Prevalence of Goiter and Urinary Iodine Status in Six-Twelve-Year-Old Rural Primary School Children of Bharuch District, Gujarat, India

Haresh Rameshkumar Chandwani, Bhavesh Dahyabhai Shroff

Department of Community Medicine, Medical College, Vadodara, Gujarat, India

Correspondence to:
Dr. Haresh Rameshkumar Chandwani, Assistant Professor, Department of Community Medicine, Plot No: 1004/1, Sector No: 2-D, Gandhinagar, Gujarat – 382 002, India.
E-mail: harsh1012@yahoo.co.in

Date of Submission: Mar 13, 2011

Date of Acceptance: May 28, 2011

How to cite this article: 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.

Origial Article

ABSTRACT

Background: Iodine deficiency disorder (IDD) creates major public health problems in India, including Gujarat. The Bharuch district is a known iodine deficiency endemic area. This study was conducted to estimate the prevalence of goiter in primary school children; to determine the median urinary iodine concentration; to assess the level of iodine in salt samples at the household and retail shop levels; and to study the profile of salt sold at retail shops.

Methods: This study was carried out by using the 30-cluster survey method in the primary schools of the rural areas in Bharuch district. A total of 70 students, including five boys and five girls from the first to seventh classes, who were present in class on the day of the visit were selected randomly for goiter examination from each village. Urine samples were collected from one boy and one girl from each class in each cluster. From each community, a maximum of two boys and two girls from each standard in the same age group were examined and also salt samples were tested from their households. From each village, one retail shop was visited and the salt purchased from those shops was immediately tested for iodine with spot kits.

Results: We found a goiter prevalence of 23.2% (grade 1 – 17.4% and grade 2 – 5.8%). As the age increased, the goiter prevalence decreased except in nine-year-olds. The median urinary iodine excretion level was 110 μg/L. An Iodine level > 15 ppm was found in 93% of the salt samples tested at the household level.

Conclusion: The present study showed moderate goiter prevalence in primary school children in the Bharuch district of Gujarat and an inadequate iodine content of salt at some household levels.

Keywords: Goitre survey, IDD, prevalence, primary school children, household level

INTRODUCTION

Iodine is an important micronutrient required for human

nutrition. Iodine deficiency is the leading cause of mental impairment and can lead to stillbirth, increased infant and child mortality, and growth abnormalities. The Iodine deficiency disorder (IDD) is a complex clinical and subclinical disorder due to the lack of adequate dietary intake. Globally, 2.2 billion people live in areas with iodine deficiencies, with the risks of resulting complications, while in India; 167 million people are at risk of IDD, 54.4 million people have goiters, and 8.8 million people have IDD-related mental / motor handicaps.[1] IDD exists in all states and union territories; out of 587 districts in the country, 282 have been surveyed for IDD and 241 have been found to be goiter endemic.[2] Several studies conducted all over India have shown a high prevalence of goiter.[3-5]

In 1983, compulsory iodization of all table salt was introduced in India, in an attempt to eliminate iodine deficiency. The Government of India re-launched the National Iodine Deficiency Disorders Control Program (NIDDCP) in 1992, with a goal to reduce the prevalence of IDD to non-endemic levels. After the implementation of NIDDCP, India has made considerable progress toward IDD elimination. Since January 2001, in Gujarat, the ban on sale of non-iodized salt was withdrawn. With this withdrawal of the ban, the availability of non-iodized salt in the market increased. In November 2005, the Central Government issued a notification banning the sale of non-iodized salt for direct human consumption in the entire country. Less than 5% total goiter rate was found in nine out of fifteen districts studied in the 11 states by the Indian Council of Medical Research (ICMR).[6] The NIDDCP performed IDD surveys, with follow-up surveys every five years, to assess the supply of iodized salt, monitored iodized salt consumption, performed laboratory monitoring of iodized salt, urinary iodine concentration, and health education.

