

Prevalence of Radiographic Appearance of Pneumoconiosis in an Unexposed Blue Collar Population¹⁻³

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Introduction

The ILO U/C International Classification of Radiographs of the Pneumoconioses (1) has been widely accepted for recording the radiographic abnormalities caused by inhalation of dusts. This classification system, which has been more recently modified (2), stresses pattern recognition and de-emphasizes interpretation of the pathologic significance of radiographic abnormalities. Other diseases involving the lung may have the same radiographic appearance as pneumoconiosis (3, 4). Thus, in epidemiologic studies that relate prevalence of small radiographic opacities to dust exposure, it may be helpful to compare radiographic findings in a dust-exposed group to similarly derived findings in a comparison group of subjects not exposed to the hazard in question. This report offers summary statistics describing the radiographic appearance of pneumoconiosis in an actively working, blue collar population with minimal history of exposure to occupational respiratory hazards.

Methods

Details of the population selection have been published in a report concerned with respiratory symptoms (5). Only 55% of the "targeted" population volunteered to be examined, but results of a follow-up questionnaire suggest that the overall bias caused by non-participation should be small (5), and health status was not a criterion for excluding examinees. In addition to a standardized smoking history, a detailed occupational history was obtained from each subject by trained NIOSH personnel. This was used to eliminate examinees with a total of 5 yr or more of work exposure to dusts or other respiratory hazards. In all, 880 blue collar workers were examined but not included in the study population because of past exposures. Also excluded were 108 examinees classified as white collar (office) workers.

Each subject had a posteroanterior chest radiograph 14 by 17 inches taken at full inspiration in the standing position, using technique specified for pneumoconiosis (6).

SUMMARY Blue collar employees currently working in environments free from exposure to respiratory hazards were examined with chest radiography and a standard occupational history questionnaire. Workers who had worked for a total of 5 yr or more in previous jobs with possible hazardous respiratory exposures were excluded. Each radiograph was read independently by 3 NIOSH-certified "B" readers. For small opacities, the median profusion was accepted as a summary reading. The 1,422 readable films represented a population of 50.6% males, 49.4% females, 52.5% whites, 44.2% blacks, 47.0% current smokers, and 38.5% nonsmokers. The mean age was 33.8 yr, with a range from 16 to 70 yr. Small opacities of profusion $\geq 1/0$ were identified in only 3 (0.21%) of the radiographs—2 with small rounded opacities and 1 with small irregular opacities. Small irregular opacities of profusion category $\geq 0/1$ were statistically associated with age, gender, and pack-years of smoking. The results suggest that using the median of 3 independent readings should rarely result in interpretation of chest radiographs as "positive" for pneumoconiosis in active workers who have not had significant dust exposure.

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The radiographs were divided into 6 batches, and each batch was sent to 3 NIOSH-certified "B" readers who, unaware of subjects' ages, occupations, or smoking histories, independently interpreted and classified films according to the ILO-U/C 1971 classification system (1). The readers were selected from those on contract with NIOSH and varied from batch to batch. A total of 11 "B" readers were involved in this study. Only 36 of 1,458 radiographs of "unexposed" blue collar workers were judged to be "unreadable" by at least 1 "B" reader, and they were excluded from the analysis, leaving a study population totaling 1,422. For small opacities, the median profusion (of the 3 readings) was accepted as a summary reading.

Results

The 1,422 readable films represented a population of 50.6% males, 49.4% females, 52.5% whites, 44.2% blacks, 47.0% current smokers, and 38.5% nonsmokers. The mean age was 33.8 yr, with a range from 16 to 70 yr. Pack-years of smoking ranged from 0 to 90.

Of these 1,422 radiographs, there were only 3 cases (0.21%) with a median reading of $\geq 1/0$ profusion of small opacities, and only 1 of these had a median reading as high as 1/1. There were also few cases with median readings for small opacities of profusion 0/1-3 with small rounded opacities, and 7 with small irregular opacities. No radiographs had large opacities.

Characteristics for subjects with

small opacities of profusion $\geq 0/1$ are listed in table 1. Both subjects with chest radiographs interpreted as rounded opacities of profusion $\geq 1/0$ were obese, middle-aged, female never-smokers. However, taken together with the 3 subjects with small rounded opacities of 0/1 profusion, there did not appear to be any consistent trends for the listed characteristics. In contrast, of the group of 8 subjects with small irregular opacities of $\geq 0/1$ profusion, all were males older than the population mean, and only 1 was a never-smoker. Compared with those without small opacities, the group with small irregular opacities (profusion $\geq 0/1$) had greater ($p < 0.01$): (1) proportion of males (100 versus 50.5%), (2) mean age (50.5 versus 33.7 yr), and (3) mean pack-years (35.9 versus 7.5).

Only 3 of the 1,422 films had pleural abnormalities noted, and these were unilateral and uncalcified in all cases.

