# STUDIES OF SILICOSIS AMONG MIGRANT WORKERS (REPORT 1) THE FREQUENT OCCURRENCE AND RELEVANT FACTORS OF SILICOSIS

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## ABSTRACT

During the 1970's many cases of serious silicosis occurred among migrant workers doing tunnel construction. Migrant workers are known in Japanese as "dekasegi". This term refers to workers who migrate seasonally from their home towns to areas where work is more available. The eastern part of Toyama, Japan is well known as being one of the areas which supply many migrant workers doing tunnel construction.

Questionnaires were sent to all male inhabitants aged 30 or over in the five selected areas between 1977 and 1978. Nine hundred and thirty-one of respondents (41%) had worked as migrant workers. Of these, 645 men (69%) had worked on the jobs with exposure to dust such as tunnel construction. Of this number, 566 men were examined by chest roentgenography. Silicosis was found in 84% (477 cases). These patients included 248 cases of category 1, 122 cases of category 2, 54 cases of category 3 and 53 cases of category 4 silicosis.

Most of the patients retired and returned to their home towns without having been given any diagnosis and medical care at their places of employment. The silicosis in 332 cases (70% of the total number of disease patients) was first detected in the course of our research.

It was considered that the important social factors which may have caused the frequent occurrence of silicosis were poor working and living conditions of migrant workers in the tunnel and poor measures for prevention of silicosis such as health examinations, educations about silicosis and wearing of a dust respirator.

## INTRODUCTION

Migrant work is defined in Japan to be employment for 1 month or more to less than a year away from the place of permanent residence followed by return to the place of residence, and such a practice is called "dekasegi". Migrant workers have often been victims of deterioration of health, work-related accidents, and occupational diseases as they have generally been forced to work for long hours under inferior working environments in addition to instability of the position and poor health management under the subcontract and the sub-subcontract employment systems.[1]

Eastern Toyama Prefecture, which is under the jurisdiction of Kurobe Health Center, is one of the areas with a high incidence of silicosis among migrant workers.[2,3] In this study, the statistical facts and the state of silicosis patients in this jurisdiction were surveyed, and factors in the high incidence and severity of their condition were examined.

## METHODS

Five areas under the jurisdiction of Kurobe Health Center, Toyama Prefecture (Figure 1) were selected arbitrarily, and questionnaire surveys primarily concerning the occupational history were conducted in summer, 1977 and 1978 in all males in these areas aged 30 years or above. The questionnaires were distributed to each subject and filled in by the subject himself. Including those whose answers were initially incomplete and who have been incorporated in the survey later through follow-up works, a total of 2,260 individuals (87% of the 2,604 to whom the questionnaires were sent) were available for the study. On the basis of the questionnaires, screening for pneumoconiosis was carried out for those who had engaged in migrant work in occupations involving dust exposure. The screening consisted of interview, somatometry, direct chest roentgenographic examination, lung function test, and arterial blood gas analysis. The radiograms were evaluated by 5 doctors including the authors according to the classification of the Pneumoconiosis Law of Japan,[4] which is based on ILO/UICC Classification, 1971. When opinion differed among the doctors, the diagnosis was made by the majority rule.

## RESULTS

### Results of Questionnaires and Screening for Pneumoconiosis

Table I shows the results of the questionnaires about migrant

work carried out in the summer of 1977 and 1978. Nine hundred and thirty-one individuals, or 41% of the valid respondents, had experienced migrant work. Of these 931 subjects, 645 (29% of valid respondents) had been exposed to dust in work. Tunnel construction was predominant among the works involving dust exposure, accounting for nearly 90%, followed by mining of minerals other than coal and coal-mining.

