Ten Years' Experience with The Coal Workers' Health Surveillance Program, 1970-1981

Rochelle B. Althouse, M.S.
Epidemiological Investigations Branch
Division of Respiratory Disease Studies
National Institute for Occupational Safety and Health

Introduction

The occupational disease, coal workers' pneumoconiosis (CWP), results from the inhalation and deposition in the lung of respirable coal-mine dust. Reaction of the lung tissue to the dust may produce coal macules, coal nodules, or progressive massive fibrosis. These relatively specific pathologic changes, and any consequent physiologic abnormalities, constitute CWP. In 1969, the underground mine labor force was estimated at 120,000. These miners, having worked in high dust levels, were potentially at risk of developing simple CWP and its more severe form, the often disabling progressive massive fibrosis.

The Coal Mine Health and Safety Act of 1969 mandated the creation of The Coal Workers Health Surveillance Program (CWHSP). The CWHSP, also called the X-Ray Surveillance Program, was designed to detect CWP, to protect the health of coal miners by allowing miners to transfer to low-dust work areas if chest radiographs show signs of CWP, and to identify mines with a high prevalence of CWP. It also provided a means for monitoring the incidence and prevalence of CWP under the respirable coal dust standard. The standard was established at 3 mg/m^3 in 1970 and reduced to 2 mg/m^3 by December 30, 1972. The National Institute for Occupational Safety and Health (NIOSH) has administered the CWHSP since its beginning in 1970. The program has now completed three "rounds" of examinations (*1,3*): Round 1 from 1970 to 1973, Round 2 from 1973 to 1978, and Round 3 from 1978 to 1981; Round 4 is currently under way. The following gives an overview of 10 years' experience with this program.

Methods

All miners employed since 1970 must have a chest radiograph taken soon after employment and again 3 years later. Subsequently, working coal miners at underground mines are eligible to volunteer for radiographs at intervals not to exceed 5 years. Each coal-mine operator is required to submit a plan specifying the time period for examinations and the facilities at which x-rays will be taken. If no plan is submitted, NIOSH draws up a plan that becomes mandatory for the mine operator. Regardless of who submits the plan, the same specifications and standards for examination and evaluation of results are maintained.

Posterior-anterior chest x-rays of the miners are taken free of charge. X-ray facilities must be certified by NIOSH and may be hospitals, clinics, or mobile units. The films are interpreted by physicians who are also certified by NIOSH; these physicians are designated as either "A" or "B" readers depending on their level of certification. Each x-ray is seen by more than one reader, and a consensus scheme is used to reach a final determination for each film. Supplemental information—such as age, mining tenure, and job in the mine—is collected at the time of x-ray examination. CWP is diagnosed by the identification and classification of opacities on the chest radiograph according to the International Labour Offices's UICC/Cincinnati classification scheme (*1*). The classification scheme and the procedure for interpreting x-rays for pneumoconiosis were modified during the 10 years of the surveillance program. NIOSH stores all the x-rays and releases results only with the permission of the individual miner.

Opacities seen in the lung are classified as large or small. In the 1971 classification scheme, small opacities are read as rounded, irregular, or a combination of both. These fall into three grades of abnormality: Category 1—opacities are present but few in number; Category 2—opacities are more profuse, with lung markings partially obscured; Category 3—opacities are very numerous, with the normal lung markings partially or even totally obscured. Large opacities, associated with massive pulmonary fibrosis, are classified by increasing size as A, B, or C. For Rounds 1 and 2 of the CWHSP, miners were eligible for transfer to a low-dust work area if their x-rays were classified as Category 2 or 3—with no restriction on the length of service—or as Category 1—with less than 10 years' service. Since 1978, all miners whose opacities are classified as Category 1 or higher are eligible for transfer, with no restrictions on time of service. Miners are informed by letter of the x-ray results and of their eligibility for transfer.

Results

The pattern of participation during the three rounds reflects changes in the coal-mine labor force during that time. In 1970, the underground mine labor force was estimated at 120,000; it increased to 159,000 in the mid 1970s and then leveled off at 150,000 in 1980. Round 1 of the CWHSP had 77,758 participants; Round 2, 122,625; and Round 3, 63,519. Of the more than 200,000 individual miners who participated, only 10,700 participated in both Rounds 1 and 3. Table 1 presents a distribution of tenure for the 3 rounds. Round 2 had the highest proportion of participants in the 0- to 4-year year tenure group; this was during a period when large numbers of new miners were entering the industry, and the work force was increasing.

