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A cohort mortality study of painters and allied tradesmen

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MATANOSKI GM, STOCKWELL HG, DIAMOND EL, HARING-SWEENEY M, JOFFE RD, JOHNSON ML. A cohort mortality study of painters and allied tradesmen. *Scand J Work Environ Health* 12 (1986) 16—21. A cohort study was conducted of the membership of a large international union of painters and allied tradesmen. The union membership consisted of both painters and associated trades such as glaziers and tile and carpet layers. The study examined the mortality experience of 57 175 current and former union members in four states (California, Missouri, New York, and Texas) in the United States (US) from 1975 through 1979. No excess mortality was observed for the total union membership when compared to that of all US white males. When the study population was subdivided by the trade affiliation, members of locals comprised primarily of painters exhibited a significant elevation in mortality from all malignant neoplasms, lung cancer, and stomach cancer, compared to all US white males. To reduce the impact of potential nonoccupational differences between the study population and all US white males, the data were also analyzed using the entire cohort as the standardization population. Significant elevations continued to be observed for all malignant neoplasms and lung cancer among the membership of painting locals compared to other locals. In addition there was a statistically significant difference in mortality from leukemia and cancer of the bladder observed between the groups.

Key terms: lung cancer, painting, stomach cancer.

In 1977 The Johns Hopkins University initiated a study of the health hazards associated with work in the construction and maintenance painting trades. Occupational exposures experienced by these painters may include a variety of solvents, pigments, and paint additives, as well as spackling and similar compounds. Few epidemiologic studies have been conducted on the mortality experience of construction or maintenance painters. The occupational tables of the Registrar General for England and Wales (13, 14), two national mortality studies (7, 18), and studies in several states (5, 6, 9, 19, 20, 21) have suggested elevated mortality ratios from cancers of several sites including the lung (7, 9, 13, 14, 18), larynx (7), esophagus (20), and stomach (20), as well as leukemias (19, 21), among painters. The use of chromate primers has been associated with an elevated lung cancer risk in some industry settings (3, 4, 8), but not in others (2, 11, 12).

Construction and maintenance painters were chosen as the focus of the epidemiologic study. These painters comprise approximately 70 % of all painters in the United States (US) (16). Construction painters typically move from one worksite to another, and this movement makes it difficult to identify a centralized source of employment data. The construction trades, including painting, have traditionally been unionized trades. The membership records of the International Brotherhood of Painters and Allied Trades (IBPAT) provided an effective mechanism for identifying a large painter cohort for epidemiologic study.

This union, with a current membership of approximately 200 000, represents most unionized construction and maintenance painters in the United States. Painters comprise approximately 60 % of the membership, and a number of allied trades the remaining 40 %. Each local is classified by the Union as either "mixed," consisting primarily or exclusively of painters, or is designated as a specific allied trade (table 1).

Material and methods

A nonconcurrent prospective study was undertaken to determine whether members of this union were experiencing any excess mortality when compared to all US white males. The study also evaluated whether significant differences existed in the mortality experience of construction and maintenance painters within the Union in comparison to that of allied trade members.

The Union membership in the four states of California, Missouri, New York, and Texas was selected for study. The Union provided the study investigators with computerized listings of its current, retired, and terminated members. These membership files identified the specialty affiliation of each local union and indi-

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cated the local to which a member belonged, but did not indicate the trade of individual members. All comparisons were therefore necessarily made by type of local affiliation of each member. Social security numbers, necessary for vital status ascertainment, were available only for recent years. For this reason, a five-year follow-up period was selected.

The eligible study population consisted of Union members who were born prior to 1940, who had at least one full year of Union membership, and who had been a Union member in one of the four states during 1975—1979. Deaths within the study population were ascertained for 1975—1979 through a search of the life insurance files of the Union, the records of the Social Security Administration, the National Death Index, the Veteran's Administration, and the Health Care Financing Administration. Death certificates were coded in the eighth revision of the International Classification of Diseases Adapted (ICDA-8). Standardized mortality ratios and proportional mortality ratios were calculated for the cohort on the basis of mortality rates for all US white males with the program developed by R Monson (10).

Information on the race and sex composition of the study population was not available from Union records. As first initial only was recorded in the Union file, first name could not be used to identify female cohort members. Based on a review of all death certificates of cohort members, 99.5 % were male and 98 % white. The entire cohort was considered as white males in the estimation of the rates. Deaths among female cohort members were excluded from the analysis, and therefore the total number of deaths was decreased by 26.

