

The role of early detection in the prevention of occupational disease — A review of work in the People's Republic of China¹

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GU XQ. The role of early detection in the prevention of occupational disease — A review of work in the People's Republic of China. *Scand J Work Environ Health* 11 (1985): suppl 4, 7—9. The early detection of occupational diseases is the main purpose of the health surveillance of workers exposed to occupational hazards. While health surveillance is one of the important approaches to occupational disease prevention (in addition to environmental monitoring and improved technology), promulgating legislation and organizing and training professional personnel could guarantee the implementation. Chinese experience in industrial development is similar to that of other countries. Research determining indicators for the early detection of occupational diseases could improve the quality of preventive measures.

Key terms: occupational disease prevention, health surveillance.

Before the Liberation in 1949, problems such as silicosis, lead poisoning, and occupational diseases related to chromium and other toxins were very serious among workers. After the Liberation, the government organized professional workers to implement environmental monitoring, health surveillance of workers, field surveys, and prevention programs. Occupational health services were emphasized. After a series of laws and regulations were established and active preventive measures were set into action, the health of workers was much improved, and the prevalence of occupational diseases decreased.

To summarize, our experience over the past 35 years has been similar to that of other countries in their development of industry. It has mainly involved promulgating legislation, organizing and training professional personnel, and emphasizing prevention to maintain the health of the workers. Among the comprehensive preventive measures, health surveillance is one of the important approaches, in addition to environmental monitoring and the improvement of technology. The early detection of occupational diseases is the main purpose of health surveillance. Early detection, in developing countries, helps maintain the health of workers, who are crucial to production; it supplements environmental monitoring; and it promotes the improvement of technological control.

Since 1956, the Ministry of Public Health, along with the Ministry of Labor, promulgated documents such as the "Temporary Regulation for Reporting of Occupational Intoxications and Occupational Diseases," and the "List of Occupational Diseases and

Preventive Measures of Reportable Occupational Diseases." By 1980, there were 15 documents related to the early detection and prevention of occupational diseases. Among these, there were diagnostic criteria and principles of prevention for silicosis and for poisoning caused by lead, mercury, benzene, amino and nitro compounds of benzene, and organophosphorus pesticides. In 1982 the diagnostic criteria and preventive measures for manganese, carbon disulfide, and industrial fluorosis were added, and those for benzene and trinitrotoluene were revised. These documents were effective in preventing occupational disease. For example, two storage battery plants, one in Shanghai and the other in Shangtung (Po-shan), showed a dramatic decrease in lead poisoning after 1956 (table 1) (1).

Before routine health examinations were performed in the two storage battery plants, the air lead concentration in the workshops exceeded the standard (0.01 mg/m³) by up to a factor of 750 times. After the implementation of health surveillance, the air lead concentration decreased markedly (table 2), followed by a marked decrease in the prevalence of lead poisoning.

In the 1960s preventive efforts were further emphasized. We gained more experience, and we and others trained more professional personnel. In the 1970s nationwide surveys began. Between 1974 and 1976, 2 900 000 workers exposed to silica dust were examined by chest radiography. The prevalence of silicosis varied by industry as follows: 5.5 % in metallurgy, 3.5 % in coal mining, 1.7 % in construction, 1.2 % in railroad building, 0.7 % in the chemical industry, and 2.6 % in other industries, the overall prevalence being 3.1 %. Between 1979 and 1981 another nationwide survey of workers exposed to lead, mercury, benzene, organophosphorus pesticides, and trinitrotoluene was performed. More than 980 000 workers were examined. The prevalence of chronic intoxication, as defined by diagnostic criteria, is shown in table 3.

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Table 1. Prevalence (%) of lead poisoning after the implementation of health surveillance in two storage battery plants.

Year	Shanghai storage battery plant	Po-shan storage battery plant
1955	..	38.2
1956	45.0	35.8
1957	10.0	16.6
1958	3.0	4.9

Table 2. Average lead content in the air and the prevalence of lead poisoning in the Po-shan storage battery plant (1955–1983).

Year	Mean lead concentration (mg/m ³) in the air	Persons examined	Lead poisoning	
			Number of persons	Prevalence (%)
1955	13.27	81	31	38.2
1956	6.71	123	44	35.8
1957	6.71	175	29	16.6
1958	2.88	185	9	4.9
1961	5.22	380	37	9.8
1963	9.62	252	37	14.6
1965	7.92	188	14	7.4
1966	0.92	238	14	6.0
1972	0.92	613	34	5.7
1975	1.24	541	7	1.3
1977	1.03	510	10	2.0
1979	2.54	529	12	2.3
1981	0.45 (fumes) 1.09 (dust)	403	10	2.5
1983	0.46 (fumes) 0.37 (dust)	414	9	2.2

Spearman's rank correlation coefficient (14) = 0.7385, $p < 0.01$.

Table 3. Prevalence of chronic intoxication by five types of exposure (1979–1981).

Exposure	Number of workers examined (in thousands)	Workers with chronic intoxication	
		Number of persons (in thousands)	Prevalence (per 1 000)
Lead	355	5.6	15.8
Mercury	62	1.3	21.0
Benzene	509	2.1	12.6
Organophosphorus ^a	17	0.5	29.4
Trinitrotoluene	42	1.1	26.2
Total	985	10.6	10.8

^a Only includes those working in industry.

Table 4. Correlation of symptoms with zinc protoporphyrin (ZPP) in the blood.

	Number with symptoms	Number without symptoms	Total
ZPP positive	24	8	32
ZPP negative	7	116	123
Total	31	124	155

Sensitivity: $(24/31) \times 100 = 77.4\%$.
Specificity: $(116/124) \times 100 = 93.5\%$.