Of the 645 subjects, 566 have undergone screening for pneumoconiosis, the results of which are shown in Table II. Signs of silicosis were observed in 477 subjects (84% of those

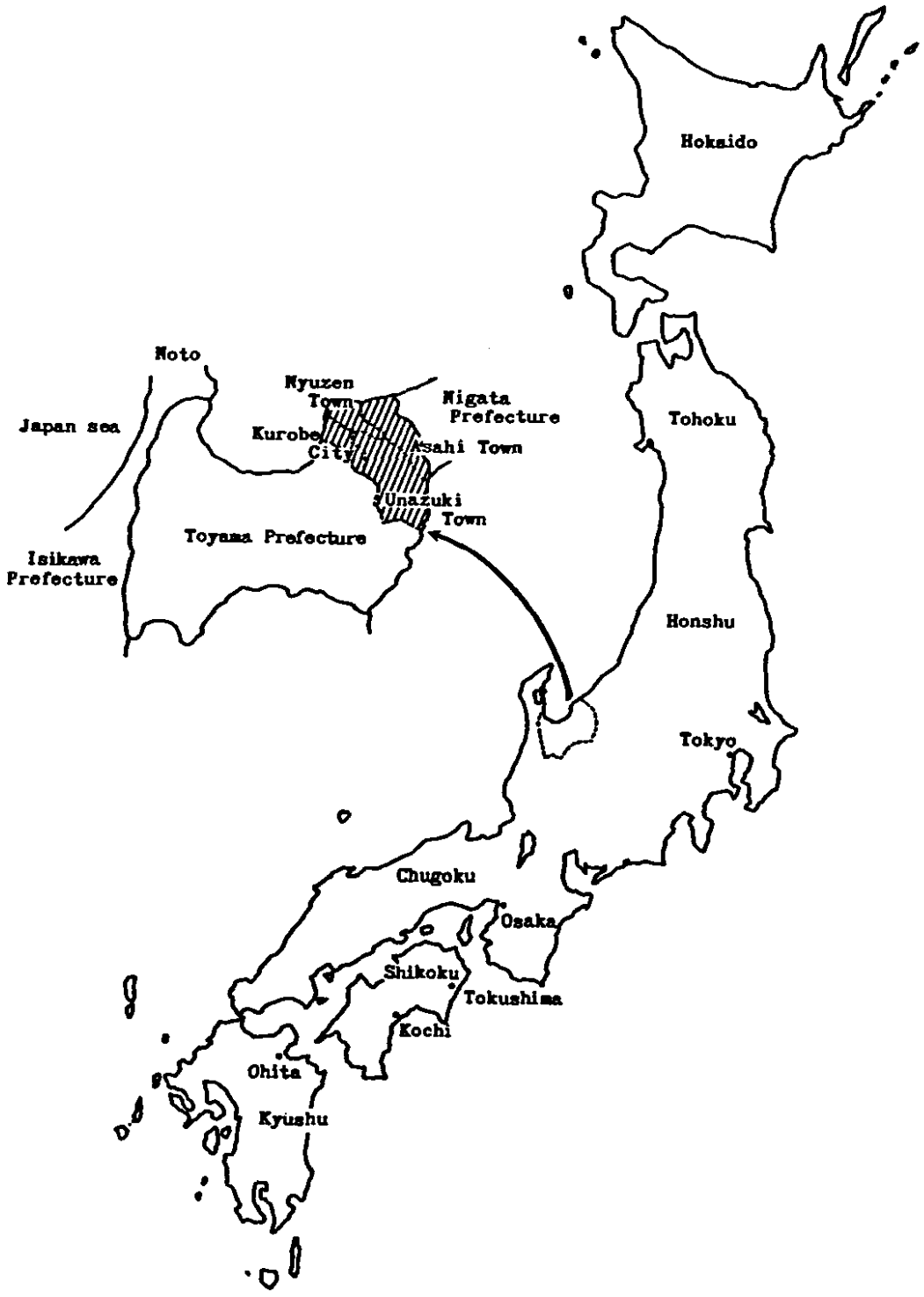


Figure 1. Study area and its location in Japan.