Age distribution of participating miners also reflects this trend: 37% of Round 1 miners were < 30 years of age, compared with 58% at Round 2 and 49% at Round 3. The highest percentage of miners (49%) fell into the 30- to 50-year age group in Round 1, compared with 31% in Round 2 and 40% in Round 3.

The regional distribution of miners in the surveillance programs also reflects general trends in the mining industry. In each round, the largest percentage was from Appalachia: 92% in Round 1, decreasing to 82% in Round 3. The percentage of participants from the West has been increasing, from 2% in Round 1 to 10% in Round 3. Percentages of participants from the Midwest remained stable.

From 1970 to 1980, a total of 9,800 miners were eligible for transfer to low-dust work areas. At Round 1, 4,100 were eligible, 2,800 at Round 2, and 2,900 at Round 3. During this 10-year period, about 1,700 (18%) of these miners actually transferred. By 1980, only 500 of the miners who had transferred to low-dust environments were still employed in mining (2). This indicates that a large number of miners who had exercised the transfer option based on eligibility from the earlier rounds had since left the industry.

TABLE 1. Percentage distribution of participants in Rounds 1, 2, and 3, by tenure group, 1970-1981

Years in mining	Round 1	Round 2	Round 3
0-4	42.1	68.7	51.9
5-9	9.8	11.4	24.8
10-19	13.1	7.5	12.9
20-29	18.4	6.5	4.6
30+	16.6	5.9	5.8

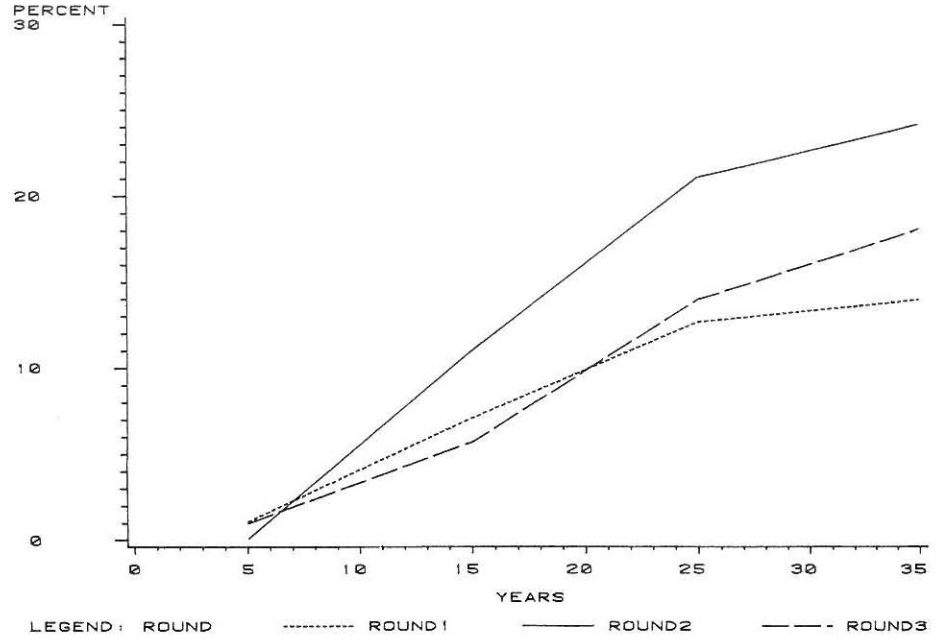
The prevalence of CWP, Category 1, by years in mining, is shown in Figure 1. Within each round, the prevalence of Category 1 CWP increased with tenure. The highest overall prevalence was seen in Round 2—29% at 35 years' experience—compared with 23% for Round 1 and 17% for Round 3. The prevalence of CWP, Category 2 or higher (Figure 2), followed a similar pattern of increasing prevalence with tenure. Overall prevalence values, however, decreased from Round 1 through Round 3. The prevalences increased sharply in the > 20-year tenure group. The pattern of increasing prevalence with tenure is similar to findings reported in other studies (*3*).

