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Improving effect of medical sociology on health status of residents in areas of coal-burning type of endemic fluorosis in Guizhou of China

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ABSTRACT

Purpose: The aim of the study was to investigate the effect of medical sociology on the health status of residents in areas of coal-burning type of endemic fluorosis.

Methods: The investigated subjects were selected from areas of coal-burning type of endemic fluorosis in Guizhou province, China. The implementation of medical sociology involved medical education and consultation. The awareness rates and stove adaptation were examined. Fluoride contents in urine, dental fluorosis and biochemical parameters in blood were determined.

Results: The different forms of health education greatly improved residents' awareness of endemic fluorosis and made primary school students actively remind their parents to prevent fluorosis; the on-site medical consultation of senior doctors greatly enhanced the confidence of the patients with chronic fluorosis for controlling the disease. The improved awareness for the hazards of fluorosis significantly raised the rates of improved stoves and correct utilization in families of fluorosis areas, thus avoiding the pollution of fluoride to human body. After more than three years of medical sociological intervention in fluorosis areas compared with less than one year of treatment, the urine fluoride content and dental fluorosis incidence of children were significantly reduced, and the impairment of liver function, disorder of lipids, and high level of oxidative stress in blood were significantly attenuated.

Conclusions: The intervention of medical sociology greatly improves the residents' understanding of the cause, harm and prevention of the coal-burning type of endemic fluorosis, which brings an important social significance for promoting their health status.

Key-words: *Endemic fluorosis; Health education; Medical consultation; Awareness rate of the hazards of fluorosis; Health status*

INTRODUCTION

Endemic fluorosis occurs as a result of excess fluoride intake due to environmental factors and induces systemic damage to the human body characterized by a vast array of symptoms and pathological changes in addition to the typical skeletal or dental fluorosis.[1,2] The disease has been found in more than 30 countries (most of them undeveloped) around the globe, and among them China and India are severely influenced.

In China, most of provinces have distributed the areas of endemic fluorosis, including three types, e.g.,

drinking water, coal-burning and brick tea contaminations, which result in a significant problem of public health and bring the influence to 1.3 billion of population in these areas.[1,3] The coal-burning type of endemic fluorosis is a new type of endemic fluorosis occurred as a result of consuming food and air contaminated with fluoride.[4]

During 1970's, a term led by Professor Zandao Wei in Guizhou Medical University conducted an extensive epidemiological survey for endemic fluorosis in Guizhou Province of China and identified high-fluoride contaminated food rather than drinking water as the source of the disease,[5] which was later determined to be the result of environmental pollution caused by smoke from burning coal with high concentration of fluoride.[6] These areas of endemic fluorosis are located in the coalfield districts major in Southwest of China with humid environment, where the local residents are used to baking corn and vegetables by burning coal contained a high level of fluoride for food storage in the harvest season, and also burn coal for warming themselves in winter.[7] Due to years of traditional habits, local residents are used to employing stoves without chimneys, as the open stoves generate more heat. However, due to the direct discharge of soot from coal combustion into the room, the baked corn and vegetables placed indoors as well as the indoor air are polluted by fluoride, in which long-term of fluoride pollution leads the residents suffered from chronic fluoride.[1,8]

Coal-burning type of endemic fluorosis affects the total population of more than 34 million located in 13 provinces of China, including 18 million of patients with dental fluorosis and 1.5 million with skeletal fluorosis.[1] While, in Guizhou Province with total 39 million of population, more than 15 million live in the areas of coal-burning type of endemic fluorosis with 10 million suffered from dental fluorosis and 1 million skeletal fluorosis, which is the severest area of the type of fluorosis.[9,10]

Since 1980's, a great deal of comprehensive work has been carried out towards the control of the coal-burning type of endemic fluorosis in China. A research group led by professor Zandao Wei suggested that in order to prevent and control endemic fluorosis fundamentally, a variety of comprehensive treatment including medical sociology interference should be adopted to reduce the total intake of fluoride and improve the anti-fluoride ability of the population in areas of endemic fluorosis.[11] Therefore, the research team took the reform of the stoves to reduce fluoride pollution and meanwhile put forward the concept of health education to the residents in fluorosis area and implemented it since 1989.