Table I

The Number of Migrant Workers Based on Questionnaires

| | Total | Age group (years) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 30 ~ 39 | 40 ~ 49 | 50 ~ 59 | 60 ~ 69 | 70 ~ 79 | 80 ~ | Unknown |
| No. of respondents | 2260 * (100) | 496 (100) | 643 (100) | 531 (100) | 378 (100) | 177 100) | 33 (100) | 4 |
| Migrant Workers | 931 (41.2) | 83 (16.7) | 287 (44.6) | 265 (49.9) | 194 (51.6) | 87 (49.2) | 15 (45.5) | |
| Migrant Workers with expoure to dust | 645 (28.5) | 42 (8.5) | 203 (31.6) | 196 (36.9) | 141 (37.5) | 52 (29.4) | 11 (33.3) | |

* Figures in brackets are percentage

Table II

Chest Roentgenographic Findings of Silicosis in Migrant Workers with Exposure to Dust by the Age at Their First Examination in the Course of This Research

| | Total | Age group (years) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30 – 39 | 40 – 49 | 50 – 59 | 60 – 69 | 70 – 79 | 80 – |
| No. of subjects | 566 ** (100) | 25 (100) | 160 (100) | 200 (100) | 134 (100) | 43 (100) | 4 (100) |
| Silicosis patiemts | 477 (84.3) | 14 (56.0) | 124 (77.5) | 180 (90.0) | 112 (83.6) | 41 (95.3) | 4 (100) |
| Classification of silicosis * | | | | | | | |
| 1 | 248 | 10 | 69 | 85 | 58 | 23 | 3 |
| 2 | 122 | 4 | 27 | 50 | 31 | 10 | 0 |
| 3 | 54 | 0 | 16 | 19 | 17 | 2 | 0 |
| 4 | 53 | 0 | 14 | 26 | 8 | 8 | 1 |

* Classification of silicosis according to the Pneumoconiosis Law of Japan

** Figures in brackets are percentages

undergoing screening). According to the roentgenographic categories, 248 (52%) belonged to type I, 122 (26%) to type II, 5 (11%) to type III, and 53 (11%) to type IV silicosis.

Table III shows the relationship between the X-ray grading of the disease and the duration of dust exposure. Silicosis was noted in 94%, 80%, and 70% of those exposed to dust for 20 years or more, 10–19 years, and less than 10 years, respectively, indicating an increase in the incidence with the duration of dust exposure.

The subjective symptoms were examined with regard to cough (continuing for 3 months or more per year), phlegm (continuing for 3 months or more per year), shortness of breath (Hugh-Jones grade III or more severe dyspnea), wheezing, and palpitation (Table IV). Cough was reported by 24%, phlegm by 25%, shortness of breath by 29% , wheezing by 19%, and palpitation by 17% of patients with silicosis. The frequencies of these symptoms were all higher than in those showing no signs of silicosis.

According to the Pneumoconiosis Law of Japan, patients showing values of %VC <60%, $FEV_1$% <standard value (SV, 91.79-0.373 * age)–3 * residual standard deviation (RSD, 7.19)(%), or $AaDO_2$ >SV (2.5 + 0.21 * age) + 3 * RSD (7.1) are considered to have marked impairment of pulmonary function.[4] Table V shows the percentage of patients with abnormal values in each roentgenographic category. By evaluating the 3 items together, 83 (15%) of all migrant workers exposed to dust were considered to have

Table III

Total Duration of Migrant Works with Exposure to dust According to the Roentgenographic Category

| | Total | Roentgenographic category of silicosis * | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 |
| No. of Subjects | 561 ** | 89 | 245 | 120 | 54 | 53 |
| Tatal duration (years) | | | | | | |
| – 9 | 208 | 62 | 108 | 24 | 8 | 9 |
| 10 – 19 | 138 | 18 | 68 | 26 | 18 | 8 |
| 20 – 29 | 129 | 5 | 40 | 44 | 18 | 22 |
| 30 – 39 | 64 | 3 | 22 | 19 | 8 | 12 |
| 40 – | 24 | 1 | 8 | 7 | 6 | 2 |
| Mean duration (Mean+S.D.) | 18.0±11.8 | 7.7±8.1 | 14.0±11.2 | 20.6±11.5 | 22.6±11.4 | 21.8± 9.9 |

