PREVALENCE OF IODINE DEFICIENCY DISORDERS AMONG SCHOOLCHILDREN IN THREE BLOCKS OF BARDHAMAN DISTRICT AND BARDHAMAN MUNICIPAL AREA OF WEST BENGAL, INDIA : A COMPARATIVE STUDY

Souvik Sen, Susruta Sen, Ashok Mondal, Anindya Dasgupta and Indranil Chakraborty

Department of Biochemistry, Burdwan Medical College, Burdwan, West Bengal, India

Abstract. Urinary iodine levels in children (6-12 years) living in three rural blocks and in the municipal urban area of Bardhaman District, West Bengal, were analyzed to compare the status of recent iodine nutrition in the rural and urban population of the district. Goiter, indicating previous iodine status, was simultaneously estimated. Iodine levels in salt samples, that provide insight into the usage of iodized salt, were estimated. Data indicated that 56.6% of urban children and 51.1% of rural children were biochemically iodine repleted and had urinary iodine excretion (UIE) levels ≥10μg/dl. Urban children (29.4%) and rural children (37.1%) were found to have goiter. Eighty percent and 50% of the rural and urban salt samples, respectively, were found to have iodine levels below 10 ppm; with significant urban-rural differences. The results indicate that iodine repletion in the surveyed area needs continuous surveillance of the proper distribution and use of iodized salt.

INTRODUCTION

Iodine, a non-metallic trace element is an essential micronutrient, deficiency of which causes protean manifestations, including goiter and cretinism. Iodine deficiency disorders (IDD) is recognized as a global health problem today. It is now accepted as the most common cause of preventable brain damage in the world (Kapil, 1998). While all age groups are affected by it, growing children and women in their reproductive years are most vulnerable. Estimates by the World Health Organization (WHO) suggest that approximately 1.4 billion people are at risk of iodine deficiency disorders (IDD) globally, of which 600 million have a goiter, and over 20 million suffer from irreversible brain damage (World Health Organization, 1993). Iodine deficiency poses a significant public health problem in 130 countries and affects 740 million people worldwide. An estimated one-third of the world's population is at risk for IDD (Clugston and Benoist, 2002). IDD is a health problem of considerable magnitude in India and the neighboring countries of Bangladesh, Bhutan, Myanmar, Indonesia, Nepal, Sri Lanka and Thailand. More people are affected and levels of severity are higher in Southeast Asia than anywhere else in the world (Clugston and Bagchi, 1986). In India, IDD constitutes a major public health problem, as goiter surveys conducted in 239 districts of 25 states and 4 union territories have identified 197 districts as endemic for IDD (NIDDCP, 1994). Studies of urinary iodine excretion (UIE) all over India suggest wide variation in the presence of iodine deficiency in eastern and western India. Bargarh district in Orissa reported a median UIE level of 2.25 μg/dl with 90% of the population having UIE levels below 10 μg/dl (Mahapatra *et al*, 2000). Another study in the Dang district of Gujarat reported a UIE level of 6.5 μg/dl, with 74% of the female population having UIE levels below 10 μg/dl (Brambhatt *et al*, 2001). On the other hand, Malda District in West Bengal reported a median UIE level of 15 μg/dl, where only 14.7% were found to be iodine deficient (Biswas *et al*, 2002).

The three most important indicators in IDD surveillance are goiter prevalence, urinary iodine excretion, and thyroid function tests, especially TSH in neonates (WHO, 1992). The WHO ad-

Correspondence: Dr Indranil Chakroborty, Block: A/2, Flat No: 7, Uttarayan Housing Estate, 102, BT Road, Kolkata: 700035, West Bengal, India.
Tel: 0091-33-25319059; Fax: 0091-342-2558636
E-mail: anindya12@hotmail.com

vised researchers to combine two indicators, one morphological and the other, a laboratory test. UIE values indicate current iodine status, which is a reflection of iodine content in foods and salt. Thyroid size suggests past iodine status, and it requires a minimum period of 6-12 months of iodine deficiency for goiter to develop. Salt iodization programs have not been in place long enough for a full evaluation of their impact on iodine status. Nevertheless, it is clear that where such a program has been in place for more than 5 years, the improvement has been dramatic. This has been demonstrated in Algeria, Bhutan, Cameroon, China, Colombia, Indonesia, the Islamic Republic of Iran, Panama, Peru, Thailand, Venezuela and Zimbabwe (Clugston and Benoist, 2002). In view of the magnitude of IDD as well as technical, administrative, financial and operational feasibility, the government of India took a decision in 1984 to iodize all edible salt in the country, known as Universal Salt Iodization (USI). However, even years later, a review showed that out of the 19 districts in West Bengal, the 5 districts surveyed had IDD (UNICEF/DGHS/Salt Department, 1996). The present study was conducted to assess the current status of IDD in the Bardhaman district and to estimate the iodine content of salt consumed by the population in the same district.