Medical sociology, a branch of sociology, studies the relationship between social conditions and people's health and disease, and mainly concerns with the social factors in the occurrence of diseases and the social role of disease prevention.[12] Medical sociology also involves special social population in the field of medicine. Importantly, medical education for preventing endemic fluorosis has been suggested in the international field of fluoride research. For reducing the health risks arising from fluoride intake in Thailand in 2010, a hands-on educational program on the sources and risks of fluoride in water was developed and implemented in the local schools and the investigators believed that the benefits of providing safe drinking water using advanced technology could be maximized only when it comes along with a participatory educational program on fluoride sources and health risks.[13] In India, due to the high prevalence of adolescent dental fluorosis, which affects nearly two-thirds of students (mainly students in public schools) and long-term residents in fluorosis areas, some scholars suggest that health education and community awareness should be considered to prevent fluorosis in addition to the establishment of defluoridation plants.[14]

In this study, we investigated the influence of medical sociology, including health education, on-site medical consultation in local areas and household stove renovation, on the health status of residents in areas with severe endemic fluorosis caused by coal- burning. The results showed that after medical sociology intervention, the health status of the residents in the epidemic fluorosis area was obviously improved..

MATERIAL AND METHODS

Selection of residents in areas of endemic fluorosis and non-fluorosis

Shuicheng and Qixingguan counties in Guizhou Province of China have the most serious areas polluted by coal-burning type of endemic fluorosis in the world. The residents living in the endemic fluorosis areas in Shuicheng county (as Area I) and Qixingguan county (as Area II) were selected as research objects. The residents of non-fluoride-affected areas in Guizhou Province were selected as the control group. The cross-sectional investigation involved about 224,000 residents in these areas.

For studying incidence of dental fluorosis, children aged 8-12 years old were selected. For evaluating the effect of comprehensive control of fluorosis in different periods, the residents in endemic fluorosis areas with more than 3 years of medical sociology intervention and those with less than 1 year of treatment were selected, respectively. At the same time, the residents in non-fluorine-affected areas were selected as controls.

Comprehensive strategy involving medical sociology for eliminating the hazard of coal-burning type of endemic fluorosis

The strategy of medical sociology intervention included the activities of health education, on-site health and disease consultation and setting up adapted stoves for the residents in fluorosis-affected areas.

Health education to the residents were mainly implemented by the local Centers for Disease Control and Prevention of Guizhou Province, with the participation of Guizhou Medical University. Spray paintings (more than 1000 copies) with the core information of fluorosis prevention were designed and pasted in the prominent public spaces of endemic fluorosis areas. Annual calendars, shopping bags and home kitchen aprons (more than 5,000 sets, respectively) with pictures of fluoride hazards and prevention measures were designed and given to individual families and housewives. Brochures and optical disk (more than 20,000 copies, respectively) were designed with where the fluoride comes from, how it enters the body and causes body damage, and how it can be prevented and treated, which were distributed free of charge to residents of fluoride-affected areas. Specially, an album of painting (more than 20,000 copies) was designed for primary school students to read with the easy-to-understanding pictures and reading text concerning the source of fluoride, dental and skeletal fluorosis of children, and prevention and treatment, which were distributed for free to students in primary school. In addition, special lectures on the knowledge of fluorosis for the residents and primary school students were provided by professional presenters.

For the on-site health and disease consultation, we organized the senior doctors from internal medicine, surgery, pediatrics, obstetrics and gynecology, imaging, and stomatology in the first-class hospitals in Guizhou Province to conduct medical consultation, disease treatment and health education for the residents in the areas of endemic fluorosis, which were held several times for many the years with more than 600 residents attending each time. In particular, specific precise consultations were given to the patients with chronic fluorosis for why they were suffered from chronic fluorosis, what the manifestations were, and how to prevent and treat the disease.

