A COMPARISON OF THE PROFUSION AND TYPE OF SMALL OPACITIES REPORTED WITH THE 1980 AND 1971 ILO CLASSIFICATIONS USING READINGS FROM THE COALWORKERS' X-RAY SURVEILLANCE PROGRAM

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INTRODUCTION

The 1980 ILO classification differs markedly from its predecessor in the way small opacities are handled (see Appendix). The 1971 system required the separate assessment of the profusion of rounded and of irregular opacities. Based on these, a combined score had then to be determined. Under the latest classification the profusion of both types of opacity is assessed simultaneously in one score. The interpreter has then to make a qualitative judgment on the relative contributions of each type of opacity to the overall profusion by stating which is primary and which is secondary.

This change, which seems fairly trivial, has certain possibly serious implications. First, it makes for difficulty in the comparison of information on rounded or irregular opacities with past data. For instance. since the new combined score for small opacities cannot be quantitatively apportioned into separate scores for rounded and irregular opacities, prevalences of specific categories of rounded, and of irregular opacities cannot be derived for comparison with figures obtained under the 1971 revision. Instead, only the comparison of prevalences based on combined opacities from the 1971 classification with those using the small opacities score from the 1980 revision is possible.

More importantly, perhaps, is the possibility that the mere change in the method of reporting has made a profound change in the manner in which small opacities are now perceived and reported. It may be, now that readers can forego the difficult task of separate assessment of the profusion of rounded and irregular opacities while still having to record the different types of opacity present, that mixtures of opacities will be reported more often.

In order to explore this and other related questions, information on profusion and type of small opacity was extracted from records of the Coalworkers' X-ray Surveillance Program (CWXSP).[1] This is a nationwide program which enables all underground coal miners to receive free periodic X-rays. Miners with signs of coalworkers' pneumoconiosis (CWP) are notified, and may at their discretion work in low dust areas of the mine. The program has been in operation since 1970. Up until 1981 it used the 1971 ILO classification.[2] At that time a change was made to the current system.[3]

METHODS

The analyses were undertaken on data for all readable films from both sets. No special account was taken of film quality. Information on tenure underground, supplied by the miners at examination, was grouped into ranges and used for stratification in the analysis.

All of the X-rays were read by interpreters who had passed the NIOSH B-reader test,[4] and all X-rays were taken at facilities that had to conform to certain NIOSH requirements for quality.[5] Each interpretation used in this analysis was that of one B reader. Sixteen B readers were utilized in the CWXSP during 1981, 15 of these being employed throughout the year.

This analysis concentrates on the profusion of small opacities, and on the primary and secondary type of small opacities reported. The zones of involvement were not considered, nor were any other abnormalities.

During 1981 the CWXSP changed from using the 1971 to using the 1980 classification. In that year 7338 X-rays were read using the former classification, and 7438 using the latter. The data for this one year therefore provide a useful base for the comparison of the two classifications. Accordingly these data were used in the following comparison.

Since the two classification systems were different, the readings from one had to be converted into the format of the other in order to be comparable. Since the 1980 data cannot be quantitatively broken down into separate assessments of round and irregular opacities, while the 1971 revision scores are capable of being combined into pseudo-1980 determinations, the earlier data were converted for comparison with the later. The following is a description of the operations performed to do this.

1971 Classification

The 1971 classifications were converted to pseudo-1980 readings using the following algorithm.

1. The 1971 combined small opacity profusion was taken as the 1980 small opacity profusion.

2. Primary Type

   Acting on the assumption that the 1980 primary type is synonymous with the greatest profusion of rounded or of irregular opacities seen under the 1971 revision, the algorithm compared the two 1971 profusions. If the rounded opacities were reported as most profuse the primary type was defined as rounded. On the other hand, if the profusion of irregular opacities was greater than that for rounded the primary type was set equal to irregular. If the two profusions were equal, the type was assigned randomly.

