Mortality among Dust-Exposed Chinese Mine and Pottery Workers

Jingqiong Chen, MD

Joseph K. McLaughlin, PhD

Jun-Yue Zhang, BS

B. J. Stone, PhD

Jiamo Luo, MD

Rong-an Chen, MD

Mustafa Dosemeci, PhD

Suzanne H. Rexing, MPH

Zhien Wu, MD

Frank J. Hearl, SM

Michael A. McCawley, PhD

William J. Blot, PhD

A cohort study of approximately 68,000 persons employed during 1972 to 1974 at metal mines and pottery factories in south central China was conducted to evaluate mortality from cancer and other diseases among workers exposed to different levels of silica and other dusts. A follow-up of subjects through December 31, 1989 revealed 6,192 deaths, a number close

From the Tongji Medical University, School of Public Health, Department of Labor Health and Occupational Diseases, Wuhan, People's Republic of China (Dr J. Chen, Mr Zhang, Dr Luo, Dr R. Chen, Dr Wu); the National Cancer Institute, Division of Cancer Etiology, Epidemiology and Biostatistics Program, Bethesda, MD 20892 (Dr McLaughlin, Dr Stone, Dr Dosemeci, Dr Blot); Westat Inc., Rockville, MD (Ms Rexing); and the National Institute for Occupational Safety and Health, Division of Respiratory Disease Studies, Morgantown, WVa (Mr Hearl, Dr McCawley). Address correspondence to Dr McLaughlin.

0096-1736/92/3403-0311$03.00

Historically, silica dust levels in many metal mining and factory operations in China have been high.[1] Respiratory diseases have been a leading cause of death throughout the country, particularly among occupational groups, but risks associated with dust exposure have seldom been quantified. To evaluate mortality from respiratory diseases, cancer, and other causes among workers exposed to silica dusts, a cohort study was undertaken among workers from four types of industrial factories/mines in south and central China where dusty conditions prevailed. Because of reports of lung and other cancers among dust-exposed workers, especially silicotics, and because crystalline silica has induced tumors in experimental animals,[2,3] particular attention was paid to ascertainment of cancer deaths among these workers.

Materials and Methods

Study Population

Personnel records, rosters, and files of 21 mines and eight factories were used to compile lists of all employees who had completed at least 1 year of employment between January 1, 1972 and December 31, 1974 in certain dusty trades. The factories/mines included were: (a) 10 tungsten mines located in Jiangxi, Henan, and Hunan provinces; (b) six copper and iron mines located in Hubei province; (c) four tin mines located in Guangxi province; and (d) eight pottery facto-

to that expected based on Chinese national mortality rates. There was, however, a nearly 6-fold increase in deaths from pulmonary heart disease (standard mortality ratio, 581; 95% confidence interval 538 to 626), and a 48% excess of mortality from nonmaligant respiratory diseases (standard mortality ratio, 148; 95% confidence interval, 139 to 158), primarily because of a more than 30-fold excess of pneumoconiosis. Pulmonary heart disease and noncancerous respiratory disease rates rose in proportion to dust exposure. Cancer mortality overall was not increased among the miners or pottery workers. There was no increased risk of lung cancer, except among tin miners, and trends in risk of this cancer with increasing level of dust exposure were not significant. Risks of lung cancer were 22% higher among workers with than without silicosis. The findings indicate that respiratory disease continues to be an occupational hazard among Chinese miners and pottery workers, but that cancer risks are not as yet strongly associated with work in these dusty trades.

ries and one clay mine also located in Jiangxi and Hunan provinces. Operations in all of these factories and mines began before 1949, although there were government reorganizations and expansions between 1952 and 1957. For each employee, the following data were obtained: name, identification number, sex, place and date of birth, and job history, including the dates work started and ended and job titles.

