	99	201	103
Diseases of respiratory system	(460–519)	62	87	27	102
All accidents and violence	(800–999)	33	86	10	57
All other causes		86	95	35	98
All causes		906	100	346	100

*Five members could not be classified.

**p=0.01. Observed deaths below five were not tested.

[a]p=0.03.

[b]Parentheses indicate that both malignant and unspecified tumors were grouped together.

Because 20% of the deceased had been members of locals with pattern shops located in shipyards, it was thought that the potential for asbestos exposure might have existed. However, a review of the death certificates revealed no mesotheliomas or asbestosis cases. Furthermore, no excess of malignant nor non-malignant respiratory system disease was seen in the data. Due to the previously mentioned requirements for death benefits eligibility, and given the well known limitations of a proportionate mortality study design, interpretation of these results by themselves should not be extended beyond hypothesis generation. However, the elevated PMRs observed for colon cancer are consistent with two other independent reports of the mortality and morbidity experience of pattern and model makers [Swanson, 1980; Schottenfeld, 1980] and suggest that this occupation is hazardous. Because the company studied in those two reports represents only 10–16% of

the current nationwide Pattern Makers' League membership, overlap of those two studies with this one is insignificant.

Colon cancer has been associated with diet [Burkitt, 1971], socioeconomic status (SES) [Kitigawa et al, 1973], and ethnicity [Segi et al, 1959]. None of these risk factors appears to have played an important role in the causation of the excess colon cancer mortality in this study. The wide geographic distribution of the local unions would have tended to reduce the impact of any regional differences in diet. Patternmakers are classified in the middle of the socioeconomic status (SES) scale [Guralnick, 1963]. Furthermore, the relationship between SES and colon cancer is weak. Extreme SES differences have been shown to account only for about a 20% difference in colon cancer rates in the U.S. [Guralnick, 1963; Kitagawa et al, 1973]. Although ethnic background could not be evaluated, only six of the 43 men who died of colon cancer had been born in countries which have colon cancer death rates higher than those of the United States.

Although two unpublished studies [Swanson, 1980; Schottenfeld, 1980] have reported elevated risks for colon cancer, none has demonstrated an excess risk of deaths due to brain tumors in association with pattern or model making. Other occupations with similar exposures (Table III), however, have been associated with mortality from both of these neoplasms. A slight increase of deaths due to brain cancer and a statistically significant excess of deaths due to stomach and colon cancer (combined) were observed after twenty years latency among machinists in one plant in the United States who had exposure to cutting oil mist [Decoufle, 1978]. A statistically significant excess of deaths due to cancer of the small intestine and colon combined was reported among machine tool and metal workers in England and Wales [Office of Population Censuses and Surveys, 1978]. Machinists and jobsetters in the United States were found to have statistically significant increased rates of cancer of the small intestine, colon, and rectum combined as well as elevated rates for other sites of cancer, including the brain [Guralnick, 1963]. Brain tumors have previously been associated with vinyl chloride [Waxweiler et al, 1976] and with employment in petroleum refineries and petrochemical plants [Thomas et al, 1980] and rubber plants [Mancuso et al, 1968; McMichael et al, 1974; Monson et al, 1978]. White male carpenters in the United States have been observed to have slightly increased rates for brain cancer and a statistically significant increased rate of lung cancer [Guralnick, 1963]. The twofold excess of leukemia deaths observed in this study in the workers from predominantly wood shop local unions parallels a previously reported twofold excess of leukemia mortality among plywood mill workers [Milham, 1976].

Increased PMRs were noted in this study for cancer mortality at a number of other anatomical sites. These various and statistically nonsignificant excesses may reflect differing exposures and work practices throughout the union. Further investigations are, however, underway to evaluate specific occupational etiologies. In the interim, the results of this report and others [Swanson, 1980; Schottenfeld, 1980] suggest that good general work practices be followed more carefully to reduce patternmakers' exposures.

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TABLE III. Some Potential Exposures of Similar Occupations*

	Cutting fluids	Metal fumes	Metal dusts	Solvents	Wood dusts	Epoxy resins	Amines	Styrene	Wood resins	Formaldehyde	Plastic dusts
Metal model and pattern markers	X	X	X	X							
Machinists	X		X	X							
Machine tool and metal workers	X	X	X	X							
Wood model and pattern makers				X	X	X	X	X	X	X	X
Plywood mill workers				X	X	X			X	X	X
Carpenters				X	X				X		

*Occupational Diseases: A Guide to Their Recognition. Revised Edition, June 1977. DHEW (NIOSH) Publication No. 77-181. National Institute for Occupational Safety and Health, Cincinnati, Ohio.

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