PREVALENCE AND INCIDENCE OF COALWORKERS' PNEUMOCONIOSIS IN U.S. UNDERGROUND MINERS

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Introduction

The results presented here are drawn from the latest data from a long-term epidemiological study on coal miners, denoted the National Study of Coalworkers' Pneumoconiosis (NSCWP). This study was begun in 1970,[1] when thirty-one underground mines around the United States were visited by a mobile examination trailer staffed by a medical team (Round 1). Radiological data, information on ventilatory function and respiratory symptoms, and data on work and smoking history were obtained on over 9,000 miners. The medical surveys were repeated about three years later (Round 2). Collection of the most recent data took place between 1985 and 1988, when a follow-up study of selected miners and ex-miners from Rounds 1 and 2 was undertaken. This paper presents results on the prevalence of coalworkers' pneumoconiosis (CWP) observed at the end of the follow-up period, and on the incidence of CWP observed over the approximately 13 year interval of the follow-up period.

Materials and methods

Participants in Round 1 or 2 of the study who were alive according to Internal Revenue Service (IRS) records and aged 58 or less in 1985 were identified for possible study. The age limit was imposed in order to confine the medical investigation to those of normal working age. After exclusion of anthracite miners (too few for analysis), those who had moved away, and those in thinly populated areas, 5,452 miners and ex-miners remained; these were targeted for examination in 26 medical surveys. The surveys consisted of three mine visits, and 23 "community surveys." In the latter, the mobile examination unit was set up in a central location, to which the miners were invited by appointment. In total, 3,280 miners and ex-miners were examined.

The examination consisted of three main parts: a standard posterior-anterior chest radiograph, spirometry, and a questionnaire on respiratory symptoms, smoking habits, and work history. Ex-miners were placed into one of three groups: current miner, ex-miner health-related (left coal mining because of sickness or injury), and ex-miner work-related (left coal mining to take another job, or laid off). Three groups (high, medium, low) were formed for analysis by coal rank, a mineralogic measure of metamorphosis by heat and pressure.

Two sets of x-ray readings were undertaken. The prevalence readings consisted of independent classifications of all single films from Round 4 by three B readers using the ILO 1980 system.[2] Summary prevalence readings of small opacities for each study participant were obtained by taking medians when either two or three readings were available.

Incidence readings were undertaken on those cases with any sign of CWP (all radiographs for which one or more readers reported category 0/1 or greater profusion of small opacities) on the prevalence reading, and on an age matched control group of the same size drawn from the remainder of the group. Each final film was paired with its initial film from Round 1 or 2, and read side-by-side using the 1980 ILO classification[2] by three B readers, after the pairs had been mixed randomly. Summary determinations of profusion of small opacities were derived using medians. Estimates of CWP incidence and progression for the whole cohort of miners were derived by combining the information from the incidence reading with extrapolated figures for the remainder of the films, using tenure-specific rates from the incidence readings.

Results

Based on replies given during examination, 53% of the group were current miners, while 33% were work-related ex-miners (mostly laid-off because of the recession in coal mining). Health-related ex-miners made up the balance (14%). The average age of the whole group was 46 years, and the group had spent an average of 18 years in mining and 14 years underground. The majority lived in Appalachia (West Virginia, Kentucky, Pennsylvania, Virginia, Ohio, and Tennessee)

Results on prevalence are based on 3,200 participants because radiographs for 80 were classified as unreadable for CWP. Similar overall prevalences of combined opacities of category 1 or greater (CWP 1+) were obtained by the three readers (7%, 7%, and 9%, respectively). CWP 1+ prevalence based on the median determinations (Figure 1) showed a very slight rise with tenure underground between 0 - 19 years, and a much steeper increase after that. Except for the 30+ years tenure group, the prevalence of CWP 2+ was close to 1% (Figure 1).

Prevalences of CWP according to employment status at Round 4 -- current miner, ex-miner (job-related), or ex-miner (health-related) -- are shown in Figure 2. Miners who left mining because of their health were more than twice as likely to have CWP 1+ compared to those who stayed in mining (OR = 2.7, $p<0.001$ based on logistic modeling). Abnormality levels for ex-miners who changed jobs or were laid off were very similar to those who remained in mining (OR = 1.1, $p>0.05$). Similar relationships (not shown) was seen for CWP 2+.

Figure 3 shows the prevalences of CWP 1+ by coal rank group. Differences were only apparent for miners with 20 or more years of tenure. As expected, the high rank area tended to have the greatest prevalence of CWP (OR = 2.0, $p<0.001$ based on logistic modeling). Surprisingly, the prevalences for the low rank group appear to be higher than those for the medium rank group (OR = 1.44), although of borderline statistical significance ($p<0.10$).

In the incidence reading, after deletion of pairs with missing data or unreadable films, data for 3,204 pairs remained. Bivariate tabulation of the initial and final x-ray data from these readings (including the extrapolated scores) (Table 1) shows that there were 152 incident cases of CWP 1+ from category 0, or an overall estimate of incidence of CWP 1+ of 4.8%. The incidence of CWP 2+ was 11/3,159 = 0.3%. The eleven affected miners who suffered incidence of CWP 2+ over the 13 or so years of the follow-up had a mean age of 57, and had worked an average of 33 years in coal mining at the time of final follow-up. Four were from areas where high rank coal is mined, as opposed to about one expected on the basis of the geographical distribution of the participants, consistent with the view that coal rank is linked with CWP incidence.

