

Analysis the Results of Control and Elimination of Coal-Burning-Borne Endemic Fluorosis in Chongqing City

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How to cite this paper: Yan, W., Xie, J., Li, X.S. and Zhou, S. (2018) Analysis the Results of Control and Elimination of Coal-Burning-Borne Endemic Fluorosis in Chongqing City. *Open Journal of Epidemiology*, 8, 145-152.

<http://dx.doi.org/10.4236/ojepi.2018.83012>

Received: July 26, 2018

Accepted: August 14, 2018

Published: August 17, 2018

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Abstract

Objective: Discuss the analysis of the results of control and elimination of coal-burning fluorosis in Chongqing, and evaluate the effect of prevention and control. **Methods:** Dean's method was used to investigate the fluorosis for the local children whose ages ranged from 8 to 12 years old, the use of improved stoves in residential households, the drying of corn and pepper for human consumption, and the results were evaluated and discussed according to the national standard for the control and elimination of coal-burning fluorosis. **Results:** The prevalence rate of dental fluorosis borne-disease in children whose ages ranged from 8 to 12 years old was about 11.28% in 661 historically diseased villages in 100 townships and in 13 districts and counties of Chongqing city. The correct utilization rates of improved stoves, qualified improved stoves, and qualified stoves were 100%, 98.82%, and 99.45%, respectively. The correct drying rates of corn and pepper for human consumption were 99.88% and 99.75% respectively. There are 24 uncontrolled villages, 225 controlled villages, and 412 villages in eliminated disease zones in administrative villages. There are 4 villages and counties in uncontrolled, 4 in controlled, and 5 eliminated areas in districts and counties. **Conclusion:** Fluorosis borne-disease caused by coal-burning in Chongqing has reached the control and elimination targets of the twelfth Five-year plan.

Keywords

Coal-Burning Fluorosis, Control and Elimination, Evaluation

1. Introduction

Coal-burning fluorosis is a systemic chronic and accumulated poisoning disease which is caused by excessive intake of fluoride through water, air, and food in a

high-fluorine environment. After nearly 30 years of health education as the forerunner, Chongqing has made general prevention and treatment in improving stoves and has achieved remarkable results. To evaluate the prevention and control effect of coal-burning fluorosis, we evaluated and eliminated the coal-fired fluorosis in our city from May to August 2015. The evaluation of the control and elimination of coal-burning fluorosis in the city is summarized as follows.

2. Objects and Methods

2.1. Survey Objects

Children whose ages were ranged from 8 to 12 years old and residents who lived in 661 coal-fired fluorosis historical villages of 100 townships from 13 districts in Chongqing were selected from May to August 2015.

2.2. Investigation Material

2.2.1. Children's Dental Fluorosis

The dental fluorosis was investigated in all children whose ages were ranged from 8 to 12 years old born locally, and the prevalence of dental fluorosis was calculated in the administrative village as a unit.

2.2.2. The Use of Improved Stoves

The use of improved stoves was to investigate the use of improved stoves in all historically endemic villages, calculate the rate of improved stoves, the rate of qualified improved stoves, and the correct utilization rate of qualified improved stoves.

2.2.3. Drying of Corn and Pepper for Human Consumption

The aim is to investigate the drying of corn and pepper for human consumption in all historically endemic villages and calculate the correct drying rate of corn and pepper for human consumption.

2.3. The Municipal Review

According to the results of the district self-inspection municipal review two districts, each district spot check 3 townships, each township spot check three administrative villages, review the dental fluorosis of all children aged between 8 to 12 years old born locally, the use of improved stoves and dry condition of corn and pepper for ten families consumption. Calculation of dental fluorosis prevalence, improved stoves rate and qualified rate of improved stoves, qualified improved stoves correct usage, for people to eat corn and chili right drying rate, compared with the districts self checking in line with the situation.

2.4. Judgment Standard

2.4.1. Control Standard

Qualified rate of improvement and correct utilization rate of stoves were over 90%; the correct drying rate of corn and capsicum for human consumption in the endemic area reached over 90%. The prevalence of fluorosis in children aged

from 8 to 12 years of age born and living locally was less than 30%.

