

Research of Iodine Nutrition Levels in Akto County, Xinjiang, China from 2009 to 2014

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Abstract

Objective: To understand the effect of prevention and control of iodine deficiency disorders with iodized salt in Akto County, Xinjiang, China, to provide a scientific basis for formulating effective method of prevention.

Methods: Sampling survey was conducted in Akto County in 2004, according to National Key Survey Scheme in High-risk Areas.

Results: The median of the iodized salt was 32.8 mg/kg in 2004, with intake rate of qualified iodized salt of 100% in the residents. Goiter rate of the children was 22.0% by palpation, and 10.0% by B-ultrasound, with the coincidence rate of 66.8%. Compared with those in 2014, there were statistical differences ($P<0.05$) in children's goiter rate by palpation ($\chi^2=86.10$) and B-ultrasound ($\chi^2=28.03$) in 2009. While statistical difference in urine iodine levels of children was also found between 2009 and 2014 ($t=5.58$, $P<0.005$).

Conclusion: Universal coverage of iodized salt is an effective way to control IDD.

Keywords: Iodine nutrition; Iodized salt; Evaluation

Introduction

Since the second half year of 2007, the people's government of Xinjiang Uygur Autonomous Region implemented control strategy of IDD by freely delivering iodized salt to people in poverty in southern Xinjiang. After the implementation for several years, the effect of iodized salt intake for IDD prevention was evaluated comprehensively in 2009 and 2014 respectively. This paper reports the results as follows.

Materials and Methods

Research method and objects

Sampling method According to Scheme of Key Survey Program in High-risk Areas in Xinjiang, and records of previous data, severely epidemic areas of IDD were sampled randomly in Xinjiang, China. And out of one city and three counties in Kizilsu Kirgiz Autonomous Prefecture, Akto County was sampled to carry out research of epidemic situation of IDD. On basis of national surveillance program of iodized salt, 5 townships (towns) were sampled at random in five directions (north, south, west and east), and 4 villages were selected in each township (town). Fifteen samples of iodized salt were collected to detect iodine content in each village.

Objects Out of the five townships, 240 children aged 8 to 10 years were sampled in each village to determine goiter by palpation and B-ultrasound. Meanwhile, their urinary samples were collected for urine

iodine analysis (there is relevance between the sampled children and the families).

Determination method

Direct titration method in GB/T 13025-1999 was taken to detect iodine content in iodized salt, and As-Ce catalytic chromatographer in WS/T 107-2006 to determine urinary iodine content.

Statistical analysis

Spss 13 was taken for statistical analysis. Numeration data were compared with chi-square test and measurement data with t-test.

Results

Iodized salt

In 2009, 288 samples of table salt were collected, including 287 samples of iodized salt and 1 sample of non-iodized salt, accounting for 0.4%, with median of iodized salt of 22.9 mg/kg, intake rate of qualified iodized salt of 87.2%. In 2014, out of the 300 samples of the table salt, all were the iodized salt, with the median of 32.8 mg/kg and the intake rate of the qualified iodized salt of 100%. There were statistical differences in coverage rate of iodized salt and intake rate of qualified iodized salt between 2009 and 2014 ($\chi^2=4.59$, $P<0.05$, Table 1).

| Year | Detected Samples | Median (mg/kg) | Rate of non-iodized salt (%) | Unqualified rate (%) | Iodized salt (%) | | |
|-------|------------------|----------------|------------------------------|----------------------|------------------|----------------|------------------------------|
| | | | | | Coverage rate | Qualified rate | Intake rate of the qualified |
| 2009 | 288 | 23 | 0.4 | 13 | 100 | 87.5 | 87.2 |
| 2014 | 300 | 33 | 100 | 5.2 | 96 | 95.8 | 100 |
| Total | 576 | 27 | | | | | |

Thyroid detection

In 2009, 240 children aged 8 to 10 years were detected by palpation, with goiter rate of 55.00%, including 21 cases of grade II. And 242 children were examined by B-ultrasound, with the goiter rate of

32.10%. The coincidence rate of the two was 66.8%. The results showed that the epidemic situation of IDD in Akto was severe in 2009. In 2014, the goiter rate of 240 children was 2.08% by palpation and 0.83% by B-ultrasound, with the coincidence rate of 73.6%. There were statistical differences in goiter rates by palpation ($\chi^2=83.06$) and B-ultrasound ($\chi^2=25.03$) between 2009 and 2014 ($P<0.01$, Table 2).

| year | Palpation | | | | | B-ultrasound | | |
|-------|--------------|------------|---------|----------|-----------------|--------------|------------|-----------------|
| | Detected No. | Goiter No. | Grade I | Grade II | Goiter rate (%) | Detected No. | Goiter No. | Goiter rate (%) |
| 2009 | 240 | 132 | 56 | 21 | 55 | 240 | 77 | 32.1 |
| 2014 | 240 | 5 | 5 | 0 | 2.08 | 240 | 2 | 0.83 |
| Total | 480 | 137 | 61 | 21 | 28.54 | 480 | 79 | 16.46 |

Table 2: Survey results of goiter rate of children aged 8 to 10 years in 2009 and 2014.

