

## Analysis of Iodine Deficiency Disorders in Kashi and Kizilsu Kirgiz Prefecture at Southern Edge of Tarim Basin in China

Ji-yong J<sup>1\*</sup>, Jiang Ning BA<sup>2</sup>, Wen Juan MS<sup>1</sup>, Wang Chen BA<sup>1</sup>, Ma Pin-jiang BA<sup>1</sup> and TuJie MS<sup>1</sup>

<sup>1</sup>The Center for Disease Control and Prevention of Xinjiang Uygur Autonomous Region, Urumqi, Xinjiang, China

<sup>2</sup>The Occupational Disease Hospital, Urumqi, Xinjiang, China

\*Corresponding author: Jiang Ji-yong, The Center for Disease Control and Prevention of Xinjiang Uygur Autonomous Region, Urumqi, XinJiang CDC of Urumqi JianQuan street NO,380,China, Tel: 0086-991-2623301; Fax: 0086-991-2633500; E-mail: [jjy1956@163.com](mailto:jjy1956@163.com)

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### Abstract

**Objective:** To investigate and analyze current situation of IDD (Iodine Deficiency Disorders) control in Kashi and Kizilsu Kirgiz Prefecture at southern edge of Tarim Basin in China, in order to provide basis for implementing synthetic iodine supplement measures.

**Methods:** According to "Focus Investigation Program of IDD in Areas with High Risk in China" formulated by China Endemic Diseases Controlling Center, integrated survey and analysis were carried out in counties/cities of Kashi (12 counties/cities) and Kizilsu Kirgiz Prefecture (1 city and 3 counties). The urine samples of children and housewives from Kashi and Kizilsu Kirghiz regions were selected. The levels of iodine nutrition in the body were surveyed, and to study its effects in controlling endemic cretinism and regression of goiter. Totally there were 65 cases with endemic cretinism diagnosed in the two investigated prefectures. Investigation on table salt intake of residents was conducted by entering into households. In Kashi and Kizilsu Kirgiz Prefecture, coverage rate of iodized salt was 73.41% and 61.53%, edible rate of qualified iodized salt was 64.62% and 54.23%; edible rate of non-iodized salt (marsh salt and rock salt) was 26.59% and 38.47%, respectively; Goiter rate of students aged from 8 to 10 year-old was 23.0% in Kashi and 13.6% in Kizilsu Kirgiz. There were 1921 cases detected with mild mental retardation ( $\leq 69$ ) in the two prefectures, accounted for 18.4%. Median of urine iodine of the students was 136.5  $\mu\text{g/L}$  in Kashi and 142.5  $\mu\text{g/L}$  in Kizilsu Kirgiz. Urine iodine of women in child-bearing period was 85.5  $\mu\text{g/L}$  in Kashi and 99.3  $\mu\text{g/L}$  in Kizilsu Kirgiz.

**Conclusions:** Kashi and Kizilsu Kirgiz Prefecture in southern Xinjiang of China are severely endemic area of IDD. Intramuscular injection or oral intake of iodinated oil should be conducted in women in child-bearing period in the two prefectures, in order to avoid the birth with endemic cretinism. There is only qualitative standard for diagnosing endemic cretinism presently, and specifically quantitative experiment diagnosis is deficient. It needs for further research.

**Keywords:** Chinese racen's test; Endemic cretinism; Spectrophotometry; Myxedema

### Background

In China, Xinjiang is a minority autonomous region where 47 nationalities live in compact communities and multiple religions coexist, including Uygur, Han, Kazak, Hui, Mongolia and so on. Xinjiang is located in the northwestern part of China and Eurasian Continental inland, far away from oceans, with unique physical geography of three huge mountain ranges running across and two enormous basins lying between the three mountains. Sea wind hardly approaches. So iodine resources are extremely short in the external environment. Xinjiang has been one of the severest areas of iodine deficiency at home and abroad. In 94 counties/cities/prefectures of Xinjiang, there is prevalence of IDD, and the severe endemic areas mainly concentrate on the areas around Tarim Basin and Turpan-Hami Basin. According to the previous documents, in 1960s before developing IDD control with iodine in large scale in Xinjiang, median of urine iodine of the residents was less than 25  $\mu\text{g/L}$ , and endemic goiter rate averaged 87.1% [1,2]. Intelligence disability of children

resulted from endemic cretinism and iodine deficiency was very common. IDD in Xinjiang not only severely affects people's constitution and intelligence of all nationalities, but also restricts improvement of population quality, economic development and social progress. In the light of "Focus Investigation Program of IDD in Areas with High Risk in Xinjiang" formulated by The Health Department of Xinjiang Uygur Autonomous Region, investigation on current situation of IDD control in Kashi and Kizilsu Kirgiz Prefecture without reaching the stage goal of IDD elimination in southern Xinjiang, was conducted two times from April to July 2007.