* Classified according to the Pneumoconiosis Law of Japan

** Durations of 5 migrant workers (type 1 : 3, type 2 : 2) are unknown

Table IV

The Prevalence Rates of Symptoms of Respiratory Disease According to the Roentgenographic Category

| | Total | Roentgenographic category of silicosis | | | | |
|---|---|---|---|---|---|---|
| | | PR 0 | PR 1 | PR 2 | PR 3 | PR 4 |
| No of subjects | 566 (100)* | 89 (100) | 248 (100) | 122 (100) | 54 (100) | 53 (100) |
| Cough in the morning | 212 (37.5) | 23 (25.8) | 80 (32.3) | 57 (46.7) | 26 (48.1) | 26 (49.1) |
| Cough for 3 or more months/year | 126 (22.3) | 12 (13.5) | 51 (20.6) | 33 (27.0) | 11 (20.4) | 19 (35.8) |
| phlegm in the morning | 215 (38.0) | 33 (37.1) | 87 (35.1) | 47 (38.5) | 24 (44.4) | 24 (45.3) |
| Phlegm for 3 or more months/year | 136 (24.0) | 17 (19.1) | 57 (23.0) | 32 (26.2) | 14 (25.9) | 16 (30.2) |
| Persistent cough and phlgem for 3 or more months/year | | 27 (15.4) | 10 (11.2) | 31 (12.5) | 23 (18.9) | 13 (24.5) |
| Shortness of breath | 228 (40.3) | 24 (27.0) | 91 (36.7) | 50 (41.0) | 26 (48.1) | 37 (69.8) |
| Shortness of breath for Hugh-Janes grade 3 or over | 148 (26.1) | 9 (10.1) | 61 (24.6) | 32 (26.2) | 18 (33.3) | 28 (52.8) |
| Wheezing[a] | 100 (17.7) | 9 (10.1) | 35 (14.2) | 20 (16.5) | 17 (31.5) | 19 (35.8) |
| Attack of shortness of breath with wheezing[a] | 46 ( 8.1) | 3 ( 1.2) | 15 ( 8.0) | 12 ( 9.8) | 7 (13.0) | 9 (17.0) |
| Palpitation[b] | 72 (15.1) | 5 ( 5.7) | 33 (13.6) | 20 (20.6) | 4 (10.8) | 10 (37.0) |

* Figures in brackets are percentage

a. Symptoms of 2 migrant workers are unknown (Type 1 : 1 ; type 2 : 1)

b. Symptoms of 88 migrant workers are unknown (Type 0 : 2, type 1 : 8, type 2 : 25, type 3 : 29, type 4 : 26)

Table V

The Number of Migrant Workers with Exposure to Dust, Classified by the Values of the Pulmonary Function Tests According to the Pneumoconiosis Law of Japan

| | Total | Roentgenographic category of silicosis | | | | |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 |
| No. of subjects | 561 ** (100)* | 88 (100) | 246 (100) | 121 (100) | 54 (100) | 52 (100) |
| %VC < 80% | 28 (5.0) | 1 (1.1) | 9 (3.7) | 5 (4.1) | 3 (5.6) | 10 (19.2) |
| FEV1% < SV−3RSD[a] | 10 (1.8) | 1 (1.1) | 2 (0.8) | 2 (1.6) | 1 (1.9) | 4 (7.5) |
| No. of subjects | 521 *** (100)* | 88 (100) | 232 (100) | 115 (100) | 54 (100) | 52 (100) |
| A-DO2 > SV+3RSD[b] | 45 (8.6) | 1 (1.5) | 20 (8.6) | 10 (8.7) | 7 (13.0) | 7 (13.5) |

* Figures in brackets are percentages
SV: Standard values RSD: Residual standard deviation
a; SV = 91.79 − 0.373 × Age (RSD = 7.19) (%)
b; SV = 2.5 + 0.21 × Age (RSD = 7.1) (TORR)
** Spirometry was not performed on 5 migrant workers
(type 0: 1, type I: 2, type 2: 1, type 4: 1)
*** Arterial blood gas analyses were not performed on 45 migrant workers
(type 0: 21, type I: 16, type 2: 7, type I: 1)

marked impairment of pulmonary function. These consisted of 80 patients with established silicosis (20%) and 3 showing no signs of the disease (3%). According to roentgenographic categories, type I silicosis was observed in 33 patients (13%), type II in 17 (14%), type III in 10 (19%), and type IV in 20 (38%), with more patients in advanced roentgenographic categories showing more severely impaired pulmonary functions.

