Status and Prevention and Control strategy of Endemic Arsenism in China

YINLONG JIN
Professor / Director
Institute of Environmental Hygiene and Health Production Safety, CDC, China
I. Background

Endemic arsenism is usually caused by excess arsenic intake from high arsenic drinking water, high arsenic air and high arsenic foods for a long time. The endemic arsenism was firstly found in Xinjiang in China in 1983, it was identified as a new endemic disease by our government in 1992, and has been listed into the national prevention and control plan of priority disease.

Up to now, the population exposed to arsenic has exceeded 2 million and the patients diagnosed has been up to 20,000. China is a new large arsenism country followed India and Bengal. Endemic arsenism in China is one of very important health problems faced in this century.
II. Characteristics of endemic arsenism in China

- Widely distributed and has an expanding trend
- Located in some poor and underdevelopment areas of Midwest in China
- Multiple types such as drinking-water type, coal-burning type and others were involved
- High arsenic and high fluoride simultaneously existed in some areas

III. Status of endemic arsenism in China

Distribution of arsenic concentration in drinking water in Inner Mongolia

The arsenic concentrations of 46% wells exceeded the national standard for drinking water among 303 wells investigated, they mainly were 0.1-0.5 mg/l which accounted for 34%.
Distribution of Arsenic concentration in drinking water in Shanxi Province

The arsenic concentrations of 33% wells exceeded the national standard for drinking water among 2,364 wells investigated.

Distribution of arsenic concentration in drinking water in one village in Xinjiang

The arsenic concentrations of 141 wells investigated in one village all exceeded the national standard for drinking water and mainly were 0.05-0.2mg/L, which accounted for 74%.

Comparison of endemic arsenism in three high water arsenic regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Population Investigated</th>
<th>Prevalence Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner Mongolia</td>
<td>15,147</td>
<td>18.54</td>
</tr>
<tr>
<td>Shanxi</td>
<td>51,278</td>
<td>11.50</td>
</tr>
<tr>
<td>Xinjiang</td>
<td>50,760</td>
<td>5.04</td>
</tr>
</tbody>
</table>
The relationship between arsenic concentrations of drinking water and prevalence rates of arsenism in Xinjiang

As concentration of drinking water

The prevalence rates of arsenism in residents were increased with the increasing of the arsenic concentrations of drinking water.

The relationship between arsenic concentrations of drinking water and abnormal rates of arsenic in human urine

Standard for urine arsenic is < 0.1 mg/L

The abnormal rates of arsenic in human urine were increased with the increasing of the arsenic concentration in drinking water.
The relationship between years of drinking high arsenic water and the prevalence rates of endemic arsenism in Xinjiang

The longer high arsenic water drunk, the higher prevalence rate of the endemic arsenism occurred.

Patients with pigmentation

Patients with pigmentation
Patients with hyperkeratosis

Skin cancer

The distribution of coal-burning type arsenism in Guizhou province

1 nature village
Exposure population 190
Patients 56

54 nature villages
Exposure population 20,981
Patients 1,919

19 nature villages
Exposure population 6,146
Patients 214

29 nature villages
Exposure population 18,082
Patients 420

Patients with hyperkeratosis

Skin cancer

The distribution of coal-burning type arsenism in Guizhou province

1 nature village
Exposure population 190
Patients 56

54 nature villages
Exposure population 20,981
Patients 1,919

19 nature villages
Exposure population 6,146
Patients 214

29 nature villages
Exposure population 18,082
Patients 420
Coalmine

Coal with high arsenic

Black wall

Stove

Coal burning
The arsenic content of coal in the arsenism counties of Guizhou province

<table>
<thead>
<tr>
<th>county</th>
<th>Arsenic content of coal (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xingyi</td>
<td>265 ± 352</td>
</tr>
<tr>
<td>Anlon</td>
<td>418 ± 530</td>
</tr>
<tr>
<td>Xingren</td>
<td>624 ± 852</td>
</tr>
<tr>
<td>Zhijin</td>
<td>2,167 ± 58</td>
</tr>
</tbody>
</table>

The arsenic contents in roasted corn and chili in the arsenism counties of Guizhou province

