RESEARCH ARTICLE

Prevalence of goiter among school children and iodine content in edible salt and drinking water in Rampurhat Sub-division of Birbhum District in West Bengal, India

Smritiratan Tripathy

ABSTRACT

Background: A deficiency of iodine in the diet leads to many visible and invisible health consequences. The major consequences of iodine deficiency are enlargement of the thyroid gland, mental defects, deaf mutism, stillbirth, and miscarriage. This study was conducted to determine the prevalence of goiter among schoolchildren in the Rampurhat Sub-division of Birbhum district in West Bengal. *Methods*: A total of 2712 school children (6–12 years) were clinically examined for goiter from eight CD Blocks and two Municipalities of the studied region. Iodine content in 350 salt samples and 80 drinking water samples were measured. *Results*: The overall goiter prevalence was found to be 13.13%. Most of the goiter is palpable, *i.e.*, Grade 1 goiter, however visible, or grade 2 goiter also exists. Observation showed that 18.28% of samples had iodine levels less than the recommended value of 15 ppm. However, the iodine contents in the drinking water samples were adequate. *Conclusion*: Observation suggests a mild degree of goiter endemicity as a public health issue, though the study region's people consume adequate iodine through edible salt and drinking water. Based on this observation, it may be concluded that to prevent and control this public health problem from the studied region, iodine nutritional status as evidenced by urinary iodine level and studies to find the etiological factors other than iodine deficiency are most urgent.

Keywords: Iodine deficiency disorders, Goiter, School children, Iodine in salts, Iodine in drinking water.

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INTRODUCTION

Micronutrient iodine is found in water, soil, and plants. Making thyroid hormones for humans' and animals' normal physiological and mental development is essential. Iodine deficiency affects the socio-economic development of a community.[1] Almost all the countries in the world, including India, are affected by iodine deficiency disorders.[2] In India, it is not restricted to the Himalayan mountain areas; it has been reported in flat lands, plains, riverine areas, deltas, and even coastal regions.[3,4]

Birbhum is the northernmost district of the Burdwan division. Rampurhat is one of the sub-divisions of Birbhum district. There is no systematic report on endemic goiter and associated iodine deficiency disorders (IDD) among school children from the Rampurhat Sub-division of Birbhum district in West Bengal. The present investigation was therefore undertaken to study the goiter rate and iodine content in edible salt and drinking water in the Rampurhat Sub-division of Birbhum district in West Bengal, India.

MATERIAL AND METHODS

Study Area

The district Birbhum is bounded on the north and west by Santhal Parganas, on the east by the districts of Murshidabad and Burdwan (East), and on the south by the district Burdwan (East) and Burdwan (West), from which the river '*Ajay*' separates it. The district extends over 4545 sq km, with its headquarters in Suri. Other important cities are Rampurhat, Bolpur, and Sainthia. There are 19 CD blocks and 6 Municipalities under three Subdivisions: Suri, Bolpur, and Rampurhat. In the present study, the Rampurhat Sub-division is considered. There are eight CD Blocks and two Municipalities in the Rampurhat Subdivision (Figure 1).

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Selection of Population

To get the representative population, 10 areas were selected each from 8 CD Blocks and 2 Municipalities of Rampurhat Subdivision by purposive Sampling. One school was randomly chosen from each selected area where the students (age group 6–12 years) of both genders (as recommended by WHO/UNICEF/ICCIDD)[2] were available. In areas where children of both genders in the age group 6 to 12 years were not available in one school, more than one school (one primary and one secondary or one boy's school and one girl's school) were chosen at random[3].

Clinical Goiter Survey

The clinical examination of each child was conducted by palpation method for goiter, and grading was done according to the criteria recommended by the joint WHO/UNICEF/

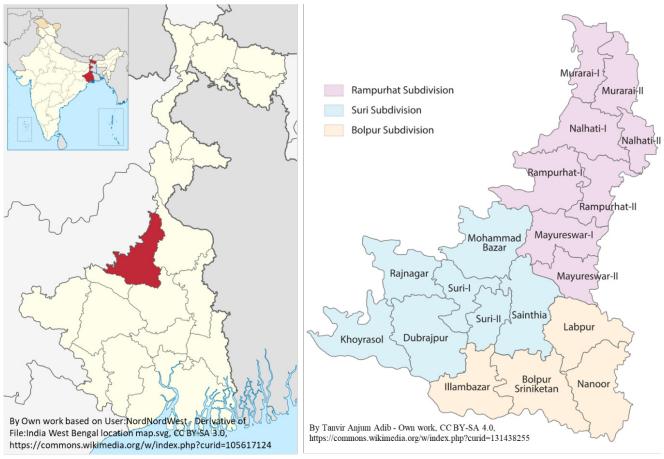

Figure 1: Birbhum district and Rampurhat subdivision (Maps collected from Wikipedia en.wikipedia.org)

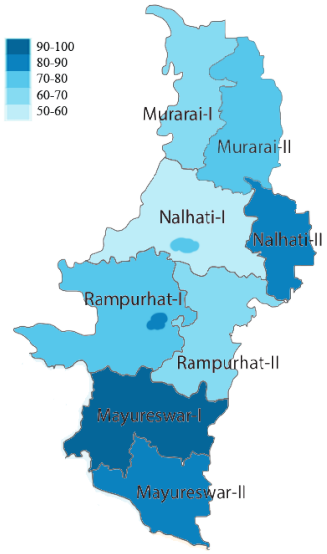

Figure 2: Distribution of iodine content in drinking water (mg/L) in Rampurhat subdivision

ICCIDD (Grade 0, no goiter; Grade 1, thyroid palpable but not visible; and Grade 2, thyroid visible with neck in normal position).[5] The ages of the students were recorded from the school register and were rounded off to the nearest whole number.