Examination of incidence by employment status revealed similar findings to those on prevalence, in that ex-miners who said they left work because of their health had elevated incidence of CWP (OR = 2.2, $p<0.01$). In addition, miners in high coal regions had elevated incidence over those in medium regions (OR = 1.8, $p<0.01$), but contrary to the prevalence findings, low rank coal miners did not have an elevated risk compared to medium rank miners.

Conclusions

The conclusions from the study were as follows:

1. Prevalence and incidence of CWP were related to both tenure underground and coal rank.

2. Individuals who left mining for health reasons had higher prevalence and incidence of CWP.

3. Most of the CWP evident at the final examination (Round 4) had developed over the study period.

4. Most of the incident cases were older miners, most of whom had worked in coal mining for extensive periods before the start of the follow-up period.

5. Miners with CWP at the initial survey had high rates of progression.

In general, it appears that CWP prevalences in U.S. underground coal miners are decreasing.[1] This suggests that the compliance measures enacted in 1969 have had some success. Nevertheless, the results of this study indicate that existing measures may not be totally sufficient to prevent all CWP incidence, nor prevent CWP progression among those who do develop the disease. However, because many of the miners in this study had received high dust exposures before dust levels were reduced in 1969, it is difficult to be sure that the degree of CWP incidence and progression observed is not a legacy of past conditions. Hence, continued surveillance of underground coal miners is necessary in order to determine whether these observations apply to miners who joined the work force after 1969. Lung diseases other than pneumoconiosis should similarly be evaluated in relation to work in these dust conditions.

References

1. Attfield MD, Castellan RB. Epidemiological data on US coal miners' pneumoconiosis, 1960 to 1988. Am J Public Health 1992;82:964-970.

2. International Labour Organization. International Classification of Radio-graphs of Pneumoconiosis (revised edition 1980) (Occupational safety and health series no. 22 (Rev. 80)). Geneva: International Labour Office, 1980.

Table 1. Incidence of CWP over study period derived from median profusion category

Initial x-ray	Final x-ray 0	1	2	3	All
0	3007	141	10	1	3159
1	2	21	14		37
2		2	6		8
3					0
All	3009	164	30	1	3204

Figure 1. Prevalence of CWP by tenure underground
Median readings

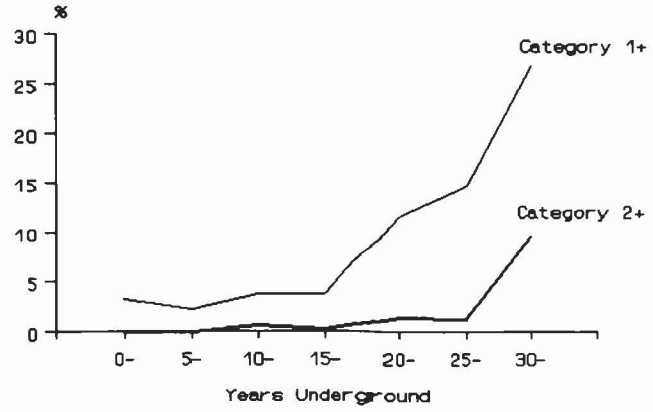


Figure 2. Prevalence of CWP category 1 or greater
by employment status and tenure underground

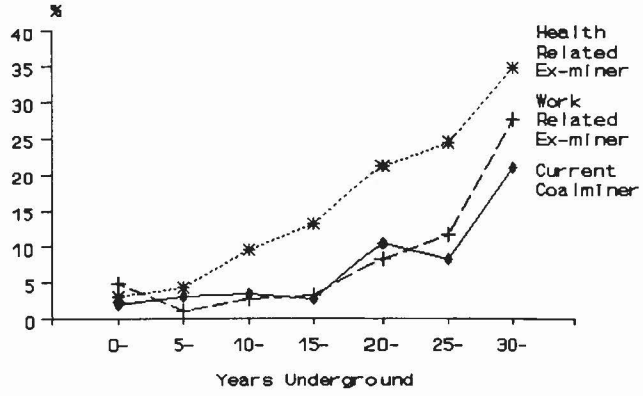
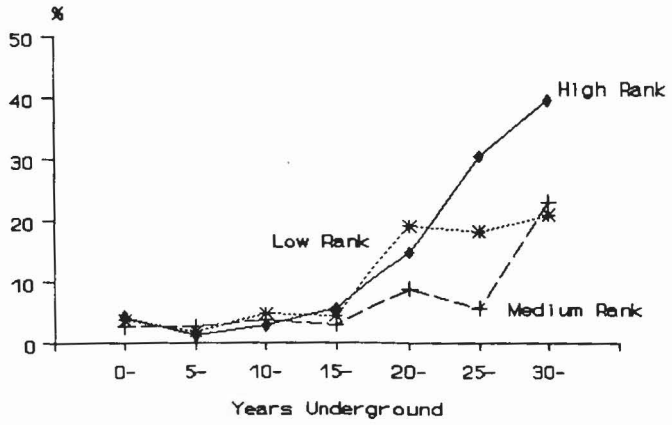


Figure 3. Prevalence of CWP category 1 or greater by coal rank and tenure underground



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