3. Secondary type

   If both rounded and irregular opacities had been recorded, the secondary type was set equal to the type for whichever profusion was the less. If the profusions were equal, the secondary type was whichever of the two that was not allocated to the primary type. If only rounded, or only irregular opacities were reported in the 1971 scheme, the secondary type was put equal to the primary type.

   Note that the above procedure, while simulating the process a reader might go through under the 1980 scheme in assessing an X-ray, cannot fully duplicate all patterns of possible responses. While mixtures of rounded and irregular types can be obtained as primary and secondary entities, mixtures of types within the rounded range (p, q, r), or within the irregular range (s, t, u), are impossible as the information is just not available in the 1971 classification. As a result such combinations as p/q or s/u are absent from these pseudo-1980 scores, with a consequential problem in comparison with the actual scores from the 1980 classification.

1980 Classification

The readings from the 1980 classification were analyzed as reported, using the actual scores. In the few cases where small opacities were reported but the secondary type was left blank it was put equal to the primary type.

RESULTS

The numbers of readings were 7,338 and 7.438 for the 1971 and 1980 classifications respectively. The mean tenure underground was 5.3 years for the first group, and 4.8 years for the second.

Profusion

Overall, the percentage of films read as showing small opacities was the same under both classifications, at 6.1%. Table I shows these percentages plus those for other profusions obtained using each classification. Figure 1 shows these data plotted against various tenure ranges.

Primary Opacity Type

The proportions of positive X-rays (category 0/1 or greater) tabulated according to opacity type by each classification are shown in Table II. No major change was seen in the general reporting of rounded and irregular opacities, 56% of all opacities being reported as rounded using the 1971 classification and 52% using the 1980 revision. Moreover, within the rounded opacity group, the percentages of opacities reported as being p, q and r remained about the same after the introduction of the 1980 scheme. However, there was a major change in the way small irregular opacities were interpreted, with type s being reported twice as frequently as before ($X^2 = 38$, 5 d.f., $p < .001$), mainly at the expense of type t.

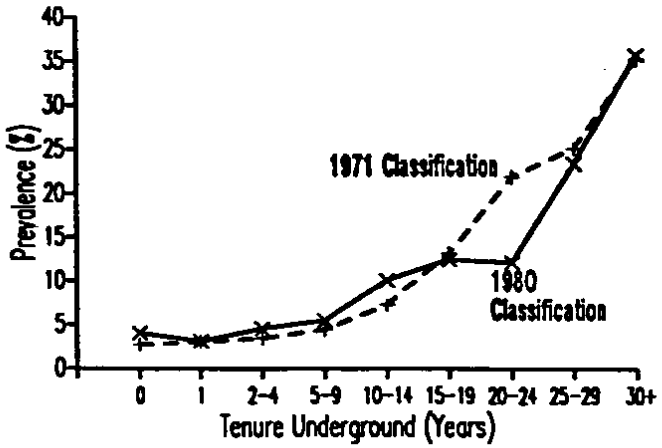

Figure 1. Percentage of films noted as showing category 0/1 or greater small opacities by tenure underground and classification used.

Figure 2 explores this topic in more detail by breaking the data down by profusion of small opacities (0/1, 1/0 and 1/1+). It shows that the readings for categories 0/1 and 1/0 are similar to those overall, with type s opacities being recorded more often than type t under the 1980 classification. However, for the small number of films classified as 1/1 or greater the findings are different, and indicate a movement from recording type p opacities to noting those of type s. While the proportions of films classified as rounded under the two classifications are quite similar for the 0/1 and 1/0 categories, the greater willingness to note type s opacities results in more irregular opacities being reported for 1/1 or greater films when read using the 1980 scheme.

Miners with longer tenure were also found to be more likely to be classified as having rounded opacities under the 1971 system (Figure 3). This was probably another manifestation of the phenomenon seen in the data of Figure 2 and associated with the higher categories of small opacities.

Secondary Types

As noted earlier, the restrictions in the way data on secondary type was derived from the 1971 classification, and the presence of missing values in the 1980 classification data complicates the interpretation of this information.