2.4.2. Elimination Standard

Elimination of the standard qualified and improved cooking rate and the correct use rate of the stove were above 95%; the correct drying rate of corn and pepper for human consumption was over 95%; the prevalence of dental fluorosis in children aged from 8 to 12 years old who were born locally was $\leq 15\%$.

2.4.3. Elimination and Control Standards of District and County

When the villages in the endemic villages are up to the standard of the control or elimination criteria, they can be judged as having achieved or eliminated goals. When 95% of the villages in the endemic district are up to the control or elimination standard, the district can be determined to meet the control or elimination criteria.

2.5. Statistical Analysis

Statistical analyses such as dental fluorosis rate and improved stoves rate were calculated by SPSS17.0 for Windows.

3. Result

3.1. Basic Situation

A total of 661 villages, 399,314 families, 142,705 population, and 91,070 children' age ranging from 8 to 12 years old were investigated in 13 districts and counties. And 66,162 children were examined, with a rate of 72.65%.

3.2. Children with Dental Fluorosis Situation

7464 were detected from 66,162 children in the district, the dental fluorosis detection rate was about 11.28%, the fluorosis index was about 0.14, and the defect rate of dental fluorosis was about 0.29%. According to the evaluation criteria for the control and elimination of dental fluorosis administrative village for children aged ranged from 8 to 12, there are 426 villages less than or equal to 15%, and 642 villages less than or equal to 30% (**Table 1**).

3.3. Household Survey Status

3.3.1. Improved Stove Status

A total of 399,314 households of improved stoves were investigated by the county and the rate of improved stoves was 100%. The number of households with qualified stoves was 394,613, and the rate of qualified stoves was 98.82%. The number of households with compatible use was 392,441, the correct utilization rate of qualified improved stoves was 99.45%, and the actual number of recipient people was 1425,705 (**Table 2**).

3.3.2. The Dry Condition of Corn and Pepper for Human Consumption

A total of 661 villages in 100 townships, towns, and counties in 13 districts and counties were investigated. The number of villages eating corn was 344. The

number of villages eating chili was 657, and the correct rate of drying pepper for human consumption was 99.75%. There were 655 villages greater than or equal to 90%, accounting for 99.70% of the total number of food villages. There were 655 villages greater than or equal to 95%, accounting for 99.70% of the total number of food villages (**Table 3**).

3.4. Municipal Review

A total of 45 administrative villages in 15 townships and towns in 5 districts and counties were re-examined at the municipal level, and 257 villages were investigated by the county level. There were 18, 124, and 115 villages uncontrolled among the detected villages, controlled and eliminated, respectively. Municipal review since the evaluation result is not controlled villages of random number is 6, check result for control, control and eliminate the village number 6, 0, 0, respectively, at the municipal level review since the evaluation result for the control of the examined selected villages for 16, the check result is not controlled, control and eliminate the village number respectively 0, 0, 16, and self-evaluation of municipal review results to eliminate village of random number was 21, check result is not control, control and eliminate the villages number respectively 0, 0, 21, consistent with counties since the evaluation result.

3.5. Ward to Determine

According to the results of self-inspection of district and county and the review of municipal level, among 661 administrative villages in 100 towns and villages of 13 districts and counties, the prevalence rate of fluorosis teeth in children aged from 8 to 12 years old is 11.28%, the rate of improved stoves is 100%, the rate of qualified improved stoves is 98.82%, and the correct utilization rate of qualified improved stoves is 99.45%. According to the evaluation criteria of administrative village control and elimination, the number of uncontrolled, controlled and eliminated villages was 24, 225, and 412, respectively. According to the evaluation criteria of district and county control and elimination, there were 4, 4, and 5 uncontrolled, controlled and eliminated counties, respectively (**Table 4**).

