RESEARCH PAPER

Iodine Deficiency Disorders in Children in East Khasi Hills District of Meghalaya, India

HIMASHREE BHATTACHARYYA,[1] CHANDAN K NATH,[2] STAR PALA,[1] GK MEDHI[1] AND HAPPY CHUTIA[2]

From Departments of [1]Community Medicine and [2]Biochemistry, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Shillong, India.

Correspondence to: Dr Himashree Bhattacharyya, Assistant Professor, Department of Community Medicine, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Mawdiangdiang, Shillong, Meghalaya, India. himashreebhattacharyya@gmail.com
Received: December 02, 2019; Initial review: December 23, 2019; Accepted: July 31, 2020.

Objective: To assess the prevalence of iodine deficiency disorders among school-going children in Meghalaya. **Methods:** Multi-stage 30 cluster sampling with probability proportionate to size (PPS) method was used. Children (age 6-12years) were examined clinically for goiter. Urinary iodine excretion (UIE) was performed by spectrophotometric method. Iodine content in the salt was analyzed using iodized salt test kits. **Results:** A total of 195 (7.22%) out of 2700 children had goiter on examination. Goitre prevalence was significantly associated with wasting (P<0.05) and stunting (P <0.001). The median (IQR) UIE level was 150 (108.05 - 189.37) µg/dL. Nineteen (9.74%) children had severe iodine deficiency (UIE<20µg/L). Iodine content was above the recommended level of 15 ppm in 95.9% salt samples. A positive correlation was observed between household salt consumption and UIE levels (r=0.25; P<0.001). **Conclusion:** Iodine deficiency disorder is a public health problem in Meghalaya, which needs to be addressed.

Keywords: *Urinary iodine excretion, Goiter, Iodized salt.*

Iodine deficiency disorder (IDD) has been a major nutritional health problem in India. Sample surveys have shown 263 out of 325 districts in India to be IDD-endemic with a goiter prevalence of more than 10% [1]. Urinary iodine excretion (UIE) and goitre are the most common indicators to assess iodine status in a population. Urinary iodine is a good marker of recent dietary iodine intake whereas goitre reflects past iodine status [2]. The median UIE levels were 100 mcg/L in 86% districts surveyed in India [3]. The Coverage Evaluation Survey, 2009 reported 91% population coverage of iodized salt in India [4]. Even though use of iodized salt is high in Meghalaya at 98% [5], no district level or state level surveys have been conducted to assess the prevalence of goiter or to monitor the impact of iodized salt.

The present study was conducted to obtain baseline prevalence of IDD among school-going children (age 6-12 years) in Meghalaya, and to estimate the percentage of households consuming the recommended level of iodized salt.

METHODS

This cross sectional study was conducted among school going children of East Khasi Hills district of Meghalaya from June, 2016 to December, 2018. The sampling strategy was a multi-stage 30 cluster sampling method. The list of all the villages/ wards in the East Khasi Hills district was collected. A sample of 30 villages in the form of clusters was selected from the district using probability proportionate to size (PPS) systematic sampling. Thereafter, we selected one school present in each cluster randomly for data collection after getting the list from the Inspector of schools. Consent was taken from the Director of mass education and Inspector of schools, East Khasi Hills district. Written consent was taken from the school authorities and the parents of all the children who participated in the study, and assent from the children. Ethical clearance to conduct the study was taken from the Institutional ethics committee.

The estimated sample size was 2700 *i.e.,* 90 children per cluster. All children in the age group of 6-10 years were taken from school as the gross enrollment was 100%. Children with known chronic diseases or thyroid disorders were excluded from the study. Systematic random sampling was used to select children from each class. In the age group of 11-12 years, four children per cluster were taken from the community considering the gross enrollment around 70%. One lane was randomly identified as the starting point in the respective cluster. Children in the specific age groups were then selected by visiting the household next to the random start following the right hand rule till the required sample size was fulfilled.

Children were examined as per standards prescribed by National Iodine Deficiency Disorder Control Programme (NIDDCP). All children were examined clinically for goiter by the standard palpation method and the score for goiter was recorded using WHO criteria of grade 0, 1 and 2 [6]. All the goiter cases reported clinically were verified by the principal investigator. The district was considered as endemic district if the total goiter rate was above 5% in children aged 6-12 years [6]. Weight and height of each child was recorded and *Z* scores were interpreted as per the WHO child growth standards. Moderate and severe underweight were defined as weight-for-age SDS ≤-2 and -3, respectively, and moderate and severe stunting as height-for-age SDS ≤-2 and -3, respectively.

Urine samples were collected from all the children in labeled plastic bottles (50 mL capacity with screw cap and thymol crystal as preservative, and transported to the laboratory in cold chain for spectrophotometric estimation of iodine in urine. A median UIE level of >99 µg/L was taken as the cut-off for adequacy for the population. Severe iodine deficiency was defined at a level of <20 µg/L [6]. Every fifth child selected in the class for goiter survey was instructed to bring approximately 20 grams of household salt in auto seal plastic pouches, which were distributed to the children a day ahead of sample collection. The test kit produced by MBI chemicals and procured from National Institute of Nutrition, Hyderabad was used for estimation of iodine in the salt sample. The salt samples were tested in the school as per manufacturer's instructions and iodine concentration was recorded as 0, <15 and >15 ppm [7].

