The economic burden of pneumoconiosis in China

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Occupational safety and health programmes are economically beneficial

China, with a population of 1.2 billion, is the most populous country. Approximately 700 million are in the active labour force, of which a large proportion is engaged in construction, mining, and other occupations with potential exposure to silica. The number of workers exposed to silica containing dusts may be as high as 12 million. Pneumoconiosis has long been the most serious and yet preventable occupational disease in China. New cases are estimated at 7500 to 10 000 annually, representing more than 70% of the total reported cases of occupational diseases in recent years.¹⁻³ The cumulative number of confirmed pneumoconiosis cases recorded in China between 1949 and 2001 reached 569 129. The majority of the cases occurred in the mining industries, particularly in coalmines, resulting in anthracosilicosis, which accounted for about 40% of the disease.¹ Among them, more than 25% had died. In addition to confirmed cases, a 1986 nationwide survey found that an even greater number of exposed workers (around 600 000) were classified as suspected cases.¹⁻³

ECONOMIC BURDEN ANALYSIS

Pneumoconiosis is a progressive and irreversible fibrogenic lung disease that results in not only human suffering but also unaffordable economic burdens. In this paper, we estimate the economic burden of pneumoconiosis in China. The methodologies of estimating economic burdens of occupational diseases vary from disease to disease and from investigation to investigation, dictated primarily by the data available.⁴⁻⁸ We use the

traditional human capital approach, which divides costs into direct and indirect categories. In our analysis, direct costs include medical expenses, work absence losses, and management costs, whereas indirect costs include production and profit/tax losses due to work absences. The data in our analysis are derived from two previous investigations in China.^{9, 10}

The first investigation is based on a 1986 national survey of economic losses associated with pneumoconiosis in several key industries in 10 provinces and selected cities in China.⁹ Table 1 presents a summary of the findings of the survey. The average direct and indirect costs were ¥2869 and ¥12 896 per person per year, respectively, and the total economic loss was ¥15 765 per person per year. [Note: ¥ is the symbol for “yuan” in the Chinese currency Renminbi (RMB). US\$1 is approximately ¥8.2. To put these figures in perspective, the typical monthly wage for a non-professional worker was ¥400 in 1986 and ¥1500 in 2002.]

“Economic losses represented 0.4% of China’s GNP”

It was estimated that there were 310 000 cases of pneumoconiosis in China in 1986. Based on the above estimates, the total yearly economic losses would have been ¥5 billion in 1986. However, it should be noted that according to market value replacement, the value of ¥1 in the late 1990s was devaluated to about one fifth of that in the mid-1980s. Therefore, based on the above estimates, the annual economic

losses associated with pneumoconiosis would have been ¥25 billion. This figure represents 0.4% of China’s total gross national product (GNP), which was around ¥6000 billion or US\$750 billion in 1999.

The second investigation was conducted in Shanghai in 1992, consisting of 2164 foundry workers at a machinery factory, who had been exposed to silica containing dust for more than one year.¹⁰ A total of 108 workers were diagnosed with pneumoconiosis during 1988–92. The prevalent cases of pneumoconiosis between 1988 and 1992 ranged from 80 to 84 in the factory. The dust exposure level was as high as 130 mg/m³ during the early 1960s. Dust controls and corrective measures implemented since the mid-1960s were successful in lowering dust level to 2.9 mg/m³ in 1992; the prevalence of pneumoconiosis was dramatically reduced.

The average direct economic loss for the prevalent cases of pneumoconiosis between 1988 and 1992 was estimated to be ¥3736 per person per year. In addition, the fatalities of pneumoconiosis during that period brought about another source of direct economic losses: death compensation and funeral expenses, estimated at ¥3285 per death. According to personnel records at the factory, about half of the workers with advanced pneumoconiosis had to leave work completely, which resulted in a tremendous decrease of production (estimated at ¥19 800 per person) and profits/tax losses (estimated at ¥4615 per person), with the annual total indirect costs for each advanced pneumoconiosis case estimated at (¥19 800 + ¥4615) or ¥24 415. Furthermore, in addition to the advanced cases, half of the workers remaining on the job with early or intermediate pneumoconiosis had about 105 sick days per year, which resulted in approximately one third of the production and profits/tax losses of those with advanced pneumoconiosis. For workers with early or intermediate pneumoconiosis who remained on the job, the indirect losses were roughly one third of those at the advanced stage—that is, ¥8057 per person. Therefore, the average indirect costs resulted from a worker suffering from silicosis were (¥24 415 + ¥8057)/2 or ¥16 236 per person per year.

