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Goitre Is No Longer Prevalent and Urinary Iodine Excretion Is above Normal among School Going Children in Jabalpur, India: Is This Major Health Problem Already Solved?

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ABSTRACT

Iodine deficiency disorder (IDD) is a major public health problem in India. We conducted this study to assess goitre prevalence, urinary iodine excretion (UIE) among school children and to determine iodine concentration in salt samples at consumer level, in Jabalpur district. We adopted "30 cluster" sampling, recommended by joint WHO/UNICEF/ICCIDD Consultation. A total of 2700 children were examined and 540 salt samples and 267 urine samples were collected. Also 150 households and 30 shopkeepers were interviewed for awareness about salt iodization. Total goitre prevalence rate was 2.2% with median UIE level as 218 μg/l and 19.1% of population had adequate iodine intake. About 90.6% of studied population consumed adequately iodized salt. Jabalpur is now no more an endemic area for goitre. The district has achieved the target of universal salt iodization (USI) but now proceeding towards toxicity. Hence the concern is the need of sustainability of the policy of USI.

KEYWORDS: goitre, iodine, endemic, urinary iodine excretion

INTRODUCTION

Iodine deficiency disorders (IDDs) are a major public health problem in India, yet easily preventable. Iodine deficiency has more damaging effects during early pregnancy as it retards foetal development, especially brain development which may in turn lead to a range of intellectual, motor and hearing deficits [1]. IDD in its severe form includes cretinism, stillbirth and miscarriage as well as increases infant mortality. Even mild iodine deficiency can cause a significant loss of cognitive ability while other significant symptoms include goitre. Iodine deficiency is the single greatest cause of mental retardation which can be easily and inexpensively prevented by iodizing all salt for human and animal consumption. Problems of iodine deficiency were initially thought to be limited in sub-Himalayan regions, as soil of this terrain was devoid of the microelement, however subsequent studies disclosed that no geographical extremity in the country is completely free of IDD.

The country has been divided into states along the political boundaries, which are further separated as divisions and subsequently the districts, which is the smallest administrative area. Studies from different districts all across India gave a varied image of Iodine deficiency in last 20 years. Goitre prevalence has been reported from 2.4% to as high as 38%, with median urinary iodine excretion (UIE) ranging from 70 μg/l to 225 μg/l [2–8].

The centrally located state of Madhya Pradesh is second largest state of the country. It is divided into 10 divisions and 51 districts in total. The present study was conducted in Jabalpur district of Madhya Pradesh. According to the 2011 census, it is the third-largest urban agglomeration in Madhya Pradesh. It is the 31st largest district in the state, in respect of area, which is 1.7% (approx.) of the total area of the Madhya Pradesh. It covers an area of 5211 km^2. It is divided into seven blocks and 1424 villages. As per the recent census the district has a total population of 2 463 289 with literacy rate of 81.1% [9]. As per District Level Household Survey (DLHS) 2007–08, percentage of boys and girls, aged 6–11 years attending schools were 99.3% and 97.2%, respectively [10].

A previous study from the district during 2000–01 found that the region was non-endemic for goitre with total goitre prevalence rate (TGR) of 2.4% and UIE of 110 μg/l [2]. However, as per the revised policy guidelines of National Iodine Deficiency Disorder Control Programme (NIDDCP, October 2006), Jabalpur was enlisted as one of the 14 endemic districts for goitre in Madhya Pradesh [11]. Another study from one of the district in Jabalpur division itself, in 2004–05, reported goitre prevalence as high as 20% among school-going children [12]. In a similar attempt, Shinde *et al.* [13] recently reported high goitre prevalence of 21.23% among children aged 3–15 years of age, from another district of the state. NIDDCP and universal salt iodization (USI) have carried out various initiatives to prevent goitre among population over a period of time. However, in spite all concentrated efforts made by different stakeholders via supply of iodized salt to entire population and awareness generation, prevalence of goitre >5% in school-age children is still prevalent. In this light, the present study was conducted to obtain scientifically valid recent estimates of prevalence of IDD and UIE in Jabalpur district identified to be endemic for IDD. The objectives of the study include assessment of the prevalence of IDD among 6–12 years children, determination of the concentration of iodine in salt samples at consumer level in study population and finally, estimation of the concentration of iodine in urine samples of children aged 6–12 years in district of Jabalpur. The findings will be helpful for the state government to modify its intervention/activities towards elimination of IDD.

MATERIALS AND METHODS

This is a descriptive cross sectional study conducted from April 2016 to May 2016 among school-going children of 6–12 years of age in Jabalpur district of Madhya Pradesh. The study was carried out by Department of Community & Family Medicine, AIIMS Bhopal on behalf of department of Public Health and Family Welfare, Government of Madhya Pradesh.

