THE ASSOCIATION OF SMALL IRREGULAR OPACITIES ON CHEST RADIOGRAPH WITH AGING IN A NONSMOKING POPULATION WITHOUT OCCUPATIONAL DUST EXPOSURE

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ABSTRACT

Small opacities on chest radiograph have been found to increase with age in several studies which have been confounded by dust exposure and/or cigarette smoking. To analyze the association of small opacities with age, we used the ILO 1980 Classification to categorize 159 radiographs of asymptomatic, lifetime nonsmokers without occupational exposure to dusts. The study population included 84 males and 75 females. Age ranged from 15 to 85 years with a mean of 51.2 years and a standard deviation of 19.9 years. Chest radiographs with ages concealed were classified independently by two B readers, Reader 1 found 133 (83.6%) to have profusion category 0/0 and 26 (16.4%) to have category 0/1. Reader 2 found 125 (78.6%) to have category 0/0 and 34 (21.4%) to have category 0/1. No subject had a profusion category greater than 0/1. Significant point biserial correlation coefficients (r_{pb}) were found between profusion category and age (r_{pb}=.1659 and .1611 for readers 1 and 2 respectively; both $p<.05$). Analysis by gender demonstrated an association of small opacities with age only in females (r_{pb}=.2761 and .3091 for readers 1 and 2 respectively; both $p\leq.01$). Changes of the breasts which take place with aging may account for this association.

The International Labor Office (ILO) International Classification of Radiographs of Pneumoconioses is used for epidemiologic research and surveillance of workers in dusty occupations.[1] It may also contribute to the evaluation of a worker for compensation. A variety of normal and abnormal structures produce radiographic patterns similar to those of the pneumoconioses complicating interpretation of the ILO 1980 Classification.[2,3] Studies have described an increase in small opacities on chest radiograph associated with age.[4-9] These investigations have been confounded by dust exposure and/or cigarette smoking which also increase small opacities on chest radiographs.[10-15]

To test the hypothesis that small opacities increase with age independent of dust exposure and cigarette smoking, we used the ILO 1980 Classification to categorize chest radiographs of asymptomatic, lifetime nonsmokers without occupational exposure to dusts.

METHOD

Subjects were volunteers, predominantly from the Church of Jesus Christ Latter-Day Saints (Mormons). A modified version of the Medical Research Council questionnaire for respiratory symptoms was administered to each individual.[16] A detailed occupational history was also obtained. Height (in meters) and weight (in kilograms) were measured with the subject wearing light outdoor clothing without shoes. A pulmonary physician examined all subjects. A 14" × 17" posteroanterior (PA) chest radiograph was taken at six feet on full inspiration with the patient in the standing position. PA radiographs with ages concealed were classified independently by the National Institute for Occupational Safety and Health (NIOSH) certified B readers (readers 1 and 2). ILO 1980 Classification standard films were used. Results were reported with OMB Form No. 68-5 1322 provided by NIOSH for the complete classification.

Subjects were included in the study population if they met the following criteria: 1) a lifetime nonsmoker (total smoking of less than 0.5 pack-year and no smoking within six months of the study); 2) no symptoms of chest wall, lung, or heart disease; 3) no history of work in a mine, quarry, foundry, or pottery; 4) no occupational exposure to asbestos, irritating gases, or chemical fumes; 5) a normal physical examination of the chest wall, lungs, and heart; and 6) a PA radiograph of technical quality acceptable to both readers.

The Chi-square goodness of fit test was used to examine the relationship of profusion category with gender.[17] To analyze associations of small opacities with age and an obesity index (weight/height^2), the point biserial correlation coefficient (r_{pb}) was applied.[18] The r_{pb} allows correlation of a continuous variable (age and obesity index) with a categorical variable which has two values (all chest radiographs were classified into two profusion categories).

