A Proportionate Mortality Study of Bricklayers and Allied Craftworkers

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Background *Mortality among members of the International Union of Bricklayers and Allied Craftworkers (IUBAC) is examined. Bricklayers and allied craft workers may be exposed to cobalt, epoxy resins, pitch, lime, and to lung carcinogens such as asbestos, silica, and nickel.*

Methods *Proportionate mortality ratios (PMRs) were computed using US age-, gender-, and race-specific mortality rates for members who died during 1986–1991.*

Results *Statistically significant PMRs among white men were found for cancers of the esophagus (PMR = 134), stomach (PMR = 131), respiratory system, trachea, bronchus, and lung (PMR = 144), other parts of the respiratory system (PMR = 216), other and unspecified sites (PMR = 125). Elevated PMRs were also found for other diseases of the blood and blood forming organs (PMR = 201), emphysema (PMR = 133) and for asbestosis (PMR = 554), and other respiratory diseases (PMR = 119).*

Conclusions *Results are consistent with those found in previous studies, and suggest the need for intervention activities directed at the prevention of these cancers, and other respiratory diseases.* Am. J. Ind. Med. 47:10–19, 2005. *Published 2004 Wiley-Liss, Inc.*†

KEY WORDS: mortality; construction industry; cancer; occupational disease, bricklayers

INTRODUCTION

The construction industry employed an estimated 6.7 million wage and salary workers and 1.6 million self-employed and unpaid family members in non-government jobs in 2000 [Bureau of Labor Statistics, U.S. Department of Labor, 2002]. Data from the 1997 census of construction industries indicated that there were about 667,000 construction companies in the United States; 197,091 were general contractors and operative builders; 37,701 were heavy construction or highway contractors; and 431,877 were specialty trade contractors [Bureau of Labor Statistics, U.S. Department of Labor, 2002].

While construction is a large industry, published studies about potential work site exposures and the safety and health of construction workers are limited for several reasons: the majority of companies employ fewer than ten workers; inadequate personnel and medical records are maintained; and skilled and unskilled workers have mobile settings with changing work [Dunlop, 1994]. Work includes new establishments, additions, alterations, reconstruction, installations, and repairs. With the wide scope of activities, the industry presents special problems in the study, identification, and control of health and safety hazards.

Bricklayers have potential exposure to various toxic chemical and physical agents due to the work they perform. Data on potential exposures for bricklayers are available from a survey conducted during 1981–1983 among a representative of 4,500 US industrial facilities with eight or more employees [NIOSH, 1988]. Additionally, researchers have identified inhalation exposures to respirable dust and respirable quartz dust [van der Molen et al., 2004], asbestos,

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Accepted 16 August 2004

DOI 10.1002/ajim.20115. Published online in Wiley InterScience (www.interscience.wiley.com)

silica [NIOSH, 1988, 2002], and nickel [Lofgren, 1993], and both inhalation and dermal exposures to hexavalent chromium epoxy resins, cobalt, pitch, and lime [Foussereau et al., 1982; Rafnsson and Johannesdottir, 1986].

This study reports results of a mortality study of the International Union of Bricklayers and Allied Craftworkers (IUBAC). Members include bricklayers, stone and marble masons, cement masons, plasterers, tile layers, terrazzo and mosaic workers, pointers, cleaners, and caulkers. The purpose of the current study was to identify causes of death in excess for targeting future preventive and intervention efforts.

PREVIOUS REPORTS

The proportionate mortality ratio (PMR) is the ratio of the proportion of deaths from a specific cause in an exposed group, to the corresponding proportion in an unexposed group, adjusted for age and race. In addition to the increased PMRs reported for all construction industry workers, differential mortality risks have been reported for various skilled trades within the construction industry. A study of mortality in Washington State [Milham, 1997] found 2,079 deaths among brick masons, stonemasons, and tile setters. Excess deaths due to cancer of the stomach, lung, bone, avitaminoses and metabolic diseases, non-malignant respiratory diseases, motor vehicle accidents, and accidental falls were found. There were 1,813 deaths among cement and concrete finishers. PMRs were elevated for rectal cancer, accidental falls, machinery accidents, electrocution, and homicide. There were 518 deaths among glaziers, with elevated PMRs for cancers of the stomach, large intestine, rectum, liver, and pancreas. Excess death due to multiple myeloma and acute leukemia were also found. Among the 320 deaths for stonecutters, stone carvers, and sandblasters, elevated PMRs were found for respiratory tuberculosis, cancer of the pancreas, silicosis, and homicide. Smoking data were available for the years 1988–1989 but were not included in the analyses.