Clinical goitre survey

The "30 cluster" sampling methodology as recommended by the joint WHO/UNICEF/ICCIDD Consultation on IDD indicators was followed for selecting the survey sites. A sample of 30 schools was selected from the district by cluster sampling technique. The survey was conducted among 6–12 years children using the method of population proportionate to size sampling in each school. A sample of 90 children (45 boys and 45 girls) of age group 6–12 years was selected from each school. Thus a total of 2700 (90 × 30) children were examined for goitre in the district. The identified children from respective schools were clinically examined for goitre by technical persons specially trained for the survey. Goitre prevalence was investigated by palpation and classified as per WHO recommendations [14].

Grade 1: A goitre that is palpable but not visible when the neck is in the normal position, even when the thyroid is not visibly enlarged. Thyroid nodules in a thyroid, which is otherwise not enlarged, also categorized into it.

Grade 2: A swelling in the neck that is clearly visible when the neck is in a normal position and is consistent with an enlarged thyroid when the neck is palpated.

An area is classified as endemic for iodine deficiency if the TGR is >5% among school children aged 6–12 years [15].

Salt sample

Every fifth child, selected from the sample of 90 children in the earlier steps for goitre survey, was covered for collection of salt sample by visiting their corresponding houses. Therefore, 18 salt samples were collected from each cluster. A total of 540 (18×30) salt samples were collected for estimation of iodine level in the district. These salt samples were tested qualitatively on spot with commercially available field testing kits and iodine concentration was recorded. Field testing kits were procured by Department of Community & Family Medicine, AIIMS, Bhopal for the purpose of the study.

Urine sample

On the spot urine samples were collected from every alternate child out of those 18 selected children in the previous step. Nine urine samples were henceforth collected for estimation of UIE level from each school. A total of 270 (9×30) urine samples were collected for estimation of UIE in the district. In brief, 5 ml of urine sample was collected in tubes with screw tops from each child for UIE. The samples were stored in air tight containers in refrigerator. When all 270 (9×30) urine samples were collected from the district, the samples were then transported to Human Nutrition Department, AIIMS New Delhi for estimation. Three urine samples were discarded as sample tubes were found broken and could not be analysed for UIE. Thus, 267 urine samples were analysed for UIE. Iodine was determined by wet digestion method. The results were expressed as micrograms iodine/l urine. The UIE values of populations are not normally distributed, hence median value is used and calculation of mean, standard deviation and standard error of UIE level of children were not being calculated [15]. WHO Epidemiologic criteria for assessing iodine nutrition based on median urinary iodine concentrations for the school-age children (6 years or older) was followed [16]. As per the following criteria median UIE levels have been corroborated with the iodine intake and interpreted as iodine status. Respective values are as follows:

In total, 150 households and 30 shopkeepers were interviewed with the help of predesigned proforma to understand the knowledge and practices on iodized salt. Member from each household was asked questions like the source of purchasing the salt, whether it is packed or loose, type of storage (closed/open container) and awareness about iodization of salt. Shopkeepers too were asked whether they sell packed or loose salt, brand name of the salt they sell, cost of it and whether aware about iodization of salt.

Statistical analysis

Data collected in pre-tested proforma were compiled in Microsoft Office Excel 2010 and analysed using statistical software SPSS version 21. Descriptive analysis was performed and all the categorical variables have been given in proportion as figures and percentages. Comparison between prevalence of goitre among gender was done using chi-square test. p-Value less than 0.05 was considered to be statistically significant at 95% confidence interval.

Ethical considerations: Ethical clearance was obtained from Institutional ethical committee, and a permission letter to conduct the study was granted from district health office administration. Written informed consent was obtained from each of the study participants/guardian.

RESULTS

In all, 2700 primary school children aged 6–12 years from 30 different clusters of Jabalpur district were examined for goitre. Of these, 50% (1350) were males and 50% (1350) were females. TGR in the present study was found to be 2.2%. No children were found to have Grade 2 goitre. This study also reported that total goitre prevalence among males (2.75%) was higher than females (1.63%) with

Urinary iodine excretion levels (μg/l)	Iodine intake	Iodine status
<20	Insufficient	Severe iodine deficiency
20–49	Insufficient	Moderate iodine deficiency
50–99	Insufficient	Mild iodine deficiency
100–199	Adequate	Adequate iodine nutrition
200–299	Above requirement	May pose a slight risk of more than adequate iodine intake
≥300	Excessive	Risk of adverse of health consequences

Table 1. *Socio-demographic details of the participants and goitre prevalence*

S. no.	Characteristics	Goitre		
1.	Total population surveyed (*N*)	2700		
2.	Age (years) specific prevalence	No goitre, *n* (%)	Grade 1, *n* (%)	Grade 2
	6	392 (97.5)	10 (2.5)	0
	7	455 (97.4)	12 (2.6)	0
	8	399 (98)	8 (2)	0
	9	382 (98.2)	7 (1.8)	0
	10	480 (98.15)	9 (1.85)	0
	11	353 (98)	11 (2)	0
	12	180 (99)	2 (1)	0
3.	Gender [*n* (%)]*			
	Male [1350 (50)]	1312 (97.25)	38 (2.75)	0
	Female [1350 (50)]	1328 (98.37)	22 (1.63)	0

*$\chi^2 = 3.899$, $p = 0.048$.

statistical significance at 95% confidence level [$\chi^2(2) = 3.899$, $p = 0.048$]. Age-specific goitre prevalence rate was highest among children of 7 years of age (2.6%) followed by children of 6 years age (2.5%) (Table 1).

