Cancer Incidence Among Union Carpenters in New Jersey

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A cohort of 13,354 male union carpenters in New Jersey was linked to cancer registry data to investigate cancer incidence during 1979 through 2000. Surveillance, Epidemiology and End Results data were used to calculate standardized incidence ratios (SIRs). A total of 592 incident cancers were observed among this cohort (SIR = 1.07), which was not statistically in excess. However, significant excesses were observed for cancers of the digestive system and peritoneum (SIR = 1.24) and the respiratory system (SIR = 1.52). Workers in the union more than 30 years were at significant risk for cancers of the digestive organs and peritoneum (SIR = 3.98), rectum (SIR = 4.85), trachea, bronchus, and lung (SIR = 4.56), and other parts of the respiratory system (SIR = 11.00). Testicular cancer was significantly in excess (SIR = 2.48) in analyses that lagged results 15 years from initial union membership. Additional etiologic research is needed to evaluate possible occupational and nonoccupational risk factors for testicular cancer.
(J Occup Environ Med. *2003;45:1059–1067*)

In 2000, 1.2 million carpenters were employed in the United States.[1] Carpenters perform numerous construction-related tasks that may place them at risk of exposure to a variety of known and suspected carcinogens, such as asbestos, silica, wood dust, man-made mineral fibers, solvents, welding fumes, and various metals.[2,3] Some cancer mortality studies, which are summarized in Table 1, suggest that carpenters and workers in related occupations are at an increased risk for cancers that correlate with these types of exposures. Higher-than-expected mortality for cancers of the lung,[4–7] pleura,[5,8] stomach,[9–11] and buccal cavity and pharynx[10] among carpenters and related crafts have been observed.

Mortality studies provide good estimates of cancer incidence for sites such as the lung and stomach, where the case fatality rate is high (ie, 5-year survival rates <20%).[12] However, studies of mortality are not useful for certain sites, such as the urinary bladder, breast, and prostate, where 5-year survival rates exceed 75% and 10-year survival rates exceed 60%.[12] Of interest for carpenters and wood dust-exposed populations are nasopharyngeal and sinonasal cancers, for which numerous epidemiologic studies have demonstrated an excess risk, especially among populations exposed to dusts from hard woods.[13–17] However, the sinonasal cancers are relatively rare and are associated with low case fatality rates (5-year survival >60%)[12]; therefore, cohort mortality studies have limited statistical power to detect elevated risks unless the

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Grant Sponsor: National Cancer Institute grants CA63782 and CA72099.

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DOI: 10.1097/01.jom.0000085892.01486.6a

TABLE 1
Previous Epidemiologic Studies of Cancer Mortality Among Carpenters and Construction Laborers

	All Cancers		Bronchus and Lung		Pleura/ Other Parts of Respiratory System		Rectum		Stomach	
Author Year (n)	*n*	RR	*n*	RR	*n*	RR	*n*	RR	*n*	RR
Hall et al* 1991 (10,824)	–	–	152	1.24[a]	17	3.06[a]	–	–	13	1.72[b]
Hrubec et al† 1992 (248,046)	383	0.9	79	1.0	–	–	18	1.2	32	1.60[c]
Milham‡ 1974 (16,443)	3,629	0.97	1,218	1.06[b]	6	1.33	110	0.85	218	1.07
Milham§ 1983 (16,843)	2,974	1.04[b]	261	1.18[a]	2	0.69	NS	NS	285	1.20[a]
Registrar‖ 1986 (3,771)	3,771	1.05[a]	–	–	47	3.61[a]	–	–	–	–
Robinson et al¶ 1995 (61,682)	3,731	1.02	1,489	1.16[a]	14	1.63	–	–	–	–
Robinson et al** 1996 (26,435)	7,337	1.15[a]	2,648	1.23[a]	27	3.01[a]	–	–	252	1.30[a]
Stern et al†† 1995 (11,685)	3,285	1.00	1,208	1.06[b]	12	1.13	62	1.20	170	1.44[a]
Dement et al# 2001 (43,180)	2,140	1.00	914	1.17[b]	8	1.15	26	0.88	55	1.06

[a] $P < 0.01$; [b] $P < 0.05$; [c] $P < 0.10$; NS = not significant, specific ratio not reported.