Occupational Exposure Data

Data from workplace air samplings for total dust (mg/m^3), percent free silica, and dust size from the 1950s through the 1980s were abstracted at the 29 factories and mines. The measurements typically were collected on a monthly basis. These data were used to estimate an exposure level for every dust-exposed job in each of several calendar-year periods. For missing data on years or jobs, consensus estimates were made by industrial hygiene experts, public health doctors, safety engineers, samplers, and local supervisors based on the history of control measures and major changes in technical processes in the factories and mines and on comparisons among the jobs.

Based on job titles and job-specific exposure estimates, each cohort member was classified into one of four total dust exposure levels: (a) high, mostly from underground open cast or separation jobs, (b) medium, (c) low, and (d) not dust-exposed.

If the subject had more than one job at the factory or mine, his or her exposure level was based on the job in which he or she was exposed to the highest dust level of at least 1 year's duration. The average annual dust levels by facility type were: 6.1 mg/m^3 (range, 2.0 to 26.3 mg/m^3) for tungsten mines, 5.6 mg/m^3 (range, 3.8 to 16.1 mg/m^3) for copper/iron mines, 7.7 mg/m^3 (range, 3.4 to 29.7 mg/m^3) for tin mines, and 11.4 mg/m^3 (9.4 to 23.8 mg/m^3) for pottery factories. The lower range in each facility type represents more recent dust levels.

Mortality Follow-Up

All subjects were traced for vital status as of December 31, 1989. Vital status and cause of death information were obtained mainly from employment registers, accident records, and medical records, although personal contacts and oral information were used for a few subjects. We divided the cause-of-death diagnoses into four levels of decreasing confidence, as follows: level 1, medical history or cause-of-death confirmation from a hospital; level 2, confirmation of cause by a personal doctor at a local hospital; level 3, cause confirmed by roentgenogram records; level 4, cause of death determined from oral sources. Of the reported deaths, 77% were at levels 1 or 2, 17% were at level 3, and 6% were at level 4.

The causes of death were coded using the Chinese Health Ministry coding system, which included 15 categories of cancer and 37 other categories of disease and accidents. For subjects who died of primary lung cancer, roentgenograms or reports were sought and were reviewed by radiologists at the Tongji Medical University to confirm further diagnosis.

Silicosis Data

Since 1963, registries of employees with silicosis have been required by law in workplaces with silica exposure. Yearly roentgenograms are given to dust-exposed workers, and silicosis diagnoses are included in a silicosis registry. Cohort subjects who had been diagnosed with silicosis or suspected silicosis were identified from dust-exposed-worker medical cards in the silicosis registry in each factory and mine. The stage of silicosis at first diagnosis and any subsequent changes in stage were recorded along with the date(s) of diagnosis. Prevalent cases (initially diagnosed before 1972) were included as well as incident cases newly diagnosed through 1989.

For all subjects, a silicosis diagnosis was based principally on 1963 Chinese pneumoconiosis roentgen-diagnostic criteria, which classified silicosis as suspected or as stage 1, 2, or 3.

Analytic Methods

Standardized mortality ratios (SMRs), defined as 100 times the ratio of observed to expected deaths, were calculated for the total cohort and various subcohorts. Observed numbers of deaths during 1972 to 1989 were totaled for specific causes. Person-years at risk of fatal disease were accumulated for each study subject from date of entry (ie, January 1972 to December 1974) to date of exit (date of death or loss to follow-up, or December 1989). Expected numbers of deaths were calculated by multiply-

ing age-, sex-, and cause-specific national death rates by the age- and sex-specific person-years at risk. National rates for cancer, tuberculosis, respiratory diseases, infectious diseases, cerebrovascular diseases, and accidents were computed as the average of rates from mortality surveys in 1973 to 1975[4] and 1987.[5] (National data for intervening years were unavailable.) For other causes of death for which only rates from 1987 were available, only deaths occurring during 1985 to 1989 were used to calculate SMRs.

