DOI: 10.66069/ojspub.27450828

Epidemiological Characteristics of Patients with Occupational Pneumoconiosis in Selected Areas of Sichuan and Chongqing

Yu Luo[1], Lun Xiao[1], Min Yang[1], Xing Luo[2], Wenzhu Tan[3], Wei Li[4], Yi Wu[1,*]

[1]Jiulongpo District Center for Disease Control and Prevention, Chongqing 400039, China
[2]Guangyuan City Center for Disease Control and Prevention, Sichuan 628017, China
[3]Xindu District Center for Disease Control and Prevention, Chengdu 610500, Sichuan, China
[4]Yongchuan District Center for Disease Control and Prevention, Chongqing 402160, China
Correspondence Author

Abstract: ***Objective:*** *To analyse the basic epidemiological characteristics of patients with occupational pneumoconiosis in selected areas of Sichuan and Chongqing, and to provide a scientific basis for the prevention and treatment of pneumoconiosis and strategic health cooperation planning between the two regions.* ***Methods:*** *Using judgemental sampling, patients with occupational pneumoconiosis were selected from Guangyuan, Suining, and Chengdu (hereafter referred to as "Sichuan area") and Jiulongpo and Yongchuan districts of Chongqing (hereafter "Chongqing area") for follow-up between August 2023 and December 2024. Data on survival status, occupational history, type and stage of pneumoconiosis were collected. Basic patient characteristics, age at first diagnosis, and dust-exposure duration were described and compared between the two areas using the chi-square test and the Mann-Whitney test.* ***Results:*** *A total of 8,316 patients were followed up in 2023–2024, of whom 7,877 living cases were included in the analysis (3,468 from Sichuan and 4,409 from Chongqing). In both areas, the prevalent cases were predominantly middle-aged and elderly males, with coal workers' pneumoconiosis and silicosis as the main disease types, and stage I being the most common. Significant differences were observed between the two areas in mean age, age at first diagnosis, mean illness duration, dust-exposure duration, disease type distribution, and stage distribution (all $P < 0.001$), while sex distribution did not differ significantly (predominantly male). For coal workers' pneumoconiosis, the age at first diagnosis was mainly concentrated in the 40–60 years range (Sichuan: 59.9%; Chongqing: 88.0%); for silicosis, it was mainly in the 50–70 years range (Sichuan: 66.4%; Chongqing: 63.2%). Dust-exposure duration was most frequent in the 10–15-year and 20–25-year groups, accounting for 1,729 (21.9%) and 1,227 (15.6%) cases, respectively.* ***Conclusion:*** *The existing pneumoconiosis cases in both regions are predominantly stage I coal workers' pneumoconiosis affecting middle-aged and elderly individuals. Coal workers' pneumoconiosis and silicosis remain the key targets for prevention and control. It is essential to formulate policies tailored to the management of pneumoconiosis in Sichuan and Chongqing, to promote cooperation and complementarity in medical rehabilitation and occupational disease management, and to further enhance social security coverage and quality of life for pneumoconiosis patients.*

Keywords: Occupational pneumoconiosis, Sichuan and Chongqing regions, Age at first diagnosis, Epidemiological characteristics.