SMR, standardized mortality ratio; PMR, proportionate mortality ratio, PCMR, proportionate cancer mortality ratio; PCIR, proportionate cancer incidence ratio.

* PCIR cancer cases among construction workers in New Jersey (white males only included in this table) 1979–1984. Expected deaths based on New Jersey cancer rates.

† SMR deaths among US veterans by occupation-known smoking status 1954–1980. Expected deaths based on US death rates.

‡ SMR death claims among carpenter union members 1969–1970. Expected deaths based on U.S. rates for 1968.

§ PMR death certificates among carpenters in Washington State 1950–1979. Expected deaths based on WA mortality.

‖ PMR death certificates among carpenters 1979–1983. Expected deaths based on England and Wales population mortality.

¶ PMR death certificates among carpenters from 19 U.S. 1984–1986. Expected deaths based on US death rates.

** PMR deaths among white, male carpenter union members from 1987–1990. Expected deaths based on US death rates.

†† PMR deaths among construction workers in the LIUNA, 1985–1988. Expected deaths based on US death rates.

PMR deaths among NC construction workers, 1988–1997. Expected deaths based on NC death rates.

cohort is prohibitively large. Studies of cancer morbidity using case-control study designs with cases identified from clinical records or cancer registries have been most useful in elucidating the risk of sinonasal cancers among carpenters and other wood dust-exposed workers. For example, nasopharyngeal cancer was significantly elevated (PCIR 227; $P < 0.05$) among construction workers, including carpenters, in a study that used incidence data from the New Jersey State Cancer Registry.[18]

The purpose of this study was to estimate the risk of all cancers and site-specific cancers among members of United Brotherhood of Carpenters and Joiners of America (UBC) in New Jersey by individually matching them with New Jersey State Cancer Registry (NJSCR) data. Cancer registry data are valuable for providing information about incident cases of cancer; however, no information is available through the Registry with regard to occupation or workplace exposures. By combining these data sets, we sought to examine the incidence of various cancers, especially those with low fatality rates that may not have been detected in previous mortality studies, among a large cohort of carpenters within the same geographical region. We calculated standardized incidence ratios (SIRs) for various cancers using national incidence rates provided by the Surveillance, Epidemiology and End Results (SEER) program. The SEER program of the National Cancer Institute collects information about persons diagnosed with incident cases of cancer from 11 population-based cancer registries, covering approximately 14% of the US population, and is considered the gold standard for providing national estimates of cancer incidence.

Materials and Methods

The current analyses of cancer incidence among carpenters were undertaken as part of an ongoing communication intervention trial to increase colorectal cancer screening among potentially higher-risk blue-collar workers funded by the National Cancer Institute. This study is being conducted in collaboration with the New Jersey Carpenters Health Fund. The New Jersey Carpenters Fund provides and administers health and welfare benefits for UBC members in New Jersey.

The initial data file used to define the cancer incidence study cohort consisted of 15,375 male UBC members in New Jersey who had participated in the New Jersey Carpenters Fund at some time prior to July 1, 2000. This cohort was matched to the New Jersey Carpenters Pension Fund to define starting and ending dates of UBC membership (month and year), pension fund contributions by year, and state and date of last known address for retired UBC members. The cohort was further restricted to 13,354 workers with some period of

active UBC work after January 1, 1979, the starting date for the NJSCR.