From these two surveys, we determined the overall prevalence of the most important occupational diseases in China, and this information served as a basis for developing future strategies for the prevention of these diseases.

In the health surveillance of workers exposed to occupational hazards, the selection of indicators for the early detection of disease is important. During the past 20 years, routine health examinations have been performed by different institutions. In addition, research on indicators for early detection has been carried out. The following description briefly summarizes our experience.

1. Research on indicators of early detection can help improve the quality of prevention. In the 1950s we only used urinary coproporphyrin and urinary lead levels and red cell stippling as indicators of lead exposure. In the mid-1960s the urinary δ -aminolevulinic acid value was added as an indicator. This change led to greater control efforts, and, as a result, the prevalence of lead poisoning decreased further, as illustrated by the change of its prevalence in the Po-shan storage battery factory (table 2) (6). Recently we have been assessing the blood zinc protoporphyrin (ZPP) level as an indicator for the early detection of lead effect. A total of 155 workers were examined (two groups of 53 and 52 workers with lead exposure and 50 with no lead exposure who served as a reference group). The content of lead in the air was 0.578 mg/m³, 0.0015 mg/m³, and 0.0006 mg/m³, respectively, at the workplaces of these individuals. No one in the three groups was diagnosed as having lead poisoning according to classic clinical diagnostic criteria. Blood samples were obtained from each worker for ZPP testing, and other routine examinations for lead exposure were performed. Lead effect was defined as the presence of five or more of the following eight subjective complaints: fatigue, nausea, impairment of memory, metallic taste, abdominal pain, sweating, numbness of extremities, and joint pain. A blood ZPP of 80 μ g/dl or greater was defined as positive. Analysis of data revealed the sensitivity of the ZPP test to be 77.4 %, the specificity being 93.5 % (table 4) (4). On the basis of this research, we concluded that ZPP could be used as an indicator for the early detection of lead poisoning. If this method can be used in routine examinations, the prevention of lead poisoning can be further improved in the 1980s.

2. Research on early detection indicators should focus on methods suitable for primary health care. For example, for the prevention of organophosphorus pesticide poisoning, the estimation of blood cholinesterase is a useful tool. Unfortunately, the estimation requires precise biochemical methods that are almost impossible for personnel in a primary health care unit. We devised a kit for the simple and rapid estimation

of cholinesterase; it has been well received by primary health care personnel.

3. Early detection indicators should not only be standardized nationally, but also be consistent with international standards. In China, the classification standard for abnormalities in chest radiographs used for the early detection and diagnosis of silicosis has one main defect in comparison with the international classification of radiographs of pneumoconioses of the International Labour Office (ILO). The Chinese grade II, which describes the most extensive signs of small opacities, covers a wide range of profusion on the ILO scale comprising 48 % in category 1, 46 % in category 2, and 6 % in category 3. Suggestions have been made to elaborate the Chinese classification system. The aim is to increase the range of appearances that are classifiable and assist international comparisons with categories defined by the ILO scheme while still retaining the basic elements of the traditional Chinese diagnostic categories (2).

4. Environmental monitoring should keep pace with research on early detection. Quantitative data on an environmental hazard is necessary for the selection of an early detection indicator. There has been some research which has not met this need, such as work that did not explore a possible exposure-response relationship. For example, in a search for an early detection indicator of benzene poisoning, one investigator tried unsuccessfully to look for a morphological change in white blood cells without considering the exposure level of benzene. Another example is that, in statistical analyses, some authors only pay attention to the sensitivity of a new indicator and neglect the importance of the specificity.

5. Research on early detection indicators should be integrated with the use of the health examination. In China, although we have documents for diagnostic criteria for some occupational diseases, there are still many diseases that lack early detection indicators. Also the already existing indicators need to be improved. The case of the value of examining the fundus for retinopathy in the early detection of carbon disulfide (CS_2) effect is illustrative. Japanese researchers found retinal abnormalities characterized by microaneurysms at a prevalence rate of 30.8 % (89/289) among workers exposed to carbon disulfide and only 4.1 % (2/49) among unexposed workers ($p < 0.01$) (5). We worked with them, using the same method, to examine a group of workers in Shanghai. This study revealed microaneurysms at a prevalence rate of 5.1 % (19/372) among exposed workers and 6.5 % (21/322) among unexposed workers ($p > 0.05$) (3). There was no statistically significant difference between the preva-

lence rate of the unexposed groups in China and Japan. The difference in the prevalence of retinopathy between the exposed workers of the two countries was discovered to result primarily from differences in the exposure levels. The plant surveyed in Shanghai had a mean airborne concentration at the current Chinese standard of 10 mg/m^3 (3.3 ppm). However, in Japan, the limit value for carbon disulfide is 60 mg/m^3 (20 ppm), and the workers studied in Japan had been exposed around this level. In northern China, workers with retinopathy were found in plants where carbon disulfide in the air is at a much higher level than the present standard. In the diagnostic standard for carbon disulfide promulgated recently in China, we use retinopathy as one of the early detection indicators.

For many occupational diseases, we still lack early detection indicators. Periodic health examinations, with a follow-up of suspect cases, can help compensate for this deficiency. If a worker is found to have some progressive, though vague, symptoms, such as neurasthenic symptoms, in a periodic health examination, the worker can be removed from his or her usual work environment, and further damage can be prevented.

There are still many gaps in our work. For example, preemployment examinations have not been performed regularly, and some occupational diseases have not been determined to be compensable. The reporting system of occupational diseases is far from complete, and the training of medical students in the prevention of occupational diseases is inadequate. All of these deficiencies will need to be corrected in the future.

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