Registrar General [1995] showed bricklayers and tile setters in England having elevated PMRs for: cancers of the rectum, trachea, bronchus, and lung, chronic rheumatic heart disease, hypertensive disease, pulmonary heart disease, (unspecified) bronchopneumonia, bronchiectasis, and duodenal ulcers. Excess deaths were also found for accidental poisonings by drugs, falls on stairs, falls from ladders or scaffolding, and undetermined injuries. From the same data, masons and stonecutters showed elevated PMRs for cancer of the esophagus, silicosis, other pneumoconiosis, and injuries due to fire. PMRs for women were not significantly elevated. Bricklayers, tile setters, and builders each formed about 10% of deaths from mesothelioma [Registrar General, 1995].

Studies in the United States and other countries found excess risk of lung cancer among brickmasons and stonemasons [Buiatti et al., 1985; Rafnsson and Johannesdottir, 1986; Keller and Howe, 1993]. Significantly elevated mortality odds ratios were also found for stomach cancer [Mallin et al., 1989].

Unpublished data from the National Institute for Occupational Safety and Health (NIOSH) based upon death certificates coded for occupation and industry for 28 US states in the National Occupational Mortality Surveillance system for the period 1984–1998 revealed a number of statistically significant PMRs for brickmasons and stonemasons. Elevated PMRs and 95% confidence intervals (CI) were found for malignant neoplasms (PMR = 108; CI 106–110) and more specifically malignant neoplasms of the esophagus (PMR = 122; CI 107–139); trachea, bronchus, and lung (PMR = 124; CI 120–128); and ill-defined and unspecified sites (PMR = 114; CI 104–125). Other causes of death that were significantly elevated were those due to mental disorders (PMR = 128; CI 116–141), particularly those related to substance abuse (PMR = 164; CI 146–185); respiratory diseases (PMR = 108; CI 104–112), especially chronic obstructive pulmonary disease (PMR = 120; CI 114–126), and asbestosis (PMR = 209; CI 104–374). Diseases of the digestive system were significantly elevated (PMR = 109; CI 102–117), including chronic liver disease and cirrhosis (PMR = 125; CI 114–136). Deaths due to transportation accidents were also significantly elevated (PMR = 120; CI 112–129), with an excess of motor vehicle traffic accidents (PMR = 119; CI 110–128). Other significant external causes of death included deaths due to accidental poisonings (PMR = 135; CI 114–159); accidental falls (PMR = 125; CI 107–146); and accidents caused by submersion or suffocation (PMR = 136; CI 114–162) [NIOSH, 2001].

In response to a request from the Center to Protect Workers Rights (CPWR) and IUBAC, a study was initiated to examine proportionate mortality among deceased members of the IUBAC. Based upon a review of the literature, we expected to find excess deaths due to cancers, particularly lung cancer, silicosis, and other respiratory diseases.

MATERIALS AND METHODS

Study Population

This study included all persons with membership in the IUBAC who died during the period January 1, 1986 through December 31, 1991. Membership in the IUBAC totaled approximately 84,000 in 1991. Bricklayers and allied craftworkers belonging to the union are eligible for health and retirement benefits, are members of a collective bargaining unit, and eligible for various other member benefits (e.g., cross-craft and pre-apprenticeship training). Contractors can belong to the union, but there are some restrictions on their membership (e.g., they cannot vote in elections).

The IUBAC provided dues history and death benefit records. Vital status was determined for all members initiated

into the union, and for whom there was a work history card, whether the member was eligible or ineligible for death benefits. Occupations included: bricklayers; cement, stone, and marble masons; mosaic workers; plasterers; tile layers; terrazzo workers; and pointers.

At death, usually the last local or a family member notified the national union requesting payment of a death benefit. Dues history cards were pulled from the membership file, and correspondence with the local union and beneficiary were generated. Eligibility for benefits should not have affected the identification of deceased union members. Local unions pay dues for each living member; and the death of a member reduced the dues paid by the local. Therefore, the local union had an incentive to notify the national union of a member's death regardless of eligibility for death benefits.