Of the 477 patients with silicosis, 332 had not known that they had contracted the disease and were given the diagnosis for the first time by our examination. Those patients naturally more often belonged to milder roentgenographic categories, accounting for 95% of type I and 64% of type II patients, but also for 22% and 11% of patients with more advanced type III and type IV lesions, respectively (Figure 2). Twenty to thirty percent of patients who were first diagnosed to have silicosis complained of cough, phlegm and Hugh Jones grade III or more severe dyspnea, and 12% were considered to have marked impairment of pulmonary function on the basis of the criteria of the Pneumoconiosis Law. Thus, this study showed that the disease was left undetected in many of migrant workers exposed to dust, even when they had relatively advanced roentgenographic profiles, notable subjective symptoms, or severe pulmonary dysfunction.

### Status of Employment of Migrant Workers of Eastern Toyama Prefecture, Japan in Occupations Involving Dust Exposure

The status of migrant work in 566 individuals who underwent screening for silicosis is summarized in Table VI. Thirty-four percent of them began migrant work in 1940–1944, 25% in 1950–1959, and 23% in 1930–1939. Those who began migrant work after 1960 were very few. A predominant portion of the subjects had stopped migrant work by the time of the present screening, 30% quitting in 1960–1969, another 30% after 1970, and 16% in 1950–1959. The greatest proportion of the subjects (63%) started migrant work in their teens, and 30% in their 20's. The age of stopping migrant work (those still engaged were excluded) was most frequently the 30's (26%), followed by the 40's (23%), 20's (22%), and 50's (18%). The annual duration of migrant work was most frequently 7–8 months (31%), followed by 9–10 months and 5–6 months (24% for both), and 10–11 months (21%). In eastern Toyama Prefecture, many of the migrant workers started migration during the 10 years after World War II during Japan's economic rebuilding, contributed to the high economic growth since 1960, and stopped migration rapidly just prior to the oil crisis in 1973. More than half the migrant workers engaged in tunnel construction started migrant work before they were 20 years old, many of them having become migrant workers immediately after compulsory education. Most of these workers were seasonal migrant workers, who migrated during the agricultural off-season, and only one-fifth were round-the-year migrant workers migrating for 11 months or more per year.

## DISCUSSION

The percentage of migrant workers in the total working population is considered to be higher in areas where the productivity of the farming industry is lower.[1] In eastern

Toyama, 61% of migrant workers from this area had to be engaged in migrant work for pure subsistence, and only 19% did so for more than subsistence. In addition to these inherent economic circumstances, several tunnels were constructed in this region between 1920 and 1960 for the development of rivers for hydroelectric power sources. The Kurobe River flowing in the eastern part of Toyama Prefecture was developed for hydroelectric power development programs since 1920's because of its rich water supply and steepness of the river bed. These programs, which peaked with the completion of the Fourth Kurobe River Power Plant in 1962, yielded 4 dams and 14 power plants (a total output of 800,000 kw) by 1970. The above survey of migrant workers employed in occupations involving dust exposure showed that the

