A Comparison of Pneumoconiosis Interpretation between Chinese and American Readers and Classifications

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Summary: As a preliminary step in joint Sino-American pneumoconiosis research efforts, a formal chest X-ray pneumoconiosis reading trial was conducted among Chinese and American radiologists. Tweleve Chinese readers from different institutions located in south central China used the 1986 Chinese Roentgenodiagnostic Criteria of Pneumoconioses. Three American radiologists, centified as NIOSH "B" readers, used the International Labour Office Classification of Pneumoconioses. The chest X-ray study set consisted of 150 posterior-anterior films. One-half were Chinese X-rays of silica-exposed workers, and the other half were American films of variously exposed workers but primarily coal miners. All readings were done independently. The results showed that the inter-reader variability among the Chinese was similar to that of the American readers, both being in an acceptable range. In addition, there was general agreement between the Chinese and American interpretations. For small opacity profusion, the Chinese readers tended to read slightly more diseases than their American counterparts, although there was exact agreement as to the major category in two-thirds of the films. Agreement for film quality, and pleural disease was less, but was not different from reported variation among American "B" readers. Overall, the results suggest that despite the use of two different classification systems, a valid correspondence exists between the Chinese and American Interpretations, which is suitable for use in epidemiologic research.

Key words: pneumoconiosis, diagnostic classification, interpretation of X-ray film

Chest X-ray is the major tool in assessing pneumoconiosis, and in general has been found to be both valid and quantitatively accurate[1,3]. However, despite an international classification system for pneumoconiosis[4], substantial differences in interpretation among X-ray readers in one country and among different countries are known to exist[5,7]. The differences between the Chinese and ILO classification systems pose one potential source of disagreement. Thus, before an effective exchange of epidemiologic pneumoconiosis data can take place, a significant correlation between the two classification systems is needed. With these thoughts in mind, we designed the present study to evaluate the intra- and interreader variability of

both Chinese and American pneumoconiosis readers, and to compare the Chinese interpretatios of a set of films (using the current Chinese classification) with American interpretations (using the ILO classification) of the same films.

METHODS

There were 12 Chinese and 3 American readers in the study. The Chinese readers came from 12 different institutions located in south central China. The Chinese X-ray interpretations were all completed in Wuhan. The Chinese radiologists used the 1986 Chinese Roentgenodiagnostic Criteria of Pneumoconioses. The 3 American readers were all certified as NIOSH "B" readers[3] and were from three different academic institutions. Their readings were performed in their respective offices. The American readers used the 1980 International Labour Office (ILO) Classification of Pneumoconioses[4], and standard National Institute for Occupational Safety and Health (NIOSH) interpretation forms.

The chest X-ray study set consisted of 150 posterior-anterior films. One-half were Chinese X-rays of silica-exposed workers pre-selected to show a number of pneumoconiotic and cancerous abnormalities. The other half were American films of variously exposed workers but primarily coal miners selected to represent normality and a variety of pneumoconiotic abnormalities. In the reading trial the Chinese and American films were alternated. All interpretations were made independently by each reader, using appropriate standard X-rays for comparison. Forms were keypunched and validated by NIOSH. Analysis of the data consisted of comparisons of film quality, small opacity profusion, large opacities, pleural disease, and cancer among the Chinese readers, and between median Chinese and median American interpretations. Besides crude agreement, the Kappa statistic[8] was also computed. The statistic adjusts for the amount of chance agreement to be expected, and is expressed as:

$$\text{Kappa} = (PC - PE)/(1 - PE)$$

where PC is the crude agreement (expressed as a proportion), and PE is the expected agreement. This is derived, as in a Chi-squared test of independence, from the expected numbers for the diagonal elements of the table, which, in turn, are obtained using the products of the marginal totals, Kappa will equal zero if there is only chance agreement, and will be one with complete agreement.

RESULTS

A comparison of readings among the 12 Chinese radiologists is presented in table 1. Although some obvious variability is seen, there is general agreement among the 12 readers. The stage of pneumoconiosis (table 1) also shows good general agreement among the 12 readers. Table 2-5 compare the median Chinese with the median American interpretation in the study set. The percentage of films classified in catagory 1 or 2 was 95% and 79% for the Chinese and American readings, respectively.