MATERIALS AND METHODS

In the present study, an attempt has been made to assess median UIE, the prevalence of goiter and the levels of iodine in salt used daily amongst people of lower socio-economic strata (a family income of less than fifteen hundred rupees per month).

Sampling was done in rural and urban sectors in and around Bardhaman Town, West Bengal, in students at free primary schools. Schoolchildren, aged 6-12 years, are recommended for assessment because of their high vulnerability to disease, easy accessibility, representativeness and usefulness in a variety of surveillance activities (Lwanga and Lemosho, 1991).

Sampling

Seven free primary schools linked to a School Health Program were selected randomly from three rural blocks: Sadar-1, Sadar-II, and Khandaghosh on the outskirts of Bardhaman Town. Similarly, eight free primary schools were randomly selected from the Bardhaman Municipal area. Thirty percent of the study population belonging to the mentioned age group were randomly selected in our cross-sectional study.

Assuming a goiter prevalence of 50%, a confidence limit of 96% and an estimated error of 10%, 720 rural children and 187 urban children were examined for goiter, giving a total sample size of 90%. Approximately 30% of the sample population was picked at random for spot urine samples which were collected in screw cap bottles with a drop of toluene added to prevent bacterial growth. The samples were stored at 4ºC.

Thirty rural and twenty urban salt samples obtained from different shops were also collected in auto-seal polyethylene packets, each containing about 20 g of salt.

Estimation of iodine in urine and salt

Iodine in the urine was determined by the wet digestion method (Dunn *et al*, 1993). Here organic content was first digested with mixtures of strong acids and then the inorganic iodine was estimated based on its catalytic property in the cerate-arsenate mixture. Results were expressed in μg/dl. The samples with very low (<0.5 μg/dl) and high (≥15 μg/dl) values were always repeated, but no differences were observed.

The iodine content of salt was estimated by iodometric titration, where iodine liberated by the addition of sulfuric acid was titrated against a standard solution of sodium thiosulfate using starch as an indicator. The results were expressed in parts per million (ppm).

RESULTS

The values of the UIE levels in both rural and urban areas are shown in Table 1. Fifty-one point one percent of the rural children and 56.6% of the urban children had adequate recent iodine intake with UIE levels ≥10μg/dl. Severe iodine deficiency (having UIE levels <2 μg/dl) was found in 14.7% of the rural and 8.2% of the urban children. Gender differences in UIE levels were not found to be statistically significant. A

Table 1
Percent prevalence of UIE in rural Bardhaman District and in the urban area (schoolchildren of the Bardhaman Town).

UIE	Rural			Urban		
	Male	Female	Total	Male	Female	Total
<2 μg/dl	13.4[a]	16.1[a]	14.7[a]	8.8[a]	7.7[a]	8.2[a]
2-4.99 μg/dl	12.4[a]	13.8[a]	13.0[a]	12.3[a]	7.7[a]	7.8[a]
5-9.99 μg/dl	21.5[a]	20.7[a]	21.2[a]	29.8[a]	21.5[a]	25.4[a]
≥ 10 μg/dl	52.6[a]	49.3[a]	51.1[a]	49.1[a]	63.1[a]	56.6[a]
Total	97	87	184	57	65	122

[a]$p>0.05$ (chi-square test).

Table 2
Percent prevalence of goiter in the rural Bardhaman District and the urban population of the Bardhaman Town.

Goiter prevalence	Rural			Urban		
	Male	Female	Total	Male	Female	Total
Gr – 0	65[a]	60.8[a]	62.9[a]	76.3[a]	64.9[a]	70.6[a]
Gr – I	18.9[a]	21.1[a]	20[a]	16.1[a]	18.1[a]	17.1[a]
Gr – II	16.1[a]	18.1[a]	17.1[a]	7.5[a]	17[a]	12.3[a]
TGR	35[a]	39.2[a]	37.1[a]	23.7[a]	35.1[a]	29.4[a]
Total	360	360	720	93	94	187

[a]$p>0.05$ (chi-square test).

comparison between urban and rural UIE levels also failed to show a statistically significant difference.

Thirty-seven point one percent of rural children and 29.4% of urban children were found to have goiter of varying degrees (Table 2). None were found to have disfiguring grade III goiter. There were no significant gender differences (Table 2), but the goiter rates in the rural and urban areas were statistically significant (Table 3).

Table 4 depicts the iodine content of salt samples. No sample was found to contain more than 15 ppm of iodine. Eighty percent of the rural samples and 50% of the urban samples had <10 ppm. The difference between the urban and rural areas proved to be statistically significant.