1. Introduction

Occupational pneumoconiosis (hereinafter referred to as "pneumoconiosis") is a disease characterised by diffuse pulmonary fibrosis. There is currently no effective cure, and both the number of cases and new diagnoses continue to rise, making it a major global public health issue [1-3]. Globally, from 1990 to 2017, the number of new pneumoconiosis cases increased by 23,900, representing a 66.0% rise compared with 36,200 cases in 1990 [4]. The situation in China is particularly concerning, as pneumoconiosis is the most prevalent and harmful occupational disease in the country [5]. A cumulative total of 915,000 occupational pneumoconiosis cases have been reported in China, imposing a substantial socioeconomic burden and significantly affecting patients' quality of life [6-8]. In 2019, the State Council issued the Notice on the Action Plan for the Prevention and Control of Pneumoconiosis [9], which explicitly called for "follow-up and retrospective investigation of reported pneumoconiosis patients... implementation of classified treatment and assistance... to reduce poverty and return to poverty caused by pneumoconiosis, and to effectively implement health poverty alleviation and poverty eradication tasks." Thus, the prevention and control of pneumoconiosis is a cornerstone of occupational disease management [10]. As key pillars of China's western development strategy, Sichuan and Chongqing have seen increasingly close exchanges and cooperation since the release of the Outline of the Construction Plan for the Chengdu-Chongqing Economic Circle and the Notice on Several Policies and Measures to Support the Healthy Development of Market Entities in the Chengdu-Chongqing Economic Circle. Research on the prevention and control of occupational pneumoconiosis in the Sichuan-Chongqing region can facilitate inter-regional collaboration and information sharing, and provide a scientific basis for strategic health cooperation planning and optimal allocation of health resources in the area.

2. Subjects and Methods

2.1 Study Subjects

Using judgemental sampling, patients with occupational pneumoconiosis were selected from Guangyuan, Suining, and Chengdu cities in Sichuan (hereafter "Sichuan area") and from Jiulongpo and Yongchuan districts in Chongqing (hereafter "Chongqing area") between August 2023 and December 2024. The selected areas are part of the Chengdu-Chongqing economic circle development and serve as collaborative cities for health strategic cooperation between the two regions.

2.2 Methods

Basic information on pneumoconiosis patients was obtained from the pneumoconiosis report cards filled in by occupational disease diagnostic institutions through the "Occupational Disease and Health Hazard Monitoring System", a subsystem of the "China Disease Prevention and Control Information System". Telephone interviews with the patients themselves or their immediate family members were conducted to collect data on survival status, occupational history, type and stage of pneumoconiosis, and social security coverage. Inclusion criteria: patients with occupational pneumoconiosis whose employing units were located in the above areas and who were recorded in the occupational disease reporting system. Exclusion criteria: patients who were lost to follow-up or confirmed deceased. A total of 8,316 patients were followed up; 439 were excluded due to loss to follow-up or death, leaving 7,877 cases for analysis.

2.3 Statistical Analysis

Statistical analyses were performed using SPSS 26.0. Quantitative data that passed the normality test (Kolmogorov-Smirnov test) were expressed as mean ± standard deviation; those not normally distributed were presented as median and 25th and 75th percentiles [M(P_{25}, P_{75})]. Categorical data were expressed as proportions/rates. For group comparisons, ANOVA and chi-square tests were used when homogeneity of variance was met; otherwise, the Mann-Whitney test was applied. The significance level was set at $\alpha = 0.05$ (two-sided).

3. Results

3.1 Basic Characteristics

Among the 7,877 living pneumoconiosis patients included in the analysis, 3,468 were from the Sichuan area and 4,409 from the Chongqing area. The prevalent cases in both regions were predominantly middle-aged and elderly; patients in Sichuan were significantly older than those in Chongqing ($P < 0.001$). Of the total, 7,867 were male and 10 were female, with males accounting for 99.9%. Overall, coal workers' pneumoconiosis and silicosis were the main disease types, but their specific distributions differed between the two areas: the proportion of silicosis was higher in Sichuan, while the proportion of coal workers' pneumoconiosis was higher in Chongqing ($P < 0.001$). There were 5,322 cases of stage I, 2,067 of stage II, and 488 of stage III. The stage distribution also differed significantly, with a larger proportion of stage III cases in Sichuan than in Chongqing ($P < 0.001$). Detailed data are shown in Table 1.

3.2 Age at First Diagnosis Among Living Patients

The median age at first diagnosis for the 7,877 living patients was 52 (46, 59) years, with Sichuan patients having a significantly higher age at first diagnosis than Chongqing patients ($P < 0.001$). When analysed by disease type, the age at first diagnosis for coal workers' pneumoconiosis was mainly concentrated in the 40–60 years range (Sichuan: 59.9%; Chongqing: 88.0%), while for silicosis it was mainly in the 50–70 years range (Sichuan: 66.4%; Chongqing: 63.2%). See Tables 1 and 2.

