Scand J Work Environ Health 1989;15(3):195-197

<https://doi.org/10.5271/sjweh.1862>

Issue date: Jun 1989

**Respiratory health of brickworkers in Cape Town, South Africa.
Radiographic abnormalities.**

by [Myers JE](#), [Garisch D](#), [Louw SJ](#)

Affiliation: Takemi Program in International Health and Occupational Health Program, Harvard School of Public Health, Boston, Massachusetts.

This article in PubMed: www.ncbi.nlm.nih.gov/pubmed/2781249

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/).

Respiratory health of brickworkers in Cape Town, South Africa

Radiographic abnormalities

by Jonathan E Myers, MD,¹ Dawn Garisch, MB, ChB,² Stephanus J Louw, MD³

MYERS JE, GARISCH D, LOUW SJ. Respiratory health of brickworkers in Cape Town, South Africa: radiographic abnormalities. *Scand J Work Environ Health* 1989;15:195-197. A cross-sectional study utilizing internal controls based on dust exposure determinations was performed on 268 brickworkers. Smoking, age, and other information from a detailed respiratory questionnaire and results from a physical examination and pulmonary function tests were investigated in relation to radiographic abnormality. The prevalence of pneumoconiosis was near 4 %. The roles of smoking, workplace dust exposure, and age as factors predicting radiographic abnormality are discussed.

Key terms: age, bricks, dust, pneumoconiosis, radiography, silicosis, smoking.

A cross-sectional study was carried out to assess the prevalence of radiographic abnormality among brickworkers. Despite pathologic evidence for mild fibrogenicity of brick and clay dust under laboratory conditions, clinical case reports and compensated silicosis in several countries for workers with many years of service in brickworks, and no other history of dust exposure, epidemiologic findings have been contradictory. Some studies report pneumoconiosis associated with exposure to brick dust, while others report no or poorly defined radiographic changes (1). Details of the study setting and methods have been described in part elsewhere (1, 2).

Subjects and methods

A full-sized posterior-anterior chest radiograph was taken for each worker by an experienced radiographer using a mobile X-ray machine. The specifications laid down in the Guidelines to the International Classification of Radiographs of Pneumoconioses (3) were used. Quality control was exercised by the radiographer and author (JEM) to ensure readability. Each film was read blind with respect to history and examination data, and independently by readers 1 (JEM), 2 (DG), and 3 (SJL). All the films were read by comparison with the standard films of the International Classification. Pneumoconiosis was diagnosed if there were

small radiographic parenchymal opacities of profusion 4 (1/0) or more. Interreader variability was assessed in an examination of the data for consistency (identical scores between readers) on a 12-point scale, correlation by means of linear regression, and measures of bias (systematic deviations of scores between readers). Bias was measured as the coefficient (the degree to which the first reader's scores was higher on the 12-point scale than the second reader's in a comparison), and as a weighted score for interreader discrepancies of more than one point on the scale. The dependent variable (pneumoconiosis) was defined as a profusion score of 4 (1/0) or more according to reader JEM for the subsequent analysis. Age, length of service, smoking status, and various indicators of dust exposure were entered as independent variables in a stepwise logistic regression analysis and multiple linear regression analysis. For the purposes of this survey large radiographic shadows regarded as consistent with tuberculosis were read as radiographic tuberculosis (past or present).

Results

Table 1 shows that all three readers found an approximately 4 % prevalence of pneumoconiosis.

Table 2 shows that the quantitative variation between the readers was low.

Table 3 shows the results of the stepwise logistic regression analysis. The dependent variable was a dichotomous dummy variable with categories 1 and 0 representing pneumoconiosis (profusion score ≥ 4) and normal, respectively. The independent variables were age, length of service, cumulative respirable dust exposure, total cumulative dust exposure, smoking status, objective categorical dustiness in current job, and subjective categorical dustiness in current job. Cumula-

¹ Takemi Program in International Health and Occupational Health Program, Harvard School of Public Health, Boston, Massachusetts, United States.

² Industrial Health Research Group, Department of Sociology, University of Cape Town, South Africa.

³ Respiratory Unit, Department of Medicine, University of Cape Town, South Africa.

Reprint requests to: Dr JE Myers, Department of Community Health Medical School, University of Cape Town, Observatory 7925, South Africa.

Table 1. Profusion category scores for the readers.

Score	Reader 1 ^a (N)	Reader 2 ^a (N)	Reader 3 ^a (N)
2	244	237	239
3	12	20	18
4	6	4	2
5	3	3	9
6	3	3	
7		1	

^a Crude prevalence of pneumoconiosis (profusion score ≥ 4) = 4.5 % for reader 1, 4.1 % for reader 2, and 4.1 % for reader 3.