Poisson regression models were used to estimate the relative risks (RRs) of cancer and other causes of death in high and medium relative to low/non-dust-exposed groups.[6] Similar internal comparisons were made to estimate RRs of cancer and other diseases for cohorts members with versus without silicosis. The regression models adjusted for decade of birth, sex, factory type, and age (in 5-year categories).

Results

A total of 70,179 workers were identified in the four groups of mines and pottery factories. Vital status was confirmed for 97.2% of the total cohort. The remaining 2.8% of workers had moved or had incomplete records and were considered lost to follow-up as of their date of entry in 1972 to 1974. The analyses thus were restricted to the 68,241 workers whose vital status was known. There were 28,442 (42%) workers in the tungsten mines, 18,231 (27%) in the copper/iron mines, 7,849 (11%) in the tin mines, and 13,719 (20%) pottery workers. Eighty-five percent of the subjects were male, and the mean age at entry into the cohort in 1972 to 1974 was 34 years. Less than 2% of the workers had begun employment before 1950, 50% during 1950 to 1959, and 47% during 1960 to 1974.

Forty-three percent of the study subjects were classified in the high dust-exposure level, 15% in the medium level, 7% in the low level, and 35% with no dust exposure. Among the workers, tungsten miners had the highest percentage of heavily exposed workers (65%), followed by tin (41%) and copper/iron (34%) miners and pottery workers (9%). Subjects with no and low dust exposure served as the referent for the analyses of trends in mortality by dust exposure level. Among occupational categories, the most common was underground mining (43% of the total, and 55% of the miners). Six percent worked in open cast areas, 8% in ore separation, and the remainder in a variety of jobs in the mines and factories.

The numbers of deaths and the SMRs during 1972 to 1989 for specific causes of death are shown in Table 1. In total, 6,192 deaths were reported. Cancer was the leading cause of death, but rates were significantly low (SMR, 86) when compared with national levels. However, cancers of the nasopharynx (SMR, 154) and liver (SMR, 115) were significantly elevated. Circulatory system diseases were the second most common cause of death, occurring at above-expected levels primarily because of high risks of pulmonary heart disease (SMR, 581). The numbers of deaths attributed to nonmalignant respiratory diseases were also significantly elevated (SMR, 148).

Table 2 presents the SMRs separately for the four groups of mine and pottery workers. For each group, the SMRs were highest for pulmonary heart disease. Numbers of deaths due to nonmalignant respiratory diseases were elevated among tungsten miners and pottery workers but not among other groups. Total cancer mortality was significantly elevated only among tin miners, where rates for nasopharyngeal, liver, and lung cancer were all high.

Table 3 shows SMRs during 1985 to 1989, using national data for 1987 to calculate expected numbers of deaths from several categories of respiratory disease (these categories were not available in the 1973 to 1975 national data) and from all causes of death. The values for all respiratory diseases combined and for lung cancer were qualitatively similar to those shown in Tables 3 and 4 for the entire

TABLE 1
Numbers of Deaths and Standardized Mortality Ratios (SMRs) during 1972 to 1989 by Cause of Death, 1972 to 1989, among All Cohort Members*

Cause of Death	Obs	Exp	SMR	95% CI
All causes	6192	5825.2	106	104–109
Cancer	1572	1835.6	86	81–90
Nasopharynx	78	50.6	154	122–193
Esophagus	91	208.4	44	35–54
Stomach	225	352.7	64	56–73
Colorectal	72	94.5	76	60–96
Liver	474	411.9	115	105–126
Lung	330	417.4	79	71–88
Leukemia	58	48.5	120	91–155
Respiratory disease	925	623.6	148	139–158
Pulmonary tuberculosis	312	404.4	77	69–86
Cerebrovascular disease	730	945.4	77	72–83
Heart disease				
Hypertensive	99	30.0	330	268–402
Ischaemic	152	122.8	125	105–145
Rheumatic	66	58.9	112	87–143
Pulmonary	695	119.6	581	538–626
Infectious disease	151	261.5	58	49–68
Accidents	602	663.3	91	84–98

* Abbreviations used are: Obs, observed; Exp, expected; CI, confidence interval.