In February 2009, the Government of Gujarat started a follow- up IDD survey in all the districts of the state. In Bharuch district, the first baseline IDD survey was done in 1989, and the next survey was done in 1998 – 1999. The present goiter survey was done in Bharuch district with the objective of estimating the prevalence of goiter in primary school children, of age six to twelve years, to determine the median urinary iodine concentration in a sample of children, to assess the level of iodine in salt samples at the household and retail shop levels, and to study the profile of salt sold at retail shops.

METHODS

Selection of study area

The present study has been conducted in the Bharuch district of Gujarat state. The district is located in the southern region of Gujarat state and surrounded by the Vadodara, Narmada, and Surat districts. The Bharuch district is an Industrial hub of Gujarat state. The main source of water is rain. Almost all types of routine vegetables are available for consumption. The district is divided into eight talukas (blocks), having a total population of 1,370,656 as per the 2001 census.[7]

Selection of study population and sample size

As per the guidelines provided by the State Nutrition Cell, Ministry of Health and Family Welfare, Government of Gujarat, a cross-sectional study of children aged six to twelve years, studying in the first to seventh classes of the primary schools of rural areas was conducted. The study was classified into two types – a school survey and a community survey. From each class, five boys and five girls who were present in class on the day of the visit were selected randomly for examination. In total, 70 students were examined from each school in the selected villages. As per the guidelines provided, almost 30% of the school children were considered absent at any given time, so a maximum of two boys and two girls from each standard, in the age group of six to twelve years, were examined from the community. Thus, a total of 2100 students were examined in schools, after obtaining informed consent from teachers as well as students, and 825 students were examined out of schools, in the selected villages, after obtaining informed consent from parents as well as children.

Training and survey technique

A state level training workshop was conducted by the State Nutrition Cell, in which Assistant Professors, Tutors, and PG students of the Department of Community Medicine of various Medical Colleges participated for case identification and grading of the goiter. These trained Assistant Professors, Tutors, and PG students examined the children during the survey. The current survey included the World Health Organization (WHO)

grading system as per the revised guidelines under NIDDCP. The child was examined by the examiner in a sitting position, with the neck in a normal position. The following classification was used for goiter: (*a*) grade 0 – not visible, not palpable, (*b*) grade 1 – palpable, but not visible, and (*c*) grade 2 – palpable and visible, as per the WHO / UNICEF / ICCIDD guidelines.[8]

Sampling method

The cluster sampling method was used for selection of villages. A list of the villages of all the talukas of Bharuch district was obtained from the Jilla Panchayat, office of the District Health Office (DHO). Subsequently, the cumulative population was figured using Microsoft Office Excel. By calculating the cluster interval, 30 villages were selected from the list. As the study was confined to only the rural areas of the Bharuch district, urban populations were excluded from the cumulative population calculations. Primary schools in each of the 30 selected villages were visited for school surveys. When the desired sample size of five boys and five girls from each class was not achieved, a primary school in the nearest village was approached and the desired sample size was achieved; the community survey was conducted in a similar manner. The children were examined by the palpatory method, and the above-mentioned criteria were used for the classification of goiter. According to these criteria, goiter prevalence rate of 5.0 – 19.9% was considered mild; 20 – 29.9% was moderate, and above 30% was considered as a severe public health problem.

Urine samples

One boy and one girl from the first to seventh classes were selected randomly for urine samples. In each cluster, 14 urine samples were collected, including seven samples from boys and seven from girls. In 30 clusters, a total of 420 urine samples was collected and tested for urinary iodine excretion. Plastic bottles with screw caps were used to collect the urine samples, which were stored in a cool, dry place and sent to the state IDD laboratory at Surat, for testing by an expert technician. A few drops of toluene were added to each urine sample to inhibit bacterial growth and to minimize bad odor. Child number, cluster number, and date of urine collection were noted on every bottle of urine sample for identification. The ammonium per sulfate titration method was used to detect urinary iodine excretion levels.[1] As per national guidelines, the severity of IDD as a public health problem was classified into three categories, including, (1) < 20 μg/L – severe, (2) 20 – 49.9 μg/L – moderate, and (3) 50 – 99.9 μg/L – mild. The value of 100 μg/L or above was considered normal.[1]