4. Discussion

Under the policy of government leadership, departmental cooperation, mass participation and health education as the forerunner of improved oven in Chongqing since 1982 in Wushan we first found coal-burning fluorosis, thanks to the efforts of the department of disease control and other departments, through the process of disease detection, etiology research, furnace modification (2 times), monitoring, health education, current situation investigation and stove application research, the prevention and control work has gone through 33 years, and remarkable achievements have been made in the prevention and control work [1] [2] [3] [4]. 1) The condition of children with fluorosis teeth was gradually

Table 1. Self-inspection results of dental fluorosis in children aged ranged from 8 to 12 years old in coal-burning fluorosis areas of Chongqing.

County name	Number of towns	Number of village	Check the number of children	Detected cases	Prevalence rate (%)	Fluorosis index	Defect rate (%)	15% or less number of village	30% or less number of village
Fengjie	18	179	14,978	2309	15.42	0.18	0.50	93	179
Pengshui	16	86	10,953	346	3.16	0.04	0.22	85	86
Qijiang	3	19	1503	140	9.31	0.13	0.47	16	19
Qianjiang	16	74	11,410	471	4.13	0.05	0.16	68	73
Wansheng	2	14	1877	101	5.38	0.07	0.21	14	14
Wushan	19	177	17,410	3086	17.73	0.22	0.21	69	163
Wuxi	8	44	3182	532	16.72	0.25	0.69	22	41
Yunyang	5	31	1226	52	4.24	0.06	0.08	31	31
Nanchuan	2	3	330	38	11.52	0.12	0.00	2	3
Xiushan	3	8	399	49	12.28	0.15	0.25	4	7
Shizhu	3	7	614	48	7.82	0.12	0.16	7	7
Kanxian	2	12	1731	250	14.44	0.15	0.00	8	12
Wulong	3	7	549	42	7.65	0.09	0.00	7	7
Total	100	661	66,162	7464	11.28	0.14	0.29	426	642

Table 2. Results of self-inspection on improved stoves in Chongqing coal-burning fluorosis area.

County name	Number of villages in the ward	Population of villages in the affected areas	The number of improved stoves	Improved ovens rate (%)	The number of qualified households for improved stoves	Improved ovens pass rate (%)	The correct number of households	Correct utilization rate of qualified improved stoves (%)	The number of recipient people
Fengjie	107,314	392,868	107,314	100	104,843	97.70	104,712	99.88	392,868
Pengshui	48,621	204,844	48,621	100	48,474	99.70	48,454	99.96	204,844
Qijiang	11,731	40,017	11,731	100	11,402	97.20	11,354	99.58	40,017
Qianjiang	57,042	200,304	57,042	100	56,563	99.16	56,451	99.80	200,304
Wansheng	12,697	44,472	12,697	100	12,639	99.54	12,620	99.85	44,472
Wushan	102,280	336,299	102,280	100	101,614	99.35	99,849	98.26	336,299
Wuxi	22,537	81,076	22,537	100	22,069	97.92	22,067	99.99	81,076
Yunyang	15,382	49,355	15,382	100	15,374	99.95	15,341	99.79	49,355
Nanchuan	2328	8875	2328	100	2313	99.36	2303	99.57	8875
Xiushan	2190	8409	2190	100	2188	99.91	2188	100	8409
Shizhu	3141	10,198	3141	100	3114	99.14	3083	99.00	10,198
Kanxian	10,851	38,867	10,851	100	10,823	99.74	10,823	100	38,867
Wulong	3200	10,121	3200	100	3197	99.91	3196	99.97	10,121
Total	399,314	1,425,705	399,314	100	394,613	98.82	392,441	99.45	1,425,705

Table 3. Results of self-inspection on the drying of corn and pepper for human consumption in Chongqing coal-burning fluorosis area.

County name	Number of townships	Number of villages	Corn drying				Pepper drying			
			Number of edible villages	Correct drying rate (%)	90% or greater number of the villages	95% or greater number of the villages	Number of edible villages	Correct drying rate (%)	90% or greater number of the villages	95% or greater number of the villages
Fengjie	18	179	44	100	44	44	179	100	179	179
Pengshui	16	86	56	99.95	56	56	84	100	84	84
Qijiang	3	19	10	99.57	10	10	19	98.53	19	19
Qianjiang	16	74	38	99.00	36	35	72	98.64	70	70
Wansheng	2	14	12	99.93	12	12	14	99.44	14	14
Wushan	19	177	108	100	108	108	177	100	177	177
Wuxi	8	44	40	100	40	40	44	100	44	44
Yunyang	5	31	19	100	19	19	31	100	31	31
Nanchuan	2	3	1	100	1	1	3	100	3	3
Xiushan	3	8	4	100	4	4	8	100	8	8
Shizhu	3	7	1	100	1	1	7	100	7	7
Kanxian	2	12	9	100	9	9	12	100	12	12
Wulong	3	7	2	100	2	2	7	100	7	7
Total	100	661	344	99.88	342	341	657	99.75	655	655