Participation of working miners (those who do not have chest radiographs as new employees) has been steadily decreasing over the 3 rounds. Participation during Round 1 was 50%; this fell to 44% for Round 2 and to 32% for Round 3. Information on tenure and age indicated that almost half the participants at each round were new to mining; by contrast, < 13% of participants in Round 2 and 11% in Round 3 had over 20 years' experience. This finding suggests that miners tend to participate initially because they are required to as new employees but do not continue participating in the program.

Discussion

These data should be interpreted with caution. First, the low participation level may introduce a selection bias (*4*). During the 10 years of this program, the mine labor force was increasing, and attrition probably took place among the older, more experienced miners. This fact, combined with the short time period, may lead to low estimates of CWP prevalance. Second, due to changes in the x-ray classification scheme and the procedures for interpreting x-rays during the study period, data from round to round are not strictly comparable. In addition, miners participating during each round are not necessarily representative of all working

FIGURE 1. Prevalence of CWP Category 1, by round and years underground, 1970-1981



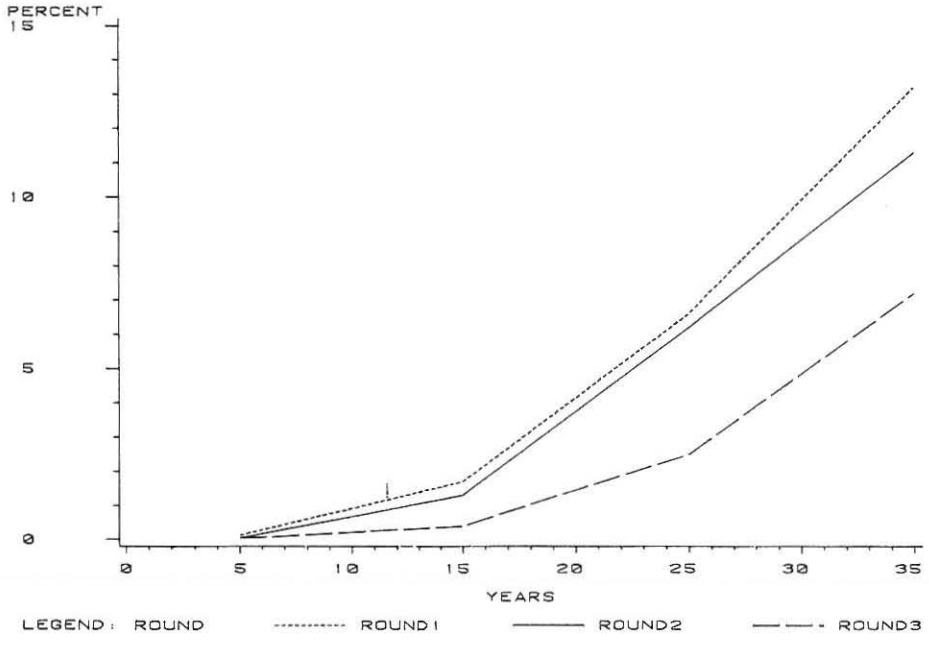
miners. Thus, decreases in the prevalence of Category 2 CWP or higher during the rounds do not necessarily imply success in dust-control methods. A previously reported study of miners who had worked only under the mandated standard indicated, however, that levels of CWP incidence are consistent with predicted levels based on British research when dust standards have been conrolled at 2 mg/m^3 (*5*).

Since only a small percentage of the miners eligible for transfer actually exercise their option to move to a low-dust job, it is difficult at this time to assess the extent to which the program is effective in protecting workers' health. And, because miners do not participate consistently, epidemiologic evaluation over time to determine progression and incidence of CWP is also difficult.

The addition of data from Round 4 will provide pertinent information with which to evaluate the effectiveness of the surveillance program: 1) A longer follow-up period from initial x-ray will have elapsed—up to 15 years for some miners; 2) Repeated participation at Round 4 for those miners new to mining at Round 1 and/or Round 2 will provide a large group of miners who have worked only under mandated dust standards.

Informally reported information suggests that the low level of participation in CWHSP reflects a lack of knowledge within the mining community about the program and its purposes. NIOSH is actively involved in overcoming this problem by promoting informational and educational activities. With a fair degree of success in this promotion effort, the surveillance program can more fully meet its objectives.

FIGURE 2. Prevalence of CWP Category 2 or higher, by round and years underground, 1970-1981



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