Salt samples

As per the guidelines provided, 10 random salt samples were tested from the homes of children examined for goiter during the community survey in each village. A total of 300 salt samples were tested. These samples were tested on the spot with an MIB kit provided by the United Nations Children's Fund (UNICEF), and the iodine concentration was recorded as 0, < 15 and > 15 ppm.[9] From each village, one retail shop was visited and salt was purchased and tested for iodine immediately with a spot kit.

Statistical analysis

All the data was entered in a Microsoft Office Excel 2007 and analyzed using Epi Info software, version 3.5.1.

The Institutional Ethical Committee approved this study, as this was a part of the National Health Program assigned by the State Government.

RESULTS

Goiter prevalence in the Bharuch district was found to be 23.2% (grade 1 – 17.4%, grade 2 – 5.8%) among primary school children [Table 1]. Severe goiter prevalence was found in Zaghadiya and Hansot talukas, while the prevalence in the Jambusar and Vaghra talukas was mild. As the age increased, the goiter prevalence decreased, except in the age group of nine years, in which goiter prevalence was the highest [Table 2]. A total of 420 urine samples were collected from the Bharuch district, out of which 56.4% samples were found to have a urinary iodine excretion (UIE) level of 10 μg/L or more, while 25.5% of the samples showed UIE levels between 50 and 99.9 μg/L, 13% between 20 and 49.9 μg/L and 5% below 20 μg/L [Table 3]. Thus, a mild deficiency was found in 25.5% of the children, moderate in 13%, and severe in 5% of the children.

Taluka-specific assessment of iodine at the consumer level was found to be the lowest in Ankleshwar taluka, where almost half of the salt

Table 1: Goiter prevalence in different study areas of Bharuch district, India

Study Talukas	Total no. of children examined	No. (%) of children with Goiter			Severity as public health problem*
		Grade 1	Grade 2	Total (1 + 2)	
Amod	282	50 (17.7)	21 (7.5)	71 (25.2)	Moderate
Ankleshwar	209	23 (11)	19 (9.1)	42 (20.1)	Moderate
Bharuch	598	115 (19.2)	25 (4.2)	140 (23.4)	Moderate
Hansot	186	41 (22)	16 (8.6)	57 (30.6)	Severe
Jambusar	401	51 (12.7)	15 (3.8)	66 (16.5)	Mild
Vaghra	346	17 (4.9)	18 (5.2)	35 (10.1)	Mild
Valiya	400	95 (23.8)	17 (4.2)	112 (28)	Moderate
Zagadiya	503	117 (23.3)	38 (7.5)	155 (30.8)	Severe
Total	2925	509 (17.4)	169 (5.8)	678 (23.2)	Moderate

*Severity of public health problem: < 5% No; 5 – 19.9% mild; 20 – 29.9% moderate; > 30% Severe

Table 2: Age-specific goiter prevalence in the Bharuch district, India

Age in years	Total no. of children examined	Goiter prevalence		
		Grade 1 (%)	Grade 2 (%)	Total Goiter* (%)
6 years	416	75 (18)	25 (6)	100 (24)
7 years	419	70 (16.7)	22 (5.3)	92 (22)
8 years	423	70 (16.5)	23 (5.5)	93 (22)
9 years	425	99 (23.3)	25 (5.9)	124 (29.2)
10 years	419	73 (17.4)	24 (5.7)	97 (23.2)
11 years	417	64 (15.3)	24 (5.8)	88 (21.1)
12 years	406	58 (14.3)	26 (6.4)	33 (20.7)
Total	2925	509 (17.4)	169 (5.8)	678 (23.2)

samples were found to have < 15 ppm iodine or no iodine at all. Out of the 300 salt samples tested, 93% of the salt samples showed > 15 ppm iodine at the consumer level. The samples of salt sold at retail shops in the Bharuch district were all well-packed, branded, powdered, and iodized as per the manufacturers' status.