Iodine in Salt

The iodine content of at least 35 salt samples collected at random from a locality provides a valid estimate of the iodine content of the salt samples of the localities.[6] To monitor the iodine content of salt samples available in the area, 350 air-tight plastic containers (35 samples from each CD Block and Municipality) were distributed randomly to the students, and they were asked to bring samples of edible salt from their homes the next day. The salt samples were kept at room temperature in the laboratory, and iodine content was measured within a week using the iodometric titration method.[7]

Iodine in Drinking Water

Iodine content in a region truly reflects the bioavailability of iodine. To cover the entire study area, 80 samples of drinking water (8 from each CD Blocks and Municipalities) were collected from only source tube wells, at random in screw-capped plastic bottles, kept at 4°C, and iodine contents were measured using the method of Karmarkar *et al.*[8]

RESULTS

In all, 2721 school children (6–12 years) of both genders were clinically examined for goiter prevalence, and the total goiter rate (TGR) was 13.13%. In most of the cases where it was present, the goiter was palpable (Grade 1 goiter; 11.95 %); however, visible goiter or grade 2 goiter (1.18%) also existed. Total goiter prevalence was found to be highest in Rampurhat

Table 1: Prevalence of Goitre among school children (6-12 yrs) of Rampurhat Sub-division of Birbhum district

Study area (CD Block/Municipality)	*Children examined*	*Number of children with goiter*			*Severity**
		Grade-1	*Grade 2*	*Total*	
Rampurhat- I	266	46 (17.29%)	02 (0.75%)	48 (18.05%)	Mild
Rampurhat- II	263	38 (14.45%)	04 (1.52%)	42 (15.97%)	Mild
Nalhati- I	275	39 (14.18%)	03 (1.09%)	42 (15.27%)	Mild
Nalhati -II	274	37 (13.50%)	04 (1.46%)	41 (14.96%)	Mild
Mayureswar- I	301	38 (12.62%)	04 (1.33%)	42 (13.95%)	Mild
Mayureswar- II	254	25 (9.84%)	03 (1.18%)	28 (11.02%)	Mild
Murarai- I	265	24 (9.06%)	02 (0.75%)	26 (9.81%)	Mild
Murarai- II	260	21 (8.08%)	03 (1.15%)	24 (9.23%)	Mild
Rampurhat Municipality	276	36 (13.04%)	05 (1.81%)	41 (14.85%)	Mild
Nalhati Municipality	278	20 (7.19%)	02 (0.72%)	22 (7.91%)	Mild
TOTAL	2712	324 (11.95%)	32 (1.18%)	356 (13.13%)	Mild

*The severity of public health problems:
Mild (5.0-19.9%); Moderate (20.0-29.9%); Severe (>30 %)

-1 CD Blocks (18.05%) and lowest in Nalhati Municipalities (7.91%), as indicated in Table 1.

Iodine content in edible salt fortified with iodine was measured, and it was found that all the salt samples tested had iodine. However, the result showed that 18.28% of samples had iodine levels less than the recommended value of 15 ppm (Table 2). Thus, about 82% of people consumed adequate iodine through edible salt. Iodine content in the drinking water of the studied region was determined from the different tube wells in the localities, and the mean iodine value was 77.9 ± 32.2 mg/L (Table 3). The distribution of the iodine level in the study areas are shown in Figure 2.

DISCUSSION

In West Bengal, goiter is reported from many districts.[9-13] The northern part of West Bengal is mostly located in India's hilly Sub-Himalayan classical conventional goiter endemic belt. Considering the consequences of IDD, supplementation of iodine through salt has been introduced in the entire West Bengal since the early nineties. The southern part of West Bengal is mainly plain, and the lands are fertile and drained by several rivers, including the Ganga, flowing from north to south. The prevalence of endemic goiter in school children (6–12 years) is the most widely accepted marker to evaluate the severity of IDD in a region. According to WHO/UNICEF/ICCIDD (1994)[5] recommended criteria, a prevalence rate of 5.0-19.9% is considered mild, 20 to 29% is considered moderate, and a prevalence rate above 30 % is considered a severe public health problem. In all, 2712 school children (6–12 years) were clinically examined for goiter from eight CD Blocks and two Municipalities of Rampurhat Subdivision of Birbhum district. The overall goiter prevalence was 13.13%, indicating that, clinically, IDD was a mild public health problem in the studied region. Though in a good number of studied children, goiter was of grade 1 (palpable), visible goiter (Grade 2) also existed.