In order to reduce the fluoride pollution from coal combustion indoors, the adapted stoves with gas ducts were designed and used to exhaust fluoride-rich soot outside. Meanwhile, we guided the residents in the areas to dry corn or chili under the sunlight or in the separate baking rooms to avoid soot pollution by fluoride during the coal-burning.

Questionnaire survey and individual interview

The forms for the questionnaire were designed to be easily identified and mastered. These investigators had been specially trained for surveys of the indoor or the sites of activities of the residents with questionnaires and interviews before they carried out the work.

The formula for calculating the awareness rate of endemic fluorosis prevention and control related knowledge is: sum of correct rate/(number of interviewers x number of questions answered per capita).

Medical evaluation for the health status of human body after comprehensive treatments

For evaluating the intervention effect of medical sociology on the endemic fluorosis, we organized large number of multidisciplinary researchers in basic and clinical medicine and local medical staff to participate in epidemiological investigation and measurement of health-related biochemical parameters.

The health examinations concerned physical signs, including fluoride contents in urine determined using a CSB-FI fluoride-ion electrode;[15] dental fluorosis detected by observation with its characteristic in clinic;[16,17] biochemical parameters in blood detected by biochemical analysis,[18] including the activities of alanine aminotransferase (ALT), aspartate aminotransferase (AST), superoxide dismutase (SOD), catalase (CAT), and glutathione-S-transferase (GST); infection rate of hepatitis B virus (HBV) and the contents of total cholesterol (TC), triglycerides (TG) and high-density lipoprotein (HDL), and malonaldehyde (MDA).

Statistical analysis

The results were expressed as percentage (%) or means□standard deviation (SD) of the values for different groups. These percentage and means were examined for statistically significant differences employing Chi-square (χ^2) test and analysis of variance (ANOVA) followed a post-hoc test of least significant difference, respectively, by using SPSS 27 software (SPSS Inc., USA). The statistical significance was determined by considering *P*-values below 0.05.

RESULTS

Publicity effect of various types of health education in areas of coal-burning type of endemic fluorosis

As shown in Table 1, different forms of health education had their own characteristics with optimal effects. These health education activities were highly valued by local residents with 85.0-96.5% approval rates. The local residents realized the harm of chronic fluorosis and knew how to prevent and control the disease.

Influence of medical consultation on residents in areas of coal-burning type of endemic fluorosis

More than 97% of the residents on the on-site believed that the medical consultation by these senior doctors was very important and made them fully understand the harm of fluoride poisoning (Table 2). In particular, through face-to-face medical consultation, the residents (more than 91%) could fully realize their health status and the harmful degree of chronic fluorosis. The medical consultations and drug treatments (the doctors provided some of the drugs for treating common ailments of fluorosis free of charge) strongly increased the confidence of the patients (more than 84%) with endemic fluorosis that the disease could be alleviated.

Awareness rates of residents for the origin and prevention of fluorosis in areas of coal-burning type of endemic fluorosis

Awareness rates of the households for the origin, and prevention and treatment of fluorosis were obviously raised from 19.3-28.3% to 81.7-82.1% after taking 3 years of health education (Table 3). In addition, the awareness rates of students in primary school were increased from 14.1-31.3% to 95.9-98.7%.

Stove adaptation and proper use after medical education in areas of coal-burning type of endemic fluorosis

An improved stove with a sealed form and a pipe for discharging the gas out of the room was designed for suitable use in areas of coal-burning type of endemic fluorosis. Through years of health education, more than 92.2% of households in fluorosis areas adopted the improved stoves instead of their traditional ones, and more than 98% could correctly use the improved stoves (Table 4).

Fluoride contents in urine and dental fluorosis of children in areas of coal-burning type of endemic fluorosis

The fluoride contents in urine from children were significantly declined about 4 folds after many years of comprehensive treatment (Table 5). In addition, prevalence of dental fluorosis from 2001-2015 in the severe areas of coal-burning type of endemic fluorosis was greatly declined after 14 years of comprehensive treatment (Table 5).