DISCUSSION

To evaluate the severity of IDD in a region, the most widely accepted marker is the prevalence of endemic goiter in school children. On the basis of IDD prevalence, the WHO / UNICEF / ICCIDD[10] recommended the criteria for understanding the severity of IDD as a public health problem in a region.

In the studied district, the total goiter prevalence rate was 23.2% (grade 1 – 17.4%; grade 2 – 5.8%) indicating that IDD was a moderate public health problem. A similar study from another district of Gujarat, reported 20.5% total goiter prevalence,[4] which was almost similar to the present study and mentioned the withdrawal of the notification banning the sale of non-iodized salt in Gujarat. The present study reports moderate prevalence rates, probably due to the availability of iodized salt everywhere now, from cities to the smallest villages; yet the consumption remains low. That may be one of the reasons why no association was found between the age of children and the high prevalence

Table 3: Urinary iodine excretion level in the different study areas of the Bharuch district

Study Talukas	n	Urinary Iodine Excretion level (µg/L)*			
		< 20.0 (%)	20.0 – 49.9 (%)	50.0 – 99.9 (%)	> 100 (%)
Amod	42	2 (4.8)	1 (2.4)	19 (45.2)	20 (47.6)
Ankleshwar	28	2 (7.2)	3 (10.7)	6 (21.4)	17 (60.7)
Bharuch	84	0	12 (14.3)	24 (28.6)	48 (57.1)
Hansot	28	2 (7.1)	4 (14.3)	4 (14.3)	18 (64.3)
Jambusar	56	5 (8.9)	5 (8.9)	11 (19.6)	35 (62.5)
Vaghra	56	6 (10.7)	8 (14.3)	12 (21.4)	30 (53.6)
Valiya	56	3 (5.4)	7 (12.5)	8 (14.3)	38 (67.9)
Zagadiya	70	1 (1.4)	15 (21.4)	23 (32.9)	31 (44.3)
Total	420	21 (5.0)	55 (13.1)	107 (25.5)	237 (56.4)

*Median urinary iodine excretion level for the Bharuch district was found to be 110 µg/L

of goiter compared to the earlier studies.[3,4] An international study from Indonesia reported 35% goiter prevalence among school children.[11] Another international study, conducted nationwide in Yemen, mentioned 16.8% goiter prevalence in school children, indicating that IDD was a public health problem internationally also.[12] In addition, this study reports that prevalence among girls was more than among boys, which was also reported by various studies.[4,5] As per the National Family Health Survey (NFHS)-3, the prevalence of goiter or other thyroid disorders was found to be 2.5 times higher in women than in men, and the number of persons with goiter or thyroid disorders increased with age, especially among women.[13]

In the present study, the Urinary Iodine Excretion (UIE) level of 100 µg/L and above was found in almost 56.4% of the samples. The median urinary iodine level was 110 µg/L in the current study. These findings indicated that 44% of the children in the study had a biochemical deficiency of iodine. It also indicated that there were continued, although inadequate efforts, to ensure a supply of iodized salt to the population. Authors of other studies in India indicated different median urinary iodine levels, which pointed to either a deficiency or no deficiency for certain populations, in their areas.[14-17] A study from Nepal reported a 93.5 µg/L median urinary iodine level.[18] An international study from Yemen documented a 17.3 µg/L median urinary iodine level,[12] while a study from Australia reported 82 µg/L.[19] Another international study from Lesotho reported 26.3 µg/L, indicating mild-to-moderate iodine deficiency in other countries.[20]