RESULTS

Eight volunteers were excluded from the study as a result

of work in mines or exposure to asbestos. Technical quality prevented classification of six radiographs. The study population included the remaining 159 subjects. There were 84 males and 75 females. Ages of males and females were comparable and were uniformly distributed from 15 to 85 years (Table I). Males were, as expected, taller and heavier.

Table I

Ages and Anthropometric Measures

	Males	Females
n	84	75
Age in years		
Range	15-85	17-84
Mean	52.1	50.2
Stand. Dev.	19.7	20.0
Height in meters		
Range	1.490-1.940	1.460-1.780
Mean	1.733	1.611
Stand. Dev.	0.073	0.068
Weight in kilograms		
Range	59.6-110.9	43.8-104.7
Mean	78.9	67.7
Stand. Dev.	11.4	12.2

Reader 1 categorized 133 (83.6%) radiographs as profusion category 0/0 and 26 (16.4%) as category 0/1. Reader 2 categorized 125 (78.6%) radiographs as category 0/0 and 34 (21.4%) as category 0/1 (Table II). No chest radiograph was found to have a profusion category greater than 0/1. Agreement between the two readers was 80.5%.

In subjects with radiographs categorized 0/1, small opacities were found only in the lower zones. The predominant shapes and sizes were *s* and *t* varieties. There were no large opacities.

Males had a higher prevalence of radiographs categorized as 0/1 but this difference between genders reached statistical significance with reader 2 only (Chi square = 4.08, p=.04). Correlation of profusion category with age, with males and females included, provided r_{pb} values of 0.1659 and 0.1611 (readers 1 and 2 respectively). Both were statistically significant (Table III). This association was then analyzed separately for each gender. Males were found to have no statistically significant correlation of profusion category with age while females had significant r_{pb} values of 0.2761 and 0.3091 (Table III). There was an association of profusion category with the obesity index in females with reader 1 only (Table III). However when age and obesity index were simultaneously regressed against profusion category, the association of the obesity index with the profusion category was not found to be significant.

DISCUSSION

No subject in our group of asymptomatic, lifetime nonsmokers without occupational exposure to dusts had a profusion category greater than 0/1 and only 16 to 21 percent were classified as category 0/1. Small opacities were predominantly *s* and *t* in shape and size and were located in the lower zones. Males were found to have category 0/1 radiographs more frequently than females. We found small opacities on chest radiograph to increase with age. However, when analyzed by gender, this association was statistically significant for females only.

A possible explanation of the association of profusion category and age in females is that the small opacities result

Table II

ILO 1980 Classification of Profusion Category

	Reader 1		Reader 2	
	Male	Female	Male	Female
0/0	67	66	59	66
0/1	17	9	25	9

Table III

Correlation of Profusion Category with Age and Obesity Index

	Reader 1		Reader 2	
	r_{pb}*	P Value	r_{pb}*	P Value
AGE				
All Subjects	0.1650	.03	0.1611	.04
Males	0.0732	.51	0.0562	.61
Females	0.2761	.01	0.3091	.00
OBESITY INDEX (WEIGHT/HEIGHT^2)				
All Subjects	0.0225	.77	0.1478	.06
Males	0.0904	.41	0.0978	.38
Females	0.1334	.24	0.2246	.04

*r_{pb} is the point biserial correlation coefficient between profusion category and either age or obesity index

from changes in breast tissue. The lobules of glandular parenchyma and its stroma are hormonally dependent. With age, involution of these tissues occurs with replacement by adipose tissue.[19,20] Fat absorbs relatively few X-rays and is therefore less radiopaque than the other tissues of the breast. As a result of this differential absorption, fat would provide sharp contrast on a radiograph to other tissues including persistent strands of fibrous connective tissue, veins, and calcified arteries. These structures may be seen as small opacities in older females and would explain the location of the small opacities and their association with aging in females.