Health status involving biochemical parameters in blood of the residents in areas of coal-burning type of endemic fluorosis as compared to controls

Table 6 showed that after medical sociological intervention, the blood parameters of the residents in endemic fluorosis areas tended to be significantly improved although the blood parameters of the residents in endemic fluorosis areas still present a significant difference compared to those in non-fluorosis areas. For the residents living in the areas of endemic fluorosis with 3 years of medical sociology intervention as compared to the group with less than one year of treatment, the rates of HBV infection, and the activities of ALT and AST (the parameters indicating hepatic function) in serum were significantly decreased; the declined TC and raised HDL (but TG) were found; for the level of oxidative stress, the activities of SOD, GST and CAT were increased, and MDA was decreased (Table 6).

Table 1. Evaluations of the residents with different forms of health education propaganda in the areas of coal-burning type of endemic fluorosis

Contents	Favorable rate (No. of residents)	Evaluating the effects
Posters with spray paintings	86.9% (6217/7154)	In the most visible places, the spray paintings always reminded the residents with the dangerous fluorosis.
Calendars, shopping bags and aprons	85.0% (3886/4572)	When doing housework at homes and shopping in the stores, the publicity about the harm of fluoride and how to prevent it was obvously present.
Brochures	91.1% (6322/6936)	A lot of reading with more detail knowledge of fluorosis and its prevention and treatments were provided.
Optical disk	85.8% (417/468)	Combination of illustrations and appreciation enhanced the interest in learning the knowledge of fluorosis.
Album of painting	96.5% (1873/1942)	The picture was vivid and attractive, and the text description was simple and easy to understand, which matches the picture.
Lecture	88.6% (4109/4636)	It was convenient for easy to understand and free to ask questions

Table 2. Evaluations of the residents for medical consultation by the doctors in the areas of coal-burning type of endemic fluorosis

Contents	Favorable rate (No. of residents)	Effects
Importance of the medical consultation	97.7% (387/396)	Providing medical consultation to residents in fluorosis areas by senior doctors in high level of hospitals was greatly conducive to the prevention and control of endemic fluorosis.
Understanding for endemic fluorosis	91.4% (362/396)	The face-to-face medical consultation significantly improved the local residents' awareness of the hazards of endemic fluorosis and their own health status and the degree of harm.
Attitude of prevention and treatment of endemic fluorosis	84.5% (335/396)	Medical consultations and some drug treatments increased the confidence of the patients with endemic fluorosis that the disease could be alleviated

Table 3. Awareness rates of the residents for knowledge relating etiology, and prevention and control of fluorosis in areas of coal-burning type of endemic fluorosis

Areas	Subjects	Comprehensive treatment		Chi-square (χ^2) test and *P* value	
		<One year	>Three years		
Area I	Households	28.3% (n=248)	81.7% (n=4394)	8.13	*P*<0.01
	Students	31.3% (n=555)	95.9% (n=632)	13.33	*P*<0.01
Area II	Households	19.3% (n=290)	82.1% (n=2760)	9.43	*P*<0.01
	Students	14.1% (n=7603)	98.7% (n=25052)	20.80	*P*<0.01

Notice: *P* value presents the comparison between one year of comprehensive treatment and 3 years.

Table 4. Conditions of improved stoves and proper use by households in areas of coal-burning type of endemic fluorosis

Areas	Total households (n)	Improved rate % (n)	Correct use rate % (n)
Area I	21363	92.2 (19697)	98.7 (21085)
Area II	28220	98.8 (27881)	98.0 (27644)

Table 5. Fluoride content in urine and dental fluorosis of children from 8-12 years old in areas of coal-burning type of endemic fluorosis

Areas	Year	Examined children (n)	Mean±SD
		Fluoride content in urine (ppm)	
Area I	2001	293	3.29±0.81
	2013	352	0.84±0.47**
Area II	2001	236	3.95±2.74
	2013	399	0.94±0.66**
		Rates of dental fluorosis	
Area I	2001	9251	72.9% (6745)
	2015	32847	13.1% (4316)##
Area II	2001	585	96.59% (565)
	2015	72877	22.2% (16179)##

Notice: **P<0.01 in comparison to the values in 2013; ##P<0.01 (χ^2=36.85 and 15.74, respectively) in comparison to the values in 2015.