Separate correspondence files contained the death benefit application, letters, and often a copy of the death certificate. Death listings of members, published bi-annually, in the union publication, and a computer file containing information including membership history were obtained. If the union did not have a copy of the death certificate, it was acquired from state vital registration offices in the state where the member died. Data from the computer files were downloaded into a customized FoxPro Version 2.5 program [Fox Software, 1991]. Microfilm records and death certificate data were double keyed into a program that performed extensive edit checks, including range checks. Following this, data were then combined into a form required for analysis using the NIOSH Lifetable Program [Waxweiler et al., 1983; Steenland et al., 1990]. An experienced nosologist coded causes of death according to the International Classification of Disease, Ninth Revision [WHO, 1977]. Deaths among members who died outside the United States (N = 480) were excluded from the study due to the difficulty in obtaining the death certificates and unavailability of appropriate death rates for analysis.

Statistical Analyses

PMR analysis based on the underlying cause of death was conducted to evaluate the mortality patterns of union members. PMR analysis was chosen due to a limitation of available records, in that no records were available for those members who had left the union and were no longer paying dues. The analyses were conducted using the NIOSH Life Table Analysis System (LTAS) [Steenland et al., 1990]. Age-adjusted, gender-race-specific PMR analyses were calculated by dividing the observed number of cause-specific deaths by the expected number for that cause-specific death, and multiplying by 100. Expected numbers for race-age-gender specific groups were based on the proportionate mortality experience of the US population for 5-year age groups and 5-year calendar time periods. The program calculates significance using a Poisson distribution and 95% confidence intervals. If the observed number of deaths was greater than 5, the Byar approximation to the exact test was used: if the observed number of deaths was less than or equal to 5, exact confidence limits were calculated [Rothman and Boice, 1979].

RESULTS

There were 10,921 deaths included in the computer file. Of these, 480 were for deaths outside of the US. There were 9,845 deaths among white men; 538 deaths among non-white men; and three deaths among white women. We were unable to locate death certificates for 55 members. Data for 10,386 (95% of all identified deaths) among white and non-white men were analyzed. No deaths were identified for non-white women, and because there were only three deaths among white women, they were excluded from the analyses. The majority of men, 93% of white and 84% of non-white men, had more than 20 years of union membership. Twenty-two percent of enrolled workers died before the age of 65. The mean age at death among white men was 71 years, and for non-white men it was 65 years.

Overall, for white men, significantly elevated PMRs were found for cancers of the digestive organs and peritoneum, respiratory system, and cancers of other and unspecified sites. Significant PMRs were also found for diseases of the blood and blood forming organs, and diseases of the respiratory system (Table I). Statistically significant PMRs were found for cancer of the esophagus (PMR = 134, CI 106–167) and cancer of the stomach (PMR = 131, CI 106–160). For cancer of the respiratory system, both cancer of the trachea, bronchus, and lung (PMR = 144, CI 136–153) and malignancy of other parts of the respiratory system (PMR = 216, CI 123–351) were statistically significant. PMRs were significantly elevated for cancers of other and unspecified sites (PMR = 125, CI 112–139), and for other diseases of the blood and blood forming organs (PMR = 201, CI 134–288). Diseases of the respiratory system showed statistically significant elevations for emphysema (PMR = 133, CI 111–157), asbestosis (PMR = 554, CI 295–947), and other respiratory diseases (PMR = 119, CI 110–129).

Among death certificates for 9,845 white men, 52 had mesothelioma listed as an underlying or contributory cause of death. Both the median and mean age at death for these men was 71 years with a range of 36–90 years. Among those with mesothelioma listed, 33 were brick masons/bricklayers, four were tile setters, in addition to one stone mason and one plasterer. The remaining 13 deaths were for occupations listed as: supervisor, foreman, part-owner/owner, maintenance, engineer, or missing information. There were no mesothelioma deaths among non-white men. There were four deaths due to silicosis and although the PMR was elevated (PMR = 322), and the confidence interval included 100.