Table 2. Variability analysis by reader (scores 2 to 12).

	Reader 1 versus 2	Reader 2 versus 3	Reader 1 versus 3
Number	268	268	268
Correlation coefficient	0.7949	0.3474	0.3155
Standard error of the estimate	0.4538	0.7013	0.5918
Consistency	89 %	82.1 %	84.7 %
Bias	3.4 % to 2	1.1 % to 2	1.1 % to 3
Bias score	3.4 % to 2	1.9 % to 2	1.5 % to 3
Prevalence	4.5 % versus 4.1 %	4.1 % versus 4.1 %	4.5 % versus 4.1 %

Table 3. Stepwise logistic regression of pneumoconiosis status on age, length of service, cumulative respirable dust exposure, cumulative total dust exposure, smoking status, objective dustiness in current job, and subjective dustiness in current job.

Dependent variable	Independent variable	F for entry	P-value (<)	Improvement chi-squared	df	P-value (<)
Pneumoconiosis	Cumulative respirable dust exposure	7.78	0.01	7.60	1	0.01

Table 4. Multiple regression of profusion score on age, height, length of service, cumulative respirable dust exposure (resp dust), cumulative total dust exposure, and smoking status. (SEE = standard error of the estimate, R = multiple correlation coefficient)

Profusion = $1.9406 + 0.2401 \times \log(\text{resp dust})$
 $R = 0.1985$
 $SEE = 0.6112$

Table 5. Contingency table analysis of pneumoconiosis status versus dust exposure. The increase in the prevalence of pneumoconiosis is shown in parentheses. (df = degrees of freedom)

	Cumulative respirable dust exposure ^a			Chi-squared test for trend	df	P-value
	Low	Medium	High			
Pneumoconiosis	1 (1 %)	4 (4.5 %)	7 (8.6 %)	6.1	2	<0.5
Normal	98	84	74			

^a Low = <6 years of exposure to respirable dust at a level of 1 mg/m³, medium = 6–16 years of exposure to respirable dust at a level of 1 mg/m³, high = >16 years of exposure to respirable dust at a level of 1 mg/m³.

tive respirable dust exposure was the sole predictor included in the regression. An additional multiple regression analysis was performed based upon the assumption of equal scaled intervals for the profusion score to determine whether it would produce results different from the logistic regression, which treated profusion score as a dichotomous variable with two levels.

Table 4 shows similar results.

Table 5 shows, in tabular form, that, when cumulative respirable dust exposure was divided into tertiles entitled low, medium, and high exposure, there was a monotonic increase in the pneumoconiosis prevalence.

The changing prevalence of pneumoconiosis with years of service is shown in table 6. The prevalence rose from 1.8 % for those exposed for less than 10 years to 17.4 % for those exposed for more than 10 years.

Eleven of the 12 pneumoconiosis cases had rounded opacities, and all 12 involved the upper lobes of the lungs. The prevalence of pleural abnormalities was 6.7 %, while that for past or present radiographic evidence of tuberculosis was 9.3 %. The prevalence of other radiographic abnormalities was 10.8 %.

Discussion

Upon returning from their rural areas of residence, African workers undergo a preemployment examination and periodic mini-radiographic examinations. These procedures would have the effect of depressing the prevalence of radiographic past or present tuberculosis in the study group. The prevalence of other pulmonary pathology manifest radiographically would be similarly reduced. The high levels of interreader agreement in table 2 are somewhat misleading and are due in large measure to the overall low prevalence of pneumoconiosis in the study group. Despite this phenomenon they do provide some indication, however weak, of the fact that the readers were not too disparate in the quantitative aspect of their profusion scoring.

There was no smoking effect in relation to radiographic small opacities, which eliminated smoking as a confounder in this analysis. The absence of a relationship between smoking and pneumoconiotic small-rounded opacities has also been reported by Landrigan et al (4) and Myers et al (5). The predictive effect

Table 6. Contingency table analysis of pneumoconiosis status versus length of service. The increase in the prevalence of pneumoconiosis is shown in parentheses.

	Length of service		Chi-squared test	P-value	Odds ratio ^a
	≤ 10 years	>10 years			
Pneumoconiosis	4 (1.8 %)	8 (17.4 %)	18.2	<0.0001	11.47
Normal	218	38			

^a 95 % confidence interval 2.9–48.1.

of cumulative respirable dust exposure on the profusion score is consistent with the finding of mainly rounded opacities.