The UBC study cohort of 13,354 carpenters was matched to the NJSCR through December 31, 2000 using worker social security number as the primary matching criteria followed by last name, date of birth, and gender. The NJSCR is a population-based incidence registry and includes all cancer cases diagnosed among New Jersey residents since October 1, 1978. New Jersey regulations require reporting of all newly diagnosed cancer cases to the NJSCR within 3 months of hospital discharge or 6 months of diagnosis, whichever occurs first. All primary malignant and in situ neoplasms are reportable, except for certain carcinomas of the skin (ICD-9 Code 173). The NJSCR collects demographic data on each cancer patient (social security number, gender, race, date of birth) as well as information on each cancer (diagnosis date, anatomic site, histology, behavior, and summary stage). Annual follow-up status (alive/dead), dates of death, and underlying cause of death are recorded for each reported cancer case. Using data on primary cancer site (ICD-O-2), histology, and behavior, an ICD-9 code was assigned to each reported cancer using the software program *IARCtools* (Version 2.01) developed by the International Agency for Research on Cancer.[19]

The PC version of Life Table Analysis System (LTAS) (LTAS Version 1.0 days) developed by the National Institute for Occupational Safety and Health was used to calculate SIRs of all cancers and site-specific cancers.[20,21] The LTAS stratified person-years at risk (PYAR) for each worker into strata by 5-year age groups, 5-year calendar time periods, length of UBC membership, and time since initial UBC membership. The PYAR for each worker began accumulating on January 1, 1979 or the date of first participation in the pension fund, which ever occurred later. The PYAR for each worker was stopped on the last date of New Jersey union pension fund contribution or last date of known residence in New Jersey for retired workers. Workers were assumed to have been a resident of New Jersey and therefore subject to cancer reporting requirements for each year in which contributions were made to the New Jersey pension fund. Only cancer cases occurring within the periods of PYAR accumulation were used for the SIR analyses. PYAR in each age and calendar time strata were multiplied by corresponding cancer incidence rates from the SEER Program of the National Cancer Institute to calculate expected malignant neoplasms by site. Although race data were not available for the entire cohort, race data were available for cancer cases reported to NJSCR and for workers participating in the colorectal cancer risk communication intervention study. Among 1236 workers with cancers reported to the NJSCR, 97.4% were white; therefore, SEER incidence rates for white males were used for all analyses.

SIRs by cancer site were calculated as the ratio of observed to expected cases. To account for occupational cancer induction periods, additional analyses were undertaken which lagged duration of carpenter union work by 15 years. These analyses discounted person-years and cancer cases prior to 15 years since initiation of work in the carpenter union.[22,23] The 95% confidence interval (CI) was computed for each site-specific SIR using the Byar approximation when the number of cases was five or more or the Fisher's exact method when the number of cases was fewer than five.[24]

For selected cancer sites, trends in risk by duration of carpenter union work were further investigated by calculation of directly standardized rate ratios (SRR) using procedures provided by the National Institute for Occupational Safety and Health LTAS. The LTAS calculates the SRR as a ratio of weighted rates in which the weight for each stratum-specific weight is the combined person-years for the observed cohort across a duration of union work categories. In these analyses, the lowest duration of carpenter work strata (<10 years) was used as the referent group for comparison with higher duration of work strata. Taylor series approximation procedures were used to calculate 95% confidence intervals for each SRR and tests for linear trend in the SRR with duration of carpenter union work were preformed using procedures described by Rothman.[23]

Results

A total of 162,520 PYARs were contributed by the 13,354 union carpenters included in this study and approximately 97% of the PYARs occurred among workers less than 65 years of age. Overall SIR analyses, as well as analyses by cancer site, are given in Table 2. Union carpenters were found to have an overall cancer incidence approximately equal to the United States (SIR = 1.07; 95% CI = 0.99–1.16); however, the distribution of cancers by site demonstrated interesting patterns. Cancers of the digestive organs and peritoneum were significantly higher than expected (SIR = 1.24; 95% CI = 1.04–1.47). Cancers of all sites of the digestive system except the peritoneum were in excess of expected; however, only rectal cancer was significantly higher than expected (SIR = 1.51; 95% CI = 1.05–2.10). Significant excess risk was observed for all cancers of the respiratory system (SIR = 1.52; 95% CI = 1.29–1.76). Cancers of the trachea, bronchus, and lung were significantly in excess (SIR = 1.45; 95% CI = 1.22–1.72) as well as cancers of other parts of the respiratory system (SIR = 4.19; 95% CI = 2.35–6.92). In these overall analyses, the only statistically significant deficit observed was for skin melanoma (SIR = 0.43; 95% CI = 0.23–0.72).