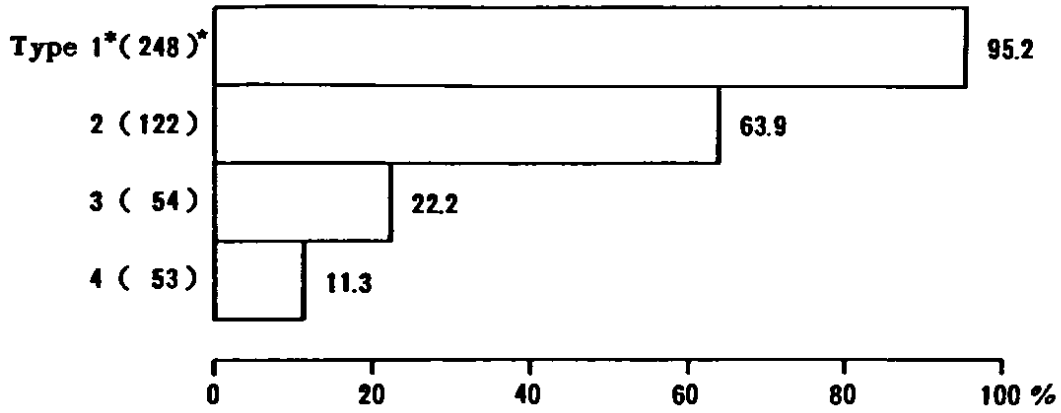


Figure 2. The rates of the silicosis patients who were first detected in the course of this research according to the roentgenographic category.
*Type 1, 2, 3, 4: Roentgenographic categories of silicosis.
*Figures in brackets are numbers of subjects.

Table VI
The Years in which Migrant Workers Began and Finished Their Jobs

| | The year of finish as migrant worker | | | | | | Working at this survey as migrant worker | Total |
|---|---|---|---|---|---|---|---|---|
| | 1920 / 1929 | 1930 / 1939 | 1940 / 1949 | 1950 / 1959 | 1960 / 1969 | 1970 / | | |
| The year of begining | | | | | | | | |
| 1910 ~ 1919 | 2 | 1 | 2 | 4 | 1 | 1 | 0 | 11 ( 2.0) |
| 1920 ~ 1929 | 4 | 6 | 8 | 7 | 14 | 20 | 3 | 62 (11.1) |
| 1930 ~ 1939 | | 10 | 20 | 20 | 20 | 49 | 9 | 119 (22.9) |
| 1940 ~ 1949 | | | 10 | 34 | 69 | 47 | 29 | 189 (33.8) |
| 1950 ~ 1959 | | | | 25 | 55 | 30 | 28 | 138 (24.6) |
| 1960 ~ 1969 | | | | | 6 | 14 | 3 | 23 ( 4.1) |
| 1970 ~ | | | | | | 5 | 4 | 9 ( 1.6) |
| Total | 6 (1.1) | 17 (3.0) | 40 (7.1) | 90 (16.1) | 165 (29.5) | 166 (29.6) | 76 (13.6) | 560 * (100)** |