The total economic burden equalled the sum of direct costs and indirect costs resulting from the prevalent cases of pneumoconiosis as well as death compensation and funeral expenses for patients who died in the fiscal year. The annual economic burden associated with pneumoconiosis could be estimated as follows: the number of prevalent cases in the year × (direct + indirect costs) + number of death of the year × (death compensation and funeral expenses). An estimate of the total economic losses as a

Table 1 Estimated economic losses due to pneumoconiosis (per person) in China, 1986

Data source	Direct costs	Indirect costs
20 plants in Shanghai	¥2623	¥30732
10 provinces or cities in other parts of China	¥3030	¥8925
13 coal mines in other parts of China	¥2620	¥6892
4 non-ferrous metal mines in other parts of China	¥3202	¥5035
Average	¥2869	¥12896

Source: Ministry of Health, People’s Republic of China.⁹

result of pneumoconiosis in China can be obtained by applying the Shanghai survey data to national statistics. According to national statistics, the average annual number of pneumoconiosis survivors was 390 089 during 1949–96.¹ With an annual death rate of approximately 1.2% for pneumoconiosis, the number of deaths was estimated to be approximately 5000 per year. The annual total economic losses to China as a result of pneumoconiosis, based on data from the Shanghai survey, can be estimated as follows: $390\,089 \times (\text{¥}3736 + \text{¥}16\,236) + 5000 \times \text{¥}3285 = \text{¥}7.81$ billion (US\$978 million). This figure accounted for 0.39% of China's GNP in 1992 (¥2022 billion), and is remarkably close to the estimate developed earlier, based on the 1986 national survey described in the first example. By way of comparison, the total personal income tax received by the central government was only 0.6% of GNP in 2000.

COST-BENEFIT ANALYSIS

The working conditions in the foundry workshops of the machinery factory in the Shanghai investigation were quite poor in the 1960s, with an average air concentration of silica containing dust of 130.1 mg/m^3 , which was 65 times the maximum allowable concentration (MAC) of 2 mg/m^3 adopted in China. After the implementation of dust control measures, average dust concentration was reduced to 3.9 mg/m^3 in 1992. Had dust control measures not been implemented, the 2164 foundry workers at the machinery factory would have continued to be exposed to much higher dust levels, which would have been expected to induce approximately 664 new cases of pneumoconiosis during 1988–92.¹⁰ However, the actual number of observed cases of pneumoconiosis was only 108; 556 cases of pneumoconiosis had thus been prevented as a result of the reduction of dust exposure.

The economic benefit from the reduction of cases of silicosis can be calculated as follows:

- Benefit from avoiding direct loss (medical costs only): $\text{¥}3736 \times 556 = \text{¥}2.08$ million.
- Cumulative saving of workforce after dust being controlled: 8340 person-years (= 556×15 additional years of work per worker).
- Benefits from avoiding indirect loss (profits/tax): $\text{¥}16\,236 \times 8340$ person-years = $\text{¥}135.40$ million.
- Total benefits from the prevention: $\text{¥}2.08$ million + $\text{¥}135.40$ million = $\text{¥}137.48$ million.

The total costs of dust reduction measures at the Shanghai machinery factory were approximately ¥10 million over a period of 30 years, 1963–92. Thus, the ratio of benefit to cost was $\text{¥}137.48 \text{ million} / \text{¥}10 \text{ million} = 13.7$. The return of investment of preventive measures was considerable as indicated by this high benefit-cost ratio.

CONCLUSION

The estimated economic losses based on both the national survey and the Shanghai investigation were remarkably close. The estimated economic losses to China associated with pneumoconiosis account for approximately 0.4% of the GNP. Therefore, this highly preventable disease has brought not only unnecessary human suffering but also unaffordable economic burdens. Neither the health consequences nor the economic burdens are acceptable or affordable. As illustrated by the Shanghai data, dust controls are effective measures in reducing both the number of pneumoconiosis cases and associated economic burden.

These data underscore the importance of showing the relation between health, productivity, and economic impact of occupational health and safety programmes on national economy. Unfortunately, programmes of occupational safety and health have often been regarded as a burden to the economy of the industry and the nation. However, recent economic appraisals show totally

different results: that is, such programmes save not only lives but also money. Occupational safety and health programmes have been found to be economically beneficial, and benefit-cost ratios in many situations are surprisingly high. It is important to publicise such results to increase the awareness of both political and economic decision makers of the benefits of occupational safety and health programmes.

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