Age in females explained less than 10% (coefficient of determination) of the variance of profusion category in this population without occupational exposure to dusts. Ten percent is an underestimate since the maximal coefficient of determination obtained using the point biserial correlation coefficient is approximately 0.80.[18] In addition, as the proportion of the study population in each of the two categories varies from 0.50, both r_{pb} and the coefficient of determination will be underestimated.[18] In our study, the inequality of subjects in categories 0/0 and 0/1 leads to an error in our determination of the true variance of profusion category explained by age. Although the exact value cannot be determined, it can be concluded that the majority of the variance of profusion category with both genders is unexplained.

Soft tissues overlying the chest wall are thought to account for small opacities[8] but could not be demonstrated to explain any variance of profusion category in our group. Radiographs of females should be categorized 0/1 more frequently than males as a result of overlying breasts if soft tissues explained a significant portion of the variance of profusion category. There was an effect of gender in our study but both readers categorized more radiographs of males as 0/1. Our study also showed that an obesity index (weight/height^2) had no association with small opacities when a multiple regression was done with age as another independent variable. Subject characteristics not investigated in our study, technical quality of the radiograph, or error in classification may explain the majority of variance of profusion category in nonsmoking, unexposed populations.

Two other investigations have categorized unexposed populations using the ILO Classification. Castellan et al. studied 1422 blue collar workers without exposure to known occupational respiratory hazards.[8] Only ten workers had profusion category 0/1 and three had categories 1/0 and 1/1. Small opacities were irregular in shape. A statistically significant difference in ages of workers with profusion category $\geq$ 0/1 was detected when compared to those with category 0/0. Almost all workers with small opacities were smokers. Epstein et al. found 35 of 200 radiographs of hospitalized patients had a profusion category of 0/1 and 22 had category $\geq$1/0.[21] Small opacities were predominantly irregular in shape and located in either the lower zones or all zones of the lungs. The higher prevalence (11%) of radiographs with categories $\geq$0/1 may have been the result of classifying a hospitalized population. An association of profusion category with age was not described.

Some studies in exposed populations have also shown profusion category to increase with age.[5-7,9] These findings may have resulted from incomplete accounting for the effect of dust exposure, decreased clearance of the dust by the respiratory tract with aging, confounding factors (e.g., other occupational exposures, environmental exposures, cigarette smoking), or an age associated increase in small opacities independent of dust exposure and confounding factors.

We conclude there is an association of small opacities on chest radiograph with age independent of dust exposure and cigarette smoking in females only. Changes in breast tissue occurring with age may account for this finding.

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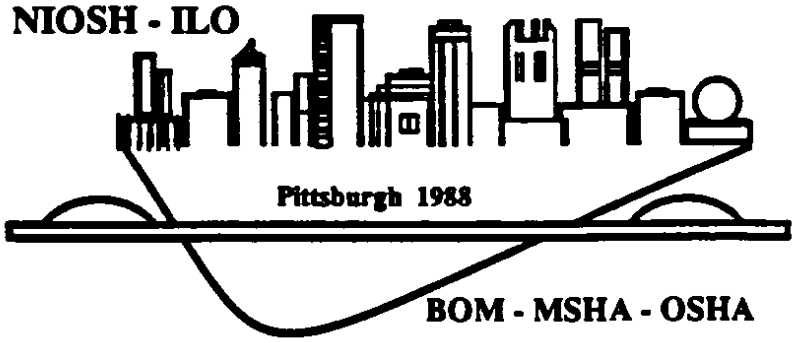
Proceedings of the VIIth International Pneumoconioses Conference *Part*
Transactions de la VIIe Conférence Internationale sur les Pneumoconioses *Tome*
Transaciones de la VIIa Conferencia Internacional sobre las Neumoconiosis *Parte*

II



Pittsburgh, Pennsylvania, USA—August 23–26, 1988
Pittsburgh, Pennsylvanie, Etats-Unis—23–26 aout 1988
Pittsburgh, Pennsylvania EE. UU—23–26 de agosto de 1988

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November 1990

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