* Data are unknown for 6 migrant workers

** Figures in brackets are percentage

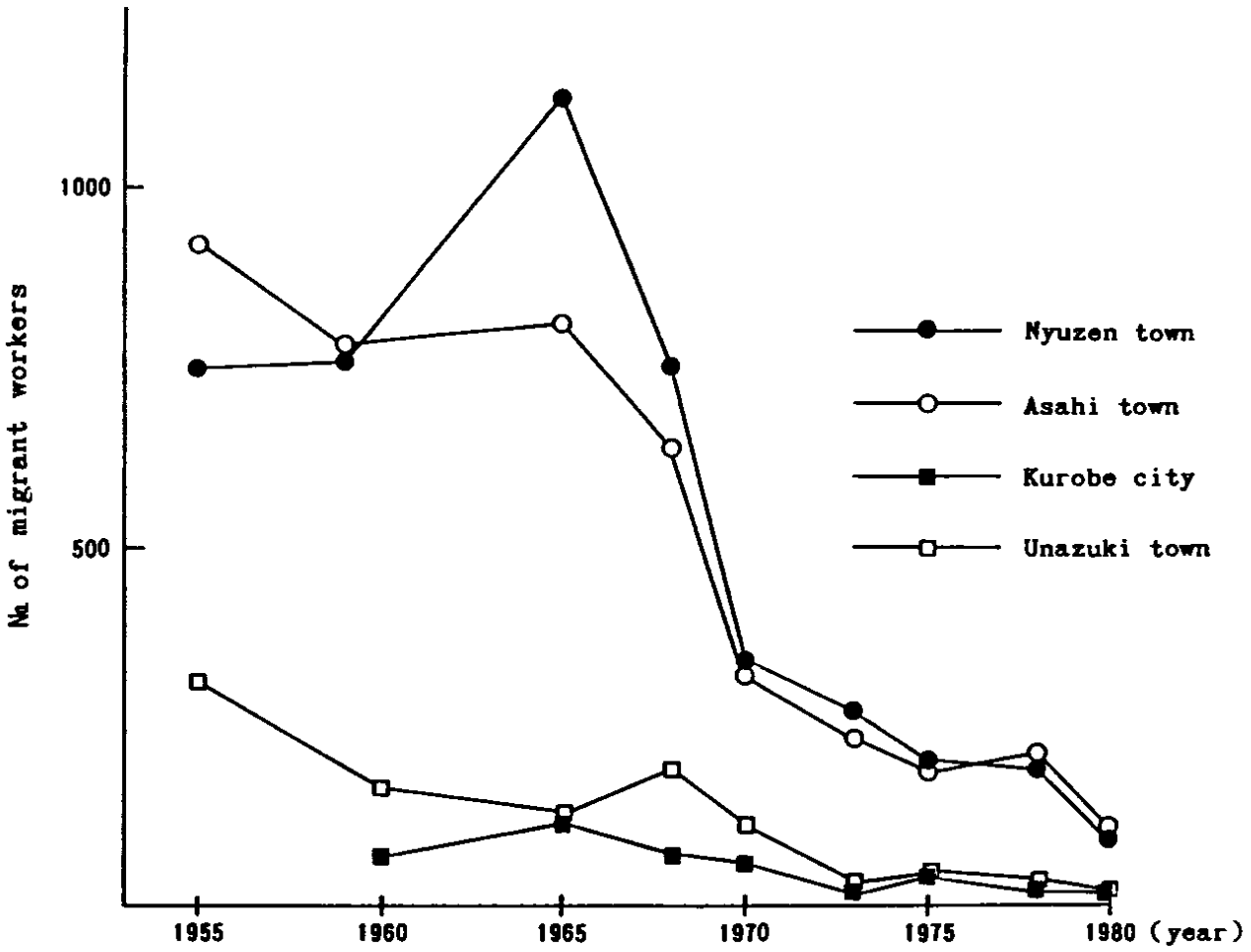


Figure 3. The number of migrant workers who had worked away from home.
(Source: Agriculture Census, Japan and Report of Fundamental Agricultural Survey of Toyama Prefecture, Japan)

number of migrant workers increased during the period of development of power sources and declined with its termination.

In eastern Toyama Prefecture, 70% of the silicosis patients had not known that they had the disease and were first diagnosed by our survey. Those who knew they had the disease at the survey had been diagnosed relatively recently (69% after 1970), and the disease was detected in many of these patients by the mass screening for tuberculosis carried out by the health center. Of the 166 patients with silicosis registered at Kurobe Health Center in 1977, when this study was started, the disease was detected in 95 (57%) by local health check-up programs rather than by examinations at work places.

In many patients, silicosis was not noted during migrant work but was first detected more than 10 years after discontinuation of the employment, first because most of them were seasonal workers not covered even by the minimum health management at the work place. The Pneumoconiosis Law of Japan requires health check-up at the beginning, during (periodic), and end of employment.[4] However, of the migrant workers employed in occupations involving dust exposure in eastern Toyma, only 60% had undergone health examinations at the work place; the percentages were lower in those in their 50's (25%) and those over 60 (10%). Migrant workers employed on monthly basis not only could seldom take periodic health check-ups (once every 3 years for those constantly exposed to dust and once every year for pneumoconiosis patients) or the examination at dismissal, which was intended for those who worked for 1 year or more, but were often excluded from the examination list. Moreover, since these workers were employed at irregular times, not many of them received the check-up at the time of employment. In addition, even after they contracted silicosis, they were not regarded as employees in operations involving dust exposure during intervals or after discontinuation of migrant work and were not covered by the follow-up programs provided by the Pneumoconiosis Law. For these reasons, migrant workers with silicosis visited medical institutions only after considerable progression of their disease and were first diagnosed. This situation lasted until 1972, when the Law of Labor Safety and Hygiene was enforced to provide free annual health check-up for those radiologically diagnosed after retirement to have type II or more advanced pneumoconiosis. However, this health check-up requires the certificate of employment at the last work place, which is

