

Changes in health conditions in the Huainan coal mine in the past three decades¹

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YANG MD, WANG JD, WANG YL, GUO PS, YAO ZQ, LU PL, GU XY, DONG YL, LU MX, ZHU P, YAN SG, LIU QP, JIANG MC, CHEN ZQ, FANG SQ, REN SY, SHEN D, QIAO TY, HUANG FS, JIANG ZD. Changes in health conditions in the Huainan coal mine in the past three decades. *Scand J Work Environ Health* 11 (1985): suppl 4, 64–67. Health conditions in the Huainan Coal Mine have improved greatly since 1950. In particular, the work and living environments, the underground dust concentration, the water supply and waste disposal systems, and the nutritional value of miners' food have become much better. Thus the rates of occupational, infectious, and parasitic diseases and nutritional deficiency diseases have decreased considerably among miners. The decreases in the prevalence of anthracosilicosis and hookworm have been especially striking.

Key terms: anthracosilicosis, dust, hookworm, nutrition, waste disposal systems, water supply.

The Huainan Coal Mine is the largest coal mine in East China. People began mining coal in this district early in the Ming Dynasty (1368–1644 AD), and the mine pits gradually took shape in the Qing Dynasty (1644–1911 AD). Prior to 1949 all equipment used in mining was primitive and simple, the underground work conditions were dangerous and hazardous to health, the miners' housing was deplorable, and health services for miners were entirely inadequate. The incidence of infectious, parasitic, and occupational diseases was extremely high. Since 1949, there have been distinct improvements in safety measures and sanitary conditions and the miners' health status. Two hospitals with modern equipment and a health and anti-epidemic station have been set up, and the management of health services and the general health level of miners have improved markedly.

In the early 1950s, studies were made of such items as underground dust concentrations, anthracosilicosis, nutrition, medical service, housing, environmental sanitation, water supply, and refuse and night-soil collection and disposal; and relevant proposals were made based on the findings. The coal mine administration implemented the necessary measures for occupational

and environmental improvement, and these measures eventually ameliorated health conditions both under and above ground. Studies have been continued in the 1970s and early 1980s. This paper summarizes the efforts undertaken to improve miners' health status and the preventive measures taken to reduce hazardous environmental conditions both on the surface and underground during the past 30 years.

Health services and diseases among miners in the Huainan mine

Before 1949 Huainan had only a small hospital with 70 beds and 15 doctors. In 1980 the number of beds was 1 695, and there were 338 doctors (table 1).

Funds for health and medical services have also increased. For example, in the Xie Jia Ji First Coal Pit (one of the subdistricts of the Huainan Coal Mine) the funding of health and medical services in 1983 was 5.37 times that in 1952 on a per capita basis (table 2). Con-

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Table 1. Development of medical establishments and personnel.

Year	Number of medical institutions	Number of hospital beds	Number of medical personnel	Number of doctors
1950	5	95	102	15
1960	45	1 169	945	68
1970	20	1 095	1 536	167
1980	42	1 695	2 441	338
1983	48	1 714	2 764	583

Table 2. Funds for health and medical services in the Xie Jia Ji First Coal Pit.

Year	Number of miners	Funds for health and medical services (RMBY)	RMBY/capita/year
1952	1 490	4 050	2.7
1960	6 752	45 635	6.8
1970	6 074	73 200	12.1
1980	9 290	169 441	18.2
1983	10 914	157 900	14.5

Table 3. Distribution (%) of diseases among miners treated in the First Hospital.

Diseases	1953	1980	1983
Infectious diseases	17.3	12.1	9.6
Malignant tumors	0.3	5.6	5.5
Cardiovascular diseases	1.8	6.0	6.6
Respiratory diseases	24.1	31.7	22.3
Digestive diseases	18.3	15.3	16.0
Other diseases ^a	38.2	29.3	40.0
Total	100.0	100.0	100.0

^a Including diseases of the skin, urinary tract, nervous system, etc.

Table 4. Miners' working history and prevalence of anthracosilicosis (AS).