Statistical analyses: Data were entered in MS Excel and analyzed using SPSS 19.0 version . Pearson correlation coefficient and chi square test was used to find out the association between continuous variables and categorical variables.

RESULTS

A total of 2700 (1365 boys) children were examined. The total goiter prevalence was 195 (7.22%) [grade 1 in 175 (6%) and grade 2 in 20 (0.7%) children], similar in both genders. The prevalence was higher in the age group 9-12 years (12.2%) than in younger children (5.5%); (*P* <0.001). Ninety three (3.9%) and 631 (25.1 %) children were severe and moderate underweight, respectively; 389 (16.8%) and 641 (31%) children had severe and moderate stunting, respectively. ***Table* I** shows the goiter prevalence with respect to clinical and laboratory variables. The median (IQR) UIE levels were 150 (108.05-189.37) µg/L.

A total of 518/540 (95.9%) salt samples tested had iodine content >15 ppm. Most (97.9%) of the children with goiter had salt iodine content >15 ppm. A positive correlation was observed between household salt consumption and UIE levels (*r*=0.25; *P*<0.001). Only 8 (0.3%) families consumed open salt, while rest consumed packaged iodized salt. Sixty (2.07%) families stored salt in open containers.

DISCUSSION

The present study reported a 7.22% prevalence of goiter in school-going children, which was more than 5% cut-off, signifying that IDD was a public health problem in this region.

A variable goiter prevalence of 2-12% has been reported earlier from Madhya Pradesh [8], Karnataka [9] and Jammu [10], respectively. The present study did not observe any significant difference in goiter rates among males and females, unlike earlier studies [11,12], which reported a higher prevalence in females. This may be due to socio-cultural factors and a positive attitude towards the girl child in this region. A higher prevalence of goiter was seen in the 9-12 year age group in this study, similar to an earlier Indian study [11]. A significantly higher goiter prevalence was seen among underweight and stunted children in the present study, as also noted in other studies [13-15].

Table I Clinical and Biochemical Characteristics of Goiter in Meghalaya, 2016-2018 (*N*=2700)

	Goiter present (n=195)	*Goiter absent (n=2505)*
#*Age*		
6-<9 y	91 (3.4)	1655 (61.3)
9-12 y	104 (3.8)	850 (31.5)
‡*UIE level (µg/L)*		
>200	22 (0.8)	412 (15.2)
100-200	89 (3.3)	1627 (60.2)
50-99	53 (1.9)	357 (13.2)
20-49	12 (0.4)	59 (2.2)
<20	19 (0.7)	50 (1.8)
Gender		
Male	101 (3.7)	1264 (46.8)
Female	94 (3.5)	1241 (45.9)
**Weight-for-age*		
Normal	83 (3.1)	1319 (48.8)
Underweight	112 (4.1)	1186 (43.9)
#*Height-for-age*		
Normal	101 (3.7)	841 (31.1)
Stunted	94 (3.5)	1664 (61.6)

*Values in n (%); *P<0.05 and #P<0.001 for inter-group comparison among those with goiter; ‡P<0.001 for comparison between those with and without goiter.*

WHAT THIS STUDY ADDS?

- The goiter prevalence in Meghalaya was 7.22%, with adequate urinary iodine excretion levels and consumption of adequately iodized salt in most households.

A significant association between goiter and UIE levels was seen in this study. However, there may be some discrepancy between UIE and goitre prevalence by the palpation method, as UIE reflects the current iodine concentrations and goiter indicates a chronic situation of iodine deficiency [16]. The median UIE levels were above the adequate cut-off level in the study. Variable UIE levels (96.5-200 µg/L) have been reported from other parts of India [8,10,17]. High goiter incidence with normal median UIE, as in this study, has been observed from some other regions in India as well [3]. This may result as the thyroid size reflects previous iodine nutrition and goitre may take years to shrink even after attaining iodine sufficiency [18].

The iodine content of salt was optimum in the present study, as reported earlier [9,10]. At the national level, the household coverage of iodized salt was 91.7% with 77.5% of households consuming adequately iodized salt [19]. A study from Mandya district of Karnataka showed higher iodine content in more than 90% of the salt samples [20]. However, a quarter of households were consuming inadequately iodized salt in Madhya Pradesh [8].

The confirmation of iodine deficiency for those with goiter could not be done by thyroid function tests due to difficulty in obtaining serum samples from school-going students. It was also difficult to predict the iodine status of an individual by a spot sample of UIE instead of a 24-hour sample, which was difficult to obtain due to technical reasons.

To conclude, the total goiter prevalence was 7.22% which suggests IDD as a significant public health problem in this region. IDD control program in the region needs to be strengthened with strong advocacy from the health sector.