In two-thirds of the films, there was exact agreement as to major category of small opacity profusion (table 2). Overall, there was a tendency for Chinese readers to read more pneumoconiosis than the American readers. An overall comparison of the pneumocoiosis interpretation between the Chinese and American readers is presented in table 3. Using the diagonal as perfect agreement, these readings constituted 90 films, or 60%. Again, the Chinese readings tended to be slightly higher than their American counterparts. The 11 films read Ⅱ+ by the Chinese and "Large Opacity" by the Americans do not necessarily imply a

Table 1. Stage of pneumoconiosis by readers(%)

Chinese Pneumoconiosis Stage	Chinese Readers											
	01	02	03	04	05	06	07	08	09	10	11	12
0	18.7	20.8	23.8	13.3	14.0	10.0	16.7	7.3	20.7	10.7	23.3	33.8
0+	16.7	20.8	13.6	12.7	24.0	22.7	18.7	20.7	10.7	9.3	16.0	7.4
I	22.0	16.8	21.1	26.0	26.7	22.0	28.0	16.7	28.7	33.3	26.0	22.3
I+	8.7	10.1	11.6	10.7	11.3	11.3	10.7	16.7	12.0	10.7	10.7	4.7
II	16.7	11.4	8.2	18.7	7.3	12.0	3.3	15.3	8.7	18.7	9.3	12.2
II+	10.0	10.1	14.3	5.3	8.0	14.0	12.7	16.7	10.0	9.3	8.0	12.2
III	5.3	8.1	4.8	12.0	7.3	8.0	8.0	5.3	5.3	3.3	6.0	5.4
III+	2.0	1.3	2.7	1.3	1.3	0	1.3	1.3	4.0	4.7	0.7	2.0
Unreadable	0	0.7	0	0	0	0	0.7	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100	100	100

Table 2. Major categories of profusion of small opacities (%)

	Chinese Small Opacity Profusion	Median American Readings				
		ILO Small Opacity Profusion				
		0	1	2	3	Total
Median Chinese readings	0	34.0	1.3	0	0	35.3
	1	15.3	20.7	1.3	0	37.3
	2	0	14.0	10.7	0	24.7
	3	0	0.7	0	2.0	2.7
	Total	49.3	36.7	12.0	2.0	100

Table 3. Overall pneumoconiosis interpretation by Chinese and American readers (%)

Median Chinese Readings	Median American Readings					
	0/0	0/1	1/0+	AX	Opacities	Total
0	16.0	0	0	0	0	16.0
0+	13.3	3.3	1.3	0	0	18.0
I, I+II	6.0	8.0	30.7	1.3	1.3	47.3
II+	0	0	1.3	2.0	7.3	10.7
III, III+	0	0	0	0	8.0	8.0
Total	35.3	11.3	33.3	3.3	16.7	100

disagreement, as noted above.

The agreement in detecting pleural abnormalities (table 4) was 89% although the Kappa statistic was only 0.48. However, this still represents a fair agreement in this difficult area of interpretation. As with pneumoconiosis detection, the Chinese radiologists described more abnormalities than the Americans. Agreement in cancer dete-

Table 4. Comparison of presence of absence of pleural abnormalities (%)

		Median American Readings		
		No	Yes	Total
Median Chinese Readings	No	83.3	0.7	84.0
	Yes	10.0	6.0	16.0
	Total	93.3	6.7	100

Table 5. Cancer Detection(%)

		Median American Readings		
		No	Yes	Total
Median Chinese Readings	No	95.3	1.3	96.7
	Yes	0	3.3	3.3
	Total	95.3	4.6	100

ction was also good (table 5). It should be noted, however, that the Chinese were strongly encouraged to mark the "cancer" box in the reading form if they thought cancer was a reasonable possibility.

DISCUSSION

The purpose of this project was to compare the chest radiographic interpretation of pneumoconiosis in China as well as in the United States. Each country uses a different classification system. This fact, as well as other possible national differences in pneumoconiosis interpretation, must be evaluated if a meaningful exchange of occupational dust exposure-response data is to be conducted. Overall, the 1986 Chinese Roentgenodiagnostic Criteria of Pneumoconioses, and the 1980 International Labour Office (ILO) Classification of Radiographs of Pneumoconioses, though different in several respects, were found to be rather clocosely correlated with each other. Meaningful quantitative pneumoconiosis data can be easily exchanged between the two classifications. Similar data have been published comparing the 1963 Chinese and the ILO classifications[9]. In addition, the readers of each country, using their own classification, reached good general agreement among themselves, and with their foreign colleagues. In this study, the Chinese readers' intra- and inter-reader variability results were as good as top American "B" readers. In this regard, recent American studies have demonstrated rather large interreader variability among qualified readers[10,11]. The recommended use of multiple readings is one partial solution to this problem.

There is so far not any official interpretation form for the 1986 Chinese Criteria. In addition, some other classification systems, with their own standard films, exist in some parts of China. These facts, as well as the variability among readers in different parts of each country, must be recognized in generalizing the results of this study to other researches. Also, some details of the 1986 Chinese Criteria are undergoing changes and a revised Criteria may be set up in the next 5 to 10 years. Similarly, the ILO

Classification is also likely to undergo modifications in the near future.

In summary, both the classifications and the readers in China and America are comparable, A useful exchange of occupational dose-response data based on these classifications is quite essential.

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