TABLE I. Proportionate Mortality Ratios (PMRs) for IUABC Members, White Men, 1986–1991[a]

Cause of death (ICD-9)	Number of deaths	PMR	95% confidence interval
Malignant neoplasm (MN) of buccal cavity and pharynx	46	101	74–135
Tongue (141)	9	88	40–168
Other parts of buccal cavity (142–145)	16	124	71–201
Pharynx (146–149)	20	92	56–142
MN of digestive organs and peritoneum	632	109*	100–117
Esophagus (150)	77	134*	106–167
Stomach (151)	94	131*	106–160
Intestine except rectum (152–153)	255	109	96–123
Rectum (154)	42	103	74–139
Biliary passages, liver, and gall bladder (155.0, 155.1, 156)	44	109	79–146
Liver not specified (155.2)	9	59	27–112
Pancreas (157)	99	89	72–108
Peritoneum and other unspecified digestive organs (158–159)	12	121	62–211
MN of respiratory system	1,229	144**	136–152
Larynx (161)	27	104	68–151
Trachea, bronchus, and lung (162)	1,186	144**	136–153
Other parts of respiratory system (160, 163–165)	16	216**	123–351
MN of male genital organs	292	98	87–110
Prostate (185)	291	98	87–110
MN of urinary organs	152	117	99–137
Kidney (189.0, 189.2)	62	110	85–142
Bladder and other urinary organs (188–189.3–189.9)	90	122	98–150
MN of other and unspecified sites	359	125**	112–139
Melanoma (172)	42	129	93–175
Other, skin (173)	14	102	56–171
Brain and other parts of nervous system (191, 192)	46	95	69–126
Thyroid gland (193)	5	142	46–332
Connective tissue and soft tissue (171)	6	53	19–116
Other and unspecified sites (minor) (187, 194–199)	242	140**	123–159
Neoplasm of lymphatic and hematopoietic tissue	222	102	89–117
Non-Hodgkin's lymphoma (200, 202)	79	94	74–117
Hodgkin's disease (201)	5	82	26–191
Leukemia and aleukemia (204–208)	97	111	90–135
Myeloma (203)	41	104	75–141
Benign and unspecified neoplasms	35	127	88–176
Benign neoplasms of eye, brain, and other parts of the nervous system (224, 225)	5	182	59–425
Neoplasms of eye, brain, and other parts of nervous system-unspecified (237.5–237.9, 239.6–239.7)	9	88	40–166
Other benign and unspecified neoplasms (210–223, 226–237.4, 238.0–239.5)	21	144	89–220
Diabetes mellitus (250)	134	82*	69–98
Diseases of the blood and blood forming organs	49	134	99–177
Anemias of other and unspecified type (280, 281.1–281.8, 282–285)	12	86	44–150
Coagulation defects, purpura, and other hemorrhagic conditions (286, 287)	8	104	45–205
All other diseases of blood forming organs (288, 289)	29	201**	134–288

(*Continued*)

TABLE I. (*Continued*)

Cause of death (ICD-9)	Number of deaths	PMR	95% confidence interval
Mental—psychoneurotic and personality disorders	59	62**	47–80
Alcoholism (303)	11	54*	27–97
Other mental disorders (290–302, 304–319)	48	64**	47–85
Diseases of the nervous system and sense organs	156	93	79–109
Other diseases of the nervous system and sense organs (320–337, 341–389)	153	94	80–110
Diseases of the heart	3,458	93**	90–96
Rheumatic heart disease—including fever (390–398)	22	123	77–186
Ischemic heart disease (410–414, 429.2)	2,780	91**	88–95
Chronic disease of endocardium (424)	53	97	72–127
Hypertension with heart disease (402–404)	65	85	66–108
Cardiomyopathy (425)	87	86	69–107
Conductive disorder (426, 427)	240	108	94–122
Other diseases of the heart (420–423, 428, 429)	208	103	90–118
Other diseases of the circulatory system	799	87**	81–93
Hypertension without heart disease (401, 403, 405)	35	106	74–147
Cerebrovascular disease (430–438)	496	84**	77–92
Diseases of the arteries—veins and pulmonary circulation (415–417, 440–459)	268	89	79–101
Diseases of the respiratory system	1,089	107*	101–113
Influenza (487)	5	81	26–188
Pneumonia (except newborn) (480–486)	295	81**	72–90
Chronic and unspecified bronchitis (490, 491)	27	130	86–190
Emphysema (492)	132	133**	111–157
Asthma (493)	6	50	18–108
Asbestosis (501)	13	554**	295–947
Silicosis (502)	4	322	88–824
Other Pneumoconioses (500, 503, 505)	11	114	57–203
Other respiratory disease (470–478, 494–499, 504, 506–519)	594	119**	110–129
Diseases of the digestive system	295	89	79–100
Disease of the stomach and duodenum (531–537)	33	91	62–127
Hernia and intestinal obstruction (550–553, 560)	17	84	49–134
Cirrhosis of the liver (571)	108	87	71–105
Other diseases of the digestive system (520–530, 540–543, 555–558, 562–570, 572–579)	137	91	77–108
Diseases of the genito-urinary system	149	87	74–102
Acute glomerulonephritis, nephrotic syndrome, and acute renal failure (580, 581, 584)	18	100	59–158
Chronic and unspecified nephritis—renal failure and other renal sclerosis (582, 583, 585–587)	84	102	82–127
Other genito-urinary system diseases (588, 589, 591, 593, 595–599)	37	64**	45–89
Diseases of the skin and subcutaneous tissue	16	139	79–226
Infections of the skin and subcutaneous tissue (680–686)	5	172	56–402
Other diseases of the skin and subcutaneous tissue (690–709)	11	128	64–229
Diseases of musculoskeletal system and connective tissue	15	83	46–136
Arthritis and spondylitis (711–716, 720–721)	8	102	44–202
Other diseases of musculoskeletal system (710, 717–719)	7	83	33–171