TABLE 2
Standardized Mortality Ratios by Cause of Death 1972 to 1989 According to Type of Mine/Factory

Cause of Death	Tungsten	Copper/Iron	Tin	Pottery
All causes	115*	104	111*	93*
Cancer	74*	108	140*	67*
Nasopharynx	173*	101	371*	68
Esophagus	19*	100	53*	46*
Stomach	48*	103	60*	66*
Colorectal	87	87	68	55*
Liver	104	140*	179*	85
Lung	53*	104	198*	58*
Leukemia	142	84	165	94
Respiratory disease	185*	92	98	144*
Pulmonary tuberculosis	56*	40*	38*	158*
Cerebrovascular disease	79*	85*	101	63*
Heart disease				
Hypertensive	430*	186	310*	273*
Ischaemic	120	257*	144	57*
Rheumatic	144	78	123	88
Pulmonary	819*	262*	372*	490*
Infectious disease	86	60*	24*	23*
Accidents	85*	131*	95	51*
Total no. of deaths	2870	1108	705	1509

* 95% confidence interval excludes 100.

TABLE 3
Standardized Mortality Ratios during the 1985 to 1989 for Selected Causes of Death According to Type of Mine/Factory

Cause of Death	Tungsten	Copper/Iron	Tin	Pottery	Total (n)*
All causes	102	81†	126†	111†	103 (2480)
Lung cancer	45†	79	262†	78	77 (160)
Respiratory disease	164†	96	76	155†	144† (381)
Pneumonia	531†	77	80	79	277† (44)
Chronic bronchitis	14†	55†	19†	63†	37† (78)
Pneumoconiosis	5006†	1594†	2428†	2966†	3625† (199)
Other	93	75	40	399†	185† (60)
Pulmonary heart disease	395†	105	309†	415†	349† (269)
Total no. of deaths	1097	375	245	763	2480

* Numbers of deaths across all mine/factories in parentheses.
† 95% confidence interval excludes 100.

follow-up period, although the SMRs for pulmonary heart disease were not as high in the late 1980s. The distribution of nonmalignant respiratory diseases in this later period reveals that the excess was largely attributable to pneumoconiosis, with 16- to 50-fold increases across the four subcohorts.

Relative risks of total mortality and deaths from pulmonary heart disease and nonmalignant respiratory diseases rose with increasing dust exposure levels, but no strong or consistent dose-response relationships were found between cancer risks and dust exposure levels (Table 4). The patterns with dust exposure tended to be similar within each mine/factory group. Only among tin miners was there a rising trend in the risks for lung cancer with increasing dust exposure: the RRs and 95% confidence intervals for medium and high relative to non/low dust exposure were 1.15 (0.4 to 3.3) and 1.72 (1.1 to 2.7). Although the SMRs for nasopharyngeal and liver cancers were elevated among tin miners, there were no clear dose-response trends for either (the RRs for none/low, medium, and high dust exposure were 1.0, 0.99, and 1.09 for nasopharynx cancer and 1.0, 0.23, and 1.08 for liver cancer).

Table 5 presents RRs for specific categories of death for workers with silicosis relative to those without it. Workers diagnosed with silicosis had a higher overall risk of death (RR, 1.72), with large excesses attributed to pneumoconiosis (including silicosis) and other nonmalignant respiratory diseases. The risks for total cancer were lower for silicotics than for nonsilicotics (RR, 0.85) (0.7 to 1.03). The RR for lung cancer was 1.22 (0.9 to 1.6). Excesses of lung cancer were seen in all groups except tungsten miners: the lung cancer RRs and 95% confidence intervals for silicotics relative to nonsilicotics were 0.63 (0.4 to 1.1), 2.22 (1.2 to 4.0), 1.38 (0.9 to 2.1), and 1.63 (0.8 to 3.4) in tungsten, copper/iron, tin, and pottery workers, respectively.