Table III gives the percentages of positive films classified by secondary type in a manner analogous to Table II.

Table I

Percentage of Films Showing Small Opacities of Various Profusions by Classification Used

Classification	Percentage of films showing 0/1+	1+	2+	Number of Films
1971	6.1	2.7	.2	7338
1980	6.1	3.1	.2	7438

Table II

Percentage of Films with Small Opacities by Reported Type of Primary Opacity

Classification	Percentage classified as type: p	q	r	s	t	u	Number of Positive Films
1971	16	39	1	15	29	0	443
1980	13	38	1	31	18	0	454

Table III

Percentage of Films with Small Opacities by Reported Type of Secondary Opacity

Classification	Percentage classified as type: p	q	r	s	t	u	Number of Positive Films
1971	16	38	1	17	29	0	443
1980	15	34	1	26	25	0	454

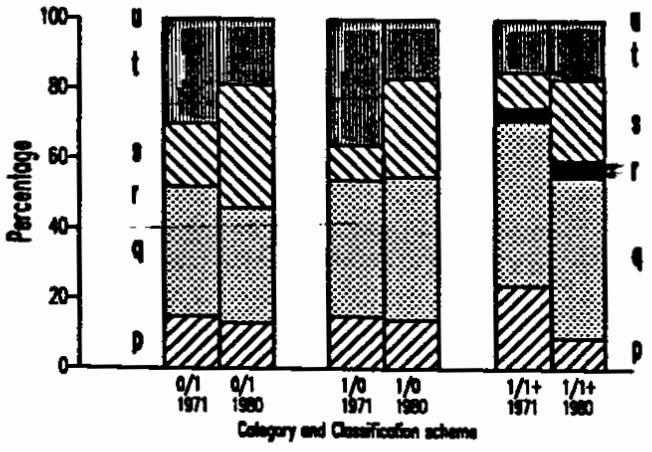

Figure 2. Rounded opacities as a percentage of all small opacities by profusion category and classification used.

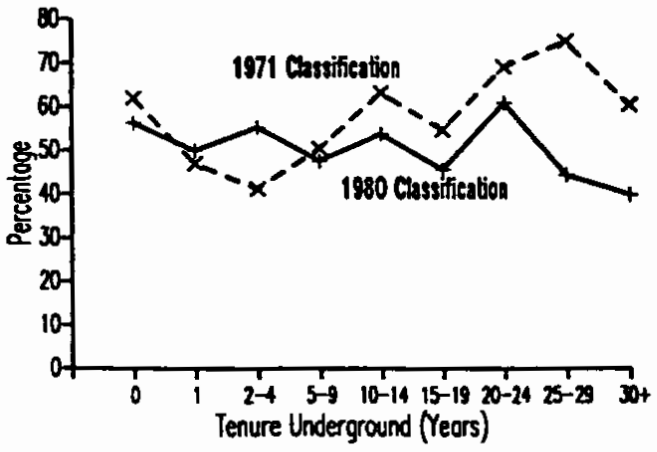

Figure 3. Rounded opacities as a percentage of all small opacities by tenure underground and classification used.

The data show similar trends to those seen for the primary type. In particular the 1971 secondary type distribution is almost identical to the primary type distribution given in Table II. While the 1980 secondary type distribution follows that for the primary type, fewer type s and more type t opacities were reported, although the division between rounded and irregular is not affected.

The relationships with secondary type and profusion, and with tenure were similar to those for the primary type for each classification scheme.

Primary and Secondary Type Together

This analysis looks at the pairs of scores for primary and secondary type among all films noted as showing small opacities (Table IV).

The main observation from this table is that the percentage of films where both primary and secondary types were reported as rounded is diminished under the 1980 scheme, the balance going to cells where mixtures of rounded and irregular opacities were reported ($X^2 = 7.1$, 1 d.f., $p < .01$). On the other hand, the percentage of films where irregular opacities were reported as primary and secondary remained the same.