Results

The study cohort consisted of 57 175 individuals who contributed 257 221.5 person-years of observation. Since the study excluded anyone who was a member of the Union for less than one year, the first year of membership was discounted for all individuals. During the study period 22 % (N = 12 628) of the members left the Union. All others remained in the Union as either active or retired members. Individuals lost to follow-up during the study period numbered 1 271 (2.2 %). All lost to follow-up were considered alive for purposes of analysis. Thirty-one additional individuals were omitted from the cohort for the calculation of the standardized mortality ratio (SMR) and proportionate mortality ratio (PMR), as specified by the Monson program, as their ages were 100 years or greater. The distribution of ages of the cohort at the start of the study are indicated in table 2. Among the cohort members, 5 313 deaths occurred. Death certificates listing cause of death were obtained for all but 288 deceased individuals (5.4 %).

Mortality from all causes of death was 88 % of that predicted based on the death rates for all US white males (table 3). This deficit was due primarily to low rates for all circulatory diseases (except rheumatic heart disease). An unexpected finding was the low rate of all accidents (SMR = 78) and motor vehicle accidents (SMR = 76). Mortality was also lower than expected from diseases of the digestive system (SMR = 83) and the nervous system (SMR = 58). In contrast, many ratios for specific cancer sites were at or above the expected mortality for the general population.

Proportional mortality ratios were also calculated to compare the distribution of causes of death in this population to that of all US white males. The results of the analysis are shown in table 4. The distribution of causes of death experienced by this study population differed from that of the general male population. The analysis indicated that in the study population there was a statistically significant excess of all malignant neoplasms and a number of specific cancer sites. The proportionate mortality ratios were significantly elevated for cancers of the stomach, large intestine, liver, lung, and kidney. That of cancer of the brain was significantly low. No other specific causes of death except cancers showed a significant excess. Mortality from diseases of the circulatory system was lower than expected.

The study cohort was then subdivided by local affiliation, as either painter or allied trade. There were 33 098 members of mixed locals and 24 054 members of one of the allied trade locals in the study. Twenty-

Table 1. Local affiliation of cohort members.

Local	Number in cohort	Percentage of cohort
Mixed (painting)	33 098	57.9
Glaziers, glass workers	4 941	8.7
Sign writers	3 694	6.5
Tile and carpet layers	3 480	6.1
Paint makers	2 413	4.2
Industrial workers	1 648	2.9
Wood finishers	1 184	2.1
Warehouse workers	1 088	1.9
All other	5 606	9.7
Total	57 152	100.0

Table 2. Distribution of ages of cohort members at the start of the study.

Age group	Cohort size	Percentage of cohort	Person-years
35—39	8 271	14.5	19 826.1
40—44	8 492	14.9	38 800.0
45—49	8 158	14.3	36 677.0
50—54	7 750	13.5	36 215.6
55—59	6 773	11.8	33 291.7
60—64	5 896	10.3	29 394.7
65—69	4 795	8.4	24 399.8
70—74	3 415	6.0	18 409.9
75—79	1 997	3.5	11 169.4
≥ 80	1 628	2.8	9 037.9
Total	57 175	100.0	257 221.5

Table 3. Standardized mortality ratios (SMR) for selected causes of death among the total study membership, 1975—1979.

Cause of death [a]	Observed	Expected	SMR	95 % confidence limits
All causes of death (000—999)	5 313	6 063.8	88	85—90
All malignant neoplasms (140—209)	1 281	1 268.8	101	96—107
Stomach (151)	69	54.3	127	99—161
Large intestine (153)	135	123.3	110	92—130
Liver (155—156)	28	19.0	147	98—213
Pancreas (157)	51	69.4	73	55—97
Lung (162)	448	424.4	106	96—116
Prostate (185)	117	118.5	99	82—118
Bladder (188)	48	45.2	106	78—141
Kidney (189)	38	29.6	128	91—176
Brain and other central nervous system (191—192)	15	27.0	56	31—92
Leukemia & aleukemia (204—207)	44	47.2	93	68—125
Diabetes mellitus (250)	63	87.8	72	55—92
Diseases of the nervous system, etc (320—389)	25	43.0	58	38—86
Diseases of the circulatory system (390—458)	2 555	3 379.5	76	73—79
Arteriosclerotic heart disease (410—414)	1 820	2 400.9	76	72—79
Vascular lesions of the central nervous system (430—438)	329	516.6	64	57—71
Diseases of the respiratory system (460—519)	387	447.2	87	78—96
Diseases of the digestive system (520—577)	201	242.1	83	72—95
All accidents (E 800—949)	157	202.6	78	66—91
Motor vehicle accidents (E 810—827)	55	72.3	76	57—99

[a] According to the International Classification of Diseases Adapted (code 8).

Table 4. Standardized proportionate mortality ratios (PMR) for selected causes of death among the total study membership, 1975—1979.