Underground working history (years)	1954			1972			1982		
	Miners examined	AS	%	Miners examined	AS	%	Miners examined	AS	%
< 10	60	2	3.3	2 679	37	1.0	182	—	0
10—19	160	6	3.8	5 868	120	2.1	123	—	0
20—29	29	4	13.8	1 456	73	5.0	107	2	1.9
≥ 30	9	3	33.3	295	22	7.5	3	—	0
Total	258	15	5.8	10 298	242	2.4	415	2	0.48

currently, the accident rate has decreased, and the rate of coal production has increased.

As indicated by data from a major hospital in the district, the First Hospital, the relative frequencies of various diseases among miners have changed considerably. The percentages of malignant tumors and cardiovascular diseases have increased markedly, while those of infectious diseases have decreased (table 3).

Miners' anthracosilicosis and dust concentration

Miners rarely do only one kind of work underground. They usually take part in coal mining and rock excavation, both of which may contribute to health problems. The prevalence of anthracosilicosis was analyzed with respect to the number of years that miners had worked underground (table 4). From the 1950s to the 1980s, the prevalence declined substantially.

In 1953 the underground dust concentrations were very high, with an average of 266 mg/m³, 133 times the national hygienic standard (2 mg/m³). Since then, a series of comprehensive control measures have been adopted, and effective modifications were made whenever and wherever necessary. The most successful measure has been the "wet" process, including drilling under a water stream, drilling under a water spray, water-sealed blasting, and rinsing of the rock wall and ceiling of galleries within a radius of 30 m around the drilling face. In addition, ventilation systems have been readjusted to meet current needs and hygienic demands. The mean dust concentration has been

Table 5. Dust concentrations with different drilling methods and ventilation systems.

Drilling system	Ventilation system	Samples tested	Dust concentration (mg/m ³)
Dry	Poor	36	> 20
Wet	Improved	57	3 (5.2%) ^a > 5 18 (31.6%) ^a 2—5 36 (63.2%) ^a < 2

^a Number and percent of the samples.

reduced to 1.3 mg/m³ as a result of these measures. Table 5 demonstrates the changes in dust concentration brought about by the implementation of the "wet" drilling processes and improved ventilation.

Miners' nutritional status and diseases of nutritional deficiency

The miners' nutritional status has improved significantly. Although the quantities of calories and protein obtained by each miner per day did not change much from 1954 to 1984 (table 6), the type of food has changed considerably. For example, the proportion of animal protein has increased from 5.6 to 26.0 % (table 7), and the prevalence of some diseases associated with nutritional deficiency has been greatly reduced (table 8).

Table 6. Average nutrient intake per person per day by the weighing method.

Year	Calories (kcal) ^a	Protein (mg)	Fat (mg)	Carbo- hydrate (gm)	Calcium (mg)	Iron (mg)	Vitamins				
							A (IU)	B ₁ (mg)	B ₂ (mg)	PP (mg)	C (mg)
1954	3 300	105.3	38.6	633	373	28.7	3 915	2.7	0.9	29.2	39.5
1981	3 408	99.5	94.0	541	1 068	53.0	4 406	2.2	0.7	18.3	188.0
1984	4 257	127.5	133.5	636	705	62.2	1 783	2.6	1.4	33.9	119.2

^a 1 kcal = 4 183 J.

Table 7. Source of protein (%).

Year	Grain	Animal products	Others
1954	75.0	5.6	19.4
1981	55.3	23.1	21.6 ^a
1984	55.8	26.0	18.2

^a Including soybeans and soybean products 13.1 %.