In our study, there seems to be some discrepancy between UIE and the prevalence of goiter by the palpation method, as UIE reflects the current iodine concentrations, and goiter indicates a chronic situation of iodine deficiency. Therefore, the prevalence of IDD as determined by the two indicators does not necessarily need to be consistent.[21]

The palpation method has been used in all IDD surveys in India as well as other countries to estimate the prevalence of goiter, because it has been stated to be useful in assessing goiter prevalence. However, there are chances of inter- and intra-observer variation with the palpation method. Trained and experienced observers were re-trained on the standardized palpation method to minimize inter- and intra-observer variation during the study. Although great efforts were taken to eliminate such variations during the study, some subjective variations bound to occur.

The WHO / UNICEF / ICCIDD also recommended that 90% of household salts should get iodized at the recommended level of 15 ppm[22] and the study shows that about 93% of the households were consuming salt at adequate levels, while about 7% of the households did not consume iodized salt at the recommended level. There was some variation in the results and the percentage of households consuming iodized salt. The underlying causes for such variations were not clear. However, the previous study conducted in a similar setting suggested that behavioral and environmental factors at the community level could contribute to such variations.[4] For example, most people were unaware of the IDD and managed iodized salt poorly. The environment within which iodized salt was stored was insufficient for maintaining proper salt iodization at the consumer level. It was also pointed out that local cultural and commercial factors could severely limit the impact of the IDD program among residents of the Bharuch district.

Chandra AK *et al*.[5] reported that more than 95% of the households were consuming salts at adequate level, while Kamath R *et al*.[23] and Biswas AB *et al*.[24] reported that only 50% of the households were consuming salt at adequate levels, a finding which was very low. Taken together, these results suggested that there was a need to strengthen the system of monitoring the quality of salt, to ensure the availability of 15 ppm of iodine at the household level.

In the present study, only 71% of the branded packed salt samples claiming iodization showed > 30 ppm iodine level, and were sold at retail shops (consumer level), while 19% of the samples had < 30 ppm iodine level which may be the reason for inadequate levels of iodized salt in 7% of the households. Mishra S *et al*.[4] reported that 39% of the salt samples claiming iodization were found with < 30 ppm iodine at retail shops.

CONCLUSION

The present study showed moderate goiter prevalence in primary school children in the Bharuch district of Gujarat and an inadequate iodine content

of salt found at the household level. This problem calls for further investigation, to identify factors that would strengthen the national program.

ACKNOWLEDGMENT

The authors are thankful to the Government of Gujarat for providing financial assistance, CDHO Bharuch and District Education Department for their support. The authors are grateful to Dr. V. S. Mazumdar, Professor and Head, Dr. R.K. Baxi, Professor, and Dr. J.D. Damor, Associate Professor of the Department of Community Medicine, Medical College, Vadodara, for their technical inputs. Contribution of Postgraduate students, Social workers, and Interns in terms of data collection also deserves a special mention.