Cause of death [a]	Observed	Expected	PMR	95 % confidence limits
All malignant neoplasms (140—209)	1 282	1 142.2	112	107—118
Stomach (151)	69	48.0	144	114—182
Large intestine (153)	135	109.0	124	105—146
Liver (155—156)	28	17.1	164	114—236
Pancreas (157)	51	62.6	81	62—107
Lung (162)	448	392.1	114	105—125
Prostate (185)	117	97.9	120	100—143
Bladder (188)	48	38.8	124	93—164
Kidney (189)	38	27.2	140	102—191
Brain and other central nervous system (191—192)	15	25.9	58	35—95
Leukemia & aleukemia (204—207)	44	41.6	106	79—142
Diabetes mellitus (250)	63	77.3	82	64—104
Diseases of the nervous system, etc (320—389)	25	39.1	64	43—94
Diseases of the circulatory system (390—418)	2 555	2 903.6	88	86—90
Arteriosclerotic heart disease (410—414)	1 820	2 086.6	87	84—90
Vascular lesions of the central nervous system (430—438)	329	423.2	78	70—86
Diseases of the respiratory system (460—519)	387	382.0	101	92—111
Diseases of the digestive system (520—577)	201	222.7	90	79—103
All accidents (E 800—949)	157	191.5	82	71—95
Motor vehicle accidents (E 810—827)	55	71.3	77	60—100

[a] According to the International Classification of Diseases Adapted (code 8).

three individuals were excluded from the analysis as their trade affiliation could not be determined. When members of mixed locals only were considered (table 5), the overall mortality was only slightly less than that of the US white male rate (SMR = 93). Mortality from malignant neoplasms was somewhat higher than expected (SMR = 110). Two individual cancer sites were significantly elevated, cancer of the stomach (SMR = 136) and cancer of the lung (SMR = 118). The mortality ratio for circulatory diseases remained low (SMR = 79). Mortality from all accidents (SMR = 91) and from motor vehicle accidents (SMR = 81) remained somewhat lower than expected.

The members of allied trade locals presented a considerably different mortality experience (table 6). Lower than expected mortality ratios were observed for all causes of death (SMR = 75), all circulatory diseases (SMR = 69), and all malignant neoplasms (SMR = 84). Most notably there was a statistically significant deficit of lung cancer (SMR = 82) and leukemia (SMR = 46) among these workers. The standardized mortality ratios for all respiratory disease, diseases of the digestive system, all accidents, and all motor vehicle accidents were low.

To investigate further the difference in mortality experience of members of mixed and specialty locals, in-

Table 5. Standardized mortality ratios (SMR) for selected causes of death for members of mixed locals, 1975—1979.

Cause of death [a]	Observed	Expected	SMR	95 % confidence limits
All causes of death (000—999)	3 811	4 092.7	93	90—96
All malignant neoplasms (140—209)	927	843.8	110	103—117
Stomach (151)	50	36.7	136	101—180
Large intestine (153)	93	83.7	111	90—136
Liver (155—156)	20	12.8	156	95—241
Pancreas (157)	37	46.4	80	56—110
Lung (162)	326	275.5	118	106—132
Prostate (185)	84	85.7	98	78—121
Bladder (188)	40	31.7	126	90—172
Kidney (189)	27	19.1	141	93—205
Brain and other central nervous system (191—192)	9	16.4	55	25—104
Leukemia & aleukemia (204—207)	37	31.8	116	82—160
Diabetes mellitus (250)	49	59.8	82	61—108
Diseases of the nervous system, etc (320—389)	20	28.3	71	43—109
Diseases of the circulatory system (390—458)	1 824	2 318.3	79	75—82
Arteriosclerotic heart disease (410—414)	1 299	1 630.9	80	75—84
Vascular lesions of the central nervous system (430—438)	237	368.8	64	56—73
Diseases of the respiratory system (460—519)	315	312.5	101	90—113
Diseases of the digestive system (520—577)	142	152.8	93	78—110
All accidents (E 800—949)	114	124.8	91	75—110
Motor vehicle accidents (E 810—827)	35	43.0	81	57—113

[a] According to the International Classification of Diseases Adapted (code 8).

Table 6. Standardized mortality ratios (SMR) for selected causes of death for members of specialty locals, 1975—1979.