Larger Temporal Changes

The above analysis has concentrated on readings obtained during the one year both classifications were in effect. Before concluding this analysis it seemed sensible to place these changes in the wider perspective of larger temporal changes. In this way the transitoriness of any effects brought about by the introduction of the 1980 classification could be assessed.

Figure 4 gives some data from 1978 to 1986 on the prevalence of various categories of rounded opacities seen in the CWXSP (Note: these must not be taken as estimates of prevalence in working miners as the CWXSP records are not representative of this group). The data show a trend towards lower prevalence with time, a trend that was not disturbed by the change to the new classification. (The apparent cyclical trend is an artifact arising from the procedures under which the CWXSP operates.)

The percentage of positive films recorded as having primarily rounded opacities in each year is shown in Figure 5. There is a clear indication of a trend towards more frequent re-

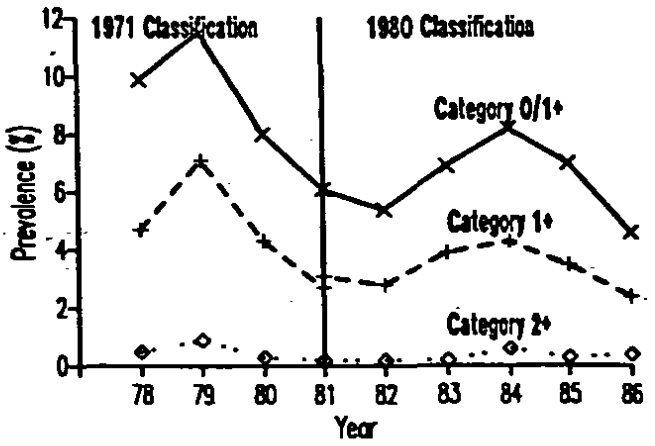

Figure 4. Percentage of films noted as showing various categories of rounded opacities by year of examination and classification used.

Table IV

Percentage of X-rays Classified by Both Primary and Secondary Type and by Classification Scheme

		1971 Secondary			1980 Secondary		
		Rounded	Irregular	Total	Rounded	Irregular	Total
PRIMARY	Rounded	215 (48.5)	33 (7.4)	248 (55.9)	187 (41.2)	47 (10.4)	234 (51.6)
	Irregular	22 (5.0)	173 (39.1)	195 (44.1)	37 (8.1)	183 (40.3)	220 (48.4)
	Total	237 (53.5)	206 (46.5)	443 (100.0)	224 (49.3)	230 (50.7)	454 (100.0)

Note: percentages of total for each classification are in parentheses.

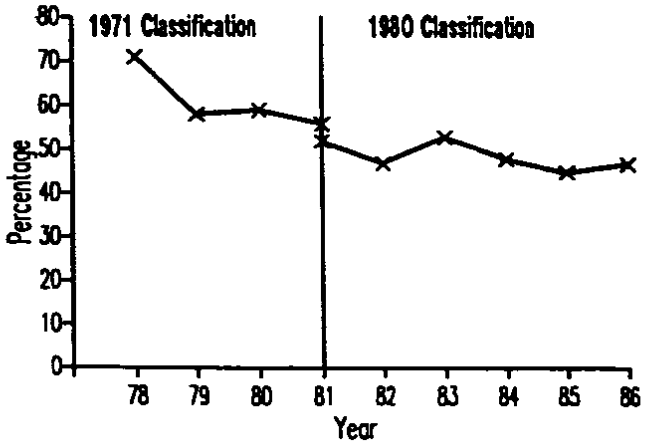

Figure 5. Small rounded opacities as a percentage of all small opacities by year of examination and classification used.