TABLE 2
Overall Cancer Incidence, New Jersey Carpenters 1979–2000

Cancer Site	ICD-9 Codes	Obs	Exp	SIR	95% CI
All malignant (Mn) neoplasms	140–208.9	592	551.67	1.07	0.99–1.16
Buccal cavity and pharynx	140–149	24	25.27	0.95	0.61–1.41
Mn of lip	140–140.9	3	3.70	0.81	0.17–2.37
Mn of tongue	141–141.9	5	5.56	0.90	0.29–2.10
Mn of other parts of buccal cavity	142–145.9	5	7.91	0.63	0.20–1.48
Mn of pharynx	146–149.9	11	8.11	1.36	0.67–2.42
Digestive organs and peritoneum	150–159	130	104.84	1.24	1.04–1.47
Mn of esophagus	150–150.9	8	7.23	1.11	0.48–2.18
Mn of stomach	151–151.9	12	11.74	1.02	0.53–1.79
Mn of intestine except rectum	152–153.9	49	42.04	1.17	0.86–1.54
Mn of rectum	154–154.9	35	23.21	1.51	1.05–2.10
Mn of biliary passages, liver, and gallbladder	155–155.1				
	156–156.9	12	7.31	1.64	0.85–2.87
Mn of liver not specified as primary/secondary	155.2	0	0.00	–	–
Mn of pancreas	157–157.9	14	11.97	1.17	0.64–1.96
Mn of peritoneum and other and unspecified of digestive organs	158–159.9	0	1.34	0.00	–
Respiratory system	160–165	166	109.53	1.52	1.29–1.76
Mn of larynx	161–161.9	14	11.59	1.21	0.66–2.03
Mn of trachea, bronchus, and lung	162–162.9	137	94.37	1.45	1.22–1.72
	160–160.9				
Mn of other parts of respiratory system	163–165.9	15	3.58	4.19	2.35–6.92
Male genital organs	185–187	123	122.40	1.00	0.84–1.20
Mn of prostate	185–185.9	104	107.66	0.97	0.79–1.17
Mn of testes	186–186.9	19	14.74	1.29	0.78–2.01
Urinary organs	188–189	45	53.90	0.83	0.61–1.12
Mn of kidney	189.0–189.2	16	18.64	0.86	0.49–1.39
Mn of bladder and other urinary organs	188.0–188.9				
	189.3–189.9	29	35.27	0.82	0.55–1.18
Other and unspecified sites	Mixed	57	92.89	0.61	0.46–0.80
Mn of skin melanoma	172–172.9	14	32.84	0.43	0.23–0.72
Mn of eye	190–190.9	0	1.37	–	–
Mn of brain and other parts of nervous system	191–192.9	14	12.78	1.10	0.60–1.84
Mn of thyroid gland	193–193.9	6	6.36	0.94	0.34–2.05
Mn of bone	170–170.9	1	1.61	0.62	0.02–3.46
Mn of connective tissue	171–171.9	2	4.37	0.46	0.06–1.65
Mn of other and unspecified sites	187–187.9				
	194–199.9	20	14.46	1.38	0.84–2.13
Neoplasms of lymphatic and haematopoietic tissues	200–208	46	60.74	0.76	0.55–1.01
Non-Hodgkins lymphoma	200–200.9				
	202–202.9	19	32.18	0.59	0.36–0.92
Hodgkin's disease	201–201.9	6	7.01	0.86	0.31–1.86
Leukemia and aleukemia	204–208.9	12	15.48	0.78	0.40–1.35
Myeloma	203–203.9	9	6.08	1.48	0.68–2.81

Analyses by age demonstrated that most excess cancer risk occurred among workers over 50 years of age as shown in Table 3. The SIR for all cancer was significantly reduced for workers less than 50 years of age (SIR = 0.60, $P < 0.05$); however, excess cancer was seen among workers over the age of 50 (SIR = 1.18, $P < 0.05$). This pattern with age is consistent with the "healthy worker effort" observed in many mortality studies of occupational cohorts.[22] Significant excess cancer incidence ($P < 0.05$) was observed for all cancers of the digestive organs and peritoneum (SIR = 1.33), rectum (SIR = 1.62), lung (SIR = 1.59), and other parts of the respiratory system (SIR = 4.88) among workers older than 50 years. Cancers of the intestine except rectum were excess among older workers (SIR = 1.22), although the excess was not statistically significant.