The sources of dietary iodine are water, food, and iodized salt, which are available in the region. The iodine content in the crop depends on the soil's iodine content. The total drinking water concentration can indicate the iodine content of the soil.[14] The dietary source of iodine is insufficient in almost all areas to fulfill the demand of the thyroid gland. Therefore, the Government of India has introduced a universal salt iodization program nationwide. The advantage of supplementing with iodized salt is that it is used by all community sections irrespective of social and economic status. Two forms of iodine can be used for iodized salt: 'iodide' and 'iodate,' usually as potassium salt. Iodate is less soluble and more stable than iodide and is preferred for topical moist conditions. Both are generally referred to as "iodized" salt. Recognizing the importance of elimination of iodine deficiency disorders as a health and developmental goal, the Government of India adopted the policy of universal salt iodization (USI) in 1984, under which the entire population of the country is to receive edible salt with a minimum of 30 ppm of iodine at the manufacture's level and 15 ppm at the consumer's level. To bring uniformity in implementation and to ensure the further success of universal salt iodization in all states, the Government of India in 1998 implemented central legislation banning the sale of non-iodized salt for edible purposes in the entire community. In the present study, the iodine content of the salt samples was categorized into four groups, *i.e.*, number of samples without iodine, number of samples below 15 ppm, in between 15 to 30 ppm, and above 30 ppm. However, no sample was found without iodine. The results showed that 18.28% of samples had iodine levels less than the recommended value of 15 ppm or the Indian recommended value at the consumption point.[15] Thus, about 82% of people consumed adequate iodine through edible salt.

Zeltser *et al*.[16] have categorized the iodine deficient zone as the severe deficient zone having iodine less than 4 g/L of water, the moderate deficient zone with an iodine level of 4-10 g/L of water, and the relative deficient zone having an

Table 2: Iodine content in edible salt collected from the study areas

Name of the CD Block/Municipality	*No. of salt samples*	*Percent of salt samples containing iodine*		
		< 15 ppm	*15-30 ppm*	*>30 ppm*
Rampurhat- I	35	08 (22.9)	07 (20.0)	20 (57.1)
Rampurhat- II	35	07 (20.0)	06 (17.1)	22 (62.9)
Nalhati- I	35	08 (22.9)	03 (8.5)	24 (68.6)
Nalhati -II	35	06 (17.1)	05 (14.3)	24 (68.6)
Mayureswar- I	35	05 (14.3)	05 (14.3)	25 (71.4)
Mayureswar- II	35	06 (17.1)	08 (22.9)	21 (60.0)
Murarai- I	35	09 (25.7)	10 (28.6)	16 (45.7)
Murarai- II	35	10 (28.6)	11 (31.4)	14 ((40.0)
Rampurhat Municipality	35	02 (5.7)	13 (37.2)	20 (57.1)
Nalhati Municipality	35	03 (8.6)	11(31.4)	21 (60.0)
	350	64 (18.28)	79 (22.57)	207 (59.14)

Figures in parentheses indicate the percentage

Table 3: Iodine content in drinking water

Study areas (CD Block/Municipalities)	*Iodine contents (mg/L)*
Rampurhat- I (n =8)	77.3 ± 13.2
Rampurhat- II (n =8)	63.6 ± 8.7
Nalhati- I (n =8)	59.3 ± 7.9
Nalhati -II (n =8)	87.6 ± 9.6
Mayureswar- I (n =8)	97.3 ± 10.3
Mayureswar- II (n =8)	88.4 ± 6.7
Murarai- I (n =8)	66.3 ± 7.3
Murarai- II (n =8)	71.5 ± 6.3
Rampurhat Municipality (n =8)	89.4 ± 8.9
Nalhati Municipality (n =8)	79.2 ± 7.7
TOTAL (n =80)	77.9 ± 32.2

Values are Mean ± SD

iodine level of 20 mg/L of water. The mean value of iodine in drinking water was found to be 77.9 ± 32.2 mg/L. The people use the drinking water from shallow tube wells 150-200 feet deep. So, according to Zeltser *et al*.[16], the iodine content in the drinking water indicates that the region is environmentally iodine-sufficient or the soil is rich in iodine. The distribution of iodine content in drinking water (g/L) in the Rampurhat subdivision is depicted in Fig 2. Iodine content in drinking water was highest at Mayureswar- I (97.3 ± 10.3 mg/L) and lowest at Nalhati- I (59.3 ± 7.9 mg/L).

The overall observation suggests that there is a mild degree of goiter endemicity as a public health issue, though the people consume adequate iodine through edible salt, and they also consume adequate iodine through drinking water. Further investigations are essential to identify the exact cause for the persistence of a mild degree of goiter endemicity in the studied region.

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PEER-REVIEWED CERTIFICATION

During the review of this manuscript, a double-blind peer-review policy has been followed. The author(s) of this manuscript received review comments from a minimum of two peer-reviewers. Author(s) submitted revised manuscript as per the comments of the assigned reviewers. On the basis of revision(s) done by the author(s) and compliance to the Reviewers' comments on the manuscript, Editor(s) has approved the revised manuscript for final publication.