Table 4. Results of comprehensive evaluation on control and elimination of coal-burning fluorosis in Chongqing.

County name	Number of township	Number of village	Uncontrolled Village number	Control the number of village	Eliminate the number of village	Determine the results
Fengjie	18	179	1	87	91	Control
Pengshui	16	86	0	1	85	Eliminate
Qijiang	3	19	0	3	16	Control
Qianjiang	16	74	4	6	64	No control
Wansheng	2	14	0	0	14	Eliminate
Wushan	19	177	15	101	61	No control
Wuxi	8	44	3	19	22	No control
Yunyang	5	31	0	0	31	Eliminate
Nanchuan	2	3	0	1	2	Control
Xiushan	3	8	1	3	4	No control
Shizhu	3	7	0	0	7	Eliminate
Kanxian	2	12	0	4	8	Control
Wulong	3	7	0	0	7	Eliminate
Total	100	661	24	225	412	

alleviated. The prevalence rates were 70.00% (1985), 51.05% (2001), 27.97% (2009), and 11.28% (2015). In 2009, there were no new cases of skeletal fluorosis in the city [5]. 2) Proper prevention and control measures. In the 1990s, more than 130,000 households completed the transformation of simple stoves in Wushan, Qianjiang and Pengshui counties. From 2004 to 2012, a total of 282,755 households in 13 disease areas and counties were engaged in fluoride-reducing back-smoke furnaces and biomass gasifiers. 3) Status monitoring of disease and prevention. Fluorosis caused by coal burning in our city has been monitored in three stages. From 1991 to 2000, dental fluorosis of children, air fluorine, and urine fluorine were mainly monitored in Wushan and Pengshui. From 2001 to 2009, the monitoring of children's dental fluorosis, air fluorine, children's urine fluorine, and improved stoves was carried out in Wushan and Qianjiang. From 2010 to the present, monitoring has been carried out in Wushan, Fengjie and Wuxi, focusing on children's fluorosis, children's urine fluorine, adult skeletal fluorosis, improvement of stoves for prevention and control, and changes in hygienic behaviors. The monitoring results showed that children's fluorosis was alleviated, children's urine fluorine was gradually decreased, no new patients with fluorosis were found, the number and quality of stoves were significantly improved, the health knowledge of endemic fluorosis was improved, and health behaviors were significantly improved [6] [7].

The results of this evaluation showed that the prevalence rate of dental fluorosis in children aged from 8 to 12 years old was 11.28%, the correct utilization rate of improved stoves, qualified improved stoves, and qualified improved used stoves were 100%, 99.82% and 99.45%, respectively, and the correct drying rates of corn and pepper for human consumption were 99.88% and 99.75%, respectively. All the indicators have reached the target of the 12th five-year plan of the state, which fully shows that after more than 30 years of prevention and control, the disease condition in the sick areas has significantly decreased, the effect of prevention and control measures in improved oven is obvious. The health behavior of the residents in the affected areas has been improved significantly, and remarkable achievements have been made in prevention and control.

It is suggested that in future prevention and control work, combined with the results of this evaluation, appropriate measures should be taken according to local conditions and classified guidance should be given to carry out appropriate improved oven, enhanced monitoring, and enhanced health education work in uncontrolled villages to promote the improvement of health behaviors of residents in the affected areas. Health education, oven maintenance and establishment of a post-management system for all-coal fluorosis in the control village to further reduce the disease; health education and a long-term mechanism for the prevention and control of coal-burning fluorosis was established to keep the elimination in the village [8] [9] [10].

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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