TABLE I. (*Continued*)

Cause of death (ICD-9)	Number of deaths	PMR	95% confidence interval
Symptoms and ill-defined conditions (780–796, 798, 799)	49	61**	45–81
Accidents	268	98	87–111
Transportation accidents (E800–848, E929.0–929.1)	112	94	78–114
Accidental poisoning (E800–848, E929.0–929.1)	22	150	94–227
Accidental falls (E880–888, E929.3)	68	118	92–150
Other accidents (E890–928, E929.4–929.9)	61	87	67–112
Medical complications and misadventure (E870–879, E930–949)	5	43*	14–99
Violence	149	96	81–113
Suicide (E950–959)	130	104	87–123
Homicide (E960–978)	19	63	38–99
HIV related (042–044)	16	40**	23–64
Other causes	175	93	80–108
All cancers	2,932	121**	117–126
All deaths	9,845	—	—

[a]Only those causes with five or more deaths are listed (with the exception of silicosis).
*Two-sided $P < 0.05$.
**Two-sided $P < 0.01$.

PMRs for white men were elevated, but non-significant for accidental falls and accidental poisoning (Table I). PMRs among white men were significantly lower for deaths due to diabetes mellitus, alcoholism and other mental disorders, ischemic heart and cerebrovascular disease, pneumonia, other genitourinary system diseases, medical complications and misadventure, and HIV related deaths, presenting a favorable mortality picture for these causes of death for union members compared to the US population.

Analyses of the 538 deaths among non-white men (Table II) failed to show significantly elevated PMRs. Although confidence intervals included 100, PMRs among non-white men were elevated for cancers of the stomach, intestine, rectum, prostate, bladder, and other urinary organs, respiratory system, cancers of other and unspecified sites, lymphatic and hematopoietic tissue, and benign and unspecified neoplasms. Non-significant elevations were also found for diabetes mellitus, diseases of the nervous system and sense organs, heart disease, accidents, and homicide. PMRs among non-white men were significantly lower for diseases of the digestive system (PMR = 37, CI 15–76), particularly cirrhosis of the liver (PMR = 27, CI 3–98).

DISCUSSION

These findings are consistent with those in the literature that have shown excess deaths for cancer of the esophagus, stomach, trachea, bronchus, and lung, other parts of the respiratory system, emphysema, and asbestosis [Buiatti et al., 1985; Rafnsson and Johannesdottir, 1986; Mallin et al., 1989; Milham, 1997; NIOSH, 2001]. Although PMRs were elevated for accidental poisoning and accidental falls, they were not statistically significant as had been reported in previous studies [Registrar General, 1995; Milham, 1997; NIOSH, 2001]. This may be due to the IUBAC's emphasis on safety training and apprenticeship programs.