The pneumoconiosis prevalence was low in comparison with that of studies of other workers exposed to siliceous dust (4, 5). Table 1 also shows the pneumoconiosis to be mild, most of the cases being of profusion score 5 (1/1) or less. The radiographic appearance was therefore not gross and advanced as might be the case in workplaces characterized by higher respirable dust exposures and higher free-silica contents, where the fibrogenicity of dust would be much higher. Such mild findings may have been, and may still be, read by some readers as either normal or as changes which are not consistent with classical silicosis. That no relationship was detected between the presence of pneumoconiosis and the prevalence of chronic respiratory symptoms or the presence of adventitious respiratory sounds was not surprising given the mild nature of the pneumoconiosis in this study and similar findings for simple pneumoconiosis in the literature (4–7). The jobs held by the workers with pneumoconiosis were generally in the dustiest parts of the factories, and they had been held for several years. The identified cases originated from the dustiest factories.

The association of pneumoconiosis with reduced lung function values (a “dust effect”) shown elsewhere (2) provides additional objective validation for the dose-response relationship demonstrated for pneumoconiosis with dust. This study indicates the existence of mild pneumoconiosis among a small percentage of long-serving brick workers.

These results fill a gap in the international literature in that this study has been the first to use standardized modern methods, in particular the 1980 radiographic classification of the International Labour Office (ILO), to investigate the prevalence of pneumoconiosis among brickworkers. As a result, it has been possible to shed some light on findings in the literature. It is suggested that one reason why some authors may find pneumoconiosis and some may not lies in the sensitivity of the diagnostic classification used. The ILO classification classifies as abnormal many films that would pass as normal in a clinical setting (8). Reader training is also an important influence. Findings atypical of pneumoconiosis like “minimal dust changes” (9), dust-related changes (10) and “L” type opacities in brickworkers (11) may have been due to age, smoking, or early dust-induced changes. None of the previous studies were able to analyze and control for these different effects and hypotheses on account of the limited information available.

The question of whether profusion score should be treated as categorical (pneumoconiosis or normal) and analyzed by logistic regression or as a continuous variable with the assumption of equal intervals between numerical scores and analyzed by multiple linear

regression appears to be rather academic as both methods produced similar results. This finding has also been the case in a previous study by us in which similar analytical methods were used (5). The assumption about the equality of intervals would therefore not appear to be unreasonable.

Acknowledgments

The authors wish to acknowledge the members and officials of the General Workers' Union, the members of the Industrial Health Research Group, Ms L Monro and Ms B van Vuuren of the Radiology Department, Groote Schuur Hospital, the brickworks' management and health personnel, and Dr D Christiani of the Occupational Health Program, Harvard School of Public Health, for their generous assistance.

References

1. Myers JE, Lewis P, Hofmeyr W. Respiratory health of brickworkers in Cape Town, South Africa: background, aims and dust exposure determinations. *Scand J Work Environ Health* 1989;15:180–187.
2. Myers JE, Cornell JE. Respiratory health of brickworkers in Cape Town, South Africa: respiratory symptoms and pulmonary functions. *Scand J Work Environ Health* 1989;15:188–194.
3. International Labour Office. International classification of radiographs of pneumoconioses. Geneva: International Labour Office, 1980.
4. Landrigan PJ, Cherniack MG, Lewis FA, Catlett LR, Hornung RW. Silicosis in a grey iron foundry: the persistence of an ancient disease. *Scand J Work Environ Health* 1986;12:32–9.
5. Myers J, Garisch D, Myers H, Cornell J. A respiratory epidemiological survey of workers in a small South African foundry. *Am J Ind Med* 1987;12:1–9.
6. Johnson A, Chan-Yeung M, Maclean L, et al. Respiratory abnormalities among workers in an iron and steel foundry. *Br J Ind Med* 1985;42:94–100.
7. Jones RN. Silicosis. In: Rom WN, ed. *Environmental and occupational medicine*. Boston, MA: Little, Brown and Company, 1983:197–206.
8. Myers J, Garisch D, Myers H, Cornell J, Rwehu R. A respiratory epidemiological study of stevedores intermittently exposed to asbestos in a South African port. *Am J Ind Med* 1985;6:273–82.
9. Keatinge GF, Potter NM. Health and environmental conditions in brickworks. *Br J Ind Med* 1949;6(1):31–44.
10. Rajhans GS, Budlovsky J. Dust conditions in brick plants of Ontario. *Am Ind Hyg Assoc J* 1972;33:258–68.
11. Report and recommendations on occupational diseases occurring in industry other than mining: part I — pneumoconiosis. Pretoria: The Government Printer, 1963. [GPS 9226956—1963—64—250: LAB 585(E).]

Received for publication: 30 September 1988