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TABLE 1

LISTING OF SUBJECTS WITH SMALL ROUNDED OR SMALL IRREGULAR OPACITIES OF \geq 0/1 PROFUSION BY MEDIAN READING (TOTAL POPULATION = 1,422 "UNEXPOSED" BLUE COLLAR WORKERS WITH CHEST RADIOGRAPHS READABLE BY ALL 3 "B" READERS)

	Age (yr)	Sex	Race	Pack-years	Weight (kg)	Reading (median)	Reading (lowest)	Reading (highest)
Rounded								
1	51	F	B	0	96	1/1	0/0	1/1
2	58	F	B	0	98	1/0	1/0	1/2
3	21	M	W	10	68	0/1	0/0	0/1
4	29	M	B	2	74	0/1	0/0	1/0
5	54	M	W	33	66	0/1	0/1	1/0
Irregular								
1	57	M	B	41	68	1/0	0/1	1/0
2	46	M	W	47	75	0/1	0/1	0/1
3	59	M	W	0	98	0/1	0/0	1/0
4	43	M	W	21	105	0/1	0/0	0/1
5	34	M	W	16	58	0/1	0/0	0/1
6	55	M	W	49	99	0/1	0/-	1/0
7	59	M	W	60	114	0/1	0/0	1/1
8	51	M	B	54	61	0/1	0/0	1/0

Two were males with prior chest trauma, and 1 was a female with no apparent cause of her pleural abnormality.

The group of 880 blue collar workers who had readable chest radiographs but were excluded as "exposed" were older (mean age of 41.2 yr), contained predominantly males (72.7%), and had a higher proportion of smokers (50.8%) and ex-smokers (17.6%) than did the group of unexposed workers. Of those, 8 (0.91%) had small rounded opacities of profusion \geq 1/0, and 9 (1.02%) had small irregular opacities of profusion \geq 1/0. The 108 examinees with readable radiographs who were excluded as white collar workers had a mean age of 38.0 yr, were predominantly females (71.3%), and were 53.7% nonsmokers and 13.9% ex-smokers. None of these white collar workers had either small rounded or small irregular opacities of profusion \geq 1/0.

Discussion

Using the median of 3 independent "B" readings, we found a very low prevalence of the radiographic appearance of pneumoconiosis among currently employed blue collar workers who were carefully screened to eliminate those with significant current or past occupational exposure. Most authorities require a profusion of small opacities of at least 1/0 by ILO criteria before considering a chest radiograph "positive" for pneumoconiosis, and only 3 (0.21%) of the "readable" chest radiographs met this criteria. Furthermore, only 1 of these had a profusion as high as 1/1, a profusion level generally accepted as being definitely abnormal.

We have used the terminology "radiographic appearance of pneumoconiosis" because radiographs alone are not diagnostic of pneumoconiosis, particularly (as in this population) in the absence of significant occupational exposure to dust. In addition to nonoccupational lung diseases which can present chest radiographs consistent with pneumoconiosis (3, 4), other factors may affect radiograph interpretation. In fact, both cases with small rounded opacities of profusion \geq 1/0 by median reading were obese females weighing in excess of 95 kg. The interpretation of their radiographs may have been influenced by soft tissue density overlying the lung fields, as well as by the tendency for less than full inspiration seen in extremely obese persons (7).

A recent study involving admission chest radiographs from 200 hospitalized patients found that 11% had small opacities of profusion \geq 1/0 by ILO standards, which could not be explained by established diagnoses or by occupational dust exposure (8). This high prevalence contrasts with the very low prevalence in our study. Their "B" readers appear not to have been blinded to the study design and objective, and this may have strongly biased the results. Also, their profusion category was obtained as a consensus reading of 2 "B" readers simultaneously viewing each radiograph, a method that has been shown to affect interpretation (7). More importantly, the use of a hospitalized population represents a strong selection bias. Our study, using only currently employed subjects, is probably biased in the opposite direction relative to the population at large, and

should be more relevant for comparison with other radiographic surveys of working populations.

Because intraobserver variability is greatest in the very low profusion categories of pneumoconiosis (7), we expected more radiographs to be interpreted as having 0/1 profusion small opacities. However, a total of only 10 films had a median reading of 0/1. Despite this low frequency, an interesting finding was the statistical association of age, gender, and pack-years of smoking with small irregular opacities of profusion 0/1 or greater. This finding relates to a controversy concerning whether or not cigarette smoking causes an appearance of pulmonary fibrosis on chest radiographs (9-11).

Much of the literature relevant to this controversy involves populations exposed to mineral dusts. Thus, among coal miners, Amandus and associates (12) and Cockcroft and coworkers (13) have found small irregular opacities to be associated with smoking as well as with age and years worked underground. In granite workers, Theriault and coworkers (14) found that small irregular opacities were related more to smoking than to dust exposure. The prevalence of small irregular opacities in asbestos workers, though dependent largely on dose and duration of asbestos exposure, has been shown to be more frequent in smokers by Samet and associates (15), Rossiter and Harries (16), and Weiss (17). Earlier studies by Weiss (18-20) came to similar conclusions, but did not use standard ILO methods.

There are few studies in nonoccupationally exposed subjects that address whether or not smoking, by itself, is related to a radiographic appearance that might be interpreted as pneumoconiosis. Carilli and coworkers (21) found that radiologists blinded to smoking status were able to determine smoking status from radiographs of female hospital employees, largely on criteria of "diffuse linear and nodular" markings observed in the lung fields of smokers. However, that study did not employ ILO standards, and neither did those that describe the radiographic findings of "increased markings emphysema" (22), an entity that not all radiologists agree exists (23), or "dirty lungs" suggesting chronic bronchitis (22).

Our data suggest that there may be a relationship between smoking and small irregular opacities (profusion \geq 0/1) by the ILO system in a large population.

However, because of the very infrequent occurrence of this smoking effect on radiographs in this population, and because of the very low profusion categories observed, we conclude that there is no evidence for a substantial smoking effect in the absence of occupational dust exposure. On the basis of our findings, we suggest that using the median of 3 independent readings should rarely result in interpretation of chest radiographs as "positive" (profusion $\geq 1/0$) for pneumoconiosis in a population of active workers without significant dust exposure, regardless of smoking status.

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