3.3 Dust-exposure Duration Among Living Patients

The median dust-exposure duration for the 7,877 living patients was 14 (7, 23) years, with the 10–15-year and 20–25-year groups being the most common, comprising 1,729 (21.9%) and 1,227 (15.6%) cases, respectively. The dust-exposure duration of Sichuan patients was significantly shorter than that of Chongqing patients ($P < 0.001$). See Tables 1 and 3.

Table 1: Basic Characteristics of Prevalent Pneumoconiosis Cases in Two Regions (n=7,877)

	Characteristic Total [M(P25,P75) or n (%)]	*Sichuan (n,%)*	*Chongqing (n,%)*	*P*
Median age (years)	61(56,71)	65(56,76)	60(56,68)	.000
Age at first diagnosis (years)	52(46,59)	53(45,64)	51(47,57)	.000
Median illness duration (years)	10(7,13)	11(7,14)	8(7,12)	.000
Dust exposure duration (years)	14(7,23)	11(5,23)	15(10,23)	.000
Sex				
Male	7,867(99.9)	3,467(100)	4,400(99.8)	.064[a]
Female	10(0.1)	1(0.0)	9(0.2)	
Disease type				
Coal workers' pneumoconiosis	6,288(79.8)	2,611(75.3)	3,677(83.4)	.000
Silicosis	1,530(19.4)	819(23.6)	711(16.1)	
Others	59(0.8)	38(1.1)	21(0.5)	
Stage				
Stage I	5,322(67.6)	2,121(61.2)	3,201(72.6)	.000
Stage II	2,067(26.2)	974(28.1)	1,093(24.8)	
Stage III	488(6.2)	373(10.7)	115(2.6)	

[a]Continuity-corrected chi-square test.

Table 2: Distribution of Age at First Diagnosis Stratified by Region and Pneumoconiosis Type Among Surviving Pneumoconiosis Cases (n=7,877)

Age at first diagnosis (years)	*Total N (%)*	*Sichuan*			*Chongqing*		
		Coal workers'	*Silicosis*	*Others*	*Coal workers' pneumoconiosis*	*Silicosis*	*Others*
<40	466(5.9)	215(8.2)	57(7.0)	3(7.9)	144(3.9)	47(6.6)	0(0.0)
40-<50	2,775(35.2)	961(36.8)	156(19.0)	13(34.2)	1,479(40.2)	160(22.5)	6(28.6)
50-<60	2,806(35.6)	602(23.1)	222(27.1)	12(31.6)	1,756(47.8)	201(28.3)	13(61.9)
60-<70	1,263(16.0)	436(16.7)	322(39.3)	10(26.3)	245(6.7)	248(34.9)	2(9.5)
≥70	567(7.2)	397(15.2)	62(7.6)	0(0.0)	53(1.4)	55(7.7)	0(0.0)

Table 3: Dust-Exposure Duration Distribution of Prevalent Pneumoconiosis Cases in the Two Areas (n=7,877)

Dust-exposure duration (years)	*Total N(%)*	*Sichuan*			*Chongqing*		
		Coal workers' pneumoconiosis	*Silicosis*	*Age at first diagnosis (years)*	*Total N(%)*	*Coal workers'*	*Silicosis*
<5	1,531(19.4)	663(25.4)	323(39.4)	10(26.3)	270(7.4)	264(37.1)	1(4.8)
5-<10	815(10.3)	437(16.7)	116(14.2)	8(21.0)	217(5.9)	33(4.6)	4(19.0)
10-<15	1,729(21.9)	318(12.2)	87(10.6)	6(15.8)	1,194(32.5)	115(16.2)	9(42.9)
15-<20	869(11.0)	259(9.9)	63(7.7)	6(15.8)	482(13.1)	56(7.9)	3(14.3)
20-<25	1,227(15.6)	324(12.4)	78(9.5)	3(7.9)	732(19.9)	86(12.1)	4(19.0)
25-<30	752(9.5)	269(10.3)	59(7.2)	2(5.3)	354(9.6)	68(9.6)	0(0.0)
≥30	954(12.1)	341(13.1)	93(11.4)	3(7.9)	428(11.6)	89(12.5)	0(0.0)