Discussion

Dust exposures have long been implicated as a serious cause of occupational disease in China.[7] Although national mortality data have been available only since the 1970s in China (and not for every year since then), nonmalignant respiratory disease is believed to have been one of the leading causes of death in the general population throughout much of the first two thirds of this century, and silicosis a primary cause of mortality among groups of dust-exposed workers.[1] Our data indicate that increased mortality from respiratory disease persisted through the 1980s among miners and pottery workers. There were clear dose-response trends, with respiratory

TABLE 4
Relative Risks (RRs) for Various Causes of Death, 1972 to 1989, for Medium and High Relative to Non/Low Levels of Dust Exposure

Cause of Death	Dust Exposure: Medium RR	Medium 95% CI	High RR	High 95% CI	P (For Trend)
All causes	1.11	1.0–1.2	1.34	1.3–1.4	<.01
Cancer	0.99	0.8–1.2	1.03	0.9–1.2	NS*
Nasopharynx	1.50	0.7–3.2	1.15	0.7–2.0	NS
Esophagus	1.15	0.7–2.0	1.15	0.7–1.9	NS
Stomach	1.14	0.8–1.7	1.00	0.7–1.4	NS
Colorectal	0.75	0.4–1.5	0.47	0.3–0.8	<.01
Liver	0.69	0.5–0.9	1.02	0.8–1.3	NS
Lung	1.38	1.0–1.9	1.10	0.9–1.4	NS
Leukemia	0.60	0.2–1.5	0.61	0.3–1.1	NS
Respiratory disease	2.39	1.9–3.0	3.65	3.0–4.5	<.01
Pneumonia	2.61	1.2–5.8	2.00	1.1–3.6	.02
Pneumonoconiosis	7.29	4.5–11.8	13.57	8.9–21.0	<.01
Chronic bronchitis	1.27	0.9–1.9	1.43	0.9–2.2	.09
Other	1.35	0.9–2.0	1.00	0.6–1.7	NS
Pulmonary tuberculosis	0.89	0.7–1.2	0.84	0.6–1.1	NS
Cerebrovascular disease	0.99	0.8–1.2	0.92	0.8–1.1	NS
Heart disease	1.03	0.9–1.2	1.55	1.3–1.8	<.01
Hypertensive	0.99	0.6–1.7	1.38	0.9–2.0	.10
Ischaemic	0.65	0.3–1.3	1.16	0.7–1.9	NS
Rheumatic	1.55	0.7–3.3	1.27	0.7–2.4	NS
Pulmonary	1.27	1.0–1.6	1.93	1.6–2.4	<.01
Infectious disease	0.89	0.5–1.7	1.39	0.9–2.1	.10
Accidents	1.35	1.0–1.8	1.68	1.4–2.0	<.01

* NS, not significant; $P > 0.10$.

and pulmonary heart disease mortality rising within each type of mine/factory as dust exposure increased.

The higher rate of nonmalignant respiratory disease in the cohort was due primarily to silicosis and other pneumoconioses, which accounted for about half of all deaths attributed to respiratory diseases and 8% of all deaths in the late 1980s. Pulmonary heart disease, occurring at 5 times the expected level, accounted for an additional 11% of all recent deaths. It is noteworthy that during 1985 to 1989, there were more deaths due to silicosis in this cohort than in the entire US population under age 65.[8] In the United States, total chronic obstructive pulmonary disease accounts for only 4% of all deaths.[8]

The existence of silicosis registries permitted the identification of cases with this occupational lung disease. In total, nearly 10% of the cohort members had been diagnosed with silicosis. As expected, death rates for pneumonoconiosis were markedly elevated among those with prevalent silicosis, as were rates for pulmonary heart disease. Risks for other causes of death, however, tended to be similar between those with and without silicosis. Except for lung cancer, risks for cancer were not higher among silicotics.

