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A COHORT MORTALITY STUDY OF STONE MASONS IN TOKYO AND YOKOHAMA OF JAPAN

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Introduction

The mortality studies of pneumoconiotic patients[1-16] and workers in foundries[17-20] and metal miners[21-24] have demonstrated an excess risk of lung cancer. In each of these situations, inhalation of well-known carcinogens including radon daughters and polycyclic aromatic hydrocarbons was suggested to be important aetiological factors. However, the mortality studies of workers for whom such carcinogens were negligible, have also demonstrated a high frequency of lung cancer. These studies indicate that pneumoconiosis or dust exposure might also be an important aetiologic factor in the development of lung cancer.

To examine these hypotheses, a retrospective cohort mortality study of stone masons, who had been the least exposed to occupational confounding factors other than silica dust, was carried out.

Materials and Methods

Almost all of the stone masons in Tokyo and Yokohama associate themselves with the Stone Mason Union in Tokyo and Yokohama. A study cohort was set up by all the male members of the stone Mason Union in Tokyo listed in 1981, and of the Stone Mason Union in Yokohama listed in 1979 and followed up through the end of 1988. A total of 634 persons (316 persons from Tokyo and 318 persons from Yokohama) served as subjects for the study.

These stone masons were engaged in cutting, polishing and engraving tombstones.

The mortality analysis was conducted using a person-years. The person-years for all workers were distributed five-year age group and each year calendar-time periods and were multiplied by the corresponding Japanese male mortality rate to yield the number of deaths expected. The estimation of risk for specific causes of death were calculated as standardized mortality ratios (SMR), i. e., observed deaths/expected deaths×100. The Poisson distribution was used to test the statistical significance of SMRs differing from 100.

Results

The total cohort consisted of 634 males and 5,196.5 person-years. The distribution of the cohort by five-year age groups is given in Table 1.

The cohort experienced 93 deaths as compared with 62.00 expected, leading to a SMR of 150, a difference that is statistically significant at the 0.12 % level.

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Table 1 Description of the study population

Material	Total 634 male stone masons (1) 316 stone masons in Tokyo; and (2) 318 stone masons in Yokohama					
Period	1979–1988					
Study type	Retrospective cohort study					
	5,196.5 person-years					
	Age	Person-years	Age	Person-years	Age	Person-years
Distribution of the cohort	15–19	9.0	40–44	691.5	65–69	306.5
	20–24	71.0	45–49	861.0	70–74	301.0
	25–29	199.0	50–54	730.5	75–79	180.5
	30–34	398.0	55–59	472.0	80–84	84.0
	35–39	567.0	60–64	304.5	85–	22.0

Table 2 shows the observed number of deaths in the cohort from each of selected causes and the number expected and the SMR. Judged by estimating the Poisson distribution, there was a large mortality excess, compared with the referent population of all Japanese males, for pneumoconiosis and tuberculosis (SMR 3,671 ; $p<0.0001$) based on 29 cases observed. There was also statistically significant excess mortality for all malignant neoplasms (SMR 151 ; $p<0.05$), for stomach cancer (SMR 195 ; $p<0.05$) and lung cancer (SMR 268 ; $p<0.01$).

In Table 3, the lung cancer mortality was analysed in relation to the smoking habit of the stone masons. For 74 (11.7 %) members of the cohort, information on smoking habits was not available. Out of the remaining 560, 76 (13.6 %) were classified as non-smokers, 105 (18.8 %) were ex-smokers and 379 (67.7 %) were smokers. The highest SMR for lung cancer was found for smokers (SMR 324 ; $p<0.01$).

Because of the small number of the subcohort and deaths from lung cancer, a statistically significant excess could not be calculated. However, an elevated lung cancer risk was also found for non-smokers (SMR 250) and ex-smokers (SMR 274). It should be noted that when non-smokers and ex-smokers were put together, the excess mortality for lung cancer became statistically significant (SMR 265 ; $p<0.05$). Anyway, an increasing trend for lung cancer with an increasing degree of smoking habit was clearly discernible.

Discussion

The results of this study show that stone masons in Tokyo and Yokohama have a higher mortality from, and probably therefore a higher incidence of, lung cancer than do the Japanese male in general.

The exposure to known carcinogens in the work site such as radon daughters and polycyclic aromatic hydrocarbons might not be an explanation for a high relative incidence of lung cancer in stone masons, because the concentrations of these carcinogens in the work site were considered to be negligible.