### Introduction

The southern region of Xinjiang is one of wards most severely threatened by Iodine Deficiency Disorders (IDD) both in china and in the world. Kashgar and Kizilsu Kirghiz has rich gram rock salt or Shoal salt, and easy to exploit. It is difficult to carry out the measure of universal iodized salt in both areas, so IDD is very serious in these areas. This study aimed to investigate the status of IDD in both areas, and to determine an appropriate measure for elimination of IDD.

## Investigation contents and methods

The volunteers of investigation and clinical diagnosis who were excluded other thyroid diseases. Nearby the surveyed primary school, housewives were randomly selected according to the cluster sampling.

### Searching for new suspicious cases with endemic cretinism

It was carried out mainly in children under 10 years old born after January 1, 1997. Diagnosis of verification of the suspicious cases was carried out by clinical diagnosis group of endemic cretinism from The Center for Disease Control and Prevention of Xinjiang Uygur Autonomous Region.

### Examining children aged 8 to 10 year-old

Five villages in focal counties and 3 villages in the secondary focal counties were sampled randomly. And 200 children at age from 8 to 10 year-old were examined thyroid volume by palpation and B ultrasound. Meanwhile intelligence of the children was measured and their urinary samples were collected to analyze urine iodine.

### Household survey

At every village, 30 families were selected and in every township 2 villages were selected to carry out household survey for investigating sources and kinds of table salt. Families' edible salt was collected to analyze iodine content with semi quantitative method. Edible salt and urine samples were collected from the selected housewives to measure iodine content of salt and urinary iodine.

### Investigation objects

On basis of "Focus Investigation Program of IDD in Areas with High Risk in Xinjiang", the program was developed in Kashi and Kizilsu Kirgiz Prefecture.

Urinary samples of women in child-bearing period, pregnancy and lactation were collected to detect for urine iodine.

### Investigation method

**Diagnosis of new patients with endemic cretinism:** The collected report cases were diagnosed with diagnostic criteria of endemic cretinism and sub-clinical endemic cretinism (WS104-1999) [3].

**Investigation on intelligence:** Chinese Racen's Test (Revised Edition for Rural Use) was taken to test and intelligence quotient was calculated with its norm.

**Thyroid examination in children:** Two method of palpation and B ultrasound were taken [4].

**Detection for iodine in salt:** Iodine content in table salt was detected with direct titration of GB/T13025-1999 [5].

**Detection for iodine in urine:** As<sup>3+</sup>-Ce<sup>4+</sup> catalyzing spectrophotometry was performed (WS/T 107-2006) [6].

### Statistical analysis

The data was recorded with EPI INFO database. Pediatric goiter for measurement data using  $\chi^2$  test, the urine iodine and salt iodine for measurement data, the frequency distribution of urinary iodine both children and women was analyzed by using t inspection method.

## Results

### Diagnosis of new suspicious cretinism and other diseases

All volunteers who got parental consent or owner's consent voluntarily accepted this check.

There were totally 65 cases with endemic cretinism diagnosed in 13 counties/cities of Kashi and Kizilsu Kirgiz Prefecture, including 56 case of neurologic type, 8 cases of myxedema and 1 case of the mixed type (Table 1).

Prefecture	Endemic counties	Endemic townships	Type (cases)			
			Neurologic	Myxedematous	Mixed	Total
Kashi	10	35	52	8	1	61
Kizilsu Kirgiz	3	3	4	0	0	4
Total	13	65	56	8	1	65

Table 1: Findings of cretinism

Prefecture	Palpation			B ultrasound		
	Investigated No.	No. of goiter	Goiter rate (%)	Investigated No.	No. of goiter	Goiter rate (%)
Kashi	7048	1623	23.0	7038	1196	16.9
Kizilsu Kirgiz	2480	337	13.6	2480	585	23.6
Total	9428	1960	20.8	9518	1781	18.7

Table 2: Findings of goiter in children aged from 8 to 10 year-old

### Findings of salt iodine and thyroid examination

Totally 4614 samples of edible salt of residents were collected by entering households in 16 counties/cities of Kashi and Kizilsu Kirgiz Prefecture, including 3459 samples in Kashi, with the coverage rate of iodized salt of 73.41%, intake rate of qualified iodinated salt of residents of 64.62% and intake rate of non-iodinated salt of 26.59%; 1155 samples in 3 counties and one city of Kizilsu Kirgiz Prefecture, with the coverage rate of iodized salt of 61.53%, intake rate of qualified iodinated salt of residents of 54.23% and intake rate of non-iodinated salt of 38.47%.