Table 4: Social Security Coverage of Prevalent Pneumoconiosis Patients in the Two Areas (n=7,877)

	Sichuan (n=3468)		*Chongqing (n=4409)*		
Type of coverage	Cases	Proportion (%)	Cases	Proportion (%)	P
Work-related injury insurance	451	13.0	3,295	74.7	.000
Compensation from employer	568	16.4	1,758	39.9	.000
Basic medical insurance for urban and rural residents	3,387	97.7	4,273	96.9	.000
Other coverage	1,134	32.7	3,616	82.0	.000
No coverage / unknown	43	1.2	51	1.2	.736

4. Discussion

Since the first recognition of pneumoconiosis in the 19th century, despite the implementation of various public health measures aimed at curbing its spread, the number of newly diagnosed cases globally continues to rise at an alarming rate [11-13]. The Chinese government attaches great importance to occupational health and has integrated pneumoconiosis prevention and control into national development strategies. The Healthy China 2030 Plan outlines tasks to strengthen work safety and occupational health [10], and the 2021 National Occupational Disease Prevention and Control Plan (2021-2025) [14] repeatedly emphasises the prevention and management of major occupational diseases, including pneumoconiosis. To date, no effective cure exists for pneumoconiosis, and prevention remains the cornerstone of control. Analysing the epidemiological characteristics of pneumoconiosis is of great significance for the rational allocation of medical resources.

Our results show that in both areas, coal workers' pneumoconiosis was the predominant type (Sichuan: 75.3%; Chongqing: 83.4%), followed by silicosis (Sichuan: 23.6%; Chongqing: 16.1%), which is broadly consistent with the overall distribution reported in other domestic studies and regions [15-17] and aligns with the industrial structure of the two areas. Guangyuan, Jiulongpo, and Yongchuan were historically major coal-producing counties/districts, with mining as the primary industry. In Guangyuan, historical railway construction involving tunnel excavation generated substantial high-risk dust. Inadequate ventilation in underground mines and tunnels, high free silica content in dust, and insufficient protective measures are the main reasons for the high incidence of coal workers' pneumoconiosis and silicosis. In both areas, stage I cases accounted for the largest proportion (Sichuan: 61.2%; Chongqing: 72.6%), consistent with other reports [18, 19]. Since the stage of pneumoconiosis directly affects patients' quality of life [20], rehabilitation treatment should be actively promoted to prevent disease progression.

Significant differences were found between the two areas in mean age and age at first diagnosis, with Sichuan patients having a higher age at first diagnosis ($P < 0.001$). The dust-exposure duration of Sichuan patients was shorter than that of Chongqing patients ($P < 0.001$), yet the proportion of stage III cases was larger in Sichuan ($P < 0.001$). This suggests that regular occupational health examinations facilitate early detection and diagnosis of pneumoconiosis. Given the delayed onset of pneumoconiosis, if employers fail to fulfil their primary responsibility by not conducting pre-employment health examinations as required by law, and if workers lack awareness of occupational disease prevention, diagnosis may be postponed and the exposure-to-diagnosis interval prolonged. The age at first diagnosis for silicosis was higher than that for coal workers' pneumoconiosis, a finding that echoes previous studies [21-23]. This may be due to severe coal dust pollution in some coal mines, where dry operations and manual handling are common, jointly contributing to the high prevalence of coal workers' pneumoconiosis. Coal workers' pneumoconiosis thus remains the most critical type requiring priority prevention and control.