Cause of death [a]	Observed	Expected	SMR	95 % confidence limits
All causes of death (000—999)	1 480	1 961.6	75	72—79
All malignant neoplasms (140—209)	354	423.8	84	75—93
Stomach (151)	19	17.5	108	65—169
Large intestine (153)	42	39.4	107	77—144
Liver (155—156)	8	6.2	129	56—255
Pancreas (157)	14	23.0	61	33—102
Lung (162)	122	148.7	82	68—98
Prostate (185)	33	32.5	102	70—143
Bladder (188)	8	13.4	60	26—117
Kidney (189)	11	10.5	105	52—188
Brain and other central nervous system (191—192)	6	10.6	56	21—123
Leukemia & aleukemia (204—207)	7	15.3	46	18—94
Diabetes mellitus (250)	14	27.9	50	27—84
Diseases of the nervous system, etc (320—389)	5	14.7	34	11—79
Diseases of the circulatory system (390—458)	728	1 054.8	69	64—74
Arteriosclerotic heart disease (410—414)	519	765.9	68	62—74
Vascular lesions of the central nervous system (430—438)	91	146.4	62	50—76
Diseases of the respiratory system (460—519)	72	133.8	54	42—68
Diseases of the digestive system (520—577)	59	89.1	66	50—85
All accidents (E 800—949)	43	77.6	55	40—75
Motor vehicle accidents (E 810—827)	20	29.3	68	42—105

[a] According to the International Classification of Diseases Adapted (code 8).

ternal comparisons were made using the method of Breslow & Day (1). The entire study population was utilized as the standard for the calculation of the expected deaths for the two subpopulations. Using the total population as the standard also eliminated possible biases due to differences between the cohort and US white males such as racial, demographic, and personal characteristics.

When the mortality experience of members of mixed locals was compared to that of specialty locals, the standardized mortality ratio for all causes of death was 106 for mixed locals and 88 for specialty locals ($p < 0.001$) (table 7). For all malignant neoplasms, the differences were slightly greater with a standardized mortality ratio of 109 for members of mixed locals and 83 for specialty locals ($p < 0.001$). These results were very similar to the standardized mortality ratios calculated with the use of US white male rates. There was an even greater difference in mortality from cancer of the lung, with a standardized mortality ratio of 113 for mixed locals and 77 for specialty locals ($p < 0.001$). Differences were also observed between the two groups in terms of mortality from cancer of the bladder ($p < 0.05$) and leukemia ($p < 0.05$).

Table 7. Standardized mortality ratios (SMR) for members of mixed versus specialty locals.

Cause of death [a]	SMR		p-Value
	Mixed	Speciality	
All causes of death (000—999)	106	88	0.001*
All malignant neoplasms (140—209)	109	83	0.001*
Lung cancer (162)	113	77	0.001*
Stomach cancer (151)	105	90	0.580
Large intestine cancer (153)	100	101	0.950
Rectal cancer (154)	117	65	0.184
Liver cancer (primary) (155)	107	85	0.667
Prostate cancer (185)	101	98	0.893
Bladder cancer (188)	122	53	0.022*
Kidney cancer (189)	108	84	0.484
Thyroid cancer (193)	85	122	0.802
Leukemia & aleukemia (204—207)	123	51	0.022*
Persons	32 884	24 064	
Person-years	147 595	109 229	

[a] According to the International Classification of Diseases Adapted (code 8).
* Significant at $p < 0.05$.

Discussion

Overall, the membership of both the mixed and specialty locals experienced a lower rate of mortality than did all US white males during 1975—1979. As many Union members were still employed, they may have been healthier than the entire US population. However, the study population included many retirees who may be either ill or well. With 20.7 % of the study population aged 65 years and older, the proportion of elderly individuals in the study cohort was similar to the age composition of the study states (17).

Analysis of the mortality experience of the membership of this union suggested that the painters and allied tradesmen presented a different mortality experience, particularly for malignant neoplasms. The overall mortality experience for members of the mixed locals was 93 % of that of all US white males. The overall mortality of members of the specialty locals was much lower at 75 %. The cause of the difference in mortality experience is not clear.

The elevated lung cancer mortality among members of the mixed locals was observed both when comparisons were made with US white males and with allied trade members. This finding is consistent with the results of a case-referent study of this population in which occupational data were collected by questionnaire (15).

Among members of the mixed locals there was an elevation in leukemia and aleukemia, whereas the mortality from these two diseases was lower among the specialty trade locals. Mortality from cancer of the stomach appeared to be slightly elevated among members of both the mixed (SMR = 136) and specialty (SMR = 108) locals, although statistically significant only for the former. As ethnicity information was not available, it was not possible to assess the impact of this factor on the stomach cancer mortality of the Union members. The standardized mortality ratio for bladder cancer was not significantly elevated among members of the mixed locals in comparison to that of US white males. The internal comparisons suggest that the differences in mortality ratios for bladder cancer of members of the mixed and specialty locals might warrant further study.

Paint technology is a rapidly changing field. The possible components of paint formulations are almost limitless. Continued assessment of the population will be required to determine whether the removal of asbestos from spackling compound and changes in paint technology over time have altered the risks experienced by these workers. Construction painters use a wide variety of paint formulations. Additional studies of painters in other industries, whose work requires the use of fewer types of paints, should be conducted in an attempt to identify specific paints and painting activities which may be associated with increased cancer risks.

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