Palpation was taken to examine 9428 children aged from 8 to 10 year-old in Kashi and Kizilsu Kirgiz Prefecture, covering 1960 persons with goiter with goiter rate of 20.8%; 9518 persons were examined with B ultrasound, with goiter rate of 18.7% (Table 2).

### Intelligence examination

Totally 9402 persons were examined, with slight mental retardation of ( $\leq 69$ ) 1921 cases, accounting for 18.4% (Table 3).

### Examination for urine iodine

Out of the examined 6845 children in Kashi, the median of urine iodine of the children was 136.5 µg/L with 45.2% less than 100µg/L and 25.3% under 50 µg/L. In Kizilsu Kirgiz Prefecture, the median of urine iodine of 2388 children was 142.5 µg/L with 42.4% less than 100 µg/L and 24.1% under 50 µg/L (Figure 1).

The median of urine iodine samples of housewives in Kashi and Kizilsu Kirgiz Prefecture was 87 µg/L, 55.2% of them were less than 100 µg/L and 26.0 % were under 50 µg/L (Figure 1).

Prefecture	Examined counties	Examined No.	No. of slight mental retardation(≤69)	Proportion of slight mental retardation(%)	Average level of intelligence
Kashi	12	6974	1353	20.8	79.7
Kizilsu Kirgiz	4	2428	568	23.4	80.0
Total	16	9402	1921	18.4	80.9

Table 3: Findings of Intelligence of School children

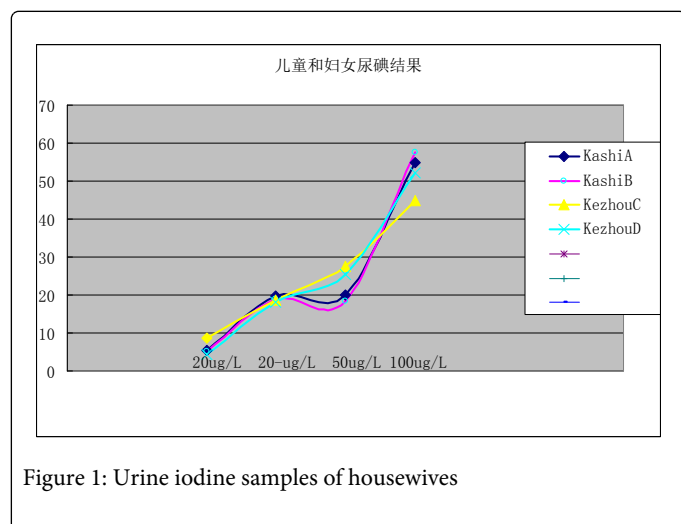


Figure 1: Urine iodine samples of housewives

### Discussion

#### Coverage rate of iodized salt and prevalence of endemic cretinism

According to the diagnostic assessment endemic cretinism and sub-clinical cretinism, 65 patients less than 10 year-old with endemic cretinism (mainly neurologic and mixed type) were diagnosed by verification in 13 counties/cities in Kashi and Kizilsu Kirgiz Prefecture. Endemic cretinism, the congenital disease because of severe iodine deficiency in embryonic or neonatal period that results in thyroid hormone dyssynthesis, can attack the postnatal infant several months later [1]. The prevalent factors of endemic cretinism in southern Xinjiang of China are mainly due to the severe iodine deficiency in external environment, low edible rate of qualified iodized salt in residents. In both of the two prefectures, there were 50 families without intake of iodized salt and qualified iodized salt. Because of economic poverty for long-term and the habit of taking in marsh salt

and rock salt [4], the women in child-bearing period didn't get iodine supplement before and after pregnancy. It is hard to implement synthetic measure of iodine supplement of iodized salt. The neonates continuously grow in the environment with severe iodine deficiency. Those are the major factors resulting in children's endemic disease in the two prefectures. There will be recurrence of cretinism if emergent measure of iodine supplement can't be taken as rapidly as possible to protect children from threatening of iodine deficiency to cerebral development.