The median dust-exposure duration in our prevalent cases was 14 years, which is lower than that reported in several recent studies focusing on newly diagnosed cases [24-26]. Since our study included prevalent rather than incident cases, the longer exposure duration among our subjects suggests that current prevention efforts have had some effect. However, the incidence of pneumoconiosis has not been fully controlled, indicating that further efforts are needed to explore more effective prevention and treatment strategies.

In terms of social security, the overall coverage rate in Chongqing was higher than in Sichuan. Patients in Chongqing had better access to work-related injury compensation, employer compensation, and other types of coverage compared with those in Sichuan, while there was no significant difference in basic medical insurance participation between the two areas. The proportion of Sichuan patients receiving work-related injury compensation (13.0%) was notably lower than the 52.66% calculated in another study for 2022 [12]. This discrepancy may be attributed to the fact that the Regulations on Work-related Injury Insurance were only promulgated and implemented on 27 April 2003 [13]; prior to that, many relevant enterprises had already closed or gone bankrupt. At that time, due to the lack of legal provisions and limited social awareness of work-related injury insurance, both employers and employees had relatively weak awareness of insurance.

In summary, the prevalent pneumoconiosis cases in Sichuan and Chongqing are predominantly coal workers' pneumoconiosis and silicosis, mostly at stage I, with significant differences in mean age, age at first diagnosis, and dust-exposure duration between the two regions. The fight against pneumoconiosis is a long-term endeavour. We should strengthen dust hazard control in workplaces, enhance workers' awareness of occupational health protection, and curb the occurrence of pneumoconiosis at its source. At the same time, supervision and management should be further intensified, implementing the "prevention, treatment, management, education, and construction" five-pronged strategy, and increasing medical assistance for pneumoconiosis patients [27]. Given the frequent exchanges between Sichuan and Chongqing, it is recommended that the relevant departments of social public affairs management, human resources and labour security, and occupational disease prevention jointly formulate policies tailored to the prevention and management of pneumoconiosis in the two regions, so as to achieve cooperation and complementarity in medical rehabilitation and occupational disease management, and further improve the social security and quality of life of pneumoconiosis patients.

Acknowledgements

This work was supported by the Science and Technology Program of Jiulongpo District, Chongqing (Grant No. 2023-02-045-D).

References

[1] Mao L, Peng LJ, Wang HQ. Chinese expert consensus on the treatment of pneumoconiosis (2018 edition). Journal of Environmental and Occupational Medicine, 2018, 35(08): 677-689.

[2] Qi XM, Luo Y, Song MY, et al. Pneumoconiosis: current status and future prospects. Chin Med J (Engl), 2021, 134(8): 898-907.

[3] Wang D, Liang R, Yang M, et al. Incidence and disease burden of coal workers' pneumoconiosis worldwide, 1990-2019: evidence from the Global Burden of Disease Study 2019. Eur Respir J, 2021, 58(5).

[4] Xie M, Liu X, Cao X, et al. Trends in prevalence and incidence of chronic respiratory diseases from 1990 to 2017. Respir Res, 2020, 21(1): 49.

[5] The Lancet. Improving occupational health in China. Lancet, 2019, 394(10197): 443.

[6] National Health Commission releases national occupational disease prevention and control situation in 2022. Occupational Health and Emergency Rescue, 2023, 41(05): 551.

[7] The Central People's Government of the People's Republic of China. New occupational pneumoconiosis cases dropped by more than 50% in ten years; the high incidence of key occupational diseases has been curbed. [EB/OL]. [2024-11-22]. https://www.gov.cn/xinwen/2022-04/28/content_5687619.htm.

[8] Li J, Yin P, Wang H, et al. The burden of pneumoconiosis in China: an analysis from the Global Burden of Disease Study 2019. BMC Public Health, 2022, 22(1): 1114.

[9] The Central People's Government of the People's Republic of China. Notice of multiple departments on issuing the action plan for the prevention and control of pneumoconiosis. [EB/OL]. https://www.gov.cn/xinwen/2019-07/19/content_5411744.htm.