DISCUSSION

Several studies of UIE in India showed wide variation in results, with pockets of iodine defi-

Table 3
Comparison of TGR between the urban and rural population (shown as a percentage of distribution).

Population group	Gr-0	TGR
Urban	70.6[a]	29.4[a]
Rural	62.9[a]	37.1[a]
Total	64.5	35.3

[a]: $p<0.05$ (chi-square test).

Table 4
Percent distribution of salt samples with different iodine contents in rural and urban areas of Bardhaman District.

Sector	<10ppm	10-15 ppm
Urban	50[a]	50[a]
Rural	80[a]	20[a]
Total	68	32

[a]: $p<0.05$ (chi-square test).

ciency in isolated areas of eastern and western India. The Bargarh District of Orissa reported a median UIE level of 2.25 μg/dl, with 90% of the population having UIE levels below 10 mg/dl (Mahapatra *et al*, 2000). Another study in the Dang District of Gujarat reported a UIE level of 6.5 μg/dl with 74% of the female population having UIE levels below 10 μg/dl (Brambhatt *et al*, 2001). However, the Malda District of West Bengal reported a median UIE level of 15 μg/dl, where only 14.7% was found to be iodine deficient (Biswas *et al*, 2002). In our present study, 51.1% of the rural population and 56.6% of the urban population had UIE ≥10 mg/dl consistent with IDD indicators (proportion of UIE below 10 μg/dl in <50% of the population) set forth by the joint WHO/UNICEF/ICCIDD consultation (WHO, 1992), and establishes that the study area is in the transitional phase of iodine repletion. The high goiter rates found in the present study did not tally with previous studies done elsewhere in India, but could be explained by the possible presence of goitrogens in soil of the area and by the fact that it takes a few years for goiter to correct itself after UIE levels are corrected.

Only 20% of rural subjects and 50% of urban subjects were found to consume adequate iodine in salt (≥15ppm) which is below the recommended goal of ≥90% set by the WHO (1992). In spite of a total ban on the sale of non-iodized salt in the country, this poor utilization suggests the improper use and storage of iodized salt. It may also be deduced that the soil and water might not contain low levels of iodine, as the area is not iodine depleted, even after the use of low iodine content salt.

In conclusion, the population living in the study area are in a transitional phase of iodine repletion with the poor utilization of iodized salt. Therefore, strict surveillance, with continuous monitoring and evaluation of the distribution of adequately iodized salt and its proper usage in the area is required for the targets to be achieved in the near future.

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REFERENCES

Biswas AB, Chakraborti I, Das DK, Nandy S, Mitra J. Iodine deficiency disorders among school children of Malda, West Bengal, India. *J Health Popul Nutr* 2002; 20: 180-3.

Brambhatt SR, Fearnley RA, Brahmbhatt RM, Eastman CJ, Boyages SC. Biochemical assessment of iodine deficiency disorders in Baroda and Dang District of Gujrat State. *J Ind Pediatr* 2001; 38: 247-55.

Clugston G, Benoist BD. Eliminating iodine deficiency disorders. *Bull World Health Organ* 2002; 80: 341.

Clugston G A, Bagchi K. Tackling iodine deficiency in Southeast Asia. *World Health Forum*1986; 7: 33.

Dunn JT, Crutchfield HE, Gutekunst R, Dunn D. Methods for measuring iodine in urine. In: A joint publication of WHO/UNICEF/ICCIDD. Geneva:World Health Organization, 1993: 18-23.

Kapil U. Goiter in India and its prevalence. *J Med Sci Fam Plann* 1998; 3: 46-50.

Lwanga SK, Lemosho S. Sample size determination in health studies. In: A practical manual. Amsterdam: ICCIDD, 1991: 26 -71.

Mahapatra SSS, Bulliyya G, Kerketta AS, Marai NS, Acharya AS. Iodine deficiency disorders in Bargarh District of Western Orissa. *J Ind Pedatr* 2000; 37: 536-9.

The National Iodine Deficiency Disorders Control Programme (NIDDCP). Status report. Policy and Advocacy Meeting on Iodine Deficiency Disorders (IDD). January 17, 1994.

UNICEF/DGHS/Salt Department-New Delhi. Prevalence and status of IDD in different states/UTs of India. August, 1996.

World Health Organization. Report of a Joint WHO/UNICEF/ICCIDD. Consultation on Indicators for Assessing Iodine Deficiency Disorders and their Control Programmes. November 1992: 14-8.

World Health Organization. Macronutrient Deficiency Information System (MDIS). Global prevalence of IDD. *WHO/UNICEF/ICCIDD*, 1993.