To account for occupational cancer induction periods, additional analyses discounted (lagged) person-years and cancer cases prior to 15 years since initiation of work in the carpenter union. Table 4 presents results for cancer sites with significant excess or deficits in the lagged

TABLE 3
Cancer Incidence by Age Group for Selected Cancer Sites, New Jersey Carpenters 1979–2000

	Standardized Incidence Ratios					
Age Group (Years)	Digestive Organs and Peritoneum	Intestine Except Rectum	Rectum	Trachea, Bronchus, and Lung	Other Respiratory System Areas	All Cancers
<50	0.82	0.88	1.00	0.45*	2.68	0.60*
>50	1.33*	1.22	1.62*	1.59*	4.88*	1.18*
Overall	1.24*	1.17	1.51*	1.46*	4.21*	1.07

* $P < 0.05$.

TABLE 4
Cancer Incidence for Selected Sites 15-Year Lag from Initial Date of Carpenter Union Work, New Jersey Carpenters, 1979–2000

Cancer Site	ICD-9 Codes	Obs	Exp	SIR	95% CI
All malignant (Mn) neoplasms	140–208	485	404.90	1.20	1.10–1.31
Digestive organs and peritoneum	150–159	110	80.74	1.36	1.16–1.60
Mn of intestine except rectum	152–153.9	42	32.52	1.29	0.98–1.67
Mn of rectum	154–154.9	28	17.84	1.57	1.12–2.15
Respiratory system	160–165	146	86.34	1.69	1.47–1.94
Mn of trachea, bronchus, and lung	162–162.9	127	74.88	1.70	1.46–1.97
Mn of other parts of respiratory system	160–160.9				
	163–165.9	11	2.45	4.47	2.50–7.39
Male genital organs	185–187	100	94.37	1.06	0.89–1.25
Mn of Testes	186–186.9	9	3.63	2.48	1.29–4.32
Other and unspecified sites	Mixed	42	45.47	0.92	0.66–1.24
Mn of skin melanoma	172–172.9	9	19.69	0.46	0.24–0.79
Mn of other and unspecified sites	187–187.9				
	194–199.9	17	10.76	1.58	1.01–2.37

analyses. These analyses demonstrated the same patterns of excess cancer risk as the overall analyses, although the SIR values were somewhat higher. In the lagged analyses, malignant neoplasms of the testes was significantly elevated (SIR = 2.48, 95% CI = 1.29–3.32) and melanoma of the skin was significantly deficit (SIR = 0.46, 95% CI = 0.24–0.79).

Duration of carpenter union work was used as a surrogate of occupational exposures among these workers. Trends in the risk of cancer were analyzed by examination of the SIR values by 10-year strata of carpenter work in the 15-year lagged analyses (Table 5). Prior to 10 years of carpenter union work, only cancers of other parts of the respiratory system (SIR = 4.22, $P < 0.05$) and testes (SIR = 2.58, $P < 0.05$) were significantly elevated. However, all other sites that were shown to be in excess in the lagged analyses demonstrated increasing trends in the SIR with duration of carpenter work, with the highest SIR values for carpenters having worked in the union for more than 30 years. In the strata greater than 30 years, the SIR for all cancers was 3.34 ($P < 0.05$) with very large excesses being observed for all cancers of the digestive organs and peritoneum (SIR = 3.98, $P < 0.05$), rectum (SIR = 4.85, $P < 0.05$), lung (SIR = 4.56, $P < 0.05$), and other parts of the respiratory system (SIR = 11.00, $P < 0.05$).