Table 6. Medical indicators in blood to assess health status

Parameters	Controls (n=143)	Comprehensive treatment	
		<One year (n=333)	>Three years (n=412)
Rates of HBV infection (%)	28.67%	49.24%** (X^2=17.28)	39.32%*# (X^2=5.19 and 7.37)
ALT (IU/l)	20.05±9.91	39.82±13.55*	28.69±10.51*#
AST (IU/l)	15.05±7.06	40.58±15.54*	30.24±13.01*#
TC (mmol/l)	3.97±1.80	6.50±3.50*	6.04±3.17*#
TG (mmol/l)	1.25±0.97	2.96±1.5*	2.88±1.55*
HDL (mmol/l)	1.15±0.67	0.59±0.34**	0.89±0.52*#
SOD (U/l)	58.57±27.20	40.29±15.93*	49.25±10.41*#
GST (kU/l)	24.31±6.27	12.44±4.97**	20.78±6.20*#
CAT (U/ml)	4.08±1.88	2.14±1.61**	3.36±1.99*#
MDA (nmol/ml)	4.38±0.86	6.42±1.13**	5.06±1.02**#

Notice: HBV: hepatitis B virus; ALT: alanine aminotransferase; AST: aspartate aminotransferase; TC: total cholesterol; TG: triglycerides; HDL: high-density lipoprotein; SOD: superoxidative dismutase; GST: glutathione S-transferase; CAT: catalase; MDA: malondialdehyde. *P<0.05 and ** P<0.01 in comparison to the control subjects; #P<0.05 in comparison to the group with less than one year of comprehensive treatment.

DISCUSSION

One important research aspect of medical sociology involves the policy of medicine and health, specific regional-health related organizations and groups, and the correlation of medical services with population health. If successful programs are to be developed to prevent disease and improve health, attention must be given not only to the behavior of individuals, but also to the environmental context within which people live.[19] Since endemic fluorosis is extensively prevalent in specific regions, affects certain groups of people and brings a complicated problem in the world, how to prevent and control the disease has attracted international attention.[20,21] In recent years, a bio-psycho-social model has integrated various factors related to disease in human life, indicating that the occurrence of disease is related to human biological abnormalities, physiological and psychological disorders, and social behavior dissonance.[22,23] In fact, the occurrence of endemic fluorosis is just the result of the abnormal operation of this model, involving multiply influencing factors such as the human body, environment and society.

During recent decades in China, a great deal of work concerning medical sociology has been performed towards the control of endemic fluorosis.[3] At the beginning, in addition to clinical treatment, the prevention and control of endemic fluorosis caused by coal burning mainly focused on using the strength of local governments and related organizations to transform household stoves. The open stoves got used to by the local inhabitants are converted into the sealed ones, allowing the smoke containing high amount of fluoride produced by burning coal to be emitted outdoors through a stovepipe and therefore reducing the contamination of fluoride.[24] However, since the areas of coal-burning type of endemic fluorosis mostly locate in Southwest of China, the economic underdeveloped districts of the country,[1] the residents living in these areas are often poverty and

backwardness with low level of education and poor health consciousness, which brings great difficulties to the prevention and control work. Many residents of these areas did not easily change their living habits and still preferred to use the old-fashioned stoves because they felt that the power of the converted stoves was not enough to cook, bake corn and vegetables, and keep warm indoors in the winter. Actually, we had seen that the improved stoves invested by the local government in endemic fluorosis areas were abandoned by some of the residents in fluorosis areas. In addition, poor economic conditions are a big problem for disease prevention. Because controlling coal-burning fluorosis involves spending money to rebuild the improved stoves, many residents could not afford it. Furthermore, some residents of endemic fluorosis areas mistakenly believed that fluorosis could not be incurable and irreversible, so they did not take any preventive measures and went to hospital for treatment despite getting sick from fluorosis. Therefore, these problems have greatly hindered the prevention and control work for endemic fluorosis.