#### Goiter of children

The goiter of children aged from 8 to 10 year-old was 20.8% in Kashi and Kizilsu Kirgiz Prefecture. There was big difference from the national standard for the stage goal of IDD elimination ≥5%. Most correlation factors affects goiter of children, such as severe iodine deficiency in external environment in the investigated areas, resources of local salt (non-iodized salt) in the areas and no supplement of iodine in embryonic period. Under condition of sufficient supplement of iodized salt or other supplement of iodine preparation, even if thyroid function of children recovers to be normal, regression of goiter will take 5 years. The spread rate of iodized salt is low in the remote and impoverished areas of southern Xinjiang in China, with little intake of iodized salt (one time a day). Concentration of iodized salt must be regulated or improved, so as to effectively ameliorate iodine deficiency situation of local inhabitants, maintain physiologic equilibrium of iodine in human body and eliminate goiter.

#### Qualified iodized salt and urine iodine of the inhabitants

The findings indicated that edible rate of qualified iodized salt was 64.62% in Kashi and 54.23% in Kizilsu Kirgiz, while that of non-iodized salt was 26.59 and 38.47%, respectively. Sum of the percentage of non-iodized salt and non-qualified salt was basically more than the value of urine iodine of the children less than 100 µg/L, that is, 45.2% in Kashi and 42.4% in Kizilsu Kirgiz. It illustrated that there were 50% investigated families without taking iodized salt and having intake of non-qualified iodized salt. The family members hadn't gotten iodine supplement or iodine deficiency in their body hadn't been improved. The research data confirmed that endemic goiter would occur but no endemic cretinism was prevalent when iodine intake amount of one person everyday was 40-80 µg/L [7]. The intake of iodine for each person daily less than 50 µg/L is the starting point of prevalence of endemic goiter. But there is also prevalence of endemic goiter in some areas where the urine iodine is out of normal range. Iodine deficiency affect over 2.2 billion individuals (38% of the world's population, and is the leading cause of preventable mental retardation worldwide. Population iodine sufficiency is defined by median by urinary iodine concentration ≥100 µg/L in non-pregnant adults.

Pregnant women are the key population for IDD control. Their nutrition situation can directly influence fetal iodine nutrition and cerebral development. Specialists consider that the appropriate median of urine iodine of the pregnant be from 150 to 250 µg/L. In this investigation, urine iodine of the women in pregnancy and child-bearing period is lower than the normal level, due to influence of many factors on absorption and utilization of iodine in the body. According to the special geographical and geological environment in southern Xinjiang and living habit of the minorities [2], reasonable synthesis measures of iodine supplement must be taken and evaluated by combining with the thyroid function. In order to supple iodine reasonably, normal value of urine iodine of all people in the local area

and cut-off of inducing goiter and cretinism must be calculated. Factors of geography, food habits and heredity, etc. affect iodine metabolism in human body [8,9] particularly concerning was the almost fourfold increase in the prevalence of urinary iodine values <50 µg/L among women of child bearing age, from 4% to 15%, over the two decades. Although women is 125 µg/L according to the most recent (2005-2008) NHANES data, 35.5% have urinary iodine levels <100 µg/L. Thus, while the overall U.S. adult population remains iodine sufficient by WHO standards, a subset of pregnant and lactating women may have inadequate dietary iodine intake [10-13].

### Intelligence quotient (IQ) of the children

Totally there were 20825 persons investigated. IQ of school children was lower 18.62 percentage points than that of the normal people, with 3831 cases of mild mental retardation ( $\leq 69$ ), accounting for 18.40%. Iodine deficiency is one of the major reasons for inducing human mental retardation and psychomotor disorder. In southern Xinjiang, edible rate of iodized salt is low because of the impact of local salt (non-iodized rock salt and marsh salt). Iodine deficiency affects cerebral development of children with obvious impaired intelligence. Many factors can influence the intelligence of children. Mental retardation of various degrees, induced by brain injuries because of iodine deficiency in fetal period and age phase of 0 to 2 year-old, has been known [11]. It is difficult to spread iodized salt in remote and poor areas of southern Xinjiang in short term. Iodinated oil supplement in high-risk population is necessary and urgent in order to ensure iodine nutrition of the population and to prevent brain development of children from the injury of iodine deficiency.

### Conclusion

In Kashi and Kizilsu Kirghiz regions, the status of Iodine Deficiency Disorders shows that endemic cretinism is caused by iodine deficiency in early Embryonic. Urinary iodine contents of 45.2 percent of children aged 8-10 years old and 55.2 percent of housewives were less than 100 µg/L. The survey exhibits Kashi and Kizilsu Kirghiz is still severely threatened by Iodine Deficiency Disorders.

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