REFERENCES

1. Directorate General of Health Services (DGHS). Policy guidelines on national iodine deficiency disorders control programme, New Delhi: DGHS, Ministry of Health and Family Welfare, Government of India; 2003. p. 1-10.
2. Kapil U. Progress made in elimination of IDD and possible impact of lifting ban on sale of non iodized salt. J Acad Hosp Admin 2000;12:33-41.
3. Chandra AK, Bhattacharjee A, Malik T, Ghosh S. Goiter prevalence and iodine nutritional status of school children in a sub-Himalayan Tarai region of Eastern Uttar Pradesh. Ind Pediatr 2008;45:469-74.
4. Misra S, Kantharia SL, Damor JR. Prevalence of goiter in 6-12 years school going children of Panchmahal district in Gujarat, India. Indian J Med Res 2007;126:475-9.
5. Chandra AK, Singh LH, Tripathy S, Debnath A, Khanam J. Iodine nutritional status of children in North East India. Ind J Pediatr 2006;73:795-8.
6. Toteja GS, Singh P, Dhilon BS, Saxena BN. Iodine deficiency disorders in 15 districts of India. Indian J Pediatr 2004;71:25-8.
7. 2001 census Panchmahal, Gujarat, India. Office of District Health Officer; 2008.
8. WHO. Report of a Joint WHO/UNICEF/ICCIDD Consultation on indicators for assessing iodine deficiency disorders and their control programmes. Geneva: World Health Organization; 1992. p. 22-9.
9. WHO. A guide for programme manager: Assessment of iodine deficiency disorders and monitoring their elimination. 2nd edition. Geneva: World Health Organization; 2001. p. 24.
10. WHO/UNICEF/ICCIDD. Indicators for tracking progress in IDD elimination. IDD Newslett 1994;10:37-41.
11. Pardede L, Hardjowasito W, Gross R. Iodine deficiency and goiter in schoolchildren in Indonesia. J Nutr 2003;178:159-62
12. Zein AZ, Al-Haithamy S, Obadi Q, Noureddin S. The epidemiology of iodine deficiency disorders in Yemen. Pub Health Nutr 2009;3:245-52
13. Ministry of Health and Family Welfare: National Family Health Survey 3, India, 2007. Available from: http://mohfw.nic.in/nfhs3/CD.htm. [Last accessed on 2011 Sep 04].
14. Kapil U, Sharma TD, Singh P, Dwivedi SN, Kaur S. Thirty years of a ban on the sale of non-iodized salt: Impact on iodine nutrition in children in Himachal Pradesh, India. Food Nutr Bull 2005;26:255-8.
15. Chandra AK, Singh LH, Debnath A, Tripathy S, Khanam J. Dietary supplies of iodine and thiocyanate in the etiology of endemic goiter in Imphal East district of Manipur, north east India. Indian J Med Res 2008;128:601-5.
16. Shankar R, Moorthy D, Pandav CS, Tiwari JS, Karmarkar MG. Tracking progress towards sustainable elimination of iodine deficiency disorders in Bihar. Ind J Pediatr 2006;73:799-802.
17. Chandra AK, Tripathy S, Ghosh D, Debnath A, Mukhopadhyay S. Iodine nutritional status and prevalence of goiter in Sundarban delta of South 24 Parganas, West Bengal. Indian J Med Res 2005;122:419-24.
18. Jimba M, Aitken I , Joshi A , Ohashi T, Poudyal A, Wakai S. A challenge for monitoring iodine deficiency disorders in rural Nepal. Trop Doct 2006;37:106-7.
19. Guttikonda K, Travers C, Lewis P, Boyages S. Iodine deficiency in urban primary school children: a cross-sectional analysis**.** Med J Aus 2003;179:346-8.
20. Sebotsa ML, Dannhauser A, Jooste PL, Joubert G. Prevalence of goiter and urinary iodine status of primary-school children in Lesotho. Bull World Health Organ 2003;81:28-34.
21. Hetzel BS. The prevention and control of iodine deficiency disorders. Amsterdam: Elsevier; 1993. p. 1-16. Administrative Committee on Coordination/ Subcommittee on Nutrition State-of-the-Art Series Nutrition Policy Discussion Paper no. 3.
22. ICCIDD/UNICEF/WHO. Assessment of iodine deficiency disorders and monitoring their elimination. A guide for programme managers. 2nd ed. WHO/NHD/01.1, 2001.
23. Kamath R, Bhat V, Rao RS, Das A, Ganesh KS, Kamath A. Prevalence rate of goiter in rural area of Belgaum district, Karnataka. Indian J Community Med 2009;34:48-51.
24. Biswas AB, Chakraborty I, Das DK, Chakraborty A, Ray D, Mitra K. Elimination of iodine deficiency disorders – current status in Purba Medinipur district of West Bengal, India. Indian J Public Health 2008;52:130-5.

Source of Support: Department of Health and Family Welfare, Government of Gujarat **Conflict of Interest:** None declared.