To solve these problems, it is difficult to rely on the medical system alone, and the medical sociology function must be involved. Therefore, carrying out health education to improve awareness of residents in fluorosis areas had been pointed out,[11] so that the residents could fully understand the harm of fluorosis and urge them to change their unsuitable living habits. If the residents believed that endemic fluorosis was really dangerous for their health and families, and could be efficiently controlled, they would like to take on their own initiative to prevent the disease. The researchers from Thai[13] and Indian[14] especially emphasized that health education can provide the best effect for controlling fluorosis and is a beneficial factor for the population in fluoride-affected areas, which is the same suggestion as our view.

In the study, a series of educational activities did bring a clear impact on the residents in area of coal-burning type of endemic fluorosis, presenting the increased awareness for the hazards of fluorosis and the enhanced confidence in prevention and clinic treatment of the disease. Among these educational activities, posters observed at the most visible places always reminded the hazard of fluorosis; calendars, shopping bags and aprons at any time during housework or shopping indicated the dangers of fluoride and how to prevent it; brochures provided more detail knowledge of fluorosis; optical disks with the combination of illustrations and pictures let you have a stronger viewing interest in fluoride hazards and prevention content; album of painting was vivid and attractive, giving the children with the simple and easy understanding description to be remembered; while, lectures were so easy to understand and could be free to ask questions. As the results of the series educations, health consciousness and the concept of disease prevention and control of the residents were greatly enhanced. Indeed, the students, who knew the dangers of fluorosis, often reminded their parents to pay more attention to prevent the pollution and harm of fluoride and see doctor if they had symptoms of chronic fluorosis.

Importantly, medical consultations achieved a clear success, as direct communication between patients and doctors had led to greater trust among the local residents and increased their confidence in the prevention and treatment of fluorosis. The current medical model has been transitioned from the original biomedical treatment model to a bio-psycho-social model in modern society, where patients now have higher demands for service awareness.[25] This way of doctors serving patients on the spot in the endemic fluorosis areas integrates the connotation of sociology for medical service.

After many years of effort, the rates of stove adaptation and the numbers of stoves correctly used in the local families of the areas of coal-burning type of endemic fluorosis were significantly increased. On the other hand, the high rates of installation of improved stoves and their correct use provided a strong basis for the benefits of health education. The control campaign has resulted in a significant decrease of fluoride contamination in food and air.[26] Therefore, comprehensive treatment has brought greatly improved effects on the clinic signs of the patients with chronic fluorosis.

Fluoride contents in urine of children in the fluorosis area were significantly declined after many years of the medical sociology intervention, suggesting that the amount of fluoride entering the body is greatly reduced. In addition, it is obvious to see the significantly preventive effect of comprehensive control by observing dental fluorosis of children. In a previous study, about 97% of children living in areas of coal-burning type of endemic fluorosis in Guizhou Province were identified with dental fluorosis.[27] In the study, we observed that the incidence of dental fluorosis in children in the fluorosis area decreased from more than 72% to less than 23% after years of comprehensive control. Excessive fluoride only gets into the teeth in the development of mineralization period and therefore dental fluorosis happens before 6 or 7 years old. Therefore, the decreased dental fluorosis of children indicated that the amount of fluoride entering the body through coal-burning pollution was significantly reduced, providing evidence for weakened damages of fluorosis on the body resulted from medical sociology intervention strategy.

Although there was still an obvious difference in the levels of biochemical parameters in the residents living in the endemic fluorosis areas compared to these of non-fluorosis area, their health status had been significantly improved after medical sociology

intervention. In clinics, the rate of HBV infection and the activities of AST and ALT are commonly used to reflect the functional damage of the liver cells.[28] Here, we observed that the decline in the rate of HBV infection, and the activities of AST and ALT in serum of the residents in the endemic fluorosis areas with long-period of comprehensive treatment as compared to short time of treatment, indicating that the comprehensive control for long-period could recover the damages of liver function induced by chronic fluorosis.