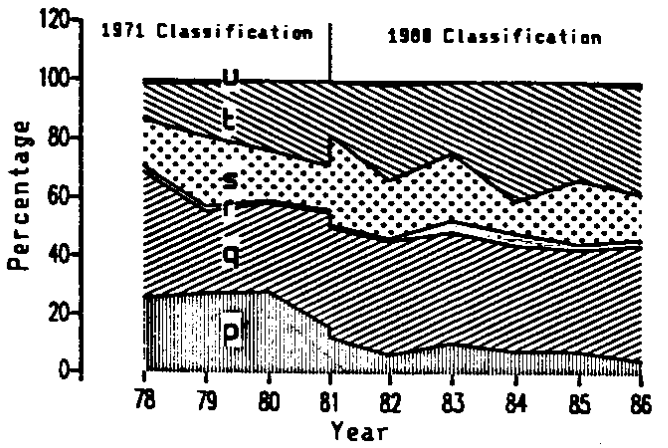

Figure 6. Small rounded opacities as a percentage of all small opacities by year of examination and classification used.

porting of irregular opacities, this being unaffected by the classification change. Figure 6 shows that this trend occurred at the expense of type p opacities, and again, the new classification is not implicated in this. Interestingly, the switch between the recording of type s and type t opacities in 1981 noted earlier is seen to be largely transient; by 1983 readers were again reporting type t opacities more frequently. Throughout the whole period r and u type opacities were infrequently reported, and no obvious trend is apparent.

DISCUSSION AND CONCLUSIONS

The data presented here indicate that the introduction of the 1980 classification had little lasting effect on the reporting of small opacities. In 1981 no marked increase or decrease in the percentage of positive film was seen, and the general temporal variation in prevalence in the program continued quite smoothly through the classification changeover.

Furthermore, although there was a switch to more frequent reporting of type s opacities at the expense of type t in 1981, this appeared to be transient, and the new classification did not interrupt a trend towards an apparent greater willingness to report irregular opacities, both as primary and secondary types. Researchers should be aware of these trends; further work is underway on this topic. In particular, the temporal trend seen in Figure 6 is being examined to see if it is reader artifact, or whether it reflects a change in the exposure and tenure of the miners x-rayed over that period.

It should also be noted that there are other differences between the 1971 and 1980 classifications which may have directly or indirectly influenced X-ray interpretation. For example, in the 1980 scheme, the standard radiographic illustrations of the small opacities take precedence over their written definitions. Many different standard X-rays were also used in the 1980 scheme. Based on the findings in this report, these changes also seemed to have had little lasting effect on the trends of reading small opacities.

It is important to note that these findings may not be applicable to readings obtained on other occupational groups. The films read in this study were all of coal miners, or coal miners to be, and the general level of abnormality reported was slight. Findings for other groups, such as those for workers exposed to fibers, and for films showing greater abnormality may well be different. Of course, it is also true that readers other than those considered in this study may not have exhibited the trends reported on here.

In summary, the conclusions are as follows. Adoption of the 1980 classification in the CWXSP did not lead to any change in the amount of small opacities reported. There was, however, a short lived switch to the greater reporting of type s opacities at the expense of those of type t. There was also an indication that fewer type p opacities were reported for X-rays with profusions of 1/1 or greater. These effects were found to be small, however, when compared with temporal trends seen over the last 10 years. These indicate that there has been a gradual but continuous movement from the reporting of rounded opacities towards irregular opacities.

REFERENCES

1. Althouse, R.B., Attfield, M.D., Hodous, T.K.: Inter-reader Variability Among Readers Using ILO 1971 and 1980 Classifications of the Pneumoconioses. These proceedings.
2. INTERNATIONAL LABOR OFFICE. ILO U/C international classification of radiographs of pneumoconiosis, 1971. Geneva, ILO, 1972. (Occupational Safety and Health Series No. 22, revised).
3. INTERNATIONAL LABOR OFFICE. International classification of radiographs of pneumoconiosis, (revised edition, 1980). Geneva, ILO, 1980. (Occupational Safety and Health Series No. 22, revised).
4. Morgan, R.H.: Proficiency Examination of Physicians for Classifying Pneumoconiosis Chest Films. *Am. J. Roentgen.* 132:803-808, (1979).
5. PUBLIC HEALTH SERVICE: Code of Federal Regulations, Title 42, 37. Specifications for medical examinations of underground coal miners—chest roentgenographic examinations. 1987.