[10] Li T, Li S. Healthy China strategy and occupational health protection. Chinese Journal of Occupational Medicine, 2020, 47(05): 505-511.

[11] Shi P, Xing X, Xi S, et al. Trends in global, regional and national incidence of pneumoconiosis caused by different aetiologies: an analysis from the Global Burden of Disease Study 2017. Occup Environ Med, 2020, 77(6): 407-414.

[12] Shi P, Xing X, Xi S, et al. (same as [11]).

[13] Chen HL, Li CH, Zhai PY, et al. Survival and disease burden analyses of occupational pneumoconiosis during 1958-2021 in Huangshi city, China: a retrospective cohort study. BMC Public Health, 2024, 24(1): 1437.

[14] The Central People's Government of the People's Republic of China. Notice on issuing the National Occupational Disease Prevention and Control Plan (2021-2025). [EB/OL]. https://www.gov.cn/zhengce/zhengceku/2021-12/18/content_5661756.htm.

[15] Chen Y, Lyu XF, Chen G, et al. Utilization of whole-lung lavage and its influencing factors among pneumoconiosis patients in China, 2018-2021. Chinese Journal of Occupational Medicine, 2023, 50(01): 7-16.

[16] Wang XQ, Yuan F, Zhang HD. Epidemiological characteristics of new pneumoconiosis in Chongqing, 2016-2018. Chinese Journal of Occupational Medicine, 2020, 47(03): 379-381.

[17] Shi GM, Lei HY, Yan XY, et al. Current status and disease burden of occupational pneumoconiosis in Qinghai Province, 2015-2019. Journal of Environmental and Occupational Medicine, 2023, 40(11): 1278-1282.

[18] Qu J, Liu MX, Dou TT, et al. Retrospective survey of occupational pneumoconiosis in Shanghai, 1949-2019. Chinese Journal of Industrial Medicine, 2021, 34(04): 301-305.

[19] Jin L, Tang TT. Retrospective survey of occupational pneumoconiosis patients in Hainan Province, 1949-2019. Chinese Journal of Preventive Medicine, 2021, 22(12): 946-951.

[20] Wang T, Wang XQ, Zhang HD, et al. Analysis of factors influencing quality of life in pneumoconiosis patients in Chongqing based on structural equation modelling. Chinese Journal of Occupational Medicine, 2022, 49(06): 662-667.

[21] Luo Y, Yin Q. Incidence characteristics and trends of occupational pneumoconiosis in Fuling District, Chongqing. Modern Preventive Medicine, 2021, 48(16): 2911-2914.

[22] Zhao J, Li XR, Guo XW. Epidemiological characteristics of new pneumoconiosis in Liaoning Province, 2006-2018. Occupation and Health, 2021, 37(07): 873-877.

[23] Shi JF, Huang X, Xie BR. Analysis of dust-exposure duration and age at first diagnosis of new pneumoconiosis patients in Sanming City, 2006-2021. Occupation and Health, 2023, 39(09): 1171-1175.

[24] Guo W, Su DM, Li PQ, et al. Epidemiological characteristics of new occupational pneumoconiosis in Henan Province, 2006-2020. Chinese Journal of Occupational Medicine, 2023, 50(01): 85-89.
[25] Jiang CM, Yi JH, Sun YS, et al. Current status of new occupational pneumoconiosis patients in Zhangdian District, Zibo City. Chinese Journal of Occupational Medicine, 2023, 50(03): 330-334.
[26] Chen SP, Hu YM, Wang B, et al. Follow-up and retrospective survey of pneumoconiosis cases in a county of Ningbo City, 1974-2019. Journal of Environmental and Occupational Medicine, 2023, 40(10): 1190-1195.
[27] Chen Z, Dong XD, Bian T, et al. Research on prevention and control of occupational hazards in coal mining faces. Coal Engineering, 2022, 54(S1): 230-234.