Trends in the risk of selected cancers were further examined in the analyses using directly standardized rate ratios (SRR) and these results are shown in Table 6. Tests for linear trends in the SRR with duration of carpenter union work were significant ($P < 0.05$) for all cancers of the digestive organs and peritoneum, lung, and other parts of the respiratory system. The SRRs for cancers of the intestine except rectum increased with work duration although the trend was not statistically significant. Although not shown in Table 6, SRRs were calculated for cancers of the rectum; however, the observed patterns of risk were not stable as a result of only one observed cancer in the reference strata (1 observed and 3.1 expected). It should be noted that all trends except cancers of other parts of the respiratory system were positive. The negative trend for cancers of other parts of the respiratory system is largely because of the significant excess for cancers at these sites observed for workers with less than 10 years of union work (see Table 5). As previously discussed, cancers in this category are largely pleural cancers (including mesotheli-

TABLE 5
Cancer Incidence for Selected Cancer Sites by Duration of Carpenter Union Work 15 Year Lag from Initial Date of Carpenter Union Work, New Jersey Carpenters, 1979–2000

	Standardized Incidence Ratios						
Years of Union Work	Digestive Organs and Peritoneum	Intestine Except Rectum	Rectum	Trachea, Bronchus, and Lung	Other Respiratory System Areas	Testes	All Cancers
0–10	0.88	0.89	1.25	1.01	4.22*	2.58*	0.83*
11–20	1.51*	1.62*	1.58	1.82*	1.08	2.57	1.15
21–30	1.39	1.06	1.54	2.03*	10.02*	–	1.40*
>30	3.98*	2.73	4.85*	4.56*	11.00*	–	3.34*
Overall	1.36*	1.29	1.57*	1.70*	4.47*	2.48*	1.20*

* $P < 0.05$.

TABLE 6
Directly Standardized Rate Ratios by Duration of Carpenter Union Work, New Jersey Carpenters, 1979–2000

	Standardized Rate Ratio (95% Confidence Interval)			
Years of Union Work	Digestive Organs and Peritoneum	Intestine Except Rectum	Trachea, Bronchus, and Lung	Other Respiratory System Areas
0–10	1.0	1.0	1.0	1.0
11–20	2.7 (1.0–7.7)	0.7 (0.2–3.0)	2.7 (0.9–7.8)	1.3 (0.2–9.2)
21–30	3.5 (1.3–9.3)	1.8 (0.6–4.9)	2.8 (1.0–8.1)	0.9 (0.2–4.0)
>30	3.8 (1.5–10.0)	1.6 (0.5–4.7)	4.5 (1.7–12.4)	0.7 (0.2–2.7)
Rothman Trend Test	$P < 0.05$	$P > 0.05$	$P < 0.05$	$P < 0.05$

oma) with asbestos exposures being the most likely risk factor. Numerous studies have shown mesothelioma to be increased among workers with low cumulative exposures.[25]

The distribution of cancers in several categories was further investigated to determine the most prominent sub-site. Within the category of "cancers of the intestine except rectum" (ICD-9 codes 152–153.9), 44 of 49 cancers were in the colon (ICD-9 codes 153–153.9). In the category cancers of 'other parts of the respiratory system' (ICD-9 codes 160–160.9 and 163–165.9), 11 of 15 cancers were of the pleura (ICD-9 codes 163– 163.9), and 2 of 15 were of the nasal cavity (160.0).

