

Prevalence of pneumoconiosis and its relationship to dust exposure in a cohort of U.S. bituminous coal miners and ex-miners.

Detailed Data Collection Methods

Cohort Derivation: Participants in Round 1 or 2 of the study who had been working in bituminous coal mines and were alive according to Internal Revenue Service records and aged 58 years or less in 1985 were identified. The age limit was imposed in order to confine the planned medical investigation to those within the normal working age range. The cohort consisted of 7,281 miners and ex-miners, about equally divided between those first examined at Round 1 and those first examined at Round 2. Not all the 7,281 were finally selected for study. Those who had moved to locations outside of the principal coal mining areas, those in thinly populated areas, and those deemed too far (about 30 miles) from the planned locations of the mobile examination unit were excluded. There remained 5,693 miners and ex-miners who were finally targeted for examination in 26 preselected locations. These consisted of three active mine sites and 23 non-mine sites referred to as “community surveys” henceforth (more mine surveys were not possible because the study mines had been closed down or were temporarily inactive during the medical examination phase of this round).

Surveys: The targeted group was divided into clusters of about 150-400 people, and a visit made to each location to seek a convenient site (e.g., health clinics, shopping malls, and union halls) for the mobile examination unit. Individuals were contacted by a locally employed telephonist, and examinations scheduled at their convenience. As considerable difficulty was experienced in obtaining telephone numbers for some, letters were sent to their homes. Personal visits were made to the homes of nonresponders to arrange an appointment for examination. About 3-4 weeks after the telephonist had started making calls, the mobile examination unit was moved to the chosen site and the survey proper began. While a team of technicians obtained the medical data, others continued to locate individuals and schedule examinations and to reschedule examinations for those who failed to keep their appointments.

Size of Study Group and Bias: Of 5,693 targeted, 3,280 miners and ex-miners participated in the examinations (see Table I for the complete breakdown by category). In order to detect any bias caused by the selection procedures for the targeted individuals, the initial data from Rounds 1 and 2 for the 7,281 people in the follow-up cohort were combined and tabulated by whether or not they had been targeted for examination. A similar analysis compared differences between participants and those of the targeted group who were not medically examined. This latter analysis excludes the 136 individuals who died before they were examined.

TABLE I. Derivation of Final Group of Coal Miners

Round 1 and 2 participants, age 58 in 1985	7,281
Excluded from invitation based on locality:	
too few or too distant	1,588
Targeted group	5,693
Non-participants	
Deaths	136
Moved away	417
Not located	390
Refused/no show	1128
Other	342
Total	2413
Examined in 3 mine and 23 non-mine sites	3,280
Excluded due to unreadable x-rays or	
missing exposure data	86
Number available for analysis	3,194

Medical Examination: The examination consisted of three main parts: a posterior-anterior chest radiograph, spirometry, and a questionnaire on respiratory symptoms, smoking habits, and work history. The coal mining jobs were classified according to the coding system used by the Mine Safety and Health Administration (MSHA) in order to facilitate amalgamation with MSHA dust concentration data for the development of estimated occupational dust exposures. Additional questions were asked of the miners concerning age, race, and other dust exposures (i.e., work in quarries, in foundries, in cotton, hemp, and flax mills, in potteries, and with asbestos). Ex-miners were asked about their reasons for leaving work in coal mining, and were placed into one of two groups based on their replies: health-related ex-miner (left coal mining because of sickness or injury), and work-related ex-miner (left coal mining to take another job, or laid off).

Coal Rank: The study participants were divided into three broad groups for analysis by coal rank, a mineralogic measure of the degree to which coal has been metamorphosed by heat and pressure. Previous studies have shown coal rank to be a risk factor for development of CWP [Walton et al., 1977; Attfield and Castellan, 1992]. Participants living in central Pennsylvania and southeastern West Virginia were put into the high rank coal group, while those residing in western Kentucky, Illinois, Colorado, and Utah were placed in the low rank coal group. All others comprised a medium rank group. These geographic groupings fit with general trends in coal rank across the country. (Separate categorization of the western miners was not possible because of small numbers.)

X-ray Readings Independent classifications of all single films from Round 4 were undertaken by three (National Institute for Occupational Safety and Health (NIOSH)-certified B readers using the ILO 1980 system [International Labour Office, 1980]. Since wide variability in classifications by B readers has been reported [Attfield et al., 1986], a

special reader selection strategy was adopted with the intent to minimize interreader disagreement while providing readings representative of B readers in general (i.e., avoiding extremes of interpretation). Readings from the Coal Workers' X-ray Surveillance Program (CWXSP) [Attfield and Althouse, 1992] made over the period 1981-1985 were employed to rank the 30 participating B readers. These readers had each classified hundreds of x-rays of current miners, supplied to them more or less randomly with regard to tenure and region. The percentage of x-rays reported to have category 1 or greater was tabulated for each reader. The readers were then ranked by this percentage, and three readers selected from the center of the range. Part way through Round 4, one of the selected readers retired and was replaced by another, who was selected using the same procedure. A summary profusion category of small opacities for each study participant was obtained by taking the median category when three readings were available. To avoid loss of data, for those cases where only two readings were available, through one reader saying the film was unreadable, the higher of the two available profusion categories was taken as the summary determination (n = 162). Films with only one reading were omitted from analysis (n = 80). Median determinations of large opacities (progressive massive fibrosis [PMF]) were derived similarly. In this report, the term CWP refers generically to radiologic evidence of small opacities and/or large opacities detected using the ILO Classification scheme. CWP 1+ will refer to any x-ray showing major category 1, 2, or 3 small and/or large opacities. CWP 2+ will refer to major category 2 or 3, and/or large opacities. PMF denotes any category of large opacities.

Dust Exposures Dust exposure estimates for each person were calculated by summing the products of time worked in each job from the Round 4 work histories with dust concentration data from the exposure matrix derived by Seixas et al. [1991]. Estimates of dust levels prior to the systematic collection of environmental information mandated by the Federal Coal Mine Safety and Health Act in 1969 were derived by extrapolation of the 1970-1972 information. This used the factor of 2.3 derived by Attfield and Morring [1992a] from Bureau of Mines data collected in 1968-1969. The resulting exposure estimates are expressed in mg-yr/m³, and represent the cumulative exposure experienced from starting work until the date of the Round 4 medical examination.

References

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