Investigations outside China have reported increased risks of lung cancer associated with silica exposure in general and among silicotics in particular.[2,3] Perhaps the most consistent reports have come from follow-up studies of silicosis patients. Cohort studies of silicosis registrants in the United States, Canada, Sweden, Finland, Italy, and Hong Kong generally show 1.5- to 3-fold excesses for subsequent lung cancer.[9–16] The nearly 6,500 silicotics among the miners and pottery workers in China represent the largest cohort studied to date. The up to 18-year follow-up of this group found a modest (22%) excess of lung cancer among silicotics. In a companion report (J. K. McLaughlin, J. Q. Chen, M. Dosemeci, et al, unpublished data), ancillary data on lung cancer case and control subjects revealed that cigarette smoking does not account for this excess risk of lung cancer among silicotics. The relatively small size of the excess and the inconsistent dose-response trend between lung cancer mortality and the estimated level of silica dust exposure in the total cohort, however, suggest that lung cancer risk is not strongly associated with occupational dust exposure in these Chinese workers.

Stomach cancer has been linked to dust exposure in several cohort and case-control studies.[17–20] Because stomach cancer is a leading cause of cancer death in China, there were relatively large numbers (225 observed) for evaluation. However, the observed number was below national expectations, there were no rising trends with increasing dust exposure levels, and the RRs for stomach cancer were lower in silicotics than in nonsilicotics. There were also no consistent trends in the RRs with dust exposure or silicosis for nasopharyngeal cancer, but the SMR was significantly elevated, primarily because of higher risks among tungsten and tin miners. Many of the tungsten and tin mines are located in parts of south China where rates of nasopharyngeal cancer exceed national levels (eg, the age-adjusted nasopharyngeal cancer death rate among men in Guangxi province is more than double the all-China rate[4]), so that much of the increase in the SMR may be due to high background levels in the general population. Provincial or local mortality rates by age and calendar period were not available, and thus we were unable to adjust for such geographic differences directly. Variation in mortality also affects the SMRs for lung and stomach cancers; rates for both of

TABLE 5
Relative Risks (RRs) for Various Causes of Death 1972 to 1989 among Silicotics

Cause of Death	RR	95% CI	P
All causes	1.72	1.6–1.8	<.01
Cancer	0.85	0.7–1.0	.03
Nasopharynx	0.95	0.5–1.7	NS†
Esophagus	0.67	0.3–1.3	NS
Stomach	0.73	0.5–1.1	NS
Colorectal	0.55	0.3–1.2	NS
Liver	0.72	0.5–1.0	.03
Lung	1.22	0.9–1.6	NS
Leukemia	0.63	0.2–1.7	NS
Respiratory disease	11.05	9.4–13.0	<.01
Pneumonia*	2.39	1.5–3.7	<.01
Pneumoconiosis*	>600	–	<.01
Chronic Bronchitis*	1.43	0.9–2.2	NS
Other*	1.80	1.2–2.8	<.01
Pulmonary tuberculosis	0.19	0.1–0.3	<.01
Cerebrovascular disease	0.77	0.6–0.9	.01
Heart disease	2.74	2.4–3.1	<.01
Hypertensive	1.17	0.8–1.8	NS
Ischaemia	1.10	0.7–1.8	NS
Rheumatic	0.77	0.4–1.7	NS
Pulmonary	4.92	4.1–5.8	<.01
Infectious disease	0.87	0.5–1.5	NS
Accidents	0.46	0.4–0.7	<.01

* SMRs for 1985 to 1989 deaths.
† NS, not significant.

these cancers tend to be below national rates in the provinces in which the study mines and factories were located.

In summary, this large cohort of workers in four groups of mines and factories in China has shown that deaths from respiratory disease and its complications have continued at elevated levels through the 1980s, but a major carcinogenic hazard has yet to appear.