Housing conditions

Until 1950 coal miners had very poor housing accommodations. Most of them lived in thatched huts with mud-and-reed walls. The average residential space was about 4.9 m³ per person. The ratio of window to floor area was 0.4—4.5 %. Even worse, some miners lived in housing with high, triangular straw roofs, with the eaves almost touching the ground. There were no windows, the rooms were dark and damp, and some of the sheds leaked on rainy days. It was not unusual for a small hut with only 4 m² of floor area to accommodate four, five, or even six persons. Since then, new apartment houses and dormitory buildings have been built; net residential floor area reaches 4.5 m² per capita on the average; and the average residential space per capita is 13.6 m³, which meets the requirements set forth in the 1950s in China. Other sanitary parameters in housing (eg, relative humidity, natural lighting) have also been greatly improved. Currently hotel-like dormitories are being operated by attendants who clean the buildings and provide other house-keeping services. Dining halls serve food at moderate prices, and there are free washing machines for laundry. There is a library with books and magazines to meet the needs of miners with different educational levels and cultural backgrounds and recreation rooms with a variety of games.

Water supply system

Up to 1950, water purification was neglected. At that time, the system supplied about 2 000 t of water daily, most of which was used in industry. Thus the tap water supply was very low. For example, in the densely populated Juren village (miner's residential area), there were only two taps for a total population of about

10 000, and the average daily consumption was less than 10 l per capita. To compensate for the insufficient flow in the distribution system, pools were dug to store water from the system during low consumption hours. Since 1955, 11 new waterworks have been built, with a total supply of 220 000 t per day for industrial use and domestic consumption combined; the average daily water consumption is 65 l per capita. These new waterworks with their clarification facilities and modern chlorinator produce water which meets China's national hygienic standards for drinking water.

Refuse and night soil collection and disposal

Public refuse cans were not provided in the Juren village prior to 1951. Refuse and garbage were dumped on the ground everywhere. When the piles reached about 1—1.7 m³, emitting an objectionable odor due to putrefaction, they were then cleared away with a horse-drawn cart. Inevitably, there were many flies in summer and fall. Now, there are 678 street cleaners in the city of Huainan. The general sanitary appearance of the city has been greatly improved.

In 1951, more than half of the night soil pits of public latrines, were without covers and not properly managed, forming a great number of breeding places for flies. A new type of flyproof, odorless latrine has been designed and constructed. Vigorous publicity is now under way to spread the use of such latrines.

Simple underground latrines, which were completely lacking in the 1950s, have been built at fixed intervals along the tunnels in the coal mine for miners to use during their workhours. These underground latrines are cleaned by specially assigned workers. The establishment of such latrines has thoroughly eliminated the scattered fecal matter in the tunnels. In addition, miners wear long or short rubber boots instead of the rubber sandals they wore in the 1950s. The hookworm infection rate among miners has thus been greatly reduced (table 9).

Changes in workshift duration

Additional changes that have benefited the miners lie in the area of mechanization and the hourly workweek. Improved drilling and mining methods have incor-

Table 8. Prevalences of glossitis, ulcer of angulus oris, and gum hemorrhage.

Year	Miners examined	Glossitis		Ulcer of angulus oris		Gum hemorrhage	
		N	%	N	%	N	%
1950	523	451	86.2	491	94.0	422	80.7
1981	442	2	0.5	6	1.4	66	15.6
1984	53	—	0.0	1	1.9	20	37.7

porated mechanized equipment, reducing the heavy labor intensiveness at this mine. Furthermore, the number of workhours has been reduced, eg, the Xie Jia Ji First Coal Pit has adopted the system of four shifts a day at 6 h per shift. The high injury and death rates in the 1950s, when the risk of mining accidents was alarmingly high, has now been improved considerably as a result of these two factors.

In summary, the present study shows that, in the Huainan Coal Mine in the past 33 years, gradual improvement in management, equipment, facilities, and the technical levels of all professional personnel have led to significant improvements in occupational and environmental conditions and in nutritional health. The work and residential conditions of miners' health status have been raised. The coal mine district author-

Table 9. Hookworm and ascaris infection.

Year	Miners examined	Hookworm infection		Ascaris infection	
		N	%	N	%
1950	338	211	62.4	143	42.3
1981	442	91	20.6	74	16.7

ity has implemented measures to improve miners' health and welfare. It provides complete medical and health care for miners, including all staff members, and enables them to work in a safer and more healthy environment. This program has been described as "Putting prevention first," which has been an effective public health policy in China.