Discussion

Our analyses used SEER cancer rates for the US population to calculate expected cancers by site among the carpenter cohort. We chose to use SEER rates as opposed to rates for only New Jersey because of their general acceptance and stability of rates when stratified by age, race, sex, and calendar time. However, cancer incidence rates vary with geographic location, and this could have some impact on our results and interpretations. Analyses of New Jersey cancer incidence for 1994 through 1998 compared with SEER data for white males have shown New Jersey age-adjusted total cancer incidence rates (cases per 100,000) to be approximately 10% higher than the US (505.3 vs. 457.7). During this same time period, rates for colorectal cancer in New Jersey also were shown to be higher than the US (62.7 vs. 53.6); however, lung cancer rates where slightly lower than US rates (77.2 vs. 78.0).[26] Based on these data, our analyses may have slightly overestimated the risk for all cancer sites combined and for colorectal cancers and slightly underestimated the risk of lung cancer among New Jersey carpenters. However, the differences in New Jersey and SEER rates are not sufficient to explain the large and statistically significant excesses observed for all cancers (SIR = 3.34), digestive system cancers (SIR = 3.98), and lung cancers (SIR = 4.56) among workers in the carpenter union for more than 30 years, after controlling for a minimum cancer latency of 15 years. These data suggest occupational exposures as contributing factors for risks at these cancer sites.

The excess risk for cancers of the trachea, bronchus and lung that we observed is consistent with findings from prior mortality studies, as well as hospital and community-based case control studies. Elevated lung cancer mortality risk estimates ranging from 1.1 to 1.2 among carpenters and related crafts have been observed,[4–7,10,11] in addition to elevated odds ratios (OR = 1.1– 1.8) when exposure to employment as a carpenter or construction worker and lung cancer have been examined.[27–30] Exposures to asbestos, sil-

ica, and wood dust, which are common among carpenters, have also been associated with an elevated risk for these cancers.[31] An increasing trend for cancers of the respiratory system was observed, with carpenters who were UBC members for at least 30 years to be at greatest risk. Duration of employment as a construction worker was also explored by Stern[7] who noted an elevated risk for lung cancer mortality for each 10-year period of union membership; however this trend did not reach statistical significance, which was observed in our study. Higher-than-expected numbers of cases were noted for other respiratory cancers, which consisted mostly of cancers of the pleura. The large excess observed for pleural cancers is largely explained by occupational exposures to asbestos, known to occur among carpenters.[32]

An increase in rectal cancer and intestinal cancer contributed to the overall increase in the incidence of cancers of the digestive tract; whereas no increased risk of stomach cancer occurred. Some studies have noted an excess in morality due to stomach cancer with risk estimates ranging from 1.2 to 1.4,[6,7,11] as well as a case-control study that observed an elevated odds ratio (OR = 1.7, 95% CI = 1.0–2.7) for stomach cancer among workers exposed to wood dust for at least 15 years.[33] Prior study findings with regard to cancers of the colon and rectum have been mixed, while some study findings are difficult to use for comparison because these cancers were combined into a single category of colorectal cancer in the analyses. Elevated odds ratios of 9.4 (95% CI = 2.0–44.7) for rectal cancer[34] and 1.4 (95% CI = 0.9–2.2) for colorectal cancer[33] were observed among workers exposed to wood dust. However, no increase in rectal cancer was observed by Dumas et al.[35] who examined workers exposed to wood dust for a minimum of 15 years. Furthermore, employment as a carpenter was not associated with an increased risk of either colon or rectal cancer in a case-control study conducted by Arman et al.[36]

A new finding from this study includes a higher than expected incidence of testicular cancer when a 15-year latency period was considered. This excess was seen only among workers with less than 10 years of union membership. Testicular cancer accounts for only 1% of all cancers in men, but it is the most common form of cancer in young men ages 15 to 35 years.[37] Of the 19 workers with testicular cancer in the present study, 15 occurred among workers less than 45 years of age. The 5-year survival rate for testicular cancer is 93%,[12] which may explain why previous mortality studies have not observed an increased risk for this cancer among carpenters or related trades. Pollan et al.[38] observed an excess incidence of testicular cancer (nonseminoma tumors only; SIR = 1.71, 95% CI = 1.01–2.92) among construction workers in Sweden; however, these findings were not noted in other studies that used incidence data.[18] The etiology of testicular cancer is poorly understood and only a few risk factors have been identified, including cryptorchidism (undescended testis), abnormal testicular development, and Klinefelter's syndrome. Occupational agents that have been explored as possible risk factors include plastics, pesticides, and solvents including dimethylformamide (DMF), which is commonly used in acrylic fiber spinning, chemical manufacturing, and pharmaceutical production.[39] Two small case studies observed higher than expected cases of testicular cancer among airframe repair shop workers,[40] and finishers in a leather tannery[41] who used DMF in their jobs. The degree to which DMF is used among carpenters and considered as a possible risk factor for this workgroup is not known.