The increased levels of TC and TG as well as decreased HDL in blood were reported with correlation to the exposure of fluoride.[29] In the present study, long-period of comprehensive control, instead of short-period, could prohibit the tendency of raised TC and decreased HDL in the residents living in the endemic fluorosis areas.

Since endemic or chronic fluorosis involves damage to many organs and systems,[30,31] a hypothesis was suggested that the increased level of oxidative stress may be the main mechanism in the pathogenesis of chronic fluorosis.[32] After then, more evidence to support the hypothesis, e.g., the increased lipid peroxidation, and the decreased antioxidant enzymes (such as SOD, GSH-px and CAT) and antioxidant materials (such as GSH and ubiquinone).[33,34] The results of this study showed that long-period of comprehensive treatment significantly attenuated the elevated level of oxidative stress caused by fluorosis, suggesting that the improvement of health status may be related to the result of medical sociological intervention.

Endemic fluorosis concerns a multi-factor fusion problem in medical science. Although the etiology, pathological changes, and individual clinical treatment of endemic fluorosis may be simple medical problems, the occurrence mechanism, and prevention and control of the disease are complex social problems. On the other hand, endemic fluorosis is also a major problem to be solved in the field of public health and most residents in the areas live in relative poverty, in which the phenomenon of poverty due to illness is serious. An important aspect of addressing the hazards of endemic fluorosis included: priority on a population-based and preventive focus; concentration on poorer, vulnerable, and underserved populations; multidisciplinary and interdisciplinary approaches.[35] The study categories related to medical sociology for coal-burning type of endemic fluorosis involves the overall management and financial support of the government for the regional disease, the overall regulation and control of pathogenic causes in the affected areas by relevant departments, the body damage and mechanism of the disease by scientific research group, and the understanding and cooperation of the regional population on the prevention and control of the disease. Therefore, the sustainable prevention and control of coal-burning type of endemic fluorosis should be the further research direction combining medical sociology and medicine.

As the prevention and control of endemic fluorosis caused by coal burning is a long-term and arduous project, we will focus on the prevention of fluoride-affected areas to carry out more extensive publicity. In addition, we will add more evaluations on the effect of comprehensive prevention and control of coal-burning type of endemic fluorosis in the population array as a broader cross-sectional study, with special selection of children and elderly cases for examination.

In addition, it is still important to promote the prevention and control of endemic fluorosis from the perspective of medical sociology. We recommend considering the following measures. 1. Targeted education: designing educational content for different groups (such as children, pregnant women, the elderly) to ensure that the information is easy to understand and accept. 2. Social support and resource allocation: calling for relative policy and unceasingly financial support to ensure the effective implementation of prevention and control measures. 3. Multi-sectoral collaboration: pushing the government, medical, environmental protection, education and other departments to work together to promote the prevention and control work. 4. Improvement of the monitoring system: regularly monitoring the prevalence of fluorosis and evaluating the effect of prevention and control measures. Through these comprehensive measures, the ultimate goal of completely eliminating coal-burning type of endemic fluorosis could be achieved.

CONCLUSIONS

This study established an effective model with medical sociology intervention for the prevention and control of coal-burning type of endemic fluorosis. The implementation of various forms of health education was a necessary step to raise awareness of the residents for the occurrence and harm of endemic fluorosis. The improved awareness of primary school students for the disease had a positive help to actively remind their parents for prevention of fluorosis. The medical consultation and service provided by senior clinic doctors at the on-site of fluorosis areas greatly enhanced the confidence of the patients with the prevention and control of chronic fluorosis. Under the influence of medical sociology, high rates for the improved stoves and correct utilization to avoid fluoride pollution were obtained. After more than three years of medical sociology intervention in endemic fluorosis areas compared with less than one year of treatment, the fluoride content in urine and the dental fluorosis incidence of children were significantly reduced, and the impairment of liver function,

disorders of lipids, and high level of oxidative stress in blood were significantly attenuated. The results indicate that intervention of medical sociology greatly improves the residents' understanding of the cause, harm and prevention of the coal-burning type of endemic fluorosis, which brings an important social significance for promoting their health status.

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CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

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