References

1. Lou J, Zhou C. The prevention of silicosis and prediction of its future prevalence in China. *Am J Public Health.* 1989;79:1613–1616.
2. Simonato L, Fletcher AC, Saracci R, Thomas TC. *Occupational exposure to silica and cancer risk.* Lyon, France: International Agency for Research on Cancer, IARC Pub No. 97, 1990.
3. International Agency for Research on Cancer. Silica and some silicates. *IARC Mongr* 1987;42:104–108.
4. Li JY, Liu BQ, Li GY et al. *Atlas of cancer mortality in the People's Republic of China,* 1973–75. Beijing, People's Republic of China: Ministry of Health, National Cancer Control Office; 1979.
5. *Report on causes of death, 1987.* Beijing, People's Republic of China: Ministry of Health; 1990.
6. Preston DL, Kopecky KJ, Kato H. Analysis of mortality and disease incidence among atomic bomb survivors. In Blot WJ, Hirayama T, Hoel DG, eds, *Statistical Methods in Cancer Epidemiology.* Hiroshima, Japan: Radiation Effects Research Foundation; 1985:109–127.
7. Ministry of Public Health and the All-China Federation of Trade Unions. An implementation program for treatment and prevention measures for dust-exposed workers. Beijing: July 15, 1963.
8. National Center for Health Statistics. *Health, United States, 1989.* Hyattsville, MD: Public Health Service; 1990.
9. Amandus H, Costello J. Silicosis and lung cancer in US metal mines. *Arch Environ Health.* 1991;46:82–89.
10. Infante-Rivard C, Armstrong B, Petitclerc M, Cloutier L-G, Theriault G. Lung cancer mortality and silicosis in Quebec, 1938–85. *Lancet.* 1989;2:1504–1507.
11. Finkelstein M, Liss G, Krammer F, Kusiak R. Mortality among workers receiving compensation awards for silicosis in Ontario 1940–1985. *Br J Ind Med.* 1987;44:588–594.
12. Westerholm P, Ahlmark A, Maasing R, Seglberg I. Silicosis and risk of lung cancer or lung tuberculosis: a cohort study. *Environ Res.* 1986;41:339–350.
13. Kurppa K, Gudbergsson H, Hannunkari I, Koskinen H, Hernberg S, Soskela RS, Ahlman K. Lung cancer among silicotics in Finland. In Goldsmith DF, Winn DM, Shy CM, eds, *Silica, Silicosis, and Cancer: Controversy in Occupational Medicine.* New York: Praezer Publishers; 1986:311–320.
14. Zambon P, Simonato L, Mastrangelo G, Winkelmann R, Saia B, Crepet M. Mortality of workers compensated for silicosis during the period 1959–1963 in the Veneto region of Italy. *Scand J Work Environ Health.* 1987;17:118–123.
15. Carta P, Cocco PL, Casula D. Mortality from lung cancer among Sardinian patients with silicosis. *Br J Ind Med.* 1991;48:122–129.
16. Ng TP, Chan SL, Lee J. Mortality of a cohort of men in a silicosis register: further evidence of an association with lung cancer. *Am J Ind Med.* 1990;17:163–171.
17. Kneller RW, Gao Y-T, McLaughlin JK, Gao R-N, Blot WJ, Liu M-H, Sheng J-P, Fraumeni JF, Jr. Occupational risk factors in gastric cancer in Shanghai, China. *Am J Ind Med.* 1990;18:69–78.
18. Wright WE, Bernstein L, Peters JM, Garabrant DH, Mack TM. Adenocarcinoma of the stomach and exposure to occupational dust. *Am J Epidemiol.* 1988;128:64–73.
19. Wu-Williams A, Yu MC, Mack TM. Life-style, workplace and stomach cancer by subsite in young men of Los Angeles county. *Cancer Res.* 1990;50:2569–2576.
20. Coggon D, Barker DJ, Cole RB. Stomach cancer and work in dusty trades. *Br J Ind Med.* 1990;47:298–301.