Urine iodine detection

In 2009, 238 urinary samples were collected, with the median of 287.76 $\mu\text{g/L}$, and 7.6% less than 100 $\mu\text{g/L}$. In 2014, there were also 238

urinary samples detected with the median of 108.40 $\mu\text{g/L}$, and 25.2% less than 100 $\mu\text{g/L}$. There was statistical difference in urine iodine content between the two years ($t=5.65$, $P<0.005$, Table 3).

| Year | Investigated No. | Median ($\mu\text{g/L}$) | Frequency of urine iodine (samples, %) | | | |
|-------|------------------|----------------------------|--|-------------------------|--------------------------|----------------------|
| | | | $\leq 25 \mu\text{g/L}$ | $\leq 50 \mu\text{g/L}$ | $\leq 100 \mu\text{g/L}$ | $>100 \mu\text{g/L}$ |
| 2009 | 238 | 287.76 | 1 (0.4) | 2 (0.8) | 15 (6.3) | 220 (92.4) |
| 2014 | 238 | 108.4 | 5 (2.1) | 8 (3.4) | 50 (21.0) | 175 (73.5) |
| Total | 476 | | 6 (1.3) | 10 (2.1) | 65 (13.7) | 395 (83.0) |

Table 3: Frequency distribution of urine iodine of children aged 8 to 10 years in 2009 and 2014.

Discussion

Intake rate of iodized salt

Out of the 288 samples of table salt detected in 2009, there was one sample of non-iodized salt, with the rate of unqualified iodized salt of 12.5%. Compared with that in 2014, the difference was significant. The intake rate of qualified iodized salt was higher 8 percentage points in 2014 than in 2009. Along with increase of the intake rate, national stage goal of IDD elimination has been reached in 2014 (national criterion of elimination rate $\geq 90\%$). Spread of iodized salt in the whole country is a simple, safe and effective way to control IDD [1-3]. The intake rate of iodized salt was 87.2% in 2009. And 7.6% of the urine iodine content of the children was less than 100 $\mu\text{g/L}$, that coincided with the intake rate of iodized salt and goiter rate of the children. The

intake rate of iodized salt of the inhabitants increases year by year. Free delivery of iodized salt to people in poverty in southern Xinjiang is very effective for IDD control and elimination. It should be reinforced furthermore, and health education and propaganda of IDD should also be strengthened, so as to enhance inhabitants' confidence of IDD control by taking in iodized salt and reach the goal of IDD elimination.

Difference between palpation and B-ultrasound

In 2009, the goiter rate was 21.9% by palpation and 9.9% by B-ultrasound, with the coincidence rate of 66.8%. There was statistical difference in the rates by the two ways ($\chi^2=85.06$ and 25.03) when comparing with those in 2014 ($P<0.01$). When the thyroid of children is examined by B-ultrasound, the isthmus portion isn't detected or its volume isn't calculated. And most of the enlargement of thyroid of

children occurs in the isthmus portion. That causes the difference mentioned above. Due to children in developmental phase, the volume of thyroid enlarges, subcutaneous tissue and fat increase along with their age growth, so that the difficulty of palpation also increases and missed diagnosis will be induced. Therefore, the experienced doctor takes the thickness of touching the thyroid gland as a sensitive index [4-5], to determine whether the thyroid of children enlarges or not. Somehow, the thyroid with obvious enlargement by visual observation or palpation, is normal by detection with B-ultrasound. Accordingly, the author considers that the normal value of the children's thyroid volume by B-ultrasound be researched or discussed further.

Relationship between urine iodine and goiter of children Iodine is the key material for synthesis of thyroid hormones. Iodine deficiency will inevitably lead to synthesis decrease of thyroid hormone, which feeds back to thyroid-pituitary. As a result, thyroid-stimulating hormone (TSH) excreted by pituitary gland will increase. TSH can promote compensatory hyperplasia and hypertrophy of follicular epithelial cell, resulting in diffuse goiter, that is simple goiter. Daily intake of inorganic iodine from food is about 100 to 200 µg, while for adults, the minimum daily requirement is about 100 µg. The iodine taking in is reduced to iodides in the gastrointestinal tract at first, then most will be absorbed rapidly in intestines. The iodides in vivo mainly accumulate in thyroid, and also in other tissues or their secretions temporarily, and eventually go back to the blood circulation for the synthesis of thyroid hormones, except for lactating mammary glands and placenta. Iodine in vivo is mainly excreted in the form of iodide by urine through the kidneys, or excreted in a small amount through sweat and feces.

Urine iodine level of children displays iodine metabolism of the body, and is an important index of surveillance of IDD control. Iodine metabolism is affected by factors of geography, food habits, and heredity, etc. [6-8]. It can maintain physiological needs of iodine in vivo, by spreading iodized salt in severe iodine deficiency areas for 3 to 5 years, and the inhabitants insisting in correct intake of iodized salt. The goiter will extinct gradually, and the goal of IDD elimination will also be reached.

Conclusions

Akto County of Xinjiang in China is severely endemic area of IDD. Although the government has implemented iodine supplementary in table salt in poverty population in Xinjiang, it is difficult to spread iodized salt for IDD elimination in Akto County due to the inconvenient transportation, because the county is located in the remote and poor area of Xinjiang, far away from the manufacturing industry of iodized salt. However, Allowance policy of iodized salt for the people in poverty by the government has improved the situation of iodine deficiency in the inhabitants, and provides a scientific basis for IDD elimination.

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