Contributors: CKN: analysis of urine samples, biochemical analysis; SP: finalization of concept proposal, execution of project in field; GKM: critical review of proposal, expert advice on data analysis and interpretation; HC: storage of samples and biochemical analysis. HB: Study concept, planning, supervision and preparation of manuscript. All authors approved the final manuscript.
Funding: Indian Council of Medical Research; *Competing interests*: None stated.

REFERENCES

1. Revised Policy Guidelines on National Iodine Deficiency Disorders Control Program. Revised Edition October 2006. IDD and Nutrition Cell. Directorate General of Health Services. Ministry of Health and Family Welfare. Government of India. New Delhi. Available from: *http://pbhealth.gov.in/Revised%20Policy%20Guidelines%20Govt.%20of%20India.pdf.* Accessed December 04, 2018.
2. World Health Organization. Urinary iodine concentrations for determining Iodine status in populations. Vitamins and mineral nutrition information system. WHO/NMH/NHD/EPG/13.1.Available from: *https://apps.who.int/iris/bitstream/handle/10665/85972/WHO_NMH_NHD_EPG_13.1_eng.pdf?sequence=1.* Accessed February 12, 2019.
3. Kapil U. Continuation of high goiter prevalence in regions with successful salt iodization program. Indian Pediatr. 2011;48: 443-4.
4. National Fact sheet-Coverage Evaluation Survey by UNICEF (2009). Available from:*https://www.indiawaterportal.org/articles/national-factsheet-coverage-evaluation-survey-unicef-2009*. Accessed April 15, 2019
5. Pandav CS, Yadav K, Srivastava R, Pandav R, Karmakar MG. Iodine deficiency disorders (IDD) control in India. Indian J Med Res. 2013;138:418-33.
6. Assessment of the iodine deficiency disorders and monitoring their elimination - a guide for programme managers. Geneva, World Health Organization; 2001. 2nd edition; *p*. 77-100. Available from: *http://whqlibdoc.who.int/hq/2001/WHO_NHD_01.1.pdf.* Accessed March 05, 2017.
7. Kapil U, Dwivedi SN, Seshadri S, Swami SS, Beena, Mathur BP, *et al*. Validation of spot testing kit in the assessment of iodine content of salt: A multi-centric study. Indian Pediatr. 2000;37: 182-6.
8. Bali S, Singh AR, Nayak PK. Iodine deficiency and toxicity among school children in Damoh district, Madhya Pradesh, India. Indian Pediatr. 2018;55:579-81.
9. Biradar MK, Manjunath M, Harish BR, Nagaraj Goud B. Prevalence of Iodine deficiency disorders among 6-12 years school children of Ramanagara district, Karnataka, India. Int J Community Med Public Health. 2016;3:166-69.
10. Bhat IA, Pandit IM, Mudassar S. Study on prevalence of iodine deficiency disorder and salt consumption patterns in Jammu region. Indian J Community Med. 2008;33:11-14.
11. Chaudhary C, Pathak R, Ahluwalia SK, Goel RKD, Devgan S. Iodine deficiency disorder in children aged 6-12 years of Ambala, Haryana. Indian Pediatr. 2013;50:587-9.
12. Mesele M, Degu G. Gebrihiwot H. Prevalence and associated factors of goiter among rural children aged 6-

12 years old in North West Ethiopia: A cross sectional study. BMC Public Health.2014;14:130.
13. Sanusi RA, Ekerette NN. Nutrition and goiter status of primary school children in Ibadan, Nigeria. J Biomed Res. 2009;12:37-41.
14. Gaitan JB, Mayoral LG, Gaitan E. Defective thyroidal iodine concentration in PEM. J Clin Endocrinol Metab. 1983;57: 527-33.
15. Brahmbhatt SR, Brahmbhatt RM, Boyages SC. Impact of protein-energy malnutrition on thyroid size in iodine deficient population of Gujarat (India). Is it an aetiological factor for goiter? Eur J Endocrinol. 2001;145:1;11-7.
16. Chandwani HR, Shroff BD. Prevalence of goiter and urinary iodine status in six-twelve-year-old rural primary school children of Bharuch District, Gujarat, India. Int J Prev Med. 2012;3: 54-9.
17. Kapil U, Singh P, Pathak P, Singh C. Assessment of iodine deficiency disorders in district Bharatpur, Rajasthan. Indian Pediatr. 2003;40:147-9.
18. Elizabeth KE, Mohammed M, Devakumar VK, Fameesh A. Goitre in pre pubertal children despite urinary iodine sufficiency. Indian J Paediatr. 2015;44:198-201.
19. Pandav CS, Yadav K, Salve HR, Kumar R, Goel AD, Chakrabarty A. High National and sub national coverage of iodized salt in India: evidence from the 1st National Iodine and salt intake survey (NISI) 2014-2015. Public Health Nutr. 2018;21;3027-36.
20. Sridhar PV, Kamala CS. Iodine status and prevalence of Goitre in school going children in rural area. J Clin Diagn Res. 2014;8:15-7.