The median UIE level of 267 urine samples analysed was 218 μg/l. Our study also found that about one out of every four children (24.7%) studied were having some form of iodine deficiency (mild, moderate or severe iodine deficiency). About one-fifth (19.1%) of the children were having adequate iodine intake and 56.2% of children studied were in above requirement category for iodine intake (18.7% = 200–299 μg/l and 37.5% ≥ 300 μg/l). (Table 2).

Overall, 540 salt samples were examined on spot for iodine content. We found that 90.6% of the study population was using iodized salt with ≥15 ppm. However, 9.4% of the population is still using salt with no iodine content. Also, 144 (96%) out of 150 households interviewed were using packet salt and 90 (60%) families purchased salt from control office. Besides, 116 (77.3%) families and only 13 (43.3%) shopkeepers were aware about benefits of iodized salt. All 30 shopkeepers interviewed were selling packaged salt.

DISCUSSION

The study aimed at assessing the prevalence of goitre among the school-going children in Jabalpur district and their UIE levels so as to corroborate with the adequacy of iodine intake in the study population. We found TGR to be 2.2% which indicates that Jabalpur district is now no more endemic for goitre as earlier classified by NIDDCP, 2006. There is also a slight

TABLE 2. *UIE levels in the study population (n = 267)*

UIE levels (μg/l)	Number	Percentage
<20	23	8.6
20–49	17	6.4
50–99	26	9.7
100–199	51	19.1
200–299	50	18.7
≥300	100	37.5

Table adopted from Urinary iodine concentrations for determining iodine status deficiency in populations, WHO [15].

decline in goitre prevalence (TGR of 2.4%) in comparison to findings from a similar study by Gakkhar *et al.* [2] in Jabalpur district in 2000–01. However the concern now is the rising median UIE level of urine samples which we found to be above the recommended iodine intake requirements [16]. A recent study by the author, from another district in the state reported similar TGR (2.08%) and interestingly the issue of median UIE heading beyond adequacy and near toxicity is identified here as well [17]. As evident by literature, excessive iodine intake may lead to iodine-induced hyperthyroidism [15]. So, excessive iodine intake (above 300 μg/l) should be discouraged as it may result in adverse health consequence such as iodine induced hyperthyroidism and autoimmune thyroid diseases. Following USI for years in India risk of excessive supplementation may arise as in countries like Zimbabwe or Spain [18, 19].

However bioavailability of iodine is guided by various other factors as well like storage of salt, cooking practices, goitrogenous elements in the diet, which need to be addressed while observing the risk of excessive supplementation.

This study found that 90.6% of the population was using iodized salt with ≥15 ppm, which is in close approximation with National Family Health Survey-4 data (2015–16), (96.5%) for Jabalpur district [20]. As the goal of USI is to cover more than 90% household to consume iodized salt, so our result confirms that Jabalpur district has achieved the required target of USI. However, the population (9.4%) still using salt with no iodine content is a matter of concern. Our results clearly suggest that although household use of iodized salt in the district is >90%, awareness level on iodized salt among buyers and sellers is sub-optimal. So, awareness generation campaign in those geographical pockets where people still consume non-iodized salt and stringent monitoring of non-iodized salt trading will further strengthen the programme in the district. Hence, this study assessing the school-going children presents a very interesting and contradictory picture of a marginal deficiency and majority heading towards excess of micronutrient levels after years of USI. It emphasizes that one size does not fit all as in the same region following same policy all are not getting the benefit be it because of accessibility or personal practices, whereas for some it is reaching the level of toxicity due to undue supplementation beyond need.

CONCLUSIONS

Our study concludes that Jabalpur is no more an endemic district for goitre with no biochemical iodine deficiency in this population. The result is also an indication of successful implementation of NIDDCP and USI in the district. However, marginal population is still deficient for iodine, hence concentrated efforts should be made to identify poor performing pockets as well as risk populations in the district and create awareness campaign in those communities on health and nutrition benefits of iodized salt. Concerned departments and district administration should work towards ensuring availability and accessibility of adequately iodized salt in these risk areas. Now the concern is risk of toxicity of iodine supplementation thus a trade-off between paucity and excess should be achieved to be in the range of adequacy. Ensuring sustainability requires regular surveillance and occasional adjustments to the iodine content in salt as per recent scenario gained through timely surveys.

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