Although the PMR for silicosis was elevated, but not statistically significant in this study, other research has shown silica to be an important risk factor affecting the health of bricklayers [DHHS, 1996]. There has also been considerable debate in the recent scientific literature concerning the role of exposure to silica in the development of lung cancer [see Brusek-Hohlfeld et al., 2000; Checkoway, 2000; McDonald, 2000; Soutar et al., 2000; Rice et al., 2001; Calvert et al., 2003]. Excess lung cancer deaths found in this study may be due to high silica exposure, but further studies are needed. Deaths from silicosis may also be attributed to other causes such as tuberculosis or chronic obstructive pulmonary disease, with no mention of silicosis or pneumoconiosis [Mannetje et al., 2002]. Chronic silicosis is a progressive disease, and its development after a long latency period and after workers leave employment increases the probability of under-reporting of cases. Silicosis may also be overlooked by clinicians who sign death certificates [Goodwin et al., 2003]. Investigators have examined a potential association between silica exposure and gastric and esophageal cancer. Although results were not statistically significant, possibly due to a small sample size, Tsuda et al. [2001] suggest that there may be an association between silica and these two diseases. However, evidence has been equivocal [Cocco et al., 1999; Engel et al., 2002; Calvert et al., 2003].

TABLE II. PMRs for IUBAC Members, Non-White Men, 1986–1991[a]

Cause of death (ICD-9)	Number of deaths	PMR	95% confidence interval
MN of digestive organs and peritoneum	37	97	68–134
Esophagus (150)	5	78	25–181
Stomach (151)	8	117	50–231
Intestine except rectum (152, 153)	14	122	67–205
MN of respiratory system	61	120	92–155
Trachea, bronchus, and lung (162)	58	121	92–156
MN of male genital organs	29	121	81–174
Prostate (185)	29	122	81–175
Urinary organs	5	110	36–257
Other and unspecified sites	17	125	73–201
Other and unspecified sites minor (187, 194–199)	15	141	79–232
Neoplasms of lymphatic and hematopoietic tissue	12	129	67–225
Leukemia and aleukemia (204–208)	5	151	49–354
Diabetes mellitus (250)	13	102	54–175
Mental psychoneurotic and personality disorders	6	87	32–190
Diseases of the nervous system and sense organs	8	139	60–275
Other diseases of the nervous and sense organs (320–337, 341–389)	8	143	61–281
Diseases of the heart	196	112	97–129
Ischemic heart disease (410–414, 429.2)	144	115	97–136
Hypertension with heart disease (402, 404)	14	116	64–195
Cardiomyopathy (425)	11	130	65–233
Conductive disorder (426, 427)	20	125	76–193
Other diseases of the circulatory system	45	84	61–112
Cerebrovascular disease (430–438)	29	79	53–113
Diseases of the arteries—veins and pulmonary circulation (415–417, 440–459)	12	91	47–159
Diseases of the respiratory system	30	73	49–104
Pneumonia (except newborn) (480–486)	13	76	41–131
Other respiratory diseases (470–478, 494–499, 504, 506–519)	12	63	33–111
Diseases of the digestive system	7	37*	15–76
Other diseases of the digestive system (520–530, 540–543, 555–558, 562–570, 572–579)	5	60	19–140
Diseases of the genito-urinary system	10	71	34–131
Other genito-urinary system diseases (588, 589, 591, 593, 595–599)	5	103	33–242
Accidents	24	130	83–193
Transportation accidents (e800–848, e929.0–929.1)	10	135	65–248
Other accidents (e890–928, e929.4–929.9)	10	153	73–282
Violence	16	127	73–207
Homicide (e960–978)	14	149	81–250
Other causes	11	72	36–128
All cancers	163	113	96–132
All deaths	538	—	—

[a]Only those causes with five or more deaths are listed.
*Two-sided $P < 0.01$.

The International Agency for Research on Cancer (IARC) recently reviewed the results of post-1986 epidemiologic studies of lung cancer and occupational exposure to crystalline silica. They concluded that there is ''sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica in the form of quartz or cristobalite from occupational sources'' (i.e., IARC category ''Group 1'' carcinogen) [International Agency for Research on Cancer (IARC), 1997]. The NIOSH recommended exposure limit (REL) is 0.05 mg/m^3 for up to a 10-hr work day during a 40-hr work week. Recommendations to reduce exposure to crystalline silica are described in several NIOSH publications [DHHS, 1996, 2002].