<table>
<thead>
<tr>
<th>county</th>
<th>Arsenic contents (mg/kg)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>corn</td>
<td>chili</td>
</tr>
<tr>
<td>Xingren</td>
<td>4.1 ± 2.8</td>
<td>512 ± 300</td>
</tr>
<tr>
<td>Anlong</td>
<td>6.7 ± 11.9</td>
<td>688 ± 586</td>
</tr>
<tr>
<td>Xingyi</td>
<td>7.0 ± 12.5</td>
<td>693 ± 545</td>
</tr>
<tr>
<td>Zhijin</td>
<td>43.6 ± 16.3</td>
<td>610 ± 77</td>
</tr>
</tbody>
</table>

The higher arsenic concentrations of coal, the higher arsenic content in roasted food, especially in roasted chili.

Roasted pork and corn
### Comparison of As contents in environmental media between before and after stove improved in Guizhou Province

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal (mg/kg)</td>
<td>524 ± 602</td>
<td>324 ± 150</td>
</tr>
<tr>
<td>Indoor air (mg/m^3)</td>
<td>0.26 ± 0.09</td>
<td>0.06 ± 0.03</td>
</tr>
<tr>
<td>Rice (mg/kg)</td>
<td>0.41 ± 0.26</td>
<td>0.26 ± 0.11</td>
</tr>
<tr>
<td>Roasted corn (mg/kg)</td>
<td>4.13 ± 2.76</td>
<td>0.56 ± 0.32</td>
</tr>
<tr>
<td>Roasted chili (mg/kg)</td>
<td>512 ± 300</td>
<td>46.43 ± 159.58</td>
</tr>
<tr>
<td>Drinking water (mg/l)</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Fresh vegetables (mg/kg)</td>
<td>0.02</td>
<td>0.02</td>
</tr>
</tbody>
</table>

### Comparison of human exposure between before and after stove improved in Guizhou Province

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population investigated</td>
<td>8,958</td>
<td>20,981</td>
</tr>
<tr>
<td>Arsenic content in urine (mg/l)</td>
<td>0.95 ± 0.53</td>
<td>0.11 ± 0.01</td>
</tr>
<tr>
<td>Total intake (mg/day/person)</td>
<td>4.76 ± 2.24</td>
<td>1.12 ± 1.23</td>
</tr>
<tr>
<td>Occurrence rate of arsenism (%)</td>
<td>17.3</td>
<td>9.1</td>
</tr>
<tr>
<td></td>
<td>(1,548/8,958)</td>
<td>(1,919/20,981)</td>
</tr>
</tbody>
</table>
So far, only some provinces (municipalities) such as Inner Mongolia, Shanxi, Xinjiang and Guizhou have been investigated on endemic arsenism, while how many population exposed to arsenic and number of endemic arsenism were still not known in the whole country. So we started to carry out a national survey on the distribution of endemic arsenism in 21 provinces in 2001.

IV. A national investigation on the distribution of endemic arsenism in China

1. Selection of survey region

16 provinces and cities were chosen for investigation on drinking-water type arsenism according to historical water monitoring data and 5 provinces and cities for investigation on coal-burning type arsenism according to contents of coal arsenic.

2. Investigation contents

- Demography
- Type of water sources
- Economy status
- Type of fuel
- Water supply moods
- Type of main foods and vegetables

Collection of data
3. Expecting results

I. Map of distribution of drinking-water arsenism

? . Map of distribution of coal-burning arsenism

? . Map of distribution of endemic arsenism
V. Problems

- Lack of low arsenic water sources
- Lack of low arsenic coal in arsenism areas
- High arsenic and high fluoride existed simultaneously
- Economic underdevelopment in arsenism areas
- The cancer morbidity will increase in the future 10 years

VI. Strategy of prevention and control

Coal-burning type
* To develop cleaning fuel
* To improve stoves and ventilation system
* To study new substitute energy resource

Drinking-water type
* To move water from south to north of China (650 million RMB)
* To find low arsenic water sources
* To develop equipments for removing arsenic

* To enhance health education to increase public awareness of the arsenism
* To increase invest from government
* To develop international cooperation and exchange