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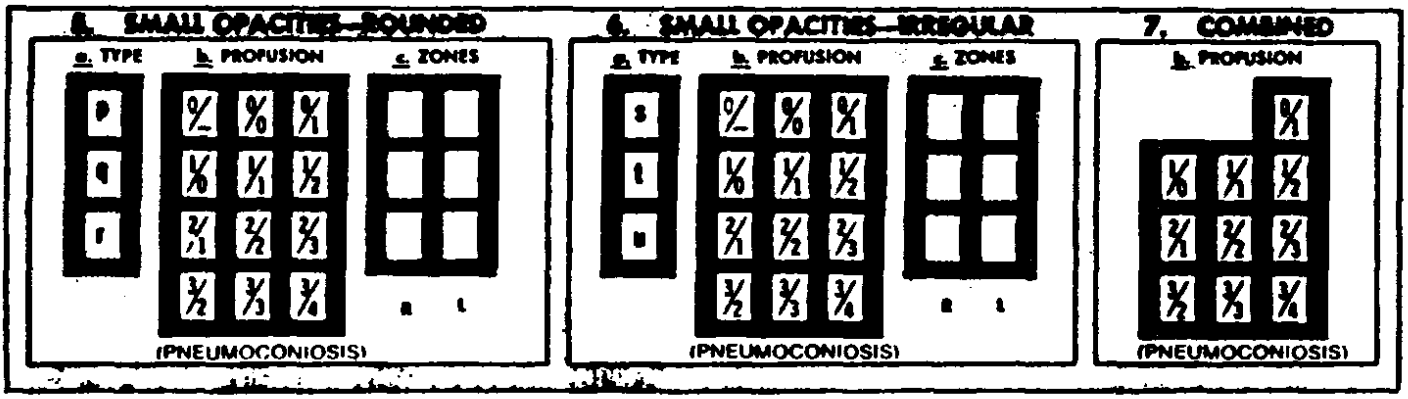
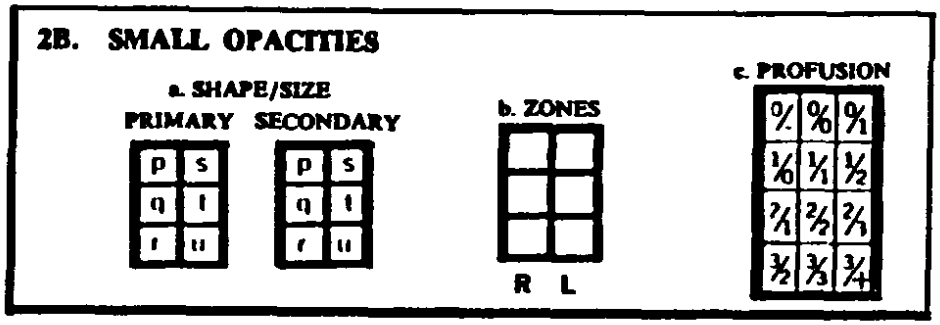
APPENDIX



1971 Classification of small opacities



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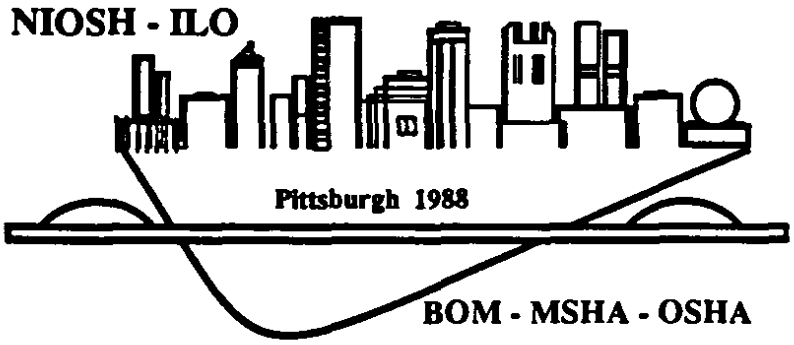

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