We observed a lower-than-expected incidence of melanoma (SIR = 0.46) among our cohort of carpenters compared with national data. After considering a 15-year lag period, lower than expected cases were also noted when we used New Jersey State Cancer Registry data for comparison, but these findings were not statistically significant (SIR = 0.65, 95% CI = 0.30–1.23). Although carpenters may be exposed to sunlight while at work, the pattern of exposure may reflect lower than expected risk estimates for melanoma. Intermittent high intensity exposure to sunlight, especially that results in sunburn has been associated with melanoma; whereas, chronic low dose exposure, which may be the more typical type of occupational exposure among carpenters, has been associated more with nonmelanoma skin cancer including basal cell and squamous cell carcinomas.[42]

Cigarette smoking is an established cause of lung cancer and has been positively associated with cancers at numerous other sites including the stomach,[43] rectum,[44] and colon.[45,46] Other lifestyle factors such as alcohol use and high dietary fat intake have also been implicated as possible risk factors for these cancers.[45,47,48] Unfortunately, information about these lifestyle factors among our cohort of carpenters was not available and therefore were not considered as possible confounders in the analyses.

Workers in the construction industry have been identified as heavy consumers of both tobacco and alcohol. For example, a higher prevalence of cigarette smoking was observed among construction laborers in National Health and Nutrition Examination Survey III compared with the overall population of employed study participants.[49] In addition, the construction industry was ranked as the third highest for alcohol use among workers ages 18 to 49 among all U.S. industry groups.[50] These study findings support the importance of controlling for these behaviors in the analyses among carpenters, especially when examining cancers that are associated with both lifestyle and occupational factors.

However, given the significant excess risk of respiratory cancers and cancers of the digestive system that we observed, especially among carpenters who were employed in the union for at least 30 years, it is unlikely that these elevated risk estimates can be attributed solely to these lifestyle factors.[51,52]

There are numerous strengths to this study including a reasonably large cohort size and the availability of union membership and health fund participation information that allowed us to maintain follow-up of carpenters who were either active UBC members or retired and still residing in New Jersey. Another strength of the study is the linkage with a well-established cancer registry. Furthermore, our data allowed us to examine the duration of union membership as a risk factor for selected cancers, which has been examined in prior mortality studies of carpenters[6,7]; however, this has not been conducted in a large cohort study that used cancer incidence data. Like other studies of construction workers, a limitation of our study is the lack of information on specific exposures experienced by cohort members. The cohort covers most union carpenters in New Jersey but does not include nonunion carpenters. The degree to which union carpenters are representative of carpenters as a whole has not been investigated; however, a general observation is that union carpenters are more likely to be employed by larger contractors. Nationally, only 19% of carpenters are union members; however, this percentage is higher in New Jersey where more than 30% of construction workers are unionized.[53]

Conclusions

Carpenters enrolled in the UBC had elevated risk estimates for cancers that have been observed in prior studies. The cancer sites with excesses are consistent with carpenter exposures to known and suspected carcinogens, such as asbestos, silica, and wood dust. An increased risk of rectal cancer has been suggested in prior studies; however, our study provided stronger evidence that carpenters are in fact at risk, especially those who were employed for more than 30 years. Further research is needed to explore possible risk factors for the elevated risk of testicular cancer that we observed.

Acknowledgments

This work could not have been accomplished without the collaboration of the New Jersey Carpenters Funds and the valuable assistance provided by George R. Laufenberg, George Fernett, and Mary K. Willis. Toshi Abe of the New Jersey State Cancer Registry provided the cancer case data for this project and expert assistance in their interpretation.

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