often difficult to obtain for many migrant workers employed as subcontractors and sub-sub-contractors. Furthermore, those who discontinued migrant work before the enforcement of the Pneumoconiosis Law are not covered by this law and are left unattended. As shown in Table VI, 27% of migrant workers in eastern Toyama had retired before 1960.

Secondly, the insufficient education about pneumoconiosis at the work place is considered to be a factor in the poor management of workers with the disease.[5,6] According to our survey, 84% of the patients were aware of the risk of pneumoconiosis associated with works involving dust exposure, but only 21% received education at the work place about the possible hazard of dust exposure, and 49% obtained the knowledge from friends or by observing colleagues developing silicosis. Six percent of the patients became aware of the danger of dust exposure for the first time after they began to be treated for silicosis. Dust masks were worn by only 51% and worn consistently by one-third of them.

As mentioned earlier, migrant workers were not regarded as workers after discontinuation of migrant work and were, therefore, excluded from the coverage of labor administration. In addition, general hygienic measures were mot extended to them in time, because silicosis has been considered an occupational disease. These factors contributed to the lack of recognition and neglect of a number of patients.

As observed above, the present legislation provides inadequate protection and management for migrant workers who engaged in occupations involving dust exposure. The 1977 amendment of the Pneumoconiosis Law, which provides for physical examinations during and after (silicosis patients) the period of employment, is still insufficient. At Kurobe Health Center, silicosis patients within its jurisdiction are registered as a major target of local health administration, and disease-control programs including annual physical assessment are executed also for those patients who had previously been excluded from public health care service, because they retired before 1960, could not obtain certificate of employment from the place of their last employment, or type I radiographic evaluation at the time of retirement.

## REFERENCES


1. Yanagisawa, B.: Epidemiology on Migrant workers. *J. Jpn.Associ Rural Med.*, 25:143-161(1977).
2. Nakagawa, H.: Pulmonary Function Impairment in Silicosis Patients Who Had Been Seasonal Labours in the East of Toyama. *Hokuriku Public Health*, 5:36-45(1978).
3. Nakagawa, H. et al.: Study on Silicosis in Migrant Workers. *J. Jpn.Associ Rural Med.*, 30:810-817(1981).
4. Ministry of Labour: *Health Check-up Handbook for Pneumoconiosis*. Japan Industrial Safety Association, Tokyo (1978).
5. Yamazaki,Y. : Process and Factors Concerning the Frequent Occurrence of Pneumoconiosis among Migrant Workers for Tunnel Construction—Analysis of the Cases in Oita Prefecture. *Jpn.J.Public Health*, 30:336-348 (1983).
6. Une, H. et al.: Pneumoconiosis and Vibration Syndrome among Migrant workers in Kochi Prefecture. *J.Jpn.Assoc1 Rural Med.*, 32:969-977 (1984).

*Proceedings of the VIIth International Pneumoconioses Conference* *Part*
*Transactions de la VIIe Conférence Internationale sur les Pneumoconioses* *Tome*
*Transaciones de la VIIa Conferencia Internacional sobre las Neumoconiosis* *Parte*

# II


Pittsburgh, Pennsylvania, USA—August 23–26, 1988
Pittsburgh, Pennsylvanie, Etats-Unis—23–26 aout 1988
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November 1990

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**DHHS (NIOSH) Publication No. 90-108 Part II**