Results of the current study again direct attention to the investigation and control of occupational exposure to asbestos. Asbestos has been strongly associated with lung disease such as asbestosis and lung cancer, as well as cancers of the larynx, esophagus, buccal cavity, and stomach. An association between asbestos and gastrointestinal cancer has also been postulated [Kang et al., 1997]. In a recent review of the epidemiology of asbestos-related diseases, Niklinski et al. [2004] suggest that an increasing incidence of mesothelioma may be expected despite a reduction in the use of asbestos. The mean latency period for mesothelioma is at least 20 years. However, robust estimations put the median latent period at least 32 years post-initial exposure. Complete bans on the use of asbestos occurred around 1985; therefore, the incidence of mesothelioma can be expected to increase until at least 2020 [Niklinski et al., 2004]. This suggests the need for follow-up for all asbestos exposed workers. Treatment has resulted in modest benefits, and individuals exposed to asbestos should be encouraged to avoid tobacco exposure because together the risk for lung cancer is significantly higher than from smoking without a history of asbestos exposure [American Cancer Society, 2004].

This study is subject to those limitations common in occupational studies based on death certificates. The data were not originally collected for use in epidemiological studies so that we cannot control for many inherent sources of bias. The contribution of non-occupational health risks to observed mortality patterns could not be quantified due to the lack of information on cigarette smoking, alcohol consumption, and other potential contributory factors. However, data on the prevalence of cigarette smoking based on the National Health and Nutrition Examination Survey, 1988–1994 showed that among 44 occupational industry groups, the construction industry had the highest prevalence of cigarette smoking (42.2%) [Bang and Kim, 2001]. Wong [2002] suggested that the most efficient approach to dealing with this lack of information typical of historical cohort studies is to conduct a subsequent nested case-control study to collect smoking information. In addition to smoking, lifestyle factors such as body mass index, low consumption of fruit and vegetables and alcohol intake may be related to cancers such as esophageal and gastric cancer [Engel et al., 2003].

In addition, in a proportionate mortality study, the magnitude of each cause of death is dependent on the magnitude for other causes of death. This may be important if a common cause has a relatively high or low mortality. If the PMR for a common cause of death is high, then PMRs for other causes are artificially reduced and vice versa. Other limitations are that some diseases are not fatal and therefore, a mortality study would not necessarily observe an increase in risk. An incidence study would be more suited to evaluate the risk of non-fatal diseases. Multiple significance testing may result in associations that arise from chance alone. Since PMR studies are exploratory in nature, significant results should be explored further in additional studies.

A strength of this PMR study is derived from the existence of a death benefit fund in the IUBAC. Studies comparing PMRs with standardized mortality ratios (SMRs) used when the population at risk by age, race, and sex is known, have shown that PMRs are useful indicators of disease risk, often showing a high correlation with SMRs, especially when there is a financial interest for survivors to report deaths [Beaumont and Okun, 1981; Roman et al., 1984]. The study failed to find statistically elevated PMRs for non-white males, probably due to a small numbers; data were available for only 538 non-white deaths during the study period. Future analytic studies should include minority construction workers in sufficient numbers to permit estimates of risk.

CONCLUSIONS

In summary, the study of 10,383 deceased members of the IUBAC had statistically elevated proportionate risk due to cancers of the trachea, bronchus, and lung, and other parts of the respiratory system, esophagus, stomach, asbestosis, and other diseases of the blood forming organs among white men. It supports the hypothesis that working in the construction industry may be associated with an increased risk for malignant diseases, especially malignant and non-malignant respiratory diseases. As surveillance data become available, opportunities emerge for prevention and intervention to reduce illness and injury for these workers.

ACKNOWLEDGMENTS

We owe special thanks to the members of the International Union of Bricklayers and Allied Craftworkers (IUBAC). We also thank the Center to Protect Workers Rights (CPWR), particularly Pete Stafford, for their assistance and support in initiating this study. Appreciation is also extended to Sally Toles, Jane Howie, Lisa Thomas, Russell Estes, Brent Tompkins, and Nina Lalich. Thoughtful and helpful reviews of the manuscript were provided by Janie

Gittleman, PhD, Eileen Betit, Martin R. Petersen, PhD, and William Eschenbacher, MD. This work has also benefited from the support and vision of John Sestito, JD, MS and Lawrence Fine, MD, DrPH.

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