The data from our previous study[16] demonstrated that persons with pneumoconiosis derived from the stone industry was subject to an increased risk of death from lung cancer, with SMR of 408 based on 12 cases observed. Kruppa et al[8], have also reported that the SMR for lung

Table 2 Selected cause-specific mortality of the cohort

Cause	ICD code	Observed deaths	Expected deaths	SMR
All causes	0-999	93	62.00	150***
Pneumoconiosis and respiratory tuberculosis	001-008 500-505	29	0.79	3761***
All cancers	140-205	27	17.83	151*
All cancers-lung cancer	140-161, 163-205	18	14.47	124
Cancer of esophagus	150	1	0.84	119
Cancer of stomach	151	10	5.12	195*
Cancer of rectum	154	1	0.75	133
Cancer of liver	155	2	2.18	92
Cancer of gallbladder	156	1	0.62	161
Cancer of larynx	161	1	0.13	769
Cancer of bronchus, trachea and lung	162	9	3.36	268**
Malignant lymphoma	202	1	0.36	278
Leukemia	204-208	1	0.39	256
Hypertensive diseases	401-405	1	0.78	128
Ischemic heart disease	410-414	3	4.32	69
Other disease of heart	420-429	3	6.34	47+
Vascular lesions affecting central nervous system	430-438	12	11.16	108
Pneumonia	480-487	3	3.62	83
Chronic obstructive lung disease	490-496	3	1.52	197
Pneumothorax	512	1	0.03	3333
Cirrhosis of liver	571	2	2.01	100
Accident	800-999	3	4.78	63
Suicide	E950-E959	1	2.05	49
Other diseases		5	6.77	74

Table 3 Lung cancer risks in relation to smoking habits

Smoking Habit	N	Person-years	Observed	Expected	SMR
Non-smokers	76	624.0	1	0.40	250
Ex-smokers	105	864.0	2	0.73	274
Non-and ex-smokers	181	1,466.0	3	1.13	265*
Smokers	379	3,128.5	5	1.85	324**
Unknown	74	582.0	0	0.39	—
Total	634	5,196.5	9	3.36	268**

cancer in Finnish pneumoconiotics from the stone industry was 27 based on 12 cases observed. Zambon et al[7], have noted that the highest lung cancer risk in Italian pneumoconiotics was present among quarry workers who had been the least exposed to occupational confounding factors other than silica dust, with SMR of 569 based on 6 cases observed.

The data from the present study demonstrate an increasing trend for lung cancer risk with an increasing degree of smoking habits. It should be noted that, even for non-smokers and ex-smokers, the relative risk for lung cancer in stone masons is significantly elevated (SMR 265 ; $p<0.05$).

Occupational dust exposure therefore problably explains at least part of the lung cancer excess in stone masons.

The present study supports and confirms the results from our previous cohort studies of pneumoconiotics in Japan[1], of pneumoconiotics in Tokyo and Shizuoka[16], and of cupper miners[25], and indicates that dust exposure per se might contribute to the development of lung cancer.

As shown from our previous studies[15,16,25], the present study also confirmed that smoking was a contributory factor towards lung cancer.

We found an increased mortality from stomach cancer among stone masons. There are many studies which showed statistically significant increased risks for stomach cancer among coal miners, foundry workers[33,34], metal miners[21,22,25], talc miners[36], cement workers[37] and pneumoconiotic patients[1,11,12,16].

As discussed in our previous paper[1], loss of immunoregulatory function due to inhalation of mineral dust[38-45] and a long acting impact on cancer defence reactions, such as disturbance of immunologic surveillance[46] by mineral dust exposure should be the explanations with respect to the excess mortality for stomach cancer.

Summary and Conclusions

A study of mortality experience was conducted among stone masons, and cause-specific comparison was made with the Japanese general male population. A higher total mortality was observed among the stone masons. The increase in mortality was partly due, firstly, to malignant neoplasms, especially of the respiratory system and stomach ; secondly to pneumoconiosis and its complications, tuberculosis.

Attention was given to the possible explanation for the 2.7 fold increase in lung cancer. This excess was not attributed to an effect of age, smoking or radioactivities such as radon daughters and polycyclic aromatic hydrocarbons. It appears likely that dust exposure per se might contribute to the development of